Performance Evaluation of MANET Routing Protocol for Varying Number of Nodes

Akhilesh Kumar, Ritesh Kumar Mishra

Abstract*— *Ad hoc network is a network formed without any central administration which consists of nodes that use a wireless interface to send packet data. Since the nodes in a network of this kind can serve as routers and hosts, they can forward packets on behalf of other nodes and run user applications. The ease of deployment and the infrastructureless nature of Mobile Ad hoc Networks (MANETs) make them highly desirable for present communication technology. MANET is probably the most well-known example of this networking paradigm being developed around for over twenty years. Furthermore, the multi-hop ad hoc networking paradigm is often used for building sensor networks to study, control, and monitor events and phenomena. Though there has been considerable research in this area. In this paper, we are analyzing the performance of AODV, DSR and DSDV routing protocol based on throughput of receiving packets and Average End-to-End Delay via increasing number of nodes and observing its effect on Quality of Service (QoS) of Mobile Adhoc Network. For our simulation we had used a discrete event simulator known as NS2 .

***Index Terms*—AODV, DSDV, DSR, MANET, NS2**

I. INTRODUCTION

Since their emergence in the 1970s, wireless networks have become increasingly popular in the computing industry. This is particularly true within the past decade which has seen wireless networks being adapted to enable mobility. There are currently two variations of mobile wireless networks. The first is known as infrastructure networks, i.e., those networks with fixed and wired gateways. The bridges for these networks are known as base stations. A mobile unit within these networks connects to, and communicates with, the nearest base station that is within its communication radius. As the mobile travels out of range of one base station and into the range of another, a "hand off" occurs from the old base station to the new, and the mobile is able to continue communication seamlessly throughout the network. Typical application of this type of network include office wireless local area networks (WLANs).The second type of mobile wireless network is the infrastructureless mobile network, commonly known as an ad-hoc network. Infrastructureless networks have no fixed routers, all nodes are capable of movement and can be connected dynamically in an arbitrary manner. Nodes of these networks function as routers which discover and maintain routes to other nodes in the network. Example applications of ad-hoc networks are emergency search and rescue operations, meetings or conventions in which persons wish to quickly share information, and data acquisition operations in inhospitable terrains.

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Akhilesh Kumar, Electronics & communication, National Institue of Technology, Patna, India.

Ritesh Kumar Mishra, Electronics & communication National Institue of Technology, Patna, India.

II. ROUTING PROTOCOL IN MANETS

According to differences in network topology reaction, the routing protocols in MANET can be categorized into table-driven routing protocol and reactive routing protocol. The table-driven routing protocols attempt to maintain consistent, up to date routing information from each node to every other node in the network whereas reactive routing protocol creates routes only when desired by the source node. Destination sequenced distance vector (DSDV) is a typical table-driven protocol. While the typical reactive routing protocol includes Ad hoc on demand vector routing (AODV) and dynamic source routing (DSR).

A. Ad-hoc on demand vector routing (AODV)

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, routing information is maintained in routing tables at nodes. Every mobile node keeps a next-hop routing table, which contains the destinations to which it currently has a route. A routing table entry expires if it has not been used or reactivated for a pre-specified expiration time. Moreover, AODV adopts the destination sequence number technique used by DSDV in an on-demand way. 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 broadcasts route request (RREQ) packets. A RREQ includes addresses of the source and the destination, the broadcast ID, which is used as its identifier, the last seen sequence number of the destination as well as the source node's sequence number. Sequence numbers are important to ensure loop-free and up-to-date routes. To reduce the flooding overhead, a node discards RREQs that it has seen before and the expanding ring search algorithm is used in route discovery operation. The RREQ starts with a small TTL (Time-To-Live) value. If the destination is not found, the TTL is increased in following RREQs. In AODV, each node maintains a cache to keep track of RREQs it has received. The cache also stores the path back to each RREQ originator. 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 RREP. Upon receiving the RREP packet, each intermediate node along the route updates its next-hop table entries with respect to the destination node. The redundant RREP packets or RREP packets with lower destination sequence number will be dropped. In AODV, a node uses hello messages to notify its existence to its neighbors. Therefore, the link status to the next hop in an active route can be monitored. When a node discovers a link disconnection, it broadcasts a route error (RERR) packet to its neighbors, which in turn propagates the RERR packet towards nodes whose routes may be affected by the disconnected link. Then, the affected source can re-initiate a route discovery operation if the route is still needed.

B. Destination Sequenced Distance Vector (DSDV)

The Destination-Sequenced Distance-Vector Routing protocol (DSDV) is a table-driven algorithm based on the classical Bellman- Ford routing mechanism. The improvements made to the Bellman-Ford algorithm include freedom from loops in routing tables. Every mobile node in the network maintains a routing table in which all of the possible destinations within the network and the number of hops to each destination are recorded. Each entry is marked with a sequence number assigned by the destination node. The sequence numbers enable the mobile nodes to distinguish stale routes from new ones, thereby avoiding the formation of routing loops. Routing table updates are periodically transmitted throughout the network in order to maintain table consistency. To help alleviate the potentially large amount of network traffic that such updates can generate, route updates can employ two possible types of packets. The first is known as a "full dump". This type of packet carries all available routing information and can require multiple network protocol data units (NPDUs). During periods of occasional movement, these packets are transmitted infrequently. Smaller "incremental" packets are used to relay only that information which has changed since the last full dump. Each of these broadcasts should fit into a standard size NPDU, thereby decreasing the amount of traffic generated. The mobile nodes maintain an additional table where they store the data sent in the incremental routing information packets. New route broadcasts contain the address of the destination, the number of hops to reach the destination, the sequence number of the information received regarding the destination, as well as a new sequence number unique to the broadcast. The route labeled with the most recent sequence number is always used. In the event that two updates have the same sequence number, the route with the smaller metric is used in order to optimize (shorten) the path.

C. Dynamic Source Routing (DSR)

The Dynamic Source Routing (DSR) is a reactive unicast routing protocol that utilizes source routing algorithm. In source routing algorithm, each data packet contains complete routing information to reach its destination. Additionally, in DSR each node uses caching technology to maintain route information that it has learnt. There are two major phases in DSR, the route discovery phase and the route maintenance phase. When a source node wants to send a packet, it firstly consults its route cache. If the required route is available, the source node includes the routing information inside the data packet before sending it. Otherwise, the source node initiates a route discovery operation by broadcasting route request packets. A route request packet contains addresses of both the source and the destination and a unique number to identify the request. Receiving a route request packet, a node checks its route cache. If the node doesn't have routing information for the requested destination, it appends its own address to the route record field of the route request packet. Then, the request packet is forwarded to its neighbors. To limit the communication overhead of route request packets, a node processes route request packets that both it has not seen before and its address is not presented in the route record field. If the route request packet reaches the destination or an intermediate node has routing information to the destination, a route reply packet is generated. When the route reply packet is generated by the destination, it comprises addresses of nodes that have been traversed by the route request packet. Otherwise, the route reply packet comprises the addresses of nodes the route request packet has traversed concatenated with the route in the intermediate node's route cache. After being created, either by the destination or an intermediate node, a route reply packet needs a route back to the source. There are three possibilities to get a backward route. The first one is that the node already has a route to the source. The second possibility is that the network has symmetric (bidirectional) links. The route reply packet is sent using the collected routing information in the route record field, but in a reverse order. In the last case, there exists asymmetric (unidirectional) links and a new route discovery procedure is initiated to the source. The discovered route is piggybacked in the route request packet. In DSR, when the data link layer detects a link disconnection, a ROUTE_ERROR packet is sent backward to the source. After receiving the ROUTE_ERROR packet, the source node initiates another route discovery operation. Additionally, all routes containing the broken link should be removed from the route caches of the immediate nodes when the ROUTE_ERROR packet is transmitted to the source. DSR has increased traffic overhead by containing complete routing information into each data packet, which degrades its routing performance.

III. SIMULATION SETUP

For simulation we have used NS-2.35 which is a discrete event simulator. It has the support for simulating multi hop wireless networks. It contains all data packets waiting for a route, such as packets for which route discovery has started but no reply has arrived yet. We have generated 9 scenarios with varying number of nodes for each type of routing protocols under FTP traffic pattern. The simulation is run using these scenarios and behaviour through the performance metrics is studied . Simulations are carried out by varying the number of nodes 3,15 and 50.

Table-1

PROTOCOLS	AODV, DSDV, DSR
NUMBER OF NODES	3,15,50
SIMULATION AREA	500x500
SIMULATION TIME	150 sec
MOBILITY MODEL	Random Way Point
TRAFFIC	FTP(TCP)
MAXIMUM SPEED	5 m/sec
IFQUE LENGTH	50

IV. PERFORMANCE METRICS

The following metrics are used in varying scenarios to evaluate the different protocols:

A) Throughput – Throughput or network throughput is the average rate of successful message delivery over a communication channel.

B) End-End Delay - The packet end-to-end delay is the time of generation of a packet by the source upto the destination reception. So this is thetime that a packet takes to go across the network.

V. SIMULATION RESULTS

A. Performance evaluation for received throughput vs simulation time for varying number of nodes

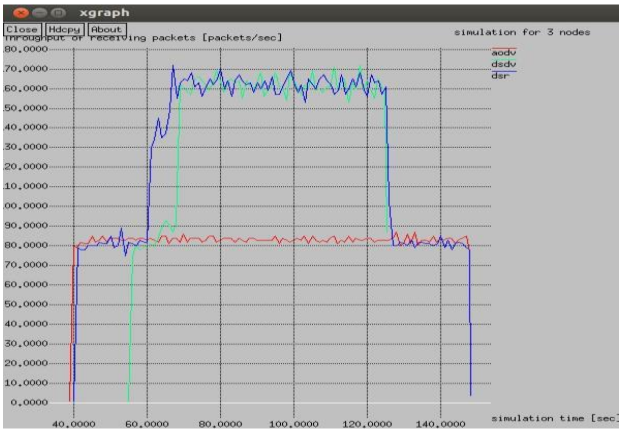

Fig.1 Received throughput vs simulation time for 3 nodes

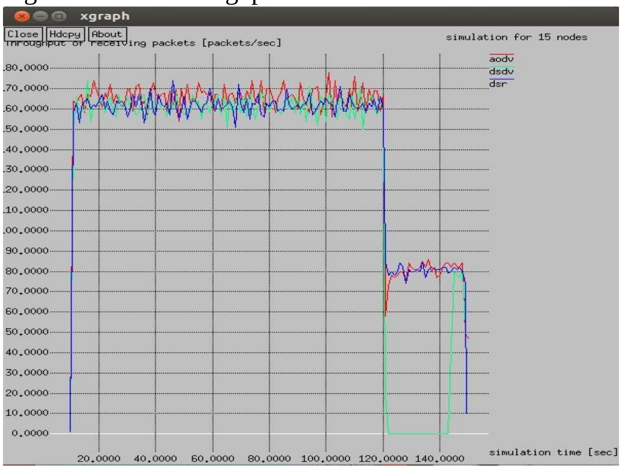

Fig.2 Received throughput vs simulation time for 15 nodes

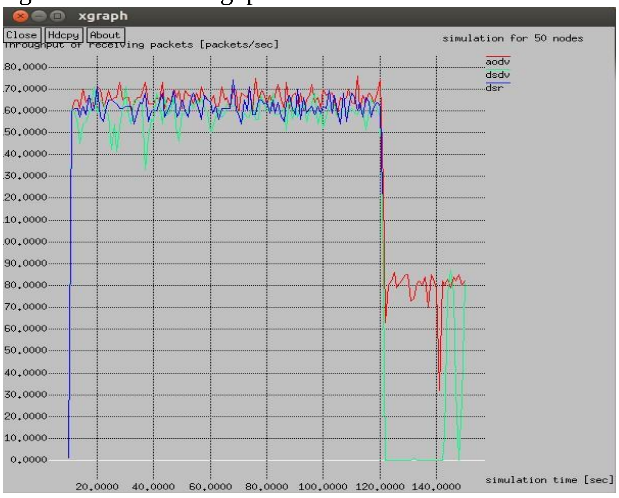

Fig.3 Received throughput vs simulation time for 50 nodes

B. Performance evaluation for average End2End delay vs throughput of receiving bits

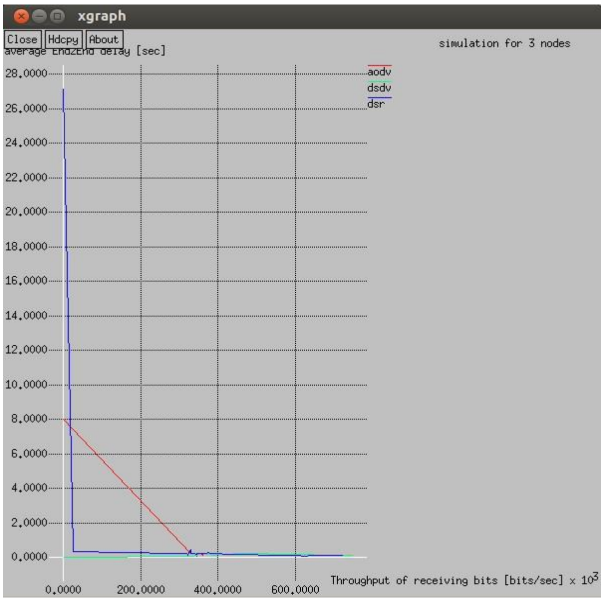

Fig.4 Average End2End delay vs throughput for 3 nodes

Fig.5 Average End2End delay vs throughput for 15 nodes

Fig.6 Average End2End delay vs throughput for 50 nodes

VI. PERFORMANCE EVALUATION & CONCLUSION

The trace file obtained by the simulation is observed in xgraph. As we know that the value of throughput should be high and from figure we see that when number of nodes are 3 DSR gives higher throughput value but when nodes are 50 we are getting higher throughput value for AODV. DSDV performs good in all the condition but due to large number of overhead it increases the traffic. Increase in number of nodes increases the traffic consequently and hence not suitable for large number of nodes. Along with the high throughput less value of delay improves the performance of network. There should be minimun fluctuation around the average value of delay .less delay results higher throughput as we see in Fig 4.but the effect is nullified when we use AODV for large number of nodes i.e a significant increase in delay does not degrade the performance (Fig 6).

Thus we can say that for less number of nodes DSR gives a better result but as we increase the number of nodes, AODV replaces it.

VII. FUTURE WORK

This study was conducted to evaluate the performance of Reactive (AODV, DSR) and Proactive protocol (DSDV) of MANET. We compared these three protocols on the basis of two parameters i.e. throughput, and Avg. End to End Delay. Future work will be to evaluate the performance of these protocols by varying the speed, simulation time, packet size, dimensions. Performance can also be analyzed for various parameters like Jitter, Routing Overhead etc. Performance of various new protocols or modified version of these could also be compared.

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