Simulation & Performance Analysis of Mobile Ad-Hoc Network Routing Protocol

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Abstract:-

A Mobile Ad-Hoc Network (MANET) or "Short-Live" network operate without any physical infrastructure and centralizes access point. MANET is dynamic in nature. Routing in Ad-hoc networks is a challenging due to mobility of nodes. In this paper, we presents simulation based performance evaluation of AODV, DSDV and DSR routing protocols for MANET, a detailed simulation based performance analysis has been carried out of Ad- Hoc On-Demand Distance Vector, Destination Sequenced Distance Vector, and Dynamic Source Routing based on Ideal network scenario of network size, node mobility and pause time. Performance matrix includes parameters like average End-to-End delay and packet delivery ratio using NS-2 as network simulator.

Keywords: Mobile Ad-Hoc Network, AODV, DSDV, DSR**.**

I.INTRODUCTION

A mobile ad hoc network (MANET) is a collection of wireless mobile nodes that dynamically establishes the network in the absence of fixed physical infrastructure. They offer quick and easy network deployment in situations where it is not possible otherwise. Ad-hoc, which means "for this or for this only." MANET network is an autonomous system of mobile nodes connected by wireless links; each node operates as a router and an end system for all other nodes in the network. Nodes in mobile ad-hoc network are free to move and organize themselves in an arbitrary fashion. Each user is free to roam about while communication with others. The path between each pair of the users may have multiple links and the radio between them can be heterogeneous. This allows an association of various links to be a part of the same network. As nodes may be mobile, entering and leaving the network, the topology of the network will change continuously. The popular "WI-FI" protocol like IEEE 802.11 is capable of providing ad-hoc network facilities at low level, when access point is not available. However in this case, the nodes are limited to receive and send information but do not route anything across the network. MANET networks can operate in a standalone fashion or could possibly be connected to a larger network such as the Internet. Mobile ad-hoc networks make the dream of getting connected "anywhere and at any time" into reality. Typical applications include a disaster recovery or a military operation. Not bound to specific situations, these networks may show better performance in other places. For example, we can imagine a group of peoples with laptops, in a business meeting at a place where no network services is present. They can easily network their machines by forming an ad-hoc network. This is one of the examples where these networks may possibly be used. MANET will establish and maintaining the ad hoc network through the use of routing protocols. Though there are so many routing protocols available, this paper considers AODV, DSDV and DSR for performance comparisons due to pause time. These protocols are analyzed based on the important metrics such as throughput, packet delivery ratio and average end-to-end delay. Most of the research study shows that DSR and AODV are performing well depend upon the environment, among the reactive protocols. In the case of proactive, OLSR protocols are performing well. The performance of different proactive, reactive and hybrid protocols have analyzed by different researchers. The comparative analysis of AODV, DSDV, and DSR is proposed in this paper

II. RELATED WORK

There are several comparison, surveys, and also some case studies about wireless network simulators. They all differ with respect to the selection of evaluated simulators, the intention of the work, the focus of the potential comparison and the level of the detail. So many researchers evaluate the AODV, DSDV and DSR for scalable network. They performed the simulation with the different scenarios like varying no. of nodes & pause time with respect to packet delivery fraction, packet loss, and average end-to-end delay. They also used different simulators like NS-2, Omnet++ and OPNET.

Performance of AODV, DSDV, and DSR is evaluated with respect to four performance metrics such as average end-to-end delay, packet delivery ratio, and throughput. Sapna S. Kaushik & P.R. Deshmukh in studied & compared the performance of DSDV, AODV and DSR routing protocols for ad hoc networks. P. Manickam1, T. Guru Baskar in studied & analyzed three protocols AODV, DSDV and DSR & was simulated using NS-2 simulator. Reactive routing protocols have got good packet delivery ration. When compared with proactive and hybrid routing protocol, hybrid routing protocol have got next higher delivery ratio. Similarly reactive routing protocols have got less delay.

III. MOBILE AD HOC NETWORK

A mobile Ad-hoc network (MANET) is composed of the mobile devices which communicate through wireless links without any fixed physical infrastructure which does not have any fixed topology. Routing in such networks is one of the major concerns because of mobility of nodes and absence of centralized administration. In this paper we evaluate the performance of Ad-hoc On Demand Distance Vector (AODV), Destination-Sequenced Distance Vector (DSDV), and Dynamic Source Routing (DSR) protocols under different performance parameters like PDF, average end-to-end delay and throughput, routing overhead and packet loss using simulator keeping packet size of 500 bytes.

IV. OVERVIEW OF ROUTING PROTOCOLS

Classification of routing protocols in MANET‟s can be done depending on routing strategy and network structure. Routing protocols can be categorized as:

1. Table-driven or proactive routing protocol
2. On-demand or reactive routing protocol and
3. Hybrid routing protocol.

Table-driven (proactive): The proactive routing protocols maintained the Routing Table at each node and with this table, nodes transmits the packets to the other nodes in the network. This protocol was motivated for the use of data exchange along changing and arbitrary paths of interconnection which may not close to any base station. Some of the existing proactive ad-hoc routing protocols are: Destination Sequenced Distance vector, Wireless Routing Protocols, Cluster head Gateway Switching Protocol, Global State Routing, Fisheye State Routing, Hierarchical State Routing, Zone Based Hierarchical Link State and Source Tree Adaptive Routing.

On-demand (Reactive): These protocols enable dynamic, self-starting, multihop routing between mobile nodes wishing to establish and maintain an Ad-hoc network. This protocol does not require nodes to maintain routes to destination that are not in active communication and obtain routes quickly for new destination by route discovery procedure. Reactive protocols are being more efficient at signaling and power consumption, suffers longer delay while route discovery. Proactive and reactive protocols have been improving to be more scalable, secure and to support higher quality of service. Some of the reactive protocols are: Cluster Based Routing Protocols (CBRP), Ad-hoc On Demand Distance Vector (AODV), Dynamic Source Routing (DSR), and Temporary Ordered Routing Algorithm (TORA).

V. PERFORMANCE OF AODV, DSDV and DSR ROUTING PROTOCOL:

Ad-Hoc on Demand Distance Vector Protocol (AODV)

The Ad-hoc On-Demand Distance Vector protocol is a very simple, efficient and effective routing protocol for mobile Ad-hoc networks which do not have fixed topology. Every node in the network acts as a specialized router and the routes are obtained as needed, which makes the network self-starting. As the protocol does not require periodic global advertisements, the demand on the available bandwidth is less. A monotonically increased sequence number counter is maintained by each node in order to supersede any stale cached routes. The route discovery process consists of a route-request message (RREQ) which is broadcasted. If a node has a valid route to the destination, it replies to the route-request with a route-reply (RREP) message. The destination node uses the so called reverse route entry in its routing table, which contains the no. of hops to source node, address of the source node, and the address of the node from which it receives the message i.e. the next hop's address. Coping up with dynamic topology and broken links: When the nodes in the network move from their places and the topology is changed or the links in the active path are broken, the intermediate node that discovers this link breakage propagates an RERR packet. And the source node re-initializes the path discovery if it still desires the route. This ensures quick response to broken links.

Whenever an AODV router receives a request to send a message, it checks its routing table to see if a route exists. Each routing table entry consists of the following fields:

- Destination address
- Next hop address
- Destination sequence number
- Hop count.

Four types of messages used by the nodes in the AODV to communicate among each other. Route Request (RREQ) and Route Reply (RREP) messages are used for route discovery. Route Error (RERR) messages and HELLO messages are used for route maintenance.

Destination-Sequenced Distance Vector (DSDV) routing protocol

DSDV is a proactive type of routing protocol which is a modification of Bellman Ford routing algorithm. It was developed in 1994 by C. Perkins and P. Bhagwat. DSDV protocol adds a new attribute, sequence number, to each route table entry at each node. Routing table is maintained at each node and with this table; node transmits the packets to other nodes in the network. This protocol was motivated for the use of data exchange along changing and arbitrary paths of interconnection which may not be close to any base station. These stations list for all the available destinations, and the number of hops required to reach each destination in the routing table. The routing entry consists of a sequence number which is originated by the destination station. In order to maintain the consistency, each station transmits and updates its routing table periodically. The packets broadcasted between stations, indicate which stations are accessible and how many hops are required to reach that

particular station. The packets may be transmitted containing the layer 2 or layer 3 addresses. DSDV protocol requires that each mobile station in the network must constantly advertise its own routing table to each of its neighbors. Since, the entries in the table my change very quickly, the advertisement should be made frequently to ensure that every node can locate its neighbors in the network. This strategy is placed, to ensure the shortest number of hops for a route to a destination; in this way the node can exchange its data even if there is no direct communication link. The data broadcast by each node will contain its new sequence number and the following information for each new route:

– The number of hops required to reach the destination and

– The new sequence number, originally stamped by the destination

– The destination address.

DSDV protocol guarantees loop free paths and count to infinity problem is also reduced. DSDV maintains only the best path instead of maintaining multiple paths to every destination. With this, the amount of space in routing table is reduced.

Dynamic Source Routing (DSR) Protocol

Dynamic Source Routing protocol is an on demand routing protocol. Source routing is a routing technique in which the sender of a packet determines the complete sequence of nodes through which to forward the packet. The sender explicitly lists this path in the packets header, identifying each forwarding hop by the address of the next node to which to transmit the packet on its way to the destination host. It allows nodes to dynamically discover a source route across multiple network hops to any destination in the ad hoc network. When using source routing, each packet to be routed carries in its header the complete, ordered list of nodes through which the packet must pass. A key advantage of source routing is that intermediate hops do not need to maintain routing information in order to route the packets they receive, since the packets themselves already contain all necessary routing information. DSR is broken down into three functional components:

Routing

Route discovery and

Route maintenance.

- Routing has already been described and is relatively trivial.
- Route discovery is the mechanism by which a node wishing to send a packet to a destination obtains a path to the destination.
- Route maintenance is the mechanism by which a node detects a break in its source route and obtains a corrected route.

VI. SIMULATION SETUP

We carried out simulation using NS2 simulator in order to simulate the performances of Ad-Hoc network routing protocols. The traffic sources are Constant Bit Rate (CBR). The mobility model uses „random waypoint model" in a rectangular field of 1000m x 1000m with 12 nodes. The experiments use a fixed number of packet sizes (500-bytes) and a queue length of 50 packets. The parameters which have been considered for the performance evaluation of the Ad-Hoc Network routing protocols is given below in Table I.

Table I Simulation Parameters.

Parameters	**Value**
Number of Nodes	12
Simulation Time	250ms
Pause Time	0.05ms
Environment Size	1000 x 1000m^2
Transmission Range	250m
Traffic Size	Constant Bit Rate (CBR)
Packet Size	500Bytes
Queue Length	50
Simulator	NS-2.34
Antenna Type	Omni Directional
Propagation	Two Ray Ground

VII. PERFORMANCE METRICS AND RESULT

To evaluate the performance of the Ad hoc network routing protocol (MANET), the following metrics are considered.

1. Packet Delivery Fraction (PDF)

PDF is the ratio of the number of data packets successfully delivered to the destinations to those generated by the sources. We find that when the numbers of nodes are minimum, while DSDV has lowest PDF, DSR has the highest PDF than AODV among the three routing protocols. When the numbers of nodes are increased, the PDF for DSDV increases, for DSR it decreases while it almost remains constant for AODV. Now as the numbers of nodes are increased further, the PDF for the three of them decreases. In case of low network size, DSR gives the highest PDF and DSDV gives the lowest PDF. In case of high network size, DSDV gives the highest PDF. Overall, AODV performs better than DSDV and DSR in terms of PDF.

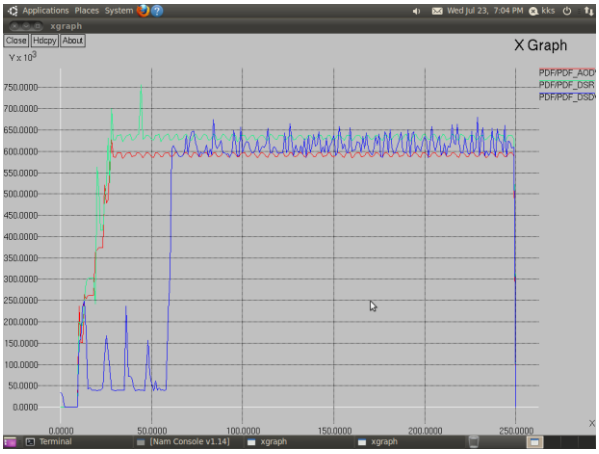

Fig. 1 X Graph Comparison of PDF for AODV, DSDV, and DSR for simulation of 12 nodes.

2. Average End-to-End Delay:

This includes all possible delays caused by buffering during route discovery latency. It is the average time from the beginning of a packet transmission at a source node until packet delivery to a destination. This includes delays caused by buffering of data packets during route discovery, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times. We observe that DSDV has the shortest End-to-End delay than AODV and DSR. DSDV has less delay compared to AODV and DSR because all the routing information is already stored in its routing table. Hence, it consumes lesser time than others.

3. Throughput:

This parameter gives the number of packets received by the destination within a given Time Interval. The effectiveness of a routing protocol can be measured with the help of this parameter. We observed that in low size network, DSR gives highest throughput; while throughput for DSDV is minimum. When comparing the routing throughput for each of the protocols, AODV has the highest throughput and DSR has the lowest throughput. Hence, AODV shows better performance with respect to throughput among these three protocols.

4. Packet Loss:

The difference between the total numbers of packets send by source and received by destination is measured by Packet Loss. It is observed from figure 2 that the Packet Loss is very high for DSDV as compared to DSR and AODV. DSR also has higher Packet loss as compared to AODV. Overall AODV has lowest Packet Loss as compared to DSR and DSDV for less i.e. 12 no. of nodes.

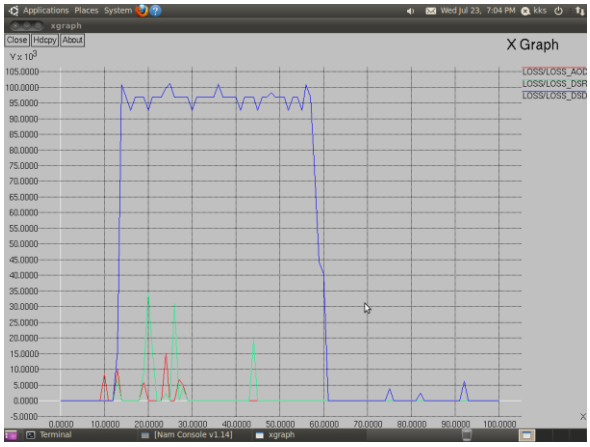

Fig. 2 X Graph Comparison of Packet Loss for AODV, DSDV, and DSR for simulation of 12 nodes.

5. Routing Overhead:

It is the ration of total no. of packets sent and total no. of packets received. In our scenario the routing overhead of the DSDV is highest than AODV and lowest for DSR routing protocol. Table II shows the simulation result for our scenario.

Table II Simulation Result.

Parameters	**AODV**	**DSDV**	**DSR**
Packet Send	5715	5715	5715
Packet Received	5708	4597	5714
PDF	99.87	80.47	99.98
Average End-to-End Delay	0.059Sec.	0.072Sec.	0.042Sec

VIII. CONCLUSION

In this project we have evaluated the performance of AODV, DSDV and DSR routing protocols for ad hoc networks using NS-2 event simulator keeping packet size of 500 Byte. AODV uses the reactive table-driven routing strategy whereas DSR uses the on demand routing strategy with different routing mechanisms and DSDV is the proactive routing protocol which uses the single path source to destination using distance vector routing protocol. Experimental results showed that DSR perform better for Packet Delivery Fraction as well as Throughput. Also, AODV apply the sequence numbers and contains one route per destination in its routing table whereas DSR uses source routing and route caches and maintains multiple routes per destination. The other observation from the experiments on AODV, DSDV, and DSR protocols, with an increase in number of nodes for a fixed area of 1000m x 1000m illustrates that even if the

terrain area of the network scenario is kept constant, the behavior of these routing protocols changes. It has been found that the overall performance of DSR routing protocol for performance matrices, Packet Delivery Fraction as well as Throughput is better than that of AODV and DSDV routing protocols. In our experimental evaluation we have taken up comparison of AODV, DSDV, and DSR protocols with keeping number of nodes same.

IX. FUTURE SCOPE

This project improves the understanding of ad hoc networks and advances the state-of the art through its contributions. Its investigation has revealed areas in ad hoc network where much work remains to be done. We have analyzed the performance evaluation of the three routing protocols (AODV, DSDV and DSR) in this paper. For the future work, we will try to simulate the other routing protocols and compare them by taking different simulation scenarios. We will try to simulate these protocols using different simulators. We will try to implement these protocols in real life in order to judge their performance.

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