Simulation Based Comparative Analysis of Reactive and Proactive Routing Protocols

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Abstract*—Wireless networks provides a lot of opportunities in current research and different applications now a days. Mobile Ad-hoc Network (MANET) consist of networking devices which are self organized, that is, every device works either as a host or a router at particular time. Each node conveys routing information to all other nodes or neighboring nodes in the network based on routing algorithms. Routing is a specific work of mobile ad hoc network that supplies a better communication among devices in a network. The performance of a routing protocol is based on performance matrices like routing overhead, Average delay, packet loss and packet delivery ratio which are evaluate to determine which protocol is best in which scenario. There are many issues of packet loss like transmission error, crushed links, no possible route to the sink. Ad hoc on demand distance vector routing protocol utilize two parameters sequence number and hop count. Sequence numbers gives on account of the fresh information of the network. Hop account is to disclose the shortest routes. Many research work is to implement Optimized Link State Routing Protocol, Destination Sequence Distance Vector Routing Protocol and Ad hoc on Demand Distance Vector Routing Protocol on ns-3 simulator and compare the performance of these three protocols in terms of different performance matrices like packet delivery ratio versus mobility, routing overhead, end to end delay.

***Keywords*—MANET; OLSR; NS-3; MPR ;**

I. INTRODUCTION

Mobile Ad-hoc network is lustful research topic in current scenario in wireless network and it is very trust worthy technology to elevate efficiency and to perform applications in the communication area of mobile nodes. Ad-hoc network is to intend for specific applications example battlefield, disaster recovery. An ad-hoc network is to arrangement for a limited amount of time. The network is not having any fixed infrastructure such as base station or access points [2]. The communication in ad-hoc network is totally decentralized. Wireless network provides communication among devices in the network without any wired medium and transfer data to each other without wiring. Wireless networking are of two types- first is infrastructure based and second is infrastructure less or Ad-hoc network.

Ad hoc network is again classified into three broad categories based on applications- MANET, Wireless Mesh Network (WMNs), Wireless Sensor Network (WSN) [15]. Wireless network became very popular in nowadays due to lots of factors like ease of installation, cost, security, power, reliability and network performance [3, 4, 14]. Ad hoc network is a group of communicating devices that forms a decentralized temporary network, i.e. there is no predefined infrastructure or centralized administration.

The rest of the paper structured as follows: Section 2 gives the description about routing protocols. Section 3 provides the overview of Optimized Link State Routing Protocol. Section 4 describe the Distance Vector Routing Protocol and section 5 gives the detail about Ad hoc On demand Distance Vector Routing protocol. The simulation results and analysis details presented in section 6. Finally, we provide conclusions and directions for future representation in section 7.

II. ROUTING PROTOCOLS

Ad hoc networks are self configuring decentralized, due to these factors the requirements of routing was felt. Also the probabilities of change in topology due to mobile nature of nodes make the necessity of ad hoc routing protocol more prominent [5]. The routing protocols are classified into two major categories, the proactive protocols and reactive protocols [6, 7].

A. Proactive Routing Protocol

The goal of proactive routing protocol is to keep up-to-date routing information between every pair of nodes in the wireless network. Every node in the network maintains routing information in one or more tables [18, 19]. So proactive routing protocol is also called table driven approach. The main advantage of this routing approach is that updated routes are available at all times. The drawback of this protocol is there are more routing overhead due to its periodic updation procedure [7]. Example: DSDV, OLSR

B. Reactive Routing Protocol

The main advantage of reactive routing protocol over proactive routing protocols are less overhead and more throughput [1], because these protocols maintains information for only active routes in the network. Routes are determined on demand when required. When a source node wants to communicate with destination nodes first it checks whether there is a route or not in routing table. If no route exist in routing table, first it finds a path by route discovery process.

Example: AODV

III. Optimized Link State Routing Protocols

The optimized version of link state routing protocol is called Optimized Link State Routing Protocol. In this protocol, node exchange the information to one another about network topology at regular time intervals [14]. The Multi Point Relay (MPR) nodes to proclaim routing information periodically in Topology Control (TC) messages. The main aim of MPRs is route calculation from a source node to any destination node in the wireless network. The MPRs are used to make certain efficient flooding of control messages within the network. At each node, the OLSR protocol discovers 2-hop neighbor information by using Hello messages, then a set of MPRs is selected. The MPRs are elected in such a way that there exist a path between the selecting node and each 2-hop neighbors through the selected MPR. Now TC messages are forwarded by these Multi Point Relay nodes which contain the information about MPR selector [17]. OLSR is very different from other routing protocols due to functionating of MPRs. In a proactive routing protocol, routes to all destination are maintained always before the use. Due to update tables its useful for several network applications because there are no extra delay to find out a new route to the destination. There is no provision for sensing of link in OLSR. It is assumed that a link is present if a hello message have received from that link. In OLSR, a huge amount of bandwidth, CPU power is required to reckon optimal paths. By using MPR flooding OLSR reduces some redundancy [11]. Data about unused routes is propagated by OLSR due to its proactive nature. OLSR automatically manages the routing tables periodically. Therefore, whenever any information is required, the node do not have to wait for the information in routing tables to be updated, there are always fresh information, So this protocol consumes less time.

OLSR is a point-to-point and based on periodically exchange of information about network topology. MPRs are used to reducing the network overhead of flooding and size of link state updates.

OLSR uses two types of messages-

A. *Hello Message*

It is used for MPR selection and neighbor sensing procedure.

B. *Topology Control Message*

A TC message is used for route calculation. Only MPR nodes are forwarding TC messages.

IV. Distance Vector Routing Algorithms

DSDV routing protocol is based on Bellman ford routing procedure. LOOP free routes are provided by this routing protocol with the help of sequence number. DSDV protocol avoids facing of immense problems. Whenever there is a change occurred in neighborhood such as addition or removal of link, the sequence number is increased by one. DSDV is dedicated in nature due to which a route of each node is kept in every other node [8].

The DSDV routing table contains the information for each entry like its destination sequence number, destination IP address, next-hop IP address & hop count. Full dump and incremental packet are the two types of messages which are used by routing protocol to update route [10]. All the information of the routing in the network is given by full dump packet whereas the incremental packet has only the modified information. A huge number of overhead is established by DSDV routing because of periodic update message. Each node in the network publish its current sequence number with the updates of routing table to its neighbor in every time interval. The structure of the routing table updates is as follows.

< Destination Ip Address, Destination Sequence Number, Hop-count >

A. *DSDV Route Process*

A routing table is provided by every node which is used to save next hop, cost metric against every destination. It has a sequence number which is generated by the destination itself. Routing table is regularly forwarded to its neighbor by each node. While sending local routing table each node increases and attach its sequence number to it. Sequence number is used to designated each route and the route having greater sequence number is given more priority than others. Each node displays a monotonically increment in sequence number itself. Whenever a route breaks up, a node increases the sequence number of the route and display it with infinite metric. New Sequence number is displayed by the destination.

B. *DSDV Route Discovery and Maintenance*

In Destination Sequence Distance Vector, a next-hop table is provided by each node which is also shared by its neighbors. The next hop table exchanges is divided into two categories: event-driven incremental and periodic full table broadcast. Node mobility is used to calculate the relative frequency of the incremental and periodic full table broadcast. Node mobility is used to calculate the relative frequency of the incremental updating and full table broadcast. A sequence number is attached by the source node in every data packet dispatched at the time of broadcast of the next hop table. Then this sequence is stored in the next-hop table entry and raised by all the nodes gathering the interrelated distance vector updates. A node can change its route to a destination if the new sequence number is greater than the earlier one and in case the new sequence number is equal to earlier one than the new route should be less than the earlier one.

A route is identified by a sequence number which shows the originality of the route and the route having greater sequence number is preferred. In case two routes having equal sequence numbers, then the route having less hops is preferred. When a node identifies that a route to the destination has broken up, then it changed its sequence number and fix its hop number to infinity.

V. Ad-hoc On Demand Distance Vector Routing

The AODV routing protocol gives the route discovery process in mobile ad hoc networks when needed [1]. There are various control messages are used by this routing protocol like Route Request (RREQ), Route Reply (RREP) for the phase of route discovery and Route Error (RERR) for the maintenance (preservation) of the route [9].

A. Route Discovery Process

In route discovery process, whenever a source node needs to deliver data packets to the destination node, firstly it search the route in routing table route to the destination node. If the route is found then it operates the route for transmission but in case the route is not present there then it will launch the route discovery process to discover routes. In route discovery process, firstly the source node generates a RREQ packets and then publish its adjoining nodes. The different fields of RREQ message are shown in figure. Both source IP address and RREQ Id which is used to identify duplicate RREQ are used to determine separately each RREQ message.

Whenever any REEQ message is obtained by its adjoining node, initially it generates a reverse route to the source node and then increase the hop count value by one in the RREQ message [12]. In case an accurate route to the destination node is not found in the adjoining node then it directly shows RREQ message in the network. But in case any central node does not have an accurate route to the destination it shows that the destination sequence number is higher or same in the RREQ message and then it creates the RREP message. Then with the help of reverse route which was generated by RREQ message, the RREP message unicast to the next hop against the source node [13]. But if the RREP message is generated by the destination node then the value of hop count is set to Zero. Whenever a RREP message is obtained by any node it establish a leading route to the destination to transmit data. If more than two RREP messages is obtained by source node then the higher sequence number and the least hop count will be selected [18].

The RERR message is generated by the node if any link splits in the network and then delivers it to the source node. A newer route to the destination is discovered by the source node when it receives the RERR message.

VI. Result and Analysis

Performance evaluation of routing protocol helps to recognize which protocol is best fit for a particular outline of mobile nodes. I have to estimated routing overhead, PDR and Avg. end to end delay for OLSR, DSDV and AODV.

Table 5.1: Experimental Simulation Setup Parameters

Parameter	**Value**
Simulator	NS – 3
Simulation Time	100 Sec
Number Of Nodes	30
Packet Size	1000 Bytes
Simulation Area	1000X1000
Packet Rate	5 packet/sec
Routing Protocol	DSDV, AODV and OLSR
Mobility Model	Random Way Point Mobility Model
Speed	10 m/s
Pause	2 sec

A. Routing Overhead

DSDV routing protocol have more routing overhead than AODV. On account of AODV only maintains active route information in ad-hoc network, while DSDV is proactive and every node maintains up to date information of all network, so DSDV have more control traffic in comparison to data traffic. This can be shows by the simulation results in figure 1.

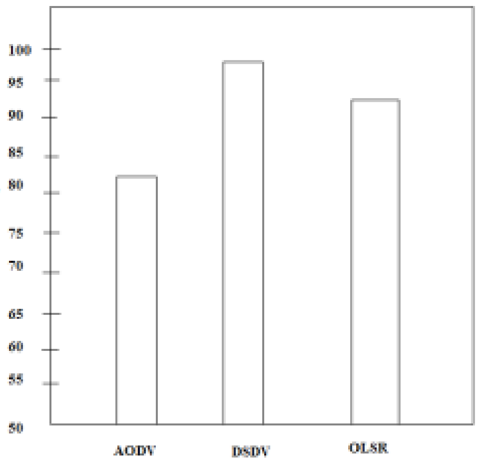

Fig. 1. Routing overhead for AODV, DSDV and OLSR

AODV gives the lowest routing overhead nearly 80% while DSDV gives approximately 100% which is worst case.

B. *Average End-to-End delay*

In the network the possible delay from source node to destination node is coined as average end-to-end delay, provides quality of communication. AODV have too much delay due to resolving route information which takes so much time than DSDV. It can be shown by the simulation results in figure 2.

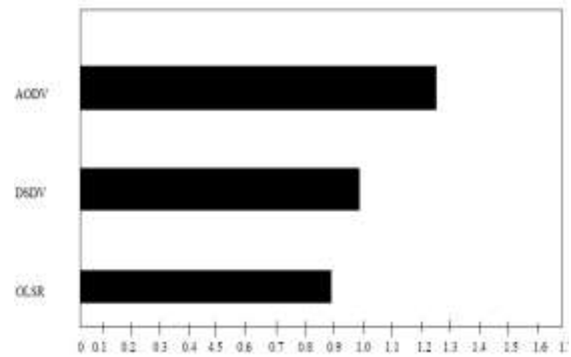

Fig. 2. End to end delay for AODV, DSDV and OLSR

OLSR performs best in case of end to end delay which delays the packet by the time nearly 0.9 msec.

C. *Packet Delivery Ratio*

The ratio of number of received packets to the number of total sent packets is called packet delivery ratio (PDR). AODV has more PDR than DSDV. When we elongate the speed of mobility very much then links are break up and this affect the delivery of packets. This can be presented by the simulation graphs in figure 3.

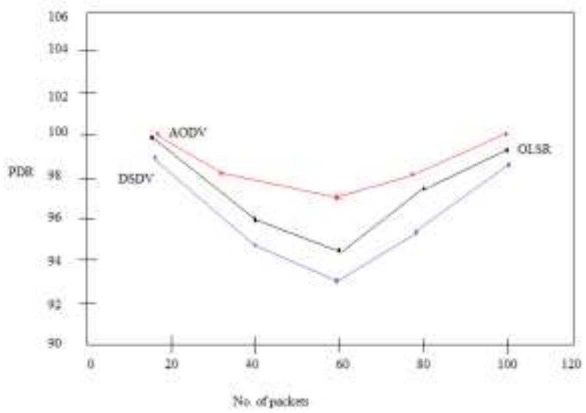

Fig. 3. PDR for AODV v/s DSDV against mobility speed

Packet delivery ratio of AODV is upto 100%, so it performs best among all routing protocols.

VII. CONCLUSION AND FUTURE WORK

In this paper, we evaluate the performance of OLSR, DSDV and AODV in terms of packet delivery ratio, routing overhead and average delay. Proactive routing protocols update routing table but they have more routing overhead. According to changing topology in terms of routing overhead AODV is best. In the case of end to end delay OLSR gives best results due to MPR nodes, while AODV is not a suitable choice. The AODV packet delivery ratio is highest than all other protocols.

Future work includes that we can evaluate what are the security issues in the routing protocols such as snoofing, intruders attack, integrity of packets and how we can overcome from these issues.

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