Performance Comparison of DSDV, DSR, AODV Protocol with IEEE 802.11 MAC for Chain Topology for Mobile Ad-hoc Network using NS-2

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ABSTRACT
An Ad-hoc network is a collection of mobile nodes dynamically forming a temporary network without the use of any existing network infrastructure or centralised administer. Because of limited communication range among mobile nodes in ad-hoc network, several network hopes may be needed to deliver a packet from one node to another node in the wireless network. In recent years, a variety of different routing protocols addressing multi-hop ad-hoc network have been presented and their performance issues are discussed. This paper is subjected to comprehensive analysis among DSR,DSDV,AODV routing protocols of ad-hoc network with IEEE 802.11 Mac protocol in chain topology using Network Simulator-2(NS-2).Various important performance metrics of MANET such as Generated Packet Vs. no. of nodes, Received Packet Vs. no. of nodes, Packet delivery ratio Vs. no. of nodes, Total dropped packets Vs. no. of nodes, Average end to end delay Vs. no. of nodes are investigated to confirm the best routing protocol in the simulation environment.

Keywords - MANET, AODV, DSDV, DSR, Packets, IEEE 802.11, Performance Metrics, NS-2 Simulation.

1. INTRODUCTION
Ad-hoc wireless network are self creating, self organizing, and self-administrating networks. Ad hoc networks are used where wired network and mobile access is unproductive and not feasible. A fundamental problem in ad hoc networking is how to deliver data packets among MNs efficiently without predetermined topology or centralized control, which is the main objective of ad hoc routing protocols. A fundamental problem in ad hoc networking is how to deliver data packets among mobile nodes efficiently without predetermined topology or centralized control, which is the main objective of ad hoc routing protocols. A central challenge in the design of ad hoc networks is the development of dynamic routing protocols that can efficiently find routes between two communicating nodes. The goal is to carry out a systematic performance study of DSDV, DSR, AODV routing protocol for ad hoc networks. Moreover performance analysis is based on varying number of nodes in the Mobile Ad Hoc Network in chain topology. The rest of the paper is organized as follows: The work contributed in this area is provided in section II. The AODV, DSDV, DSR routing protocol description is summarized in section III. The simulation environment and performance metrics are described in Section IV .The simulation results and observation are described in section V. The best performing protocol is presented in section VI and the conclusion is presented in section VII.

2. RELATED WORK
A Several researchers have done the qualitative and quantitative analysis of Ad Hoc Routing Protocols by means of different performance metrics. They have used different simulators for this purpose.

1) Mr.Rafi U Zamam [1] studied & compared the performance of DSDV, AODV and DSR routing protocols for ad hoc networks using NS-2 simulations. In this paper, auther observed that the competitive reactive routing protocols, AODV and DSR, both show better performance than the other in terms of certain metrics. It is still difficult to determine which of them has overall better performance in MANET.

2) Vahid Garousi [2] studied an analysis of network traffic in ad-hoc networks based on the DSDV protocol with an emphasis on mobility and communication patterns of the nodes. In this paper, he observed that simulations measured the ability of DSDV routing protocol to react to multi-hop ad-hoc network topology changes in terms of scene size, mobile nodes movement, number of connections among nodes, and also the amount of data each mobile node transmits.

3) C.E. Perkins & P. Bhagwat[3] studied & proposed an efficient DSDV (Eff-DSDV) protocol for ad hoc networks. Eff-DSDV overcomes the problem of stale routes, and thereby improves the performance of regular DSDV. The proposed protocol has been implemented in the NCTUns Simulator and performance comparison has been made with regular DSDV and DSR protocols. The performance metrics considered are packet-delivery ratio, end-end delay, dropped packets, routing overhead, route length. It has been found after analysis that the performance of Eff-DSDV is superior to regular DSDV and sometimes better than DSR in certain cases.

4) *Das,S.R., Perkins,C.E., and Royer,E.M* [2] studied & compared the performance of DSDV, AODV and DSR routing protocols for ad hoc networks using NS-2 simulations. In this paper, they observed that DSDV uses the proactive table-driven routing strategy while both AODV and DSR use the reactive on-demand routing strategy. Both AODV and DSR perform better under high mobility simulations than DSDV. High mobility results in frequent link failures and the overhead involved in updating all the nodes with the new routing information as in DSDV is much more than that involved AODV and DSR, where the routes are created as and when required.

5) *Chao,C-M., Sheu,J-P.,and Hu,C-T.[5]* studied the performance comparison based on packet delivery fraction and normalized routing load. In the future, extensive complex simulations could be carried out in gain a more in-depth performance analysis of the ad hoc routing protocols. This would include delay of data packet delivery and performance comparison on location-based ad hoc routing protocols.

6) Md.*Anisur Rahman,Md.Shahidual Islam, Alex Televasky* [17]studied & analyzed that Packet dropping rate for DSR is very less than DSDV and AODV indicating its highest efficiency. Both AODV and DSR perform better under high mobility than DSDV. High mobility occurs due to frequent link failures and the overhead involved in updating all the nodes with the new routing information as in DSDV is much more than that involved in AODV and DSR.

7) *B. Cameron Lesiuk*[18] studied & presented an overview of ad hoc routing principles and thereby demonstrating how

these differ from conventional routing. Three proposed ad hoc routing protocols, DSDV, TORA,and DSR were presented and commented on.

8) *A.E. Mahmoud, R. Khalaf & A, Kayssi*[21] studied & analyses three protocols AODV, DSDV and I-DSDV & were simulated using NS-2 package and were compared in terms of packet delivery ratio, end to end delay and routing overhead in different environment; varying number of nodes, speed and pause time. Simulation results show that I-DSDV compared with DSDV, it reduces the number of dropped data packets with little increased overhead at higher rates of node mobility but still can't compete with AODV in higher node speed and number of node.

9) *N Vetrivelan & Dr. A V Reddy* [24] analysed the performance differentials using varying network size and simulation times. They performed two simulation experiments for 10 & 25 nodes for simulation time up to 100 sec.

10) *S. Gowrishanker et al* [25] performed the Analysis of AODV and OLSR by using NS-2 simulator, the simulation period for each scenario was 900 seconds and the simulated mobility network area was 800 m x 500 m rectangle. In each simulation scenario, the nodes were initially located at the centre of the simulation region. The nodes start moving after the first 10 seconds of simulated time. The application used to generate is CBR traffic and IP is used as Network layer protocol.

11) *Arunkumar B R et al.* [26] in this paper they present their observations regarding the performance comparison of the routing protocols for variable bit rate (VBR) in mobile ad hoc networks (MANETs). They perform extensive simulations, using NS-2 simulator [2]. Their studies have shown that reactive protocols perform better than proactive protocols.

12) *S. P. Setty et.al.*[27] evaluated the performance of existing wireless routing protocol AODV in various nodes placement models like Grid, Random and Uniform using QualNet 5.0.

13) *Khan et al*. [28] studied and compared the performance of routing protocols by using NCTUns 4.0 network simulator. In this paper, performance of routing protocols was evaluated by varying number of nodes in multiples of 5 in the ad hoc network. The simulations were carried out for 70 seconds of the simulation time. The packet size was fixed to 1400 bytes.

14) *Jorg D.O.* [29] studied the behaviour of different routing protocols on network topology changes resulting from link breaks, node movement, etc. In his paper performance of routing protocols was evaluated by varying number of nodes etc. But he did not investigate the performance of protocols under heavy loads (high mobility +large number of traffic sources + larger number of nodes in the network), which may lead to congestion situations.

15) *J Broch et al.* [30] performed experiments for performance comparison of both proactive and reactive routing protocols. In their Ns-2 simulation, a network size of 50 nodes with varying pause times and various movement patterns were chosen.

3. DESCRIPTION OF THE PROTOCOLS

This section briefly describe the key features of DSDV, DSR and AODV protocols that being studied in this paper.

3.1 Destination-Sequenced Distance Vector (DSDV)

The Destination Sequenced Distance Vector Protocol (DSDV) is a proactive, distance vector protocol which uses the Bellmann -Ford algorithm. DSDV is a hop-by hop distance vector routing protocol, wherein each node maintains a routing table listing the "next hop" and "number of hops" for each reachable destination. This protocol requires each mobile station to advertise, to each of its current neighbors, its own routing table (for instance, by broadcasting its entries). The entries in this list may change fairly dynamically over time, so the advertisement must be made often enough to ensure that every mobile computer can almost always locate every other mobile computer of the collection. In addition, each mobile computer agrees to relay data packets to other computers upon request. This agreement places a premium on the ability to determine the shortest number of hops for a route to a destination we would like to avoid unnecessarily disturbing mobile hosts if they are in sleep mode. In this way a mobile computer may exchange data with any other mobile computer in the group even if the target of the data is not within range for direct communication.

3.2 Dynamic Source Routing (DSR)

The Dynamic Source Routing (DSR) protocol is an on demand routing protocol based on source routing. DSR Protocol is composed by two "on-demand" mechanisms, which are requested only when two nodes want to communicate with each other. Route Discovery and Route Maintenance are built to behave according to changes in the routes in use, adjusting them-selves when needed. Along with those mechanisms, DSR allows multiple routes to any destination, thus can lead easily to load balancing or increase robustness .In the source routing technique, a sender determines the exact sequence of nodes through which to propagate a packet. The list of intermediate nodes for routing is explicitly contained in the packet's header. In DSR, every mobile node in the network needs to maintain a route cache where it caches source routes that it has learned. When a host wants to send a packet to some other host, it first checks its route cache for a source route to the destination. In the case a route is found, the sender uses this route to propagate the packet. Otherwise the source node initiates the route discovery process.

3.3 Ad Hoc On-Demand Distance Vector (AODV)

AODV is a purely reactive routing protocol. In this protocol, each terminal does not need to keep a view of the whole network or a route to every other terminal. Nor does it need to periodically exchange route information with the neighbor terminals. Furthermore, only when a mobile terminal has packets to send to a destination does it need to discover and maintain a route to that destination terminal. In AODV, each terminal contains a route table for a destination. A route table stores the following information: destination address and its sequence number, active neighbors for the route, hop count to the destination, and expiration time for the table. The expiration time is updated each time the route is used. If this route has not been used for a specified period of time, it is discarded.

4. SIMULATION ENVIRONMENT

4.1 Simulation Model

This section have given the emphasis for the simulation of performance of Ad Hoc routing protocols AODV,DSDV,DSR with varying the number of mobile nodes. The simulations have been performed using network simulator NS-2 [12]. The network simulator ns-2 is discrete event simulation software for network simulations which means it simulates events such as sending, receiving, forwarding and dropping packets. The latest version, ns-allinone-2.34, supports simulation for routing protocols for ad hoc wireless networks such as AODV, TORA, DSDV, and DSR. Ns-2 is written in C++ programming language and Object Tool Common Language (OTCL). Although ns-2.34 can be built on various platforms, we chose a Linux platform [FEDORA 7] for this paper, as Linux offers a number of programming development tools that can be used along with the simulation process. To run a simulation with ns-2.34, the user must write the simulation script in OTCL, get the simulation results in an output trace file. The performance metrics are graphically visualized in XGRAPH(Fig.1,2,3,4,5). Ns-2 also offers a visual representation of the simulated network by tracing nodes movements and events and writing them in a network animator (NAM) file. The fig.1 shows the flow chart of exact flow of data.

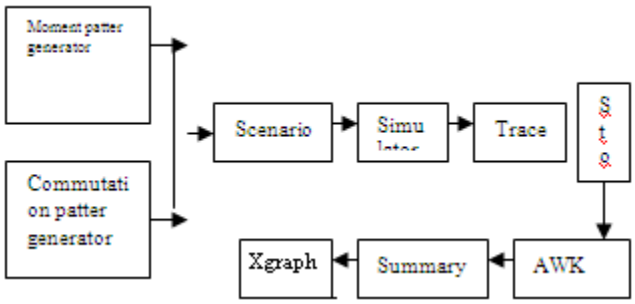

Fig 1: Simulation Model

4.2 Simulation Parameters

We consider a network of nodes placing within a 2200m X 500m area. The performances of AODV,DSDV,DSR are evaluated by keeping the network speed and pause time constant and varying the network size that is number of mobile nodes. Table 1 shows the simulation parameters used in this valuation.

TABLE 1 PARAMETERS VALUES FOR SIMULATION

Simulation Parameters	
Simulator	ns-2.34
Protocols	AODV,DSDV,DSR
Simulation duration	200 seconds
Simulation area	2200 m x 500 m
Number of nodes	5,9,25,35,40
Transmission range	250 m
Movement model	Chain topology
MAC Layer Protocol	IEEE 802.11
Maximum speed	50 m/s
Packet rate	4 packets/sec
Traffic type	CBR
Data payload	512 bytes/packet

4.3 Performance Metrics

While analysing the AODV,DSDV,DSR protocol with chain topology, we focused on performance metrics such as Generated Packets vs. No. of nodes, Received Packets Vs. no. of nodes, Packet delivery ratio Vs. no. of nodes, Total dropped packets Vs. no. of nodes, Average end to end delay Vs. No. of nodes and investigate the best routing protocol with simulation environment.

5. SIMULATION RESULTS & OBESRVATION

The simulation results are shown in the following section in the form of line graphs. The performance of AODV, DSDV, DSR based on the varying the number of nodes in chain topology [10] is done on parameters like Received Packets, Packets Delivery ratio & Average End to End delay,. "Fig. 2" shows the creation of chain topology with mobile nodes.

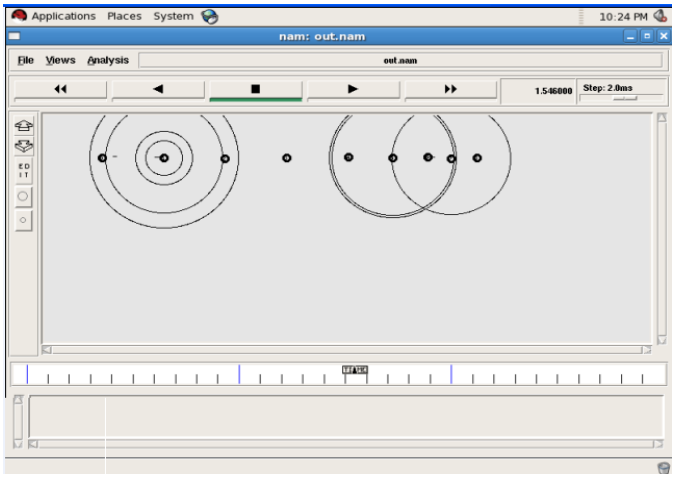

Fig 2. Chain Topology

"Fig. 3" highlights the relative performances of AODV DSDV, DSR protocols for Generated Packets with varying numbers of nodes of 5, 9,25,35,40. From figure it is observed that DSR protocols have better performance than AODV & DSDV protocols.

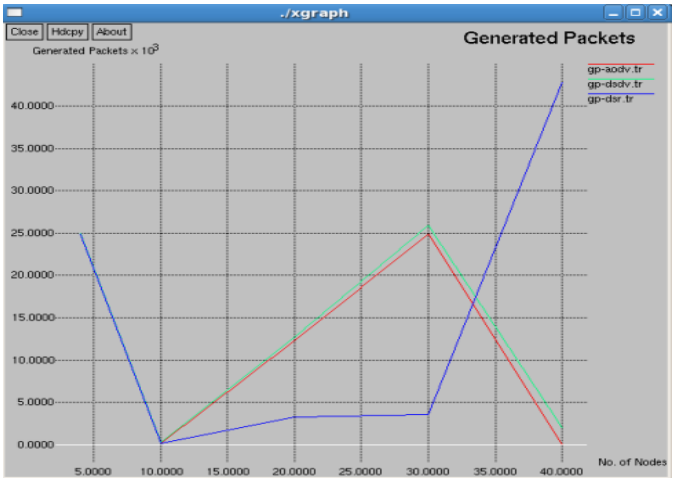

Fig 3. Generated Packets

"Fig. 4" highlights the relative performances of AODV DSDV,DSR protocols for Received Packets with varying numbers of nodes of 5,9,25,35,40. From figure it is observed that for small number of nodes up to 10 numbers, the performance of DSR protocol have better performance than AODV & DSDV protocols but for more numbers of nodes that is more than 10 nodes, the performance of AODV protocol have better performance than DSR & DSDV protocol.

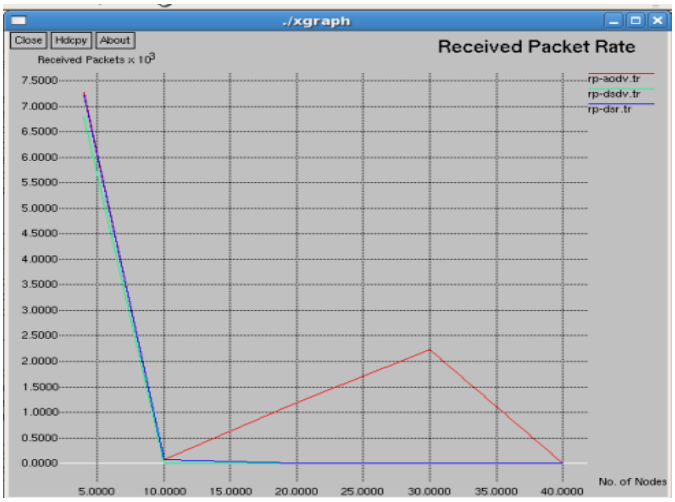

Fig 4. Received Packets Vs, numbers of nodes.

Fig.5 highlights the relative performance of AODV, DSDV & DSR protocols for Total Dropped Packet with varying numbers of nodes of 5, 9,25,35,40. From figure it is observed that DSR protocol outperformed both AODV & DSDV protocols. For more than 10 numbers of nodes, DSR protocol with chain topology has less Total Dropped packets than AODV & DSDV protocols.

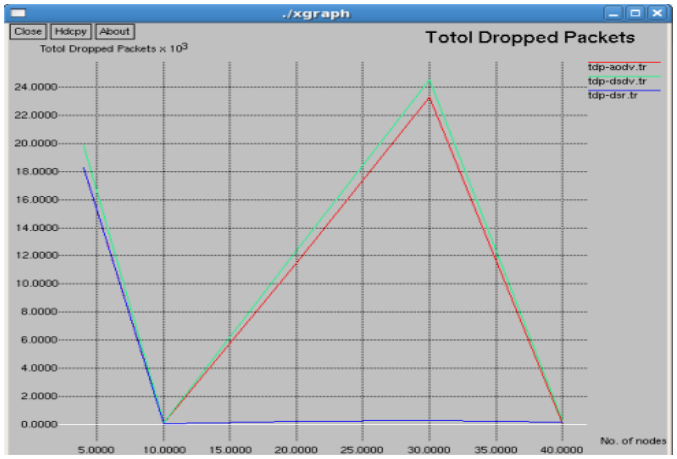

Fig 5. Total Dropped Packets Vs. numbers of nodes.

Fig.6 highlights the relative performance of AODV, DSDV & DSR protocol for Packet Delivery Ratio with varying numbers of nodes of 5, 9,25,35,40 . From figure it is observed that AODV protocol have better performance over DSR & DSDV protocols in term of Packet Delivery Ratio. AODV protocol delivered more data packets to the destination than DSR & DSDV protocols.

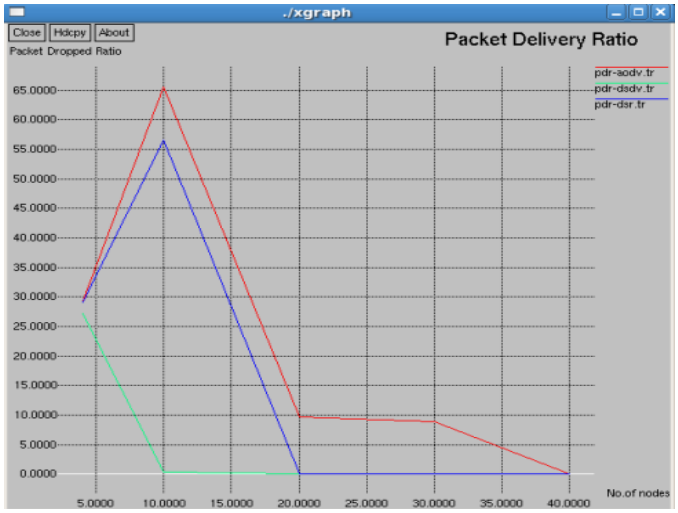

Fig 6. Packet Delivery Ratio Vs. numbers of nodes

Fig.7 highlights the relative performance of AODV, DSDV & DSR protocols for Average End To End delay with varying numbers of nodes of 5,9,25,35,40. From figure it is observed that AODV protocol have better performance over DSR & DSDV protocols for chain topology in terms of Average End To End delay. It is observed that up to 10 numbers of nodes, AODV protocol have better performance but above 10 numbers of nodes DSR have better performance as compared to AODV & DSDV protocol while transmitting data packets from source to destination.

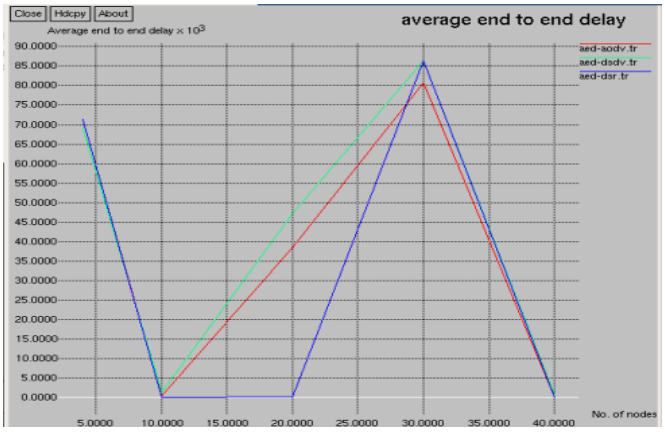

Figure 7..Average End to End delay Vs. numbers of nodes.

6. SELECTING THE BEST MANET ROUTING PROTOCOL

Simulation analysis as shown in above figures produces Table 2 wherefrom the best performing protocol with respect to a specific network parameters for chain topology can be selected to optimize MANET performance.

TABLE 2 Best performing protocol

Parameters	Best Protocol
Generated Packets	DSR
Received Packets Vs. No. of nodes	DSR up to 10 nodes,AODV for more than 10 nodes
Total Dropped Packets Vs. No. of nodes	DSR
Packet Delivery Ratio Vs. No. of nodes	AODV
Average End To End Delay Vs. No. of nodes	AODV upto 10 nodes, DSR for more than 10 nodes.

7. CONCLUSION

This study was conducted to evaluate the performance three MANET protocols i.e. DSR, AODV and DSDV based on CBR traffic. These routing protocols were compared in terms of Packet delivery ratio, Average routing overhead and Average end-to-end delay when subjected to varying no. of nodes. Though the numbers of authors as mentioned in the literature survey have worked on these three standard protocols of MANET, in the worked presented here, the authors has used higher area, more speed, larger duration for simulation & higher range for chain topology & successfully shown that the results of DSR protocol is superior for parameters such as Generated packets, Received Packets up to 10 nodes, total dropped Packets & Average End To End Delay for more than 10 nodes as compare to DSDV or AODV & for Packet Delivery Ratio, AODV protocol have better performance for the given simulation environment, the results of which are reflected in Table no.2.So authors conclude that the competitive reactive routing protocols, AODV and DSR, both show better performance than the other in terms of certain performance metrics. It is still difficult to determine which of them has overall better performance in MANET for Chain topology.

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