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Analysis of Proactive and Reactive Routing Protocol with a Change in Network Topology for MANET Using Network Simulator

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Abstract: ***Due to the dynamic nature of the network topology & the resource constraints, routing in MANET's is a very difficult task. Also due to the built-in mobility nature of mobile ad-hoc networks, the network topology constantly changes. In this paper, the work focuses on the comparison and analysis where routing protocols gives the best performance when the mobility of user increases. Here NS-2 software is used for simulation process and comparison of Reactive type AODV & DSR and the proactive type DSDV protocols. Finally, by analyzing result we get that the table driven routing protocols give better results as compare to conventional routing protocol. So in this work we try to analyze the performance of both reactive as well as proactive type protocol under various network topology changes. This result might help to judge that which protocol is efficient with less drop-tail.***

Keywords*:* Mobility models, MANET, AODV, DSR, DSDV, NS-2.

1. Introduction

We have seen the advancement and emerging capabilities of mobile devices but still many challenging issues are striking in wireless MANET. Due to increase of portable mobile devices, mobility of hosts are increasing. As a result, number of users tremendously increases so mobility is concerned as big issue for MANET. With the emerging trends in wireless technology host mobility management is becoming more challenging issue [1].

Nodes (Clients and Servers) move randomly and freely as MANET is a self-configuring network of mobile nodes using wireless links, forming a random topology and may not remain connected to the MANET throughout their life .Although mobile nodes are capable of transmitting the packets to the nodes which are in its proximity.

Mobility of mobile network is the main feature in MANET's. Two types of mobility schemes are to be considered. One is micro mobility which stands for minimum distance. Another stands for macro mobility which is long distance. Macroscopic mobility [2] describes overall quantities of concerns, such as density, treating node traffic according to fluid dynamics whereas microscopic mobility considered as a unique individual. Example (Macro-Mobility): It includes all the aspects which affect vehicular traffic such as road topology, per-road characterization, speed limits, number of lanes, the traffic controls mechanism, the vehicle class dependent constraints and provide rulings with priorities to different types of vehicles.

Example(Micro-Mobility): Travelling speed in different traffic conditions, general acceleration, car following, lane changing, gap-acceptance, conduct in the presence of road intersections and traffic signs also general driver attitude related to age group, sex, nature etc.

In this proposed work a movement of node will change randomly at different positions with a change in time. And with the help of different time intervals we put our efforts to change the position of each node and observe that what will be the packet drop, packet delivery ratio, throughput etc. for reactive and proactive type protocol. we also try to analyze the effect of movement of node on MANET to maintain a service execution closest to their location.

Due to the restricted and limited bandwidth, it is a vital situation that the mobile nodes make the most advantageous use of the connectivity on its arrival. Hence in order to select the data that need to be transmitted first, some sort of data prioritization is essential [3].

In addition, a simulation has been designed that ensures enhanced accuracy and reduced delay. It shows that our scenario reduces the packet drop, increases quality of service by the extensive simulation result.

2. Mobile Ad hoc Network (MANET)

Mobile Adhoc Network (MANET)[4]is a completely wireless connectivity through the nodes constructed by the action of the network, which usually has a dynamic shape & a limited bandwidth. MANET's have infrastructure less & wireless in which there are several routers which are free to move arbitrarily and can manage themselves in same manner. MANET's[5] have characteristics that network topology changes very rapidly and unpredictably in which many mobiles nodes moves to and from a wireless network without any fixed access point where routers & hosts move so topology is dynamic. It has to support multihop paths for mobile nodes to communicate with each other and can have multiple hops over wireless links. If mobile nodes are within the communication range of each other then source node can send message to the destination node otherwise it can send through intermediate node. MANET routing protocols are subdivided into two categories as shown below;

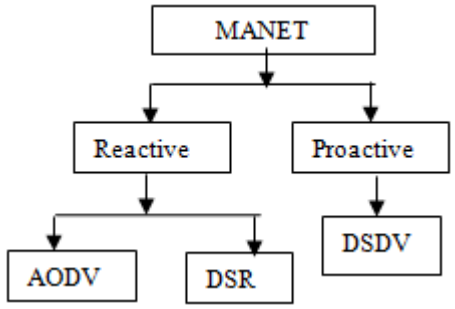

Figure 1: MANET and it's concerned Routing Protocols

2.1. Reactive Routing Protocol

These routing protocols are also called on demand [6] routing protocol since they do not maintain routing information or routing activity at the network nodes if there is no communication. If a node wants to send a packet to some another node then this protocol searches for the route in an on-demand manner and build the connection in order to transmit and receive the packet. The route discovery usually occurs by flooding the route request packets throughout the network.

2.1.1. Ad-hoc On-demand Distance Vector Routing (AODV):
AODV [7] uses routing tables, with one route entry per destination where each entry stores next hops towards destination. It broadcast route request (RREQ) packets and this RREQ [7] is uniquely identified by the sender address, destination address and request ID. If the node is either the destination node or has a route to the destination node then it returns a route reply (RREP) containing the route, to sender. AODV uses sequence numbers and node compares the destination sequence number of the RREQ with that of its route table entry this protocol either response with its own route if entry is fresh, or rebroadcasts the RREQ to its neighbors. In AODV [8], each node maintains a routing table which is used to store destination and next hop IP addresses as well as destination sequence numbers. And each entry in the routing table has a destination address, next hop, precursor nodes list, life time and distance to destination. Finally, after processing the RREP packet, the node forwards it toward the source. The node can later update its routing information if it discovers a better path or route.

2.1.2. Dynamic Source Routing (DSR) Protocol: DSR [8] protocol is on demand which generally reduces the bandwidth especially in situation where the mobility is low. It is a simple and efficient routing protocol for using in ad-hoc networks this protocol has two important phases namely, route discovery and route maintenance. A node that desires communication with another node first searches its route cache to see if it already has a route discovery mechanism. This is done by sending Route Request message. When the node gets this message, it searches its own cache to see if it has a route to the destination. If it does not, it then appends its ID to the packet and forwards the packet to the next node. This process continuous until either a node with a route to the destination is encountered or the destination receives the packet. DSR support relatively rapid rates of mobility.

2.2. Proactive Routing Protocol (Table-Driven Routing Protocol):

In proactive routing, each node has one or more tables that consists of latest and update information of the routes to any node in the network. Each row has the next hop for reaching a node/subnet and the cost of this route. Various table-driven protocols differ in the way the information about a change in topology is propagated through all nodes in the networks. There exist some differences between the protocols that come under this category depending on the routing information which is updated in each routing table. Also, these routing protocols maintain different number of tables. This protocol is not well node entries for each and every node in the routing table of every node this will cause more overhead in the routing table leading to more consumption of bandwidth. Example: Conventional routing schemes, DSDV.

2.2.1. Destination-Sequenced Distance-Vectors Routing (DSDV) Protocol: DSDV [8] is a table-driven routing method for ad-hoc networks that is based on the Bellman-Ford algorithm. The main contribution of this algorithm was to sort out the Routing Loop problem which is present in Bellman-Ford algorithm. And to do so, this protocol makes use of sequence numbers. Here each entry in the routing table contains a sequence number. Even if a link is present else, an Odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently.

3. Scenario for Performance Analysis

In this work 20 mobile nodes are considered, the initial position of these nodes are random in the flat grid area of 800x800 and in z-direction 2000-3000 are considered, so nodes are spared in 800x800x1000 area. In this work one source and one destination node is considered, the starting node is the source node and last node is destination node. All nodes have mobility, in this work mobility is set as each node changes its position after 10 sec. and after this, node changes its position in every 5 sec. all new positions are random in nature. So finally we compare 3 different routing protocols in the above scenario.

4. Simulation Tool and its Environment

The simulations performed using Network Simulator-2 (NS-2) [9], which is particularly popular in the ad-hoc networking family. NS-2 is an object-oriented, discrete event driven network simulator written in C++ & OTcl [10]. NS-2 is useful for simulating local and wide area networks. NS-2 interprets the simulation scripts written 0Tcl. The user has to set the different components libraries up in the simulation environment. The user writes his simulation program as a OTcl scripts. The main aim of choosing NS-2 as a simulation tool among the other simulation tool because it supports networking research and education. It is also

suitable for designing a new protocol, and comparing different protocol in different environment.

NS-2 is distributed freely and open source. A large number of institutes and people in development and research use NS-2.It also provide substantial support for simulation of TCP, UDP, routing and multicast protocol over wired and wireless network [10].

The traffic sources are CBR (Constant Bit-Rate). The source-destination are randomly spread over the network [9]. The mobility model uses ((RANDAM WAYPOINT MODEL)) in a rectangular area of 800m x 800m with 20 nodes .In the beginning, simulation starts its journey form a random spot to a random chosen destination and after every 5 second the topology of the network changes. Once the destination reached, the node takes a rest period of time in seconds and another random destination is chosen after that pause time, the variation of pause time is 10s, 20s and 50s. 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 time are generated. The model parameters that have been used in the following experiments are summarized in Table 1.

Table 1: Simulation Parameters

Parameter	Value
Simulator	NS-2
Protocols Considered	AODV, DSR & DSDV
Simulation Time	10s, 20s & 50sec.
Simulation Area	800m x 800m
Transmission Range	200-300m
Node Movement Model	Random Waypoint
Bandwidth Used	3 Mbps
Traffic Type	CBR (TCP)
Data Payload	Bytes/packet

5. Calculation and Result

In this work three routing protocols has been considered that is two reactive type (DSR & AODV) and one proactive type (DSDV) routing protocol. Finally we compare on the basis of Packet Delivery Fraction or Throughput, Packet loss, Routing load Fraction.The calculation of one routing protocol (AODV) is described below and in similar fashion the remaining two routing protocols are calculated and analyzed.

AODV (Reactive type):

Case I:
Number of nodes considered = 20
Pause time = 10sec.
Packet received will be = 4926
Therefore original packet received = 4926-1235(Routing Packet) = 3691
Packet sent will be = 4312
Therefore Packet Delivery Fraction (PDF) = 85.59%
And packet loss = 621
Now sent routing packet = 612
Received routing packet = 1235
Therefore total routing packet = 1847
Finally, routing load fraction will be = 37.49%

Case II:
Number of nodes considered = 20
Pause time = 20sec.
Packet received will be = 8725
Therefore original packet received = 8725-2167(Routing Packet) = 6558
Packet sent will be = 7768
Therefore Packet Delivery Fraction (PDF) = 84.42%
And packet loss = 1210
Now sent routing packet = 1305
Received routing packet = 2167
Therefore total routing packet = 3472
Finally, routing load fraction will be = 39.97%

Case III:
Number of nodes considered = 20
Pause time = 50sec.
Packet received will be = 32,130
Therefore original packet received = 32,130-9806(Routing Packet) = 22,324
Packet sent will be = 24515
Therefore Packet Delivery Fraction (PDF) = 91.06%
And packet loss = 2191
Now sent routing packet = 4149
Received routing packet = 9806
Therefore total routing packet = 13955
Finally, routing load fraction will be = 43.43%

5.1 Simulation Result

For each simulation, we collect data about number of packets being dropped when the link breaks due to random motion. We also collected information about packet delivery ratio, packet loss and routing load fraction. And the simulation result is achieved from the trace file made by NS-2 that report the time for each event in simulation model.

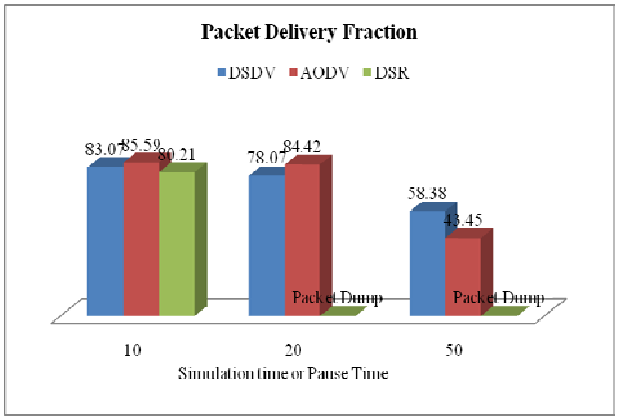

Figure 1: Packet Delivery Fraction

(Figure 1) shows the packet delivery ratio for different routing protocol and depending on which link that breaks for pause time 10 sec. AODV has highest packet delivery fraction compare to other routing protocol. For pause time 20 sec again AODV shows good performance compare to other protocol. Finally, for pause time 50 sec. DSDV has much better throughput compare to other routing protocol.

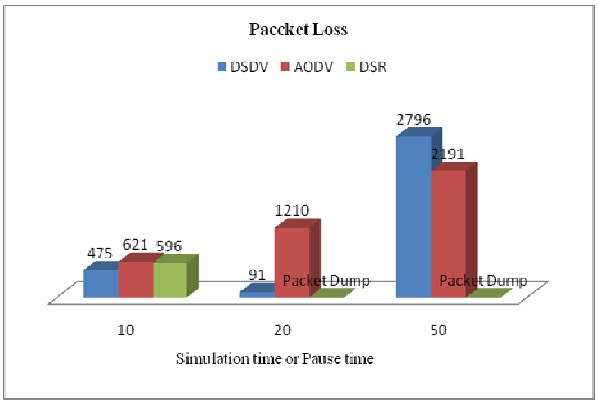

Figure 2: Packet Loss

(Figure 2) shows the packet loss for different routing protocols in different pause times, for pause time 10sec. DSDV has lowest packet loss compare to other routing protocols. For pause time 20sec AODV has the highest packet drop and DSDV has minimum packet drop. For 50sec. the packet drop will be much higher in DSDV compare to other routing protocol. DSR protocol gives core dumped result for 20 & 50sec because of time out.

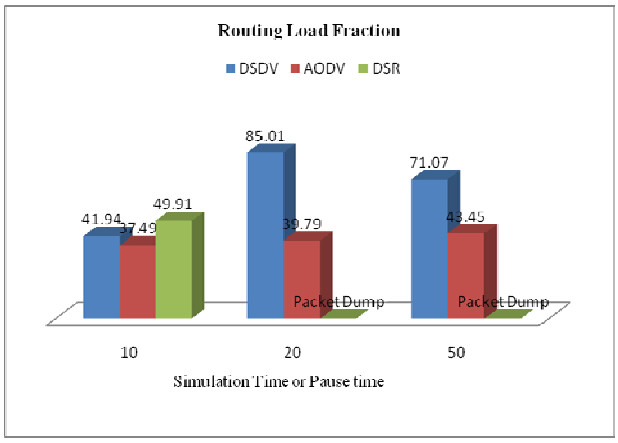

Figure 3: Routing Load Fraction

(Figure 3) show the routing load fraction in different pause times for different routing protocols. For pause time 10sec. the routing load fraction of DSR is highest compare to other routing protocols. For pause time 20sec the DSDV has the highest routing load fraction. Finally for pause time 50sec.,again DSDV has highest routing load fraction compared to other routing protocols. DSR give core dump result due to drop-tail.

6. Conclusion

From above simulation, result and calculation in different network environments that uses different topologies, we conclude that the packet delivery fraction is more efficient for DSDV in different pause time. The packet loss will be much higher for DSDV when pause time increases. Finally we conclude for routing load fraction AODV proves to be more efficient and better than other routing protocol. The entire scenario in this simulation has been considered with our own consideration. Network security is the challenging issue which can be considered for further work.

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