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The Comparative Study of MANET Routing Protocols AODV, DSDV, OLSR and DSR in Random Walk Mobility Model using NS-3

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Abstract: A mobile ad-hoc network (MANET) is a wireless, self-organizing, self-configuring network of mobile nodes or devices that are connected without any specific infrastructure. The mobile nodes can receive and forward packets as a router. In this study compare the performance of four MANET routing protocols Ad hoc On-demand Distance Vector (AODV), Dynamic source routing (DSR), Optimized Link State Routing (OLSR) and Destination Sequenced Distance Vector (DSDV). The performance differences are analyses basing on varying simulation time and number of nodes. The delay, throughput and packet delivery ratio are the common measures used for the comparison of the performance the protocols. These simulations are performed on NS-3 network simulator.

Keywords: MANET**,** Random Walk models, AODV, DSR, OLSR, DSDV, Throughput, PDR, End-to-End delay.

I. INTRODUCTION

Wireless network can be classified into infrastructure based and infrastructure less network. In the case of infrastructure based networks, Access Points are used for communication. They act as routers for the nodes within their communication range. Whereas, in infrastructure less networks, also known as, ad hoc networks, nodes act as routers. A Mobile ad hoc network (MANET) is a type of ad hoc network in which nodes can change locations.

The routing protocols in MANET are broadly classified into three categories, namely, proactive protocols, reactive protocols, hybrid protocols. Proactive protocols, also known as table-driven protocols, maintain routing information in the routing table of each node. The proactive routing protocols are Optimized Link State Routing (OLSR) protocol, Destination-Sequenced Distance-Vector (DSDV) routing protocol. The reactive protocols are Ad-hoc On-demand Distance Vector (AODV), Dynamic Source Routing (DSR).

A. Ad-hoc On-demand Distance Vector (AODV)

AODV is a combination of on-demand and distance vector i.e. hop-to-hop routing methodology [1]. When a node needs to know a route to a specific destination it creates a ROUTE REQUEST. Next the route request is forwarded by intermediate nodes which also create a reverse route for itself for destination. When the request reaches a node with route to destination it creates again a REPLY which contains the number of hops that are require to reach the destination. All nodes that participate in forwarding this reply to the source node create a forward route to destination. This route created from each node from source to destination is a hop-by-hop state and not the entire route as in source routing.

B. Destination Sequenced Distance Vector (DSDV)

DSDV is a hop-by-hop distance vector routing protocol requiring each node to periodically broadcast routing updates based on the idea of classical Bellman-Ford Routing algorithm [2]. Each node maintains a routing table listing the "next hop" for each reachable destination, number of hops to reach destination and the sequence number assigned by destination node.

The sequence number is used to distinguish stale routes from new ones and thus avoid loop formation. The stations periodically transmit their routing tables to their immediate neighbors. A station also transmits its routing table if a significant change has occurred in its table from the last update sent. So, the update is both time-driven and event-driven. The routing table updates can be sent in two ways: a "full dump" or an "incremental".

C. Optimized Link State Routing (OLSR)

OLSR is an optimization of pure link state algorithm [3], uses the concept of Multi point Relays (MPR) for forwarding control traffic, intended for diffusion into the entire network. The MPR set is selected such that it covers all nodes that are two hops away. Due to proactive nature, OLSR works with a periodic exchange of messages like Hello messages and Topology Control (TC) message only through its MPR.

The parameters used by OLSR to control the protocol overheads are Hello-interval parameter, TCinterval parameter, MPR coverage parameter and TC-redundancy parameter. So, contrary to classic link state algorithm, instead of all links, only small subsets of links are declared.

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D. Dynamic Source Routing (DSR)
DSR is a simple and efficient routing protocol designed specifically for use in multihop wireless adhoc networks of mobile nodes [4]. It allows nodes to dynamically discover a source route across multiple network hops to any destination in the adhoc network. Each data packet sent then carries in its header the complete ordered list of nodes through which the packet must pass, allowing packet routing to be a trivially loop free and avoiding the need for up-to-date routing information in the intermediate nodes through which the packet is forwarded. With the inclusion of this source route in the header of each data packet, other nodes forwarding or overhearing any of the packets may easily cache this routing information for future use.

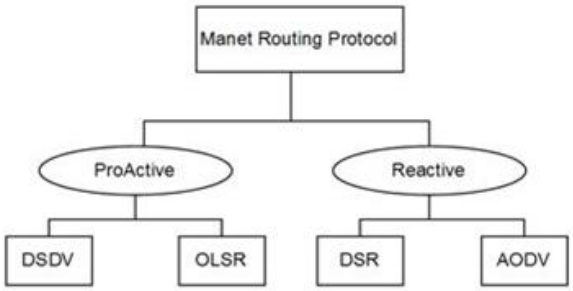

Fig: 1 Manet Routing Protocols

II. LITERATURE SURVEY

In their work they examined two routing protocols for mobile ad hoc networks the Destination Sequenced Distance Vector (DSDV), the table- driven protocol and the Ad hoc on Demand Distance Vector routing (AODV), an On demand protocol and evaluated both protocols based on packet delivery fraction, normalized routing load, average delay and throughput while varying number of nodes, speed and pause time. D. Manjunatha et al proposed Performance Study of AODV with Variation in Simulation Time and A Survey on Performance Ascertainment of MANET Routing Protocols Using NS-2 Ad-hoc Routing Protocols Proactive Reactive Hybrid A Survey on Performance Ascertainment of MANET Routing Protocols Using NS-2 77 www.erpublication.org Network Size [5]. In their work the effect of network size and simulation time on the performance of AODV routing protocol under 802.11 is analyzed. Qualnet Network Simulator is used to study the performance of the protocol with the metrics such as packets delivered, throughput, end-to-end delay and jitter. The results are compared for the networks without and with mobility of nodes. Mohammed Bouhorma et al proposed Performance comparison of ad-hoc routing protocols AODV and DSR [6]. In their work They have done the performance comparison between two reactive routing protocols for mobile ad hoc networks: Dynamic Source Routing (DSR), Ad Hoc On demand distance Vector (AODV).Both protocols were simulated using the tool NS-2 and were compared in terms of packet loss ratio, end to end delay, with mobile nodes varying number of nodes and speed. V. Rajesh kumar et al proposed Comparative Study of AODV, DSDV and DSR Routing Protocols in MANET Using Network Simulator-2. In their work they have made performance comparison and study of reactive and proactive protocols AODV, DSR and DSDV based on metrics such as throughput, control overhead, packet delivery ratio and average end-to-end delay by using the NS-2 simulator. Sachin Kumar Gupta et al proposed Performance Metric Comparison of AODV and DSDV Routing Protocols in MANETS Using Ns-2 [8]. In their work the performance of AODV and DSDV routing protocol have been evaluated for Mobile Ad-hoc Networks (MANETs) in terms of throughput, the average end to end delay.

Extensive research has been done to develop Adhoc network models successfully for the different application domains. Many of the researchers, though, have faced the dilemma that much of their data is plagued by an uncertainty, vagueness and approximation. This review work on Mobile adhoc network elaborates the scope of Mobile adhoc networks in various fields.

S. Yiannis (2014) evaluated the performance of OLSR versus AODV and DSDV, under heavy background traffic in terms of packet loss, routing overhead, throughput. The author simulates the scenario under different duration times. A heavily loaded wireless environment is simulated with wide range of number of nodes and extracts specific results. Simulation duration indeed affect the performance both qualitatively and quantitatively.
M. Zafar (2014) analyzed the comprehensive experimental performance of DSR, AODV, and DSDV routing protocol for different metrics values with predefined constraints. Different scenario had been designed with fixed number of nodes but varying mobility.
K. Dilpreet (2013) described the characteristics of AODV, OLSR, TORA, DSDV, DSR routing protocols based on performance metrics under low mobility and low traffic network as well as high mobility and high traffic network in mobile ad-hoc networks.
M. Puneet (2013) analyzed the performance of AODV, OLSR, GRP and DSR Routing protocols under different parameter like delay, load, media access delay, network load with database load in MANET.
S. Lakhan dev (2012) analyzed the effect of mobility on performance of three MANET on-demand routing protocols i.e. DYMO, DSR, and AODV. Author used EXata/Cyber 1.2 from scalable networks for simulation of these protocols.
A. Hossein (2010) evaluated the performance of four widely used ad hoc network routing protocols using different packet size patterns (uniform distribution and 1024 bytes) and also, different MAC layer (802.11b, 802.11g) for ordinary and large-scale MANETS using simulation environment (OPNET 14.0).
S. Chien-Chung (2006) proposed to map probability-based directional and Omni directional broadcast to bond and

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site percolation, respectively, and described a collection of directional antenna-based broadcast schemes for mobile ad hoc networks.

K. Latha (2005) described the performance analysis of a policy-based mobile adhoc network management system, developed under the CERDEC DRAMA (Dynamic Re-Addressing and management system) program. Authors presented their use of modeling and simulation (M&S) techniques to develop detailed models of the DRAMA architecture and analyze the performance under range of operational parameters.

L. Se-Young (2005) proposed ANMAS (Adhoc network multicasting with Ant system), a novel multicasting algorithm for mobile adhoc network (MANET). This algorithm utilized the indirect communication method of the ants via "pheromone" to effectively obtain dynamic topology change information, safer multicasting path are generated and adapts the well-known CBT (Core based tree) multicasting algorithm into the ANMAS framework with proper modifications to make "tolerable" multicasting group in MANET.

D. Andrea (2004) investigated the inefficiency of the overlay multicasting solution in mobile ad-hoc networks with respect to the network layer multicasting by comparing the distribution tree cost of different solutions. The authors measured the ratio between the cost of distribution tree in case of network layer and of multicasting overlay.

R. Aniruddha (2003) proposed Shared-Tree MZR a new multicast protocol. This protocol is a shared tree variant of the multicasting routing protocol based on Zone routing (MZR). The results shows that Shared- Tree MZR perform well and had low overhead in scenarios with multiple sources.

III. EXISTING SYSTEM

In other papers they give study about reactive protocols, proactive protocols and hybrid protocols using TCP protocols in NS-2 simulator. The performance comparison of the MANET routing protocols DSDV, DSR, AODV and TORA. We have made the simulations with above explained performance metrics by changing the number of nodes in the network, TCP agents. We analyzed the results individually and we infer that the overall performance of the AODV is better when compared with the DSDV, DSR, and TORA with the taken metrics along with the variability of TCP agents. After AODV, the DSR is having better performance against others. In this paper mainly working for comparative study of routing protocols under mobility models using NS3.

IV. PROPOSED SYSTEM

In this paper mainly dealing with reactive protocols AODV, DSR and proactive protocols OLSR, DSDV. In this paper performance of these protocols is calculated using parameters Throughput, End-to-End delay, and Packet Delivery ratio. Performance of these protocols is calculated using mobility models like Random Walk Mobility model.

a. Throughput:

It is the rate of successfully transmitted data packets in a unit time in the network during the simulation [4]. It is represented in bps or kbps and is calculated using awk script by processing the trace file which then produces the result.

Throughput=Received_Data*8/DataTransmissionPeriod

b. Packet Delivery Ratio-PDR

The PDR can be defined as the ratio of the number of packets received and number of packets sent from between source and destination [8]. It is also called as packet delivery fraction (PDF). Highest PDR value indicates the good performance.

$\sum$ Number of packet receive / $\sum$ Number of packet send

PDR = (received packets/sent packets) * 100

c. End-to-End Delay

It can be defined as the average time taken for data packet to arrive at destination. It may also include the route discovery delay and data packet transmission queue. The successfully delivered data packets to the destinations are counted [7]. The better performance of protocol only occurs if the delay is lower.

$\sum$ (Arrive_time – Sent_time) / $\sum$ No. of connections.

V. RESULTS

In this project, each protocol implemented with 50 nodes. Network simulator NS3 is used for this project to implement all the algorithms. This section describes our implementation of all protocols, which has been included in ns-3.10 stable release [10]. The main components of the DSDV implementation are routing up- date mechanisms, the performance differences are analyses basing on varying simulation time and number of nodes. The delay, throughput and packet delivery ratio are the common measures used for the comparison of the performance the protocols. DSDV maintains valid routes and flushes out invalid routes based on the periodic update interval. This feature is implemented for testing the performance of the protocol with and without packet buffering and also to provide users with more options.

Table: 1, Performance of Protocols

No of Nodes		10	30	50	70	100
Protocols	DSR	5%	5%	5%	5%	5%
	DSDV	90%	89%	88%	88%	88%
	OLSR	92%	92%	93%	93%	93%
	AODV	94%	94%	94%	95%	96%

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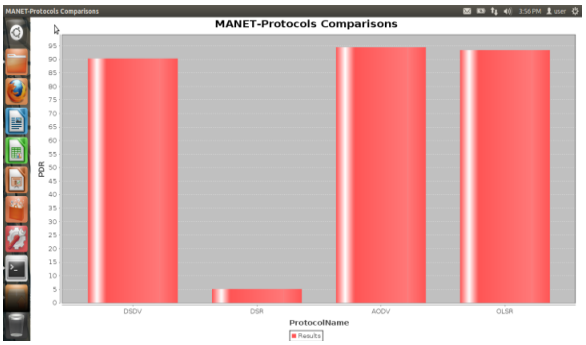

Fig: 1 Graph Generated from NS3 using. ./plot command and showing packet delivery ratio after checking all the protocols.

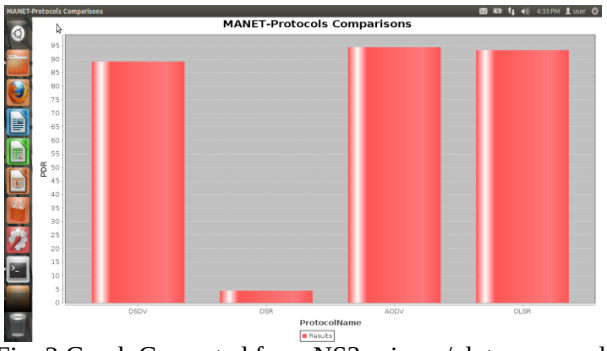

Fig: 2 Graph Generated from NS3 using. ./plot command and showing packet delivery ratio after checking all the protocols.

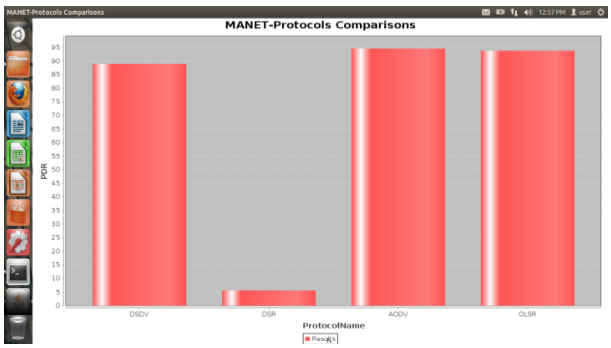

Fig: 3 Graph Generated from NS3 using. ./plot command and showing packet delivery ratio after checking all the protocols.

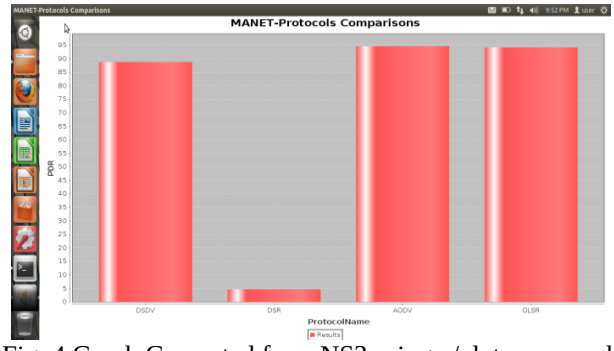

Fig: 4 Graph Generated from NS3 using. ./plot command and showing packet delivery ratio after checking all the protocols.

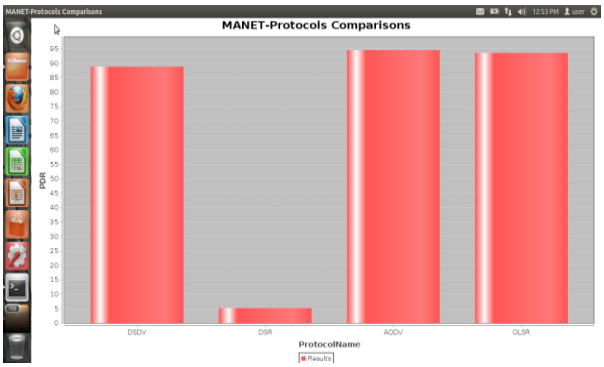

Fig: 5 Graph Generated from NS3 using. ./plot command and showing packet delivery ratio after checking all the protocols.

VI. CONCLUSION

In this paper, mainly describes the performance of four routing protocols and showing the results for four routing protocols DSDV, DSR, AODV and OLSR protocols. Calculating Packet delivery ratio is main target in this project. The performance differences are analyses basing on varying simulation time and number of nodes. The delay, throughput and packet delivery ratio are the common measures used for the comparison of the performance the protocols. These simulations are performed on NS-3 network simulator.

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