Comparative Analysis of Proactive, Reactive and Hybrid Routing Protocols for Improving Quality of Service in Mobile Ad-Hoc Networks

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Abstract: *- A Manet is set of wireless mobile nodes that communicate with each other without any dynamic infrastructure or centralized supervision. Each mobile node act as a router which forwards the packets to destination by first sending the packet to the nearest hop, various routing protocol are designed for this purpose. Selecting an appropriate routing protocol holds a significant position in the performance evaluation of wireless network. This paper aims to analyse and compare the performance of well- known On-demand routing protocols Ad hoc On demand Distance Vector (AODV), Table-driven routing protocol Destination Sequenced Distance Vector (DSDV) and Hybrid routing protocol Zone Routing Protocol (ZRP).The simulation environment used for these protocols is Network Simulator 2 (NS-2). The performance of the three routing protocols is analysed with respect to throughput, minimum delay and routing overhead. The major goal of this study is to analyse the performance of popular MANETs routing protocol.*

Keywords-*AODV, DSDV, MANET, Quality of service, ZRP.*

I. INTRODUCTION

A network is set of interconnected nodes. A mobile ad-hoc network is defined as an infrastructure less, decentralized network that utilizes multi-hop radio relaying and is capable of operating without the any infrastructure that is they consist of a group of wireless mobile nodes that can freely move around, co-operating with each other in routing and forwarding of packets. Ad-hoc wireless network is adaptive and self- organizing. This means that a formed network be de-formed on the fly without the need for any administration [18]. An example of mobile ad-hoc network (Manet) is shown below in Fig 1.

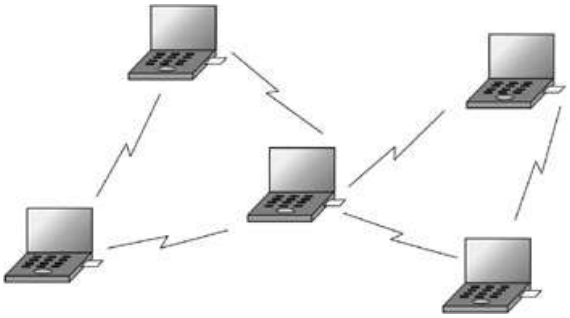

Fig. 1 Example of Mobile Ad-hoc Network

In comparison to wireless sensor networks that are composed of large number of sensor, which are densely and randomly deployed and are utilized in various applications for instance, environment surveillance and security monitoring. MANET is a set of independent mobile nodes forming autonomously and communicating in an infrastructure less environment. A mobile ad-hoc network is becoming popular and user friendly as they provide the user to access the information anywhere and anytime. The topology of ad-hoc networks is dynamic and relies on the degree of node mobility which may change rapidly and unexpectedly. One of the major issues in Mantes is the efficient delivery of data packets among mobile networks where there is no centralized control on network. A hypothesis in ad-hoc network is that each node can be used to send data packets among arbitrary sources and destination. In order to complete this, some routing protocols are required in order in order to make the routing decisions. Since ad-hoc network relies on forwarding of data packets, power consumption becomes a critical issue. Other various problems in routing like mobility, limited bandwidth and reduced battery life makes routing complicated [1].

Outline of the paper:-

To summarize, this paper is divided in to six sections. Section II describes the previous related work. Section III discusses about types of routing protocols in Mantes. In Section IV we briefly describe about different protocols used for analysis. Section V

frames the proposed work. Section VI describes the conclusion.

II. RELATED WORK

In[2] Rahul Desai and B.P. Patil evaluates the comparison between AODV and DSDV by comparing certain parameters like throughput, end-to end delay and packet delivery ratio under different load conditions and mobility pattern. The comparison was made using NS-2 environment. It is observed that DSDV returns poor results as number of nodes are increased. Also it is seen that on-demand routing protocol AODV is more effective in high traffic diversity as well as high mobility. Tanya K Araghi et. al. evaluated performance comparison of reactive protocols. AODV, DSR and AOMDV were compared and analysed using NS-2 environment and the results showed the performance enhancement in AODV and AOMDV. Also, Savita Gandhi et. al. presented the performance evaluation of three different routing protocols using network simulator [NS-2.33]. The simulations resulted in performance variations across different network sizes. It is seen that presence of high mobility implies frequent link failures. In [15] Zygmunt J. Hass, Marc R. Pearlman, Prince Samar demonstrated about ZRP. They said that ZRP protocol is suitable for highly versatile network. The taxonomy of different routing protocols was done by Anuj. K Gupta et. al. and comparison was made between them. Their comparison represented the design of secure ad-hoc network [9]. Performance analysis of DSR, DSDV and AODV done by Samayk Shah et. al. showed that both AODV and DSR perform better under high mobility simulations than DSDV[13]. Also DSR showed poor performances in application oriented metrics such as delay and packet delivery ratio.

III. TYPES OF ROUTING PROTOCOLS

Selection of optimum path in a network is known as routing. The responsibility of routing protocols is to find the feasible path or route between communicating nodes, based on certain criteria such as hop length, minimum power and utilizing minimum bandwidth. There are two fundamentals steps in routing, Firstly forwarding packets to the next hop and secondly, taking decision to forward packets [18]. The various challenges that routing protocols designed for ad-hoc network faces are mobility of nodes, resource constraints, hidden terminal problem and expose terminal problem. Nodes in an ad-hoc network are free to move randomly and speed of mobility is not predicted before. Also, wireless channels provide lower and more variable bandwidth than wired network so routing protocols should be bandwidth efficient. All the above mentioned characteristics along with bandwidth and energy are mandatory to consider while designing ad-hoc network. The network topology of mobile ad-hoc network is dynamic and changing. Thus, it makes routing as one of the important aspect [1]. There are various way to classify routing protocols in Mantes, majority of them rely on routing strategy and structure of network. Routing protocols can be broadly classified in to several categories based on different criteria's [18]. The four different categories can be broadly classified as shown in the Fig 2 below.

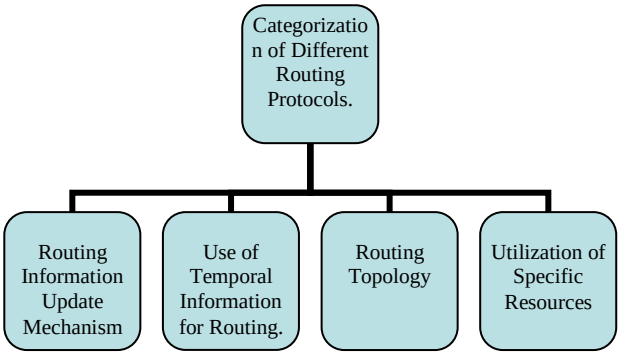

Fig. 2 Categories of routing protocols.

In this paper we have worked on protocols based on information update mechanism. Based on this criteria these protocols are further classified in to three types as shown in Fig 3

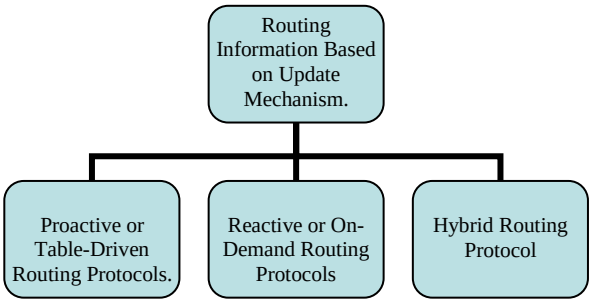

Fig. 3 Classification of routing protocols

***Proactive or table-driven routing protocol*: -** As the name suggests these protocols maintain the table to update the routing information. These protocols are an extension to the wired routing protocols. The main function is to maintain the global topology information. Since the tables need to be updated frequently so any change in the network topology

should be reflected in the table and propagate the information throughout the network. The destination sequenced distance-vector routing protocol (DSDV), wireless routing protocol (WRP) and optimized link state routing (OLSR) are examples of some proactive routing protocols.

Reactive or on-demand routing protocols:-In contrast to proactive protocols, reactive protocols are not capable of maintaining the network topological information instead they compute the route to the destination when required. Since routing starts when data packets are going to be transmitted, it is also known as on-demand routing protocols. The act of route finding is done by flooding the route request messages in the network. Dynamic source routing (DSR), Ad hoc on-demand distance-vector routing protocol (AODV) are some popular reactive protocols. The main advantage of these protocols is the obstruction of bandwidth used for broadcasting routing table. Also, on demand or reactive routing protocols cam minimize the network traffic overhead.

Hybrid routing protocols: **-** Protocols falling in this category combine the best features of two mentioned routing protocols [18]. The route is initially established by some proactively prospected and then serves the demand from activated nodes by reactive flooding. The nodes which are present in a particular geographical region are said to be in the routing zone of the given node. The nodes within the zone uses proactive approach and the nodes beyond this zone uses on-demand approach. Zone routing protocol (ZRP) is an example of this type of routing protocols.

IV. DESCRIPTION OF ROUTING PROTOCOLS

Destination sequenced distance-vector (DSDV):- DSDV is one of the first protocols for ad-hoc wireless networks. This protocol is based on classical Bellman-ford routing algorithm designed for Mantes. As it is a table-driven routing protocol, each node maintains its up-to-date routes to every other node in the network [13]. Routing information is periodically transmitted in order to maintain routing table consistency. Each entry in the table is marked with a sequence number to avoid looping problem. The table uses two types of update-full dump and incremental update to reduce the network traffic generated while route update [18]. An incremental update takes single network data packet unit (NDPU) while full dump update takes multiple NDPUs. Table updates are initiated by destination with new sequence number which is always greater than the previous one. In case, if a route already exists before traffic arrives, transmission occurs without any delay. In case, of failure of a route to the next node, the node instantly updates the sequence number and broadcasts the information to its neighbour.

The advantage of using DSDV is the availability of routes to all the destinations at all the times, thus less delay is involved in route setup process. But DSDV suffers from excessive control overhead due to frequent updates of broken links. This may choke the bandwidth.

Ad-hoc on demand distance-vector (AODV):-

AODV is another classical variant distance-vector routing algorithm [19]. AODV is pure on-demand routing protocol, as it uses on-demand approach for finding routes that is a route the destination is established only when a node wants to send data to that destination. It maintains traditional routing table that is one entry per destination. In AODV, each node maintains at most one route to the destination and as a result, destination replies to the first incoming request only once during a route discovery. Four types of control messages are used in AODV protocol. Route request, route reply, route error messages and hello messages are utilized for route repair [2]. The source broadcasts the route request packet in the network when it wants to find a path to the destination. The RREQ packet contains the sequence number and the broadcast Id. Fig 4 shows the route discovery. Each neighbour satisfied with RREQ replies with the route reply (RREP) packet. Unlike DSDV, if a node in AODV cannot specify the RREQ, it keeps the track of information in order to implement reverse and forward path setup that will help in transmission of RREP. The major difference between AODV and other on-demand protocols is that it uses a destination sequence number to determine up-to-date path to destination. These sequence numbers guraantee freshness and loop-free routing. AODV provides loop free routing in case of link breakage.

The main advantage of this protocol is the use of destination sequence number to find the latest route destination. But disadvantage of this protocol is the multiple route reply packets in response to the single route request packet that leads to heavy control overhead.

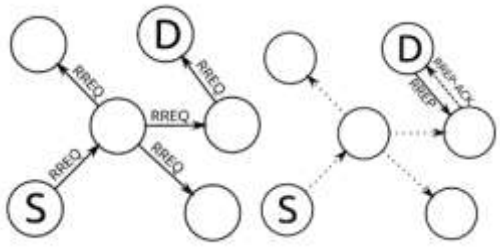

Fig. 4 Route Discovery (i) RREQ (ii) RREP

Zone routing protocol (ZRP):-

ZRP is a hybrid protocol which was desgined to mitigate the problem of proactive and reactive protocols. It combines the best features of these protocols. The key concept employed in this protocol is to use proactive routing scheme within a node's local neighbourhood and reactive scheme for nodes beyond that neighbourhood. These local neighbourhoods are called zones. The size of routing doesnot depend on the geographical area , it is described by a parameter known as zone radius. The routing zone of a given node is a subset of network , within which all the nodes are reachable within less than or equal to zone radius hop.

For intrazone routing, ZRP uses intrazone routing protocol (IARP). This protocol is used in the zone where a particular node employs a proactive routing, that is the node communicates within the interior nodes of its zone and is limited by zone radius. Interzone routing protocol (IERP) is the reactive component of ZRP, that uses a reactive approach to communicate with nodes in other zones. When there is a request for route, routes queries are issued within IERP. The delay caused in route discovery is minimized by border casting. An approach in which node doesnot send any query to all local nodes, but only peripheral ones. Border cast resoultion (BRP) provides packet delievery service [11].

By combining the advantage of reactive and proactive scheme, ZRP reduces control overhead, but there is certain limitation of this protocol is that for large values of routing zone the protocol may behave like a puure proactive protocol, while for small values, its beahves like reactive protocol and it often creates overlapping zones.

V. PROPOSED WORK

The related work done on routing protocols showed various results. Our paper evaluates the comparison of different routing protocols based on routing information update mechainism. As per the literature survey various protocols have been compared and analysed using NS-2 environment with different performance parameters like throughput ,average end to end delay and packet delievery ratio by varying node mobility and pause time.

Definition of performance meterics:-

Throughput:- It is defined as the amount of data packets received at the destination node in the given period of time. It is generally measured in bits per second or datapackets per second or datapackets per time slot

End –to-end delay:- Time taken by data packet to be transmitted across a network from source to destination. The average end-to-end delay is calculated by adding all the times taken by the received packets divided by their total number.

Packet delievery ratio:- It is defined as the ratio between numbers of data packet sent by the source to the number to data packet received at the destination.

Routing overhead:-Number of control packets sent during the simulation indicates the routing overhead.

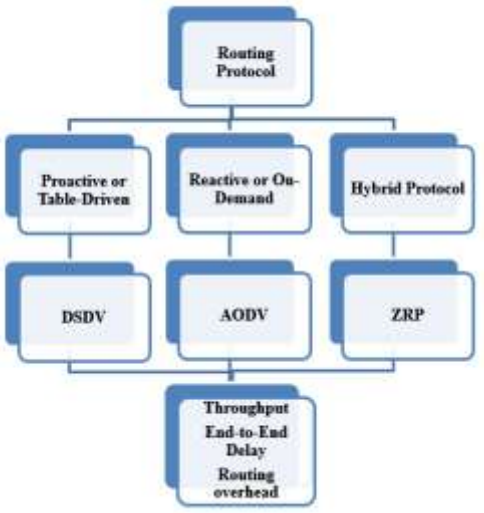

Fig. 5 Parameters for analysing different routing protocols

In our paper, we will be simulating and analzying the three different protocols on-demand (AODV), Proactive (DSDV) and hybrid routing protocol (ZRP) in the Network Simulator-2 based on various QOS parameters like throughput, end-to-end delay and routing overhead by varying node mobility and pause time simulations will be done and the results shown by previous work will be modified. The Fig 5 shows the different parameters for comparative

study of different routing protoccols in manet. ***e.g***: maximizing throughput and minimizing end-to-end delay by keeping certain parameters constant.

VI. CONCLUSION

In this paper, we have discussed the taxonomies of different routing protocols in mobile ad hoc networks and provided comparisons between them.The protocols are divided into three main categories based on update mechanism (i) on-demand (reactive), (ii) table-driven (pro-active), (iii) hybrid protocols. Based on this mechanism the proposed work will be analysed and simulated using ns-2 environment to compare different routing protocols AODV, DSDV, ZRP based on different parameters to maximize the throughput and minimize the end-to-end delay. A representative of each routing protocol is used for analysis and comparison. Each routing protocol has its unique features and analysis of these routing protocols has explained the characteristics of these routing protocols. Their comparison based on different performance parameters helps us to desgin a adhoc network with improved performance and better quality of service.

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