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PERFORMANCE ANALYSIS AND COMPARISON OF ROUTING ALGORITHMS

Thesis submitted in fulfillment for the requirement of the Degree of

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DECLARATION

I hereby declare that the work reported in the M.Phil. Thesis entitled **"Performance Analysis and Comparison of Routing Algorithms in Mobile Ad Hoc Network"** submitted at **LOVELY PROFESSIONAL UNIVERSITY,** is an authentic record of my work carried out under the supervision of **Dr. Manmohan Sharma.** I have not submitted this work elsewhere for any other degree or diploma. I am fully responsible for the contents of my M.Phil. Thesis.

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SUPERVISOR'S CERTIFICATE

This is to certify that the work reported in the M.Phil. Thesis entitled **"Performance Analysis and Comparison of Routing Algorithms in Mobile Ad Hoc Network"** submitted by **Mandeep Kaur** at **LOVELY PROFESSIONAL UNIVERSITY** is a bonafide record of his / her original work carried out under my supervision. This work has not been submitted elsewhere for any other degree or diploma.

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LIST OF ACRONYMS & ABBREVIATIONS

DSDV	Destination-Sequenced Distance Vector
OLSR	Optimized Link State Routing
FSR	Fisheye State Routing
TBRPF	Topology Dissemination Based on Reverse Path Forwarding
STAR	Source Tree Adaptive Routing Protocol
WRP	Wireless Routing Protocol
AODV	Ad hoc On Demand Distance Vector
DSR	Dynamic Source Routing
TORA	Temporally Ordered Routing Algorithm
ABP	Alternating Bit Protocol
CBRP	Cluster based Routing Protocol
LAR	Location Aided Routing
ABR	Associativity Based Routing
SSR	Scalable Source Routing
ZRP	Zone Routing Protocol
DSMR	Dynamic Source Multipath Routing

ADV	Adaptive Distance Vector
AOMDV	Ad hoc On Demand Multipath Distance Vector
AROD	Adaptive Routing in Dynamic Ad hoc Routing
NDMLNR	Node Disjoint Multipath Routing considering Link & Node Stability
DRCA	Dynamic Route Change Algorithm
DNDR	Dual Node Disjoint paths Routing
DMAODV	Distensible Multipath Ad hoc On Demand Distance Vector
EAODV	Enhance Ad hoc On Demand Distance Vector
EAOMDV	Energy Aware On Demand Multipath Distance Vector
HOMDV	Hybrid On Demand Multipath Distance Vector
LARZRP	Location Aided Zone Routing Protocol
LRMR	Link Reliable Multipath Routing Protocol
MAODV	Multipath Ad hoc On Demand Distance Vector
E2MR	Energy Efficient Multipath Routing
RREQ	Route Request
RREP	Route Reply
QoS	Quality of Service
E2E	End to End
ROH	Routing Overhead
PDR	Packet Delivery Ratio
MRP	Mixed Routing Protocol
Ns	Source Node
Nd	Destination Node

CHAPTER – 1 WIRELESS NETWORKS

1.1 INTRODUCTION

In the 1970's with the emergence of wireless network, it has become more and more popular in the computing trade. A wireless network is defined as a network which is not using existing network infrastructure and uses radio waves to connect to other computing devices instead of wires. Wireless networks are broadly having two types: infrastructure network and infrastructure less network. The first one network is having wired and fixed type including base stations and gateways. In this the mobile node communicates with other nodes through their nearest base station that is within its range. In case of mobility when the node will be out of range of one base station and will enter into another base station's range then it will continue its communication through this. Another type is infrastructure less network also called as ad hoc network, are having no fixed and wired base stations and routers. In this kind of network all the mobile nodes are able to communicate with other nodes on their own [1]. In a wireless system, currently mobile Ad-hoc network has become an essential part. Now days the applications of mobile computing is acting as a primary element because mobile devices are being used anywhere and everywhere. (2)

Wireless Ad Hoc Network (WANET) comprises of three types of network:

Wireless Mesh Network (WMN)

Mobile Ad Hoc Network (MANET)

Wireless Sensor Network (WSN)

1.2 MOBILE AD HOC NETWORK: It can be defined as the collection of mobile nodes (wireless) that works without centralized control and nodes can

communicate with each other without fixed infrastructure (3). In the network environment each and every node acts as a router and also forwards data packets to other nodes. The data packets are passed on from one router to another where the router generally acts as intermediate nodes in a network environment.

An ad-hoc network is dynamic in nature as a result of which the algorithms and protocols used in wired network will not work suitably for an ad-hoc network specifically. Since the ad-hoc network contains features with great flexibility as any node can leave or join the network any time, any node can mobilize from a specific random state to any state within the network. Additionally, two nodes might not come into the range of one another. Although. They will communicate to each other via other intermediate nodes by using them as router.

As mentioned above, the features of an ad-hoc network, it requires a different set of protocols and different mechanisms which are capable of bringing dramatic change(s) in the current topology. The protocol that one required should be adaptive and have an efficient failure recovery mechanism so that the network able to recover from the rapid and continuous change in topology.

Fig: 1 MANET

Following are some of the requirements of ad-hoc network that must be fulfilled.

(i) The protocol used must not require too much effort to establish a connection and then to transfer the data because data amount to be transfer is

comparatively small and frequent establishment then direction of connection is needed to be adjusted in ad-hoc network.

(ii) Rather than having a single path an efficient protocol can have multiple paths between the source and the destination, if there is a probability of congestion on some route(s) (when various data packets tend to pass via those path (s) and route getting overloaded) then communication may acquire other route and even if one links blocked or has failed due to leaving of a node or any other cause, then also communication continues with other links (if available).

(iii) The path acquired for communication should be free from loop otherwise the data sent (in from of data packets) through that path may get stuck in that loop and never reach to its destination. A protocol should be designed in a way that hides all the complexity of the communication mechanism and provides an easy interface to the user.

As these protocols are used for mobile nodes and in mobile nodes resources are limited such as battery backup, memory, heat control, weight, etc. so, the protocol needs to be efficient and optimum in the usage of such resources. The protocol in ad-hoc network requires to be quick enough while connecting to the internet and other networks.

In ad-hoc network, multiple routes are possible between source and destination. It is not possible that all routes are equal in length and it is also not possible that all routes are free to communicate or go through it. So both the aspects such as traffic congestion and shortest path should be taken under consideration while finding the optimum path for the communication and also ability to change from one path to another on any change in network topology. It may use more than one path to transfer data at one time, so that part of data go through one route and rest of data go through some other route.

1.3 CLASSIFICATION OF ROUTING PROTOCOLS: Ad-hoc network routing protocols can be classified into three broad sections respectively:

1.3.1 PROACTIVE ROUTING: In this routing, as soon as any network going to establish or joining of any node or removal of any node happens, the information about the node is transferred to all its neighbors and these keep them aware of any change that occurs in the network. For this, these protocols need to maintain a table regularly, regarding the information about every node present in that network. After every short and fixed interval each node in Proactive Routing updates the current information or position of the nodes connected to it directly to the other successive nodes. In this way, all the nodes always keep updated information about all the routes and nodes so that data can be sent anytime form any node as source to any node as a destination through any possible path from source to destination. As these protocols keep the record of all the possible paths from one node to another without concern about whether they are actually needed or not. This makes the less efficient use of resources as most of the resources are consumed in maintaining routes rather than data transfer. The traffic is almost congested with the control packets and therefore data packets suffer from collision and retires, which lead to the delay in communication. This is a disadvantage of Proactive Protocol that, due to lots of overhead of updating and control data packets suffer from less priority and these protocol are not able to adapt the rapid and continuous changes that occur in the topologies and occur in the ad-hoc network during communication. In other words, we can say that the proactive routing is useful if a good amount of resources are available and nodes shows less displacement during communication. Besides of some disadvantages as this routings exists, it also has some advantages.

(i) As each node contains its own route table which makes every node aware of, which path is to be selected.

(ii) If at any instance a route failed and is unable to transfer data then a quick recovery can be made to transfer data to its destination by adopting another path.

(iii) Availability or unavailability of any node can be examined quickly from the regular update before performing any large and time consuming action for communication.

(iv) Multiple paths from source to destination provide a facility for a node to choose the best possible path among the available paths with consideration of necessary aspects such as traffic congestion, distance, etc.

Following are the Pro-active routing protocols:

(i) DSDV

(ii) OLSR

(iii) FSR

(iv) TBRPF

(v) STAR

(vi) WRP

1.3.2 REACTIVE ROUTING PROTOCOL: In proactive routing there is a big problem which seems as an obstacle in enhancing the facilities served by routing, that problem is excessive traffic load due to the need of regular updation of table entries whether it is needed or not. The problem of regular maintenance is overcome by reactive routing which reduces the traffic up to a great extent as it updates the table and performs other actions only when they are needed, instead of regular updation. It starts finding a path for communication between the source and destination node only when there is a requirement of finding a new path or another path is demanded for communication through network. Thus, the route is also known as, "on-demand routing" respectively. In this routing phenomenon, the routes are only created depending upon the request put by the source. Whenever a route by the node is required in order to reach to the destination, route discovery process commences within the network. After establishment of the route, route maintenance procedure is started until route is not further required. On-demand protocols were designed with the aim of reducing overhead, thus increasing bandwidth and conserving power at the mobile station. Overhead reduction, power conservation of the mobile station and bandwidth improvement are the important aspects of, "on demand routing".

Following are the Reactive routing protocols:

(i) AODV
(ii) DSR
(iii) TORA
(iv) ABP
(v) CBRP
(vi) LAR
(vii) ABR
(viii) SSR

1.3.3 HYBRID ROUTING PROTOCOL:

When we enlighten, "Proactive Routing", the protocol uses excess bandwidth to conserve the routing information. Whereas, reactive routing protocols includes long RREQ delay. A reactive routing protocol subsequently floods the RREQ packets to whole network during the routing discovery process. So Hybrid routing protocol is a mixture of both the techniques.

ZRP- In ad-hoc network, the largest part of traffic is directed to the nearby nodes. Therefore, ZRP reduces the proactive scope to a zone. In a limited zone, the maintenance of routing information is much easier. The Zone Routing Protocol (ZRP) is a hybrid routing protocol comprising of (proactive and reactive protocols) which has been developed with the aim to address the above mentioned issues. ZRP is a routing protocol having two components such as Intrazone Routing Protocol (IARP) which is a proactive routing protocol and Interzone Routing Protocol (IERP) which is a reactive routing protocol. This algorithm is adaptive in nature.

1.4 METRICS USED IN ROUTING

Following are the **metrics** commonly used in networking for the performance analysis.

Throughput: The rate of effective packet delivery over a correspondence channel and measured in bps (bits per second). The throughput can be defined as the aggregate sum of data a receiver received by sender partitioned by the total time taken to receive the last packet.

End- to- End delay: It is the ratio between the aggregate delay and number of packets sent and received. The total delay can be explained as the sum of delay encountered by each packet. Single packet delay is the difference between the time span when the packet was first sent and the packet received at the final destination host.

Packet Delivery ratio: It is the ratio between the incoming data packets and actually received packets of data respectively.

Routing overhead: It describes that prior sending the actual data packets; packets related to path discovery and path maintenance need to be sent.

Average Delay: It is the measurement of how much seconds the packet took to reach from the source to the destination's application layer.

Path optimality: With respect to the source and destination it describes about the path being actually opted and the best possible path that could have taken in order to transit the data packet.

CHAPTER-2: LITERATURE REVIEW

2.1 EVOLUTION OF ROUTING PROTOCOLS

V. D. Park proposed a protocol TORA in [11] to work in large kind of network. It results in less overhead as compared to the previous algorithms by creating routes fast and also keeps acyclic paths from source to destinations.

C.E. Perkins et al proposed a new novel algorithm in [12] named as AODV [Ad hoc On Demand Distance Vector] to work in ad hoc networks .This algorithm is the mixture of two algorithms DSR and DSDV. This comes under the category of reactive routing protocols. It is using the conception of sequence numbers of DSDV so helps in reducing the loops and also scalable algorithm to use in large number of nodes. AODV only stores routes that are of the need in the routing. It is helpful in giving quick response in breakage of link active routes.

G. Pei et al introduced a novel routing algorithm FSR [13]. It is based on link-state routing category. This algorithm solved the problem of convergence and looping in the in the routing so results in scalable and efficient protocol to work in MANET.

C. R. Lin et al proposed a protocol in [14] that fulfills quality of service parameters to work in this kind of environment. This protocol not only finds the path between source to destination but also calculated bandwidth. The route will be terminated in case if intermediate node doesn't have required bandwidth to satisfy the QoS requirements.

R. V. Boppana et al presented an algorithm in [15] ADV [Adaptive Distance Vector] depends on distance vector routing category by using sequence number to skip loops with some features of on-demand by changing the size and recurrence of updates in routing. By comparing ADV with AODV & DSR it results as a strong protocol to work in ad hoc networks.

M. K. Marina et al in [16] proposed a protocol that is different from basic AODV in the sense of finding paths in the route discovery process by computing multiple paths instead of single path. AODV is responsible to give response to every route break by initiating route discovery so results in high overhead and latency. This problem can be reduced in AOMDV paths when all the available paths are break only then it will initiate route discovery.

S. Taneja in [17] done a comparative analysis to measure the performance of protocols AODV, DSR and TORA on the base of their characteristics, benefits and limitations was carried out. They have compared the protocol on the basis various parameters. After analysis the performance was traced out to be more stable with low traffic .TORA was more efficient during the packet delivery. AODV keeps on improving at faster speed and with denser mediums. It is better in route updating and maintains process.

K. Levchenko et al proposed an algorithm in [18] based on link-state routing category that increased routing efficiency by suppressing updates from parts of the network. It works by proliferate just some of the link state updates it gets, to reducing the frequency of routing updates in the network scenario. . It is different from the basic link-state protocols in generating only few updates.

After simulation it has been proved that it works better than the previous link-state nd distance-vector routing protocols.

S. Kumar et al in [19] compared DSDVwith AODV and DSR. The later protocols performed better under high mobility situations than first one. AODV and DSR delivered nearly 85% of packets regardless of mobile rate when compared with DSDV and also showed high average E2E delay.

S. Mohapatra in [20] done a performance analysis on prominent protocols AODV, DSR, DSDV and OLSR. As a result DSR was termed the bets protocol in terms of average PDR.

D.B J. Rao et al proposes that the DSR works relentlessly great and excels in routing phenomenon in[21], when the issue is related with mutli-hop wireless ad hoc network. Bu concluding it can be stated as the efficiency factor was more promising. Another benefit of the DSR is it adapts any network without being particularly having a specific infrastructure.

B.V.Dineshkumar proposed a routing protocol AODV_V based on AODV in [22]. The protocol show better performance compared to normal AODV.

DSR works relentlessly great in when the issue is related with wireless ad hoc network as analyzed in [23]. By concluding it can be stated as the efficiency factor was most promising. Another benefit of DSR is it adapts any network without being particularly having a specific infrastructure.

Lanjewar, N. Gupta in [24] concentrate on minimizing the factor such as network load, E2E delay and data packet loss in AODV and proposed a new algorithm based on AODV. In that the performance metrics were evaluated with no of transfers. With the increment of no. of nodes the new advanced AODV performed well.

The routing protocols and their performance are considered to be the major section for concern by assuming the protocols based upon routing topology by P. Rohal et al in [25]. Enlightened further it is with respect to both reactive (AODV, DSR) and proactive (DSDV) utilized for the study. By concluding it has been observed that among all the three protocols AODV is highly efficient and in comparison with reactive based protocols and proactive based protocols the first one is absolutely acceptable for the metrics (PDR, Throughput, E2E delay).

V. Rani et al describes the ad-hoc network and the various protocols in [26] being used such as :

WMN

WSN

MANET

Some other key points discussed so far in the paper are:

Features

Advantages

Types of MANET networks

It is solely carried out for describing the functioning and its applicability areas.

M. K. Gulati et al authors performed a comparison between reactive and proactive routing protocols based on Quality of Service in [27]

As a result, DSDV was few nodes comprising of low mobility. DSR was preferable for moderate traffic with moderate mobility but if the traffic is more and nodes are dense AODV performs better so AODV performs optimally well.

Sumitha J, describes the difference between adoptive and non-adoptive routing algorithms in[28]. Adoptive algorithms such as:

Distance vector algorithms

Link state algorithms

are more efficient when compared with non-adoptive algorithms such as :

Flooding

Shortest path algorithms

Random walk etc.

It is also seen that the redundancy of the changing links has been reduced by recomputing the affected areas.

M. K. Gulati et al in [29] done a comparison between reactive and proactive protocols based on Quality of service. As a result, DSDV was few nodes comprising of low mobility. DSR was preferable for moderate traffic with moderate mobility but if the traffic is more and nodes are dense AODV performed better so AODV performed optimally well.

S. Abid in [30] done and described the analysis of performance of wireless routing protocols based upon ROH, Throughput, E2E delay and PDR proposed MRP[Mixed Routing Protocol]. The authors have compared MRP with various protocols like AODV and DSR and TORA and DSR using NS2 simulator. As a result MRP worked better than other routing protocols.

Y.Choi et al proposed DRCA in [31] that is different from other protocols by finding a better and shorter path to the destination. They have brought the concept of HELLO message of adjacent node in AODV. The HELLO message will contain the list of only newly destinations with the no. of sequence and the hop counts so after receiving this HELLO message nodes will choose whether they will change the adjacent hop or not. By comparing it with the basic AODV it results in better PDR and average delay.

B.Bansal et al proposed a system [32] is the modified result of AODV protocol to reduce congestion in ad hoc network and named as EAODV. In this the node will wait for ACK for the given period of time or the value of threshold that is predefined set. If the node will not receive ACK within the set time then it will choose other path instead of waiting for the ACK. By simulation the proposed protocol gives better results than the basic algorithm by using different parameters and also controlled congestion effectively and fastly than the previous algorithm.

D. Sharma et al proposed a protocol in [33] by considering the one of main features that is power in ad-hoc network. The algorithm is an extension of AODV and works same as AODV but differs in phase of RREP. For this the threshold value is being set for all the nodes. If the node is suffering from low battery power then it will choose next better path to transfer the packet. After comparing the results this protocol found better as compared with the previous.

Z. D. Katheeth et al done a comparative analysis in[34] between all routing protocols AODV, DSDV, DSR and OLSR representing their performance on various metrics like throughput and PDR. It is concluded that throughput results as OLSR was the best for both cases of no. of nodes. So they performed better than reactive protocols. These routing protocols show consisting in their throughput values. OLSR was rarely affected by changes in halt time or no. of nodes whereas the maximum effect of change in halt time was seen in DSR.

2.2 RESEARCH FINDINGS

YEAR	ALGORITHM	TECHNIQUE USED
1996	DSR	On Demand source routing
1997	TORA	Link state routing
1999	AODV	Single path distance vector on demand
2000	FSR	Link state routing
2001	DSMR	On demand routing
2001	ADV	On demand distance vector routing
2001	AOMDV	On demand multipath distance vector routing
2001	OLSR	Proactive link state routing

2005	AROD	On demand routing
2008	XL	Link state routing
2009	NDMLNR	On demand routing
2014	DRCA	On demand AODV
2015	DNDR	On demand Reversing AODV and node disjoint multipath routing
2015	Cluster based AODV	On demand routing based on AODV
2015	DMAODV	On demand based on MAODV
2015	EAODV	On demand routing based on AODV
2015	EAOMDV	Multipath AOMDV
2015	HOMDV	Based on AOMDV
2015	LARZRP	Based on ZRP
2015	LRMR	Based on demand AODV
2015	MAODV	Based on demand AODV
2015	M-DSR	Based on demand DSR
2015	Modified DSR	Based on demand DSR
2016	E2MR	Energy efficient

2.3 PROBLEM FORMULATION:

Following issues were not handled properly in the previous research work.

(1) In case of high mobility, most of the routing algorithms show less efficient performance.

(2) In case of increased frequency of routing updates in the network the communication between the nodes of the network also increases, which is need to be minimized for reducing communication overhead.

(3) When the number of nodes increases in the network an issue of average end to end delay of packet delivery affects the quality of service.

2.4 OBJECTIVES:

(1) To improve and analyze the performance of the network for the particular routing algorithms.

(2) To give better PDR, throughput and minimize overhead in routing.

(3) To compare the various techniques of routing with the proposed routing algorithm.

2.5 ORGANIZATION OF THESIS:

Chapter 1 describes about Wireless network, Mobile Ad Hoc Network, its various categories and commonly used metrics in the routing.

Chapter 2 describes Literature review, Research findings, problem formulation and objectives of thesis.

Chapter 3 defines a comparative analysis of routing protocols

Chapter 4 defines methodology and system model of the work.

Chapter 5 deals with implementation and evaluates the results.

Chapter 6 deals with conclusions and future work.

2.6 TIMELINE

Steps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Study various Routing algorithms																		
Collection of data and Problem identification																		
Design a new routing algorithms. Implementation, Analysing the performance of proposed algorithms and Comparison with Existing Algorithms																		

Table-1 TIMELINE

Chapter-3

A Comparative Study of On-Demand Routing Protocols for Mobile Ad-hoc Networks

ABSTRACT

With a boost of mobile devices in today's era, Mobile Ad Hoc Network has become an essential part and has gained an interest of researchers. It is a collection of self- organizing and adaptive mobile nodes or devices that works without fixed infrastructure where every single mobile node work as an end device and as well as router to move forward the data packets. As MANET is of highly dynamic in nature, the mobile nodes moves openly and freely and change their positions very often. This chapter emphasis on various on-demand routing protocols. A critical overview of each protocol is also provided on the basis of the related work done in this area. We also tabulate the comparative analysis of these protocols on the basis of various parameters.

1. INTRODUCTION

Wireless networks are having huge attention mainly developed in two types: Infrastructure mode and Infrastructure less or Ad-hoc mode. In first one, Access Points [AP] are used for communication between nodes. They help in forwarding data from node to node. While in Ad-hoc or Infrastructure less mode it works without Access point or centralized device. So each and every node is capable of doing both the jobs i.e. to forward data and also to transmit their own data [1]. MANET comprises of mobile components in a wireless network. These mobile nodes are having short range of transmission so nodes seek the support of their neighboring nodes to forward the data packets [2, 13].

The topology of MANET is much more dynamic as compared to the internet i.e. a wired network. So the protocols that are used in wired network will not be suitable for this network [3]. Due to this kind of nature the protocol must not require too much effort to establish a connection. Despite of having a single path the protocol should have multiple paths between the source and the destination. Due to the dynamic nature congestion is likely to occur on some routes in the network scenario so the protocol may acquire other route for communication. If one link has blocked or failed due to leaving of a node or any other cause communication should be continued with other links (if available). The path acquired for communication should be free from loop otherwise the data sent through that path may get stuck in that loop and will never reach to its destination. So the protocol should be designed in a way that hides all the complexity of the communication mechanism and provides an easy interface to the user.

MANET works best in the situation of emergency like natural disasters, military, etc. due to its minimal configuration, easily development and without centralized governing structure. [4]. Each and every node in the network discovers the path by RREQ and RREP packets [5]. The resource (bandwidth, battery power and memory space) availability is the major issue in this kind of network. Because the nodes or mobile devices are mainly battery worked so battery power is the primary issue. Instead of searching a new path and to retransmit a data packet, nodes also consume battery power in data transmission. So power management should be main concern.

Each and every node is responsible for two types of jobs. One is as an intermediate node to forward data to another node and also as a source node for transmitting its own particular data [1].

2. ROUTING PROTOCOLS

Mainly routing protocols are categorized into three types:

- Table driven or Proactive routing protocols
- On demand or Reactive routing protocols
- Hybrid routing protocols

2.1 Table-Driven or Proactive Routing Protocols

In this kind of routing when any network is going to establish or joining or removing of any node happens, the information about that node is transferred to all the neighboring nodes in the network so these keep them aware of any change that will occur. For this purpose these protocols maintain a table regularly about every node's information in the network. After a fixed time each node updates the position or current information connected to the nodes to the other succeeding nodes. As a result all the nodes are having updated information about the routes so data packets can be sent from any node at any time. This kind of routing scheme results in less efficient use of the resources as resources are utilized in maintaining routes instead of data transfer. Routes are almost congested so data packets suffer from retires that lead to delay in the communication. These kinds of protocols are not well suited to work in the network where the changes are occurring continuously and rapidly because updation of the nodes results in overhead and data packets suffer from less preference. In other words, these kinds of protocols will work well where the resources are in good amount and during communication nodes will show less movement. These protocols are having some advantages also like:

- Every node is having its own routing table that makes aware of the path to be selected.
- Quick recovery of the route is possible by adopting alternate path.

- Nodes can choose the best possible path from the available multiple paths between source and destination.

Various proactive routing protocols are available like: DSDV, OLSR, FSR, TBRPF, STAR and WRP.

2.2 On Demand or Reactive Routing Protocols

It has been seen that Proactive routing protocols are facing the problem of extreme traffic load because of the regular updation of the entries in case they are having need of it or not.

So that problem is overcome in Reactive routing that reduces the traffic up to a great extent because it will update the table only when there is a need of it rather than of regular updation. It starts finding path between source and the destination only when there is a need of finding it that's why it is also called On-demand routing. Reactive routing consumes less bandwidth as there is no need of regular updation of the table entries.

In this kind of routing, paths are only made when it is demanded by the source, only then a node will start route discovery process. After that route maintenance procedure is started until route is not farther mandatory. Reactive routing protocols were designed with the purpose to reduce overhead.

Various kinds of routing protocols are: AODV, DSR, TORA, ABP, CBRP, LAR, ABR, and SSR.

2.3 Hybrid Routing Protocols

Proactive routing protocols using too much bandwidth to maintain the information of the routes whereas Reactive routing are having long route request delays. So with the purpose to address the problems of both the approaches ZRP was designed. ZRP is known as hybrid routing protocol because of having the properties of both the techniques.

3. ON-DEMAND ROUTING PROTOCOLS

3.1 Ad-hoc On-demand Distance Vector (AODV)

As the name implies AODV is a protocol mixture of two techniques that are on demand using hop by hop routing and distance vector using destination based sequence numbers so it combines both the properties of DSR and DSDV protocols [2, 6]. It discovers route when there is a need of it generating a route request [RREQ] via a route discovery process rather than to maintain routes from each node to all other nodes. The intermediate nodes will forward RREQ. When request reaches to the destination it will create reverse route by generating route reply [RREP] message. From source to the destination each and every node works in hop by hop state as opposed in the source routing[the entire route] [3,6,7]. AODV handles one entry per destination based on traditional routing tables. When repairing link breakages it provides loop free routing. The salient feature of AODV is it provides communication in unicast, multicast and broadcast. Same as DSR this protocol uses the mechanism of discovering and maintaining of route to sustain a route. Whenever a source node has to transmit information to the destination it will check its own routing table to know whether the route exists or not , if the route does not exist then it will create a request that will hold the information regarding the source address, destination address, destination sequence number, broadcast ID and hop count. A RREQ message is distinctively identifiable by its source address and broadcast ID. Different categories of messages are used to perform the route maintenance to maintain the route: route error message, hello message and route time out message. If any message fails in the route then route error message is created. The purposes of hello messages are to maintain the link between the nodes. So it avoid the forward and in reverse pointers from termination. Respectively the third message is used when for a certain time there is no activity on the route and the time will be out for route pointers at the intermediate nodes. For those nodes link will be deleted. Routes [8] that are not in the use will be deleted from the table. The sequence number will avoid loops in the routing. AODV [9] will discover and maintain any route only if two nodes wants to interact with each other. The[10] basic difference between DSR and AODV is that each packet in DSR holds the complete information of routing as opposed to AODV where the packet holds only the destination address, so it results in fewer overhead than DSR. In DSR another variance is that the route

reply will hold the address of every node in the route but in AODV the route reply will carry both destination address and the sequence number.

Benefit of AODV is that it is suitable for extremely dynamic environment or network, but the nodes may experience long delays while construction of routes and due to failure in links node could create another route discovery that results in extra delays and will utilize more bandwidth when the size of the network will increase. For [11] a single route request there will be more route reply messages so it will results in overhead. Another disadvantage leads to more utilization of bandwidth due to periodic hello messages.

3.2 Dynamic Source Routing (DSR)

DSR is a kind of protocol that follows the procedure of source routing. In this the sender has the whole information between source to destination (hop by hop). Route cache is responsible for storing the information of routes. In this protocol first the sender node will check the route in the cache that wish to send data to some destination. If that route is not available in the cache then it will start route discovery process by generating a RREQ. This route holds the source node's address, destination node's address and unique ID number. Every node who receives the packet(data) checks if it knows the route to the destination, if no then will add its personal address to the data packet then forward this packet with its outgoing links[2,12]. It is not using any periodic "hello" messages like in AODV so it reduces the bandwidth overhead also saves battery power. There are two techniques on which working of DSR is based are: Route discovery and Route maintenance. Both techniques work collectively to permit nodes to discover and preserve routes from sender to receiver. When the receiver node receives RREQ, it will create RREP message to the sender in return, in case of a new message to the destination. The RREP holds basically the source route so after evaluating the source that is in the RREP packet; the sender knows the whole path to the destination and will store this in its cache for future use [3]. There are various advantages of DSR as it provides fast and easy recovery from breakage of links because source node already knows another path. Another advantage is that loop in routing will not occur. This protocol does not sustain a table so it will work well in large network where nodes are moving continuously. Another advantage is route cache of nodes are able to store

various routes it means before creating route discovery the source node will check its route cache for a legitimate route and if that route found so there will be no need for route discovery procedure[14].

3.3 Temporally Ordered Routing Algorithm (TORA)

TORA is a highly flexible, adaptable and powerful distributed routing protocol. It is built on the technique of link reversal to work in highly dynamic network. It finds various routes between the source and the destination. The protocol is mainly responsible for these tasks: Route creation, Route maintenance and Route erasure [3]. This protocol maintains various routes between source and destination so failure of any node will not affect the routing process, node can quickly switch to another route. To commence routing process, QRY packet will be transmitted from source to its neighbor and again QRY will be transmitted over the network until either it achieves the destination or the middle node having path to the destination. Then UPDATE packet will be transmitted by receiver of the QRY packet, that packet contains its height towards the destination. Each node's height will be set according to the value that is greater than the height of the neighbor node and then broadcast this packet. In the case node is having no neighbor of fixed height then it will find new route towards the destination. In case of network partition node generates a CLR packet to reset of routing in the network. [7].

4. RELATED WORK

Many researchers provide comparisons between different types of routing algorithms. Some of the following are mentioned here. In [7] a comparative analysis to measure the performance of protocols AODV, DSR, and TORA on the base of their characteristics, benefits and limitations was carried out. They have compared the protocol on the basis of various parameters. After analysis the performance was traced out to be more stable with low traffic. TORA was more efficient during the packet delivery. AODV keeps on improving at faster speeds and with denser mediums. It is better in route updating and maintenance process. In [11] a comparison between

reactive and proactive protocols has done based on Quality of Service. As a result, DSDV was few nodes comprising of low mobility. DSR was preferable for moderate traffic with moderate mobility but if the traffic is more and nodes are dense AODV performs better so AODV performs optimally well. In [14] the routing protocols and their performance are considered to be the major section for concern by assuming the protocols based upon routing topology. Enlightened further it is with respect to both reactive [AODV, DSR] and proactive [DSDV] utilized for the study. By concluding it has been observed that among all the three protocols AODV is highly efficient and in comparison with reactive based protocols and proactive based protocols the first one is absolutely acceptable for the metrics [PDR, Throughput, and E2E Delay].In [15] DSDV protocol is compared with AODV and DSR. The later protocols performed better under high mobility situations than first one. AODV and DSR delivered nearly 85% of packets regardless of mobile rate when compared with DSDV and also showed high average E2E delay. In [16] performance analysis was done on prominent protocols AODV, DSR, DSDV and OLSR. As a result DSR was termed the best protocol in terms of average PDR. In [17] a routing protocol AODV_V based on AODV was proposed. The proposed protocol show better performance compared to normal AODV.

DSR works relentlessly great when the issue is related with wireless ad hoc network as analyzed in [18]. By concluding it can be stated as the efficiency factor was most promising. Another benefit of DSR is it adapts any network without being particularly having a specific infrastructure.

In [19] the authors concentrate on minimizing the factors such as network load, E2E delay and data packet loss in AODV and proposed a new algorithm based on AODV. In that the performance metrics were evaluated with no. of transfers. With the increment of no. of nodes the new advanced AODV performed well. In [20] the analysis of performance of wireless routing protocols was described based upon ROH, Throughput, E2E delay and PDR and proposed MRP [Mixed Routing Protocol]. The authors have compared MRP with various protocols like AODV and DSR and then TORA and DSR using NS2 Simulator. As a result MRP worked better than other routing protocols.

A comparative analysis between all routing protocols AODV, DSDV, DSR and OLSR is done in [21] representing their performance on various metrics like throughput and PDR. It is concluded

that throughput results as OLSR was the best for both cases of no. of nodes. So they performed better than reactive protocols. These routing protocols show consistency in their throughput values. OLSR was rarely affected by changes in halt time or no. of nodes. Whereas the maximum effect of change in halt time was seen in DSR.

5. A COMPARATIVE ANALYSIS

The table-1 provide a comparative analysis of the three On demand routing protocols AODV, DSR and TORA based on the various parameters like technique used, mobility, loop free, multiple paths etc. The analysis shows that in case of routing overhead DSR works the best whereas in case of high mobility both AODV and TORA will show good performance and provides multicast routing, on the other hand in the similar conditions DSR provides only unicast. In DSR, there exits multiple paths while, in AODV and TORA only single route available from source to destination. Bandwidth utilization in DSR and TORA is less than AODV. All the three protocols are free from loop.

Table -2 Comparison of Protocols

Parameters	**AODV**	**DSR**	**TORA**
Source Routing	No	Yes	NO
Overhead	Less	Less than AODV	Most
Mobility	Good performance in high mobility conditions	Low performance in high mobility conditions	Good performance in high mobility conditions
Technique	Unicast and Multicast	Mainly unicast	Multicast
Multiple paths	No	Yes	No
Sequence no. used	Yes	No	Yes
Utilization of bandwidth	More	Less	Less
Free from loop	Yes	Yes	Yes

This chapter presents the overview of various on-demand routing protocols, their benefits and limitations. Their comparative study has shown in tabulated form on the basis of different parameters. In case of routing overhead DSR algorithm shown best performance in providing multiple paths, however, in high mobility the other algorithms shown better performance in providing single path. DSR and TORA shown better performances in bandwidth utilization compare to AODV. DSR provides unicast and the other protocols provide multicast routing. As in MANET the system topology is frequently changes with the time. Due to this characteristic of MANET it is hard to maintain the quality of service in the mobile ad hoc networks. Many routing protocols have been proposed till now, but still there are many challenges in the old routing protocols and these challenges creates a large scope to the future work for the development of powerful routing algorithm that will provide enhanced quality of service as well as satisfy all other metrics of the routing.

CHAPTER-4: METHODOLOGY

4.1OVERVIEW OF PROPOSED FRAMEWORK:

In our work we propose an algorithm that is energy efficient and is based on prominent On-demand protocol AODV.

The algorithm has following considerations.

1. Source node has the information of residual battery power cost, cost to send data as well as minimum distance to be covered for all the nodes in particular area.
2. There is a mechanism named as automatic update mechanism, which keeps on updating the information of other nodes to the source node.
3. There is no transmission delay while transmitting the message.
4. Every node has the capability to update battery life in the network.

4.2 PSEUDO CODE:

In this algorithm we consider alternative path selection criteria.

1. Low power consumption: The power consumption must be low.
2. Maximum power battery: The node which we selected, their power of battery must be high.
3. Minimum cost: The cost of transmission along path should be as minimum as possible.

   Cost Min= Pdf max + Hop min

   Basically the algorithm works on three different phases.

   1. Adjacency list preparation: In this phase each node prepares there its adjacency list i.e. each node find the list of its entire neighbor through which data can be sent.
   2. Message sending phase: In this phase source node send a query message or in this algorithm we can call as help message too, to all its nodes which is present into the adjacency list like ((x0,y0) (x1,y1)…….(xn,yn))
   3. Wait phase: in this phase or receiving query message or 'help' message, each node prepares its reply message with containing constant power of the path from the destination node.
   4. While packet sending or receiving the pdf [power dissipation factor] count of the node will be reduced which will determine the battery life and stored in the packet of network communication channel.
   5. Initially the pdf count will be full at the time of network installation.
   6. Basic communication in the network is taken same as from AODV.

      Packet receive/packet sending

      BL=PDF max

      PDF min=0

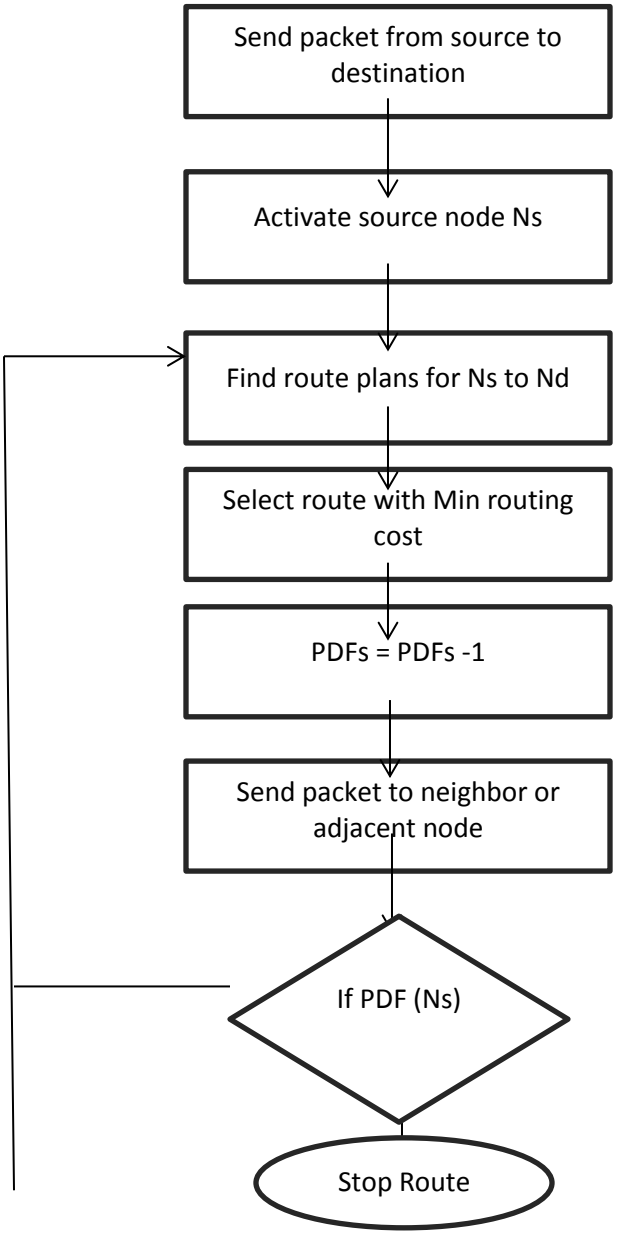
      PDF=PDF-1

      Where BL= Battery Life

      If (PDF max = = PDF min)

Node battery down

4.3 FLOW CHART



Cost route

Set PDFv = 0

Set Nr = null

For each route Ri

If(PDF(Ri) > PDFv)

Nr=Ri

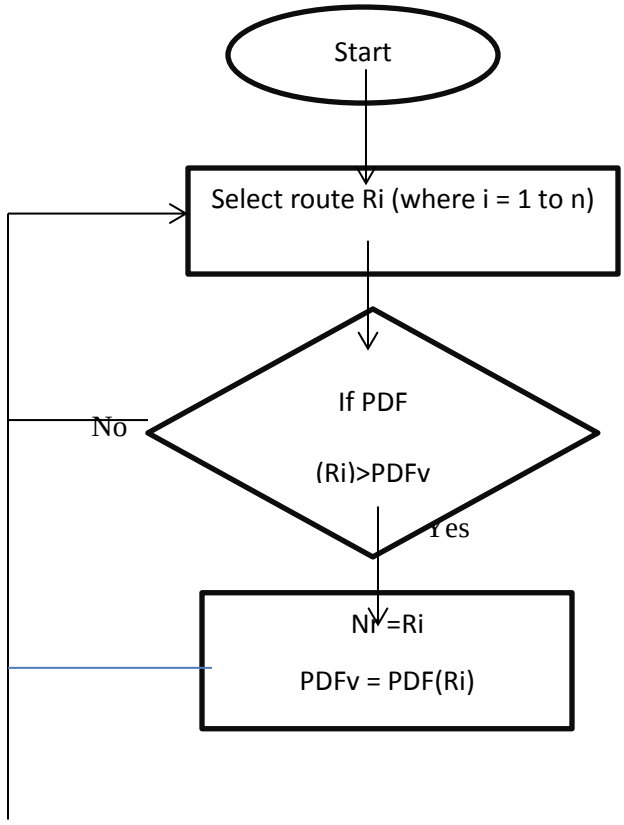
PDFv=PDF(Ri)

End if

End for

Update PDF factor

Select path and send packet



CHAPTER-5: IMPLEMENTATION AND PERFORMANCE ANALYSIS

S No.	Protocol	Packets Generated	Packets Received	Packets Dropped	PDR	Delay	Avg. Throughput
1.	DSDV	11901	2232	9669	18.7	125.4	83.24
2.	DSR	12514	2557	9957	18.0	127.9	80.21
3.	AODV	11213	2044	9169	18.2	137.3	81.42
4.	EMAODV	11523	2249	9274	19.5	115.4	84.57

TABLE- 3 PERFORMANCE OF DSDV, DSR, AODV & EMAODV

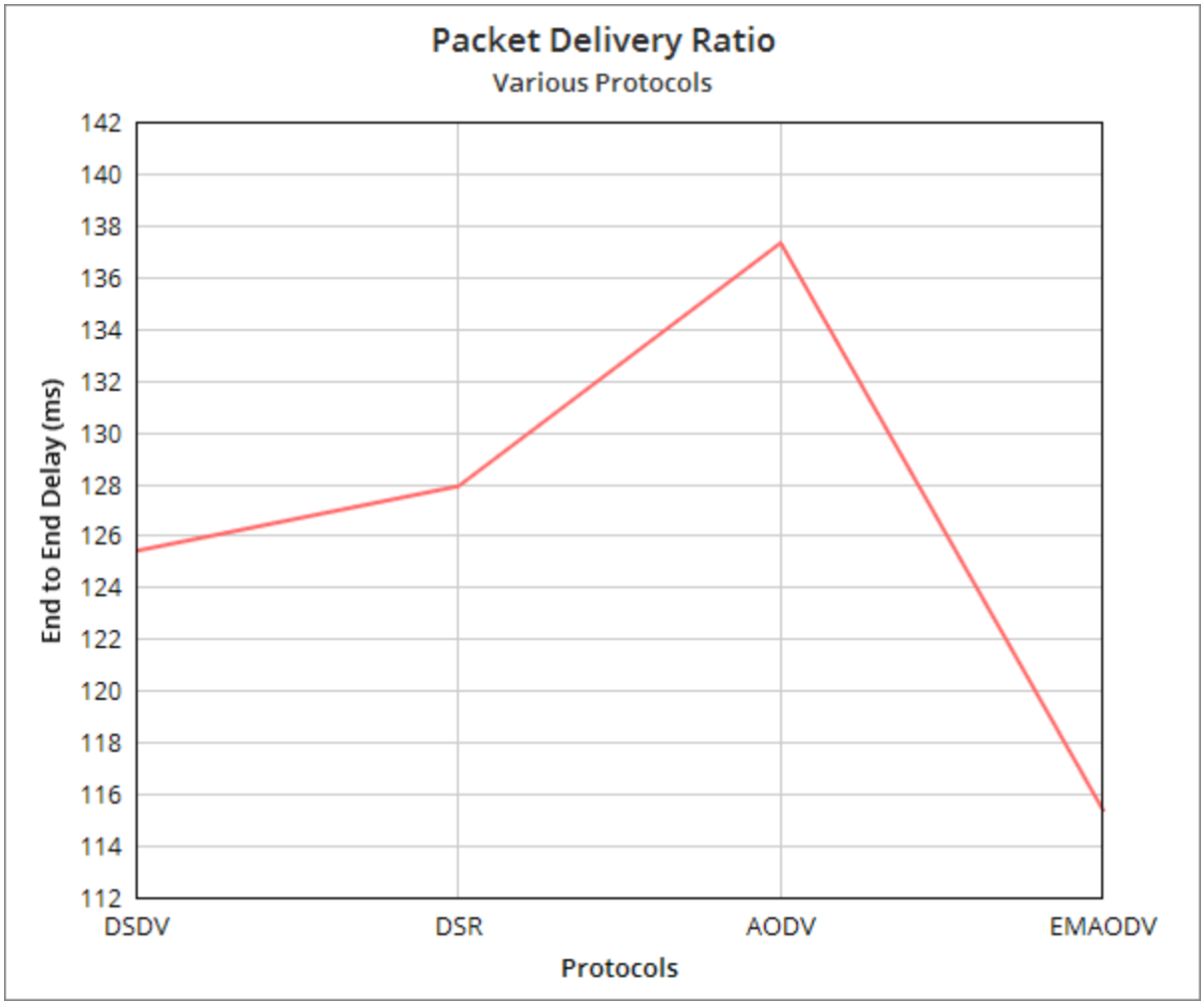


FIG -1.2 AVERAGE END TO END DELAY

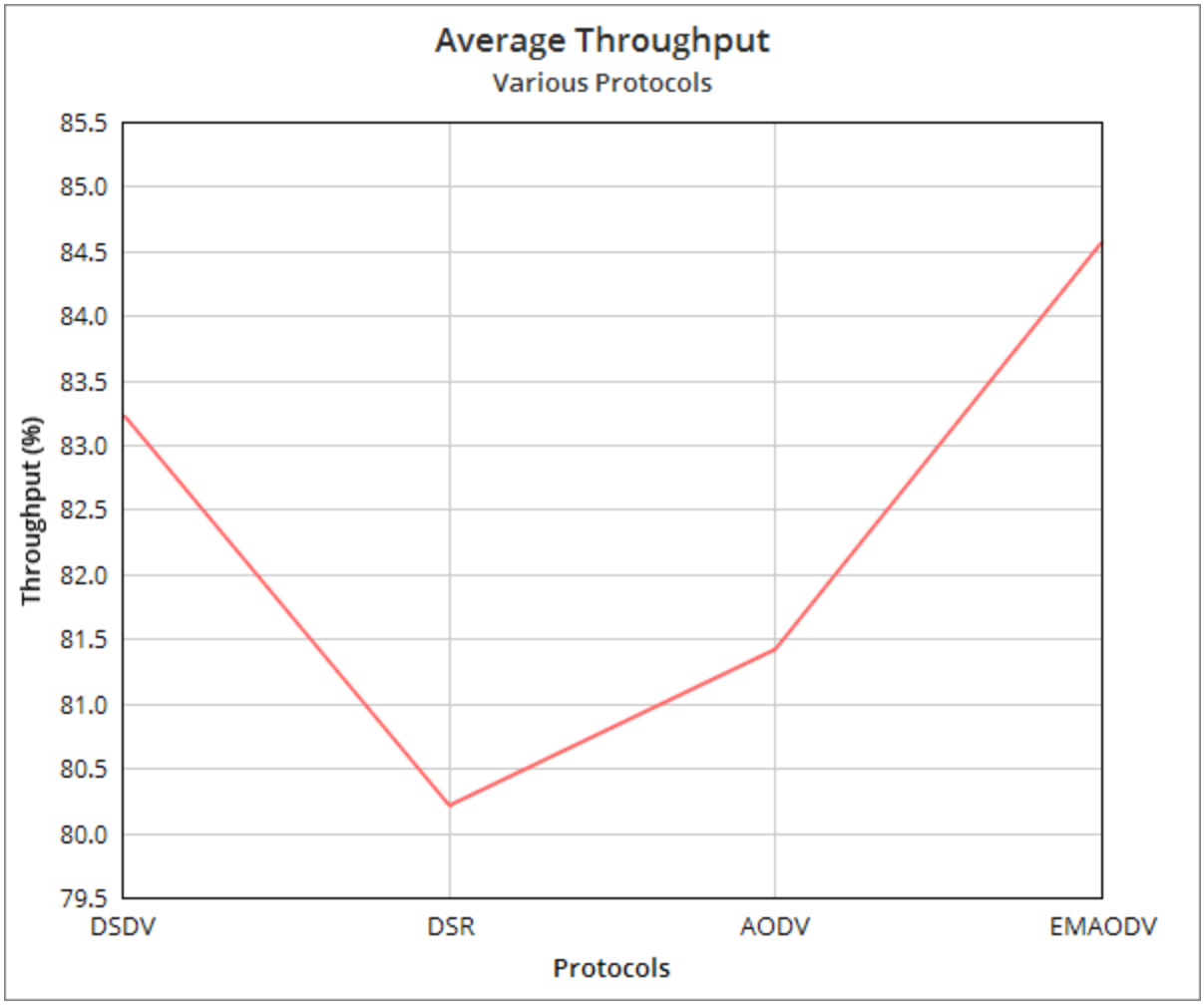


FIG-1.3 AVERAGE THROUGHPUT (%)

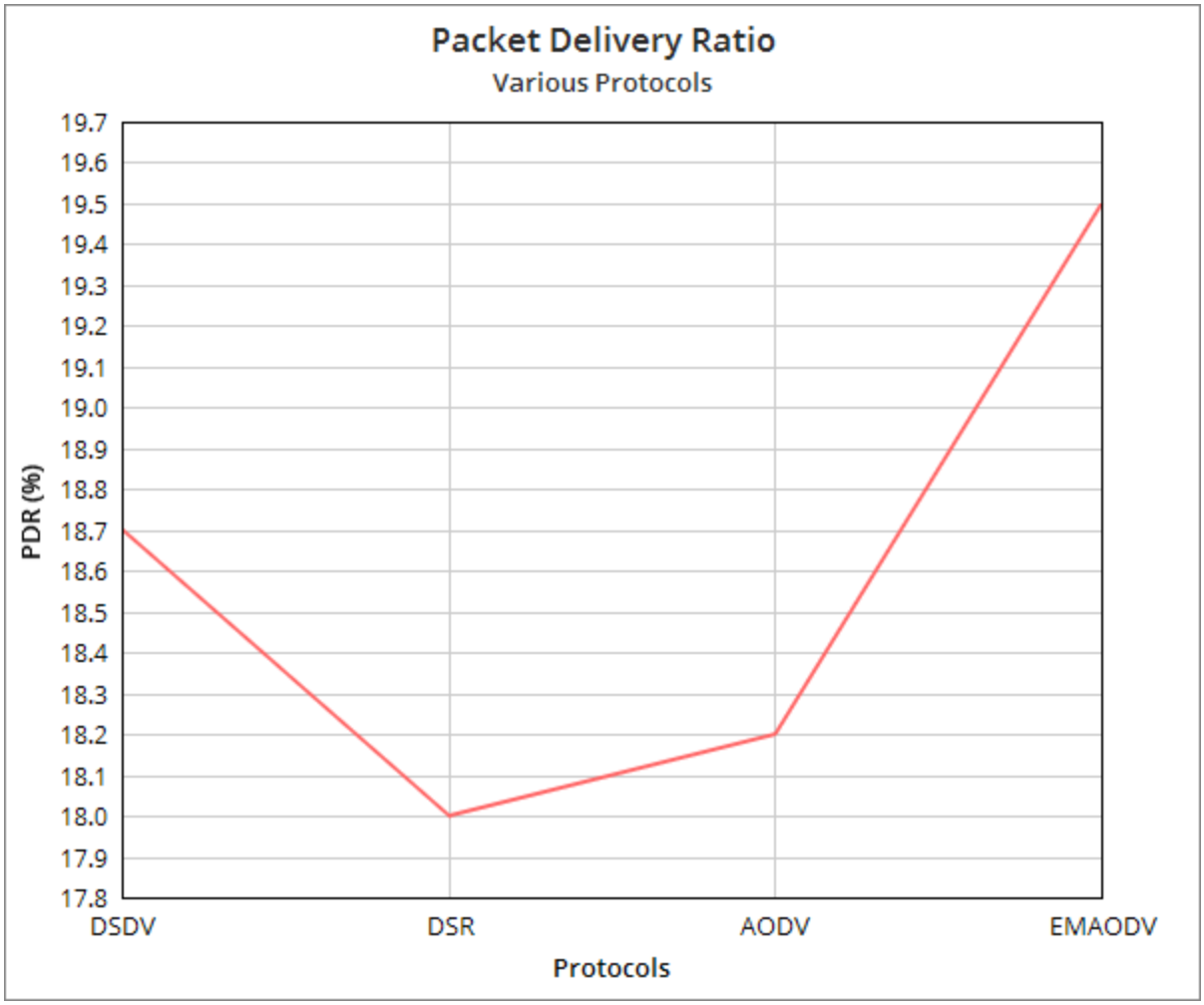


FIG-1.4 PACKET DELIVERY RATIO

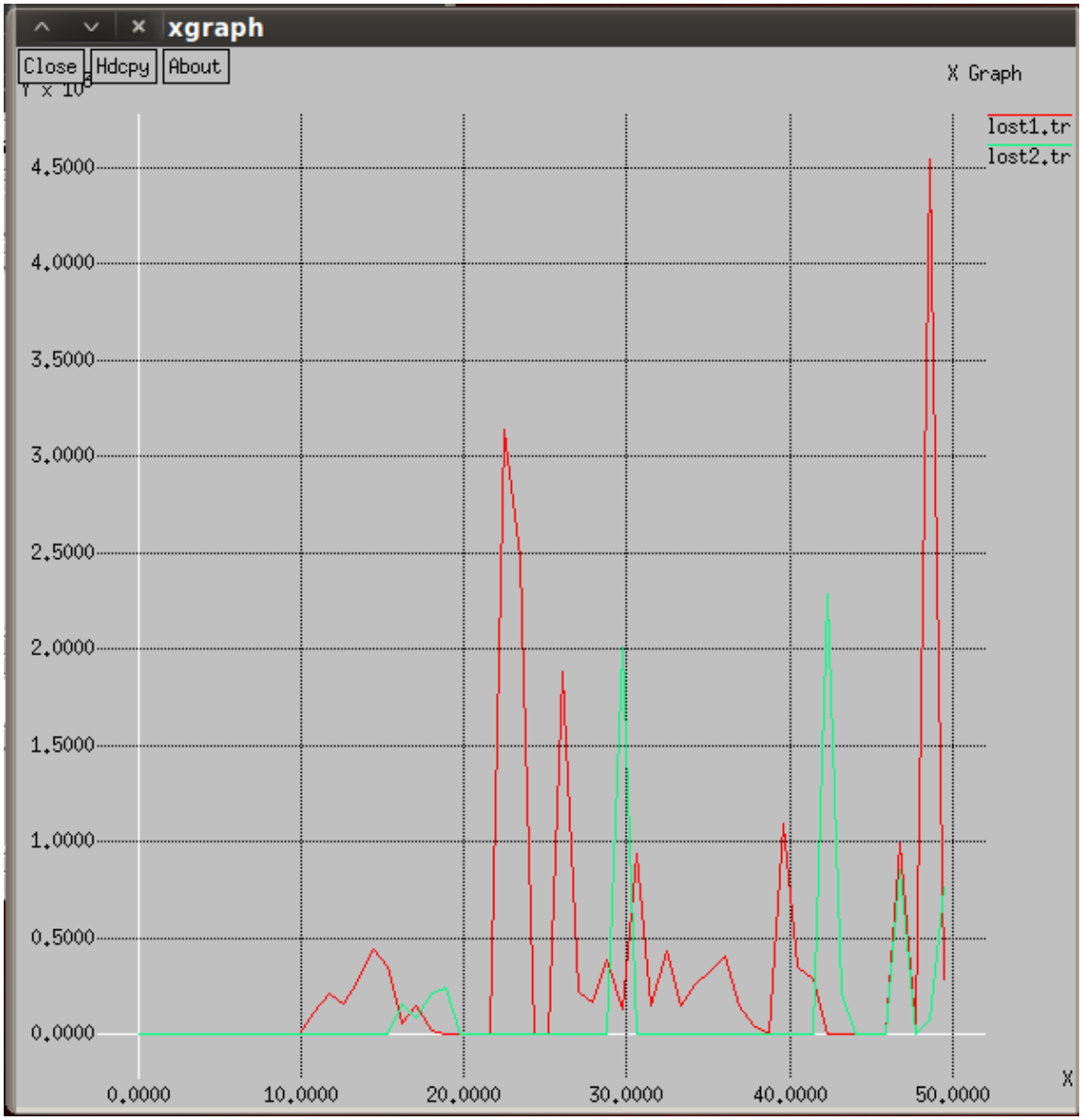
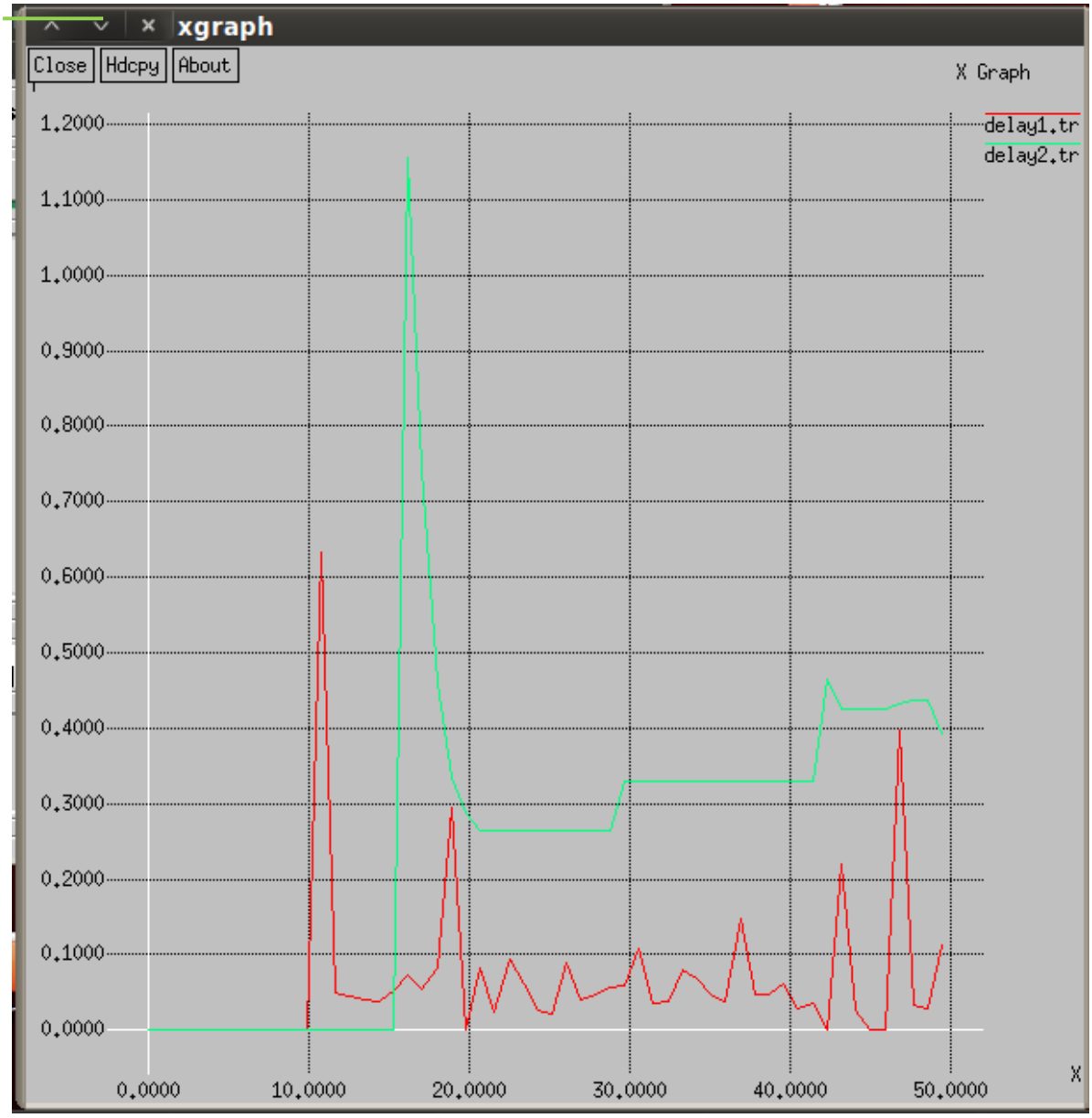

xgraph
Close
Hdcpy
About
X Graph
Y x 10^8
lost1.tr
lost2.tr
4.5000
4.0000
3.5000
3.0000
2.5000
2.0000
1.5000
1.0000
0.5000
0.0000
0.0000
10.0000
20.0000
30.0000
40.0000
50.0000
X

FIG-1.5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Close
Hdcpy
About
X Graph
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delay2.tr
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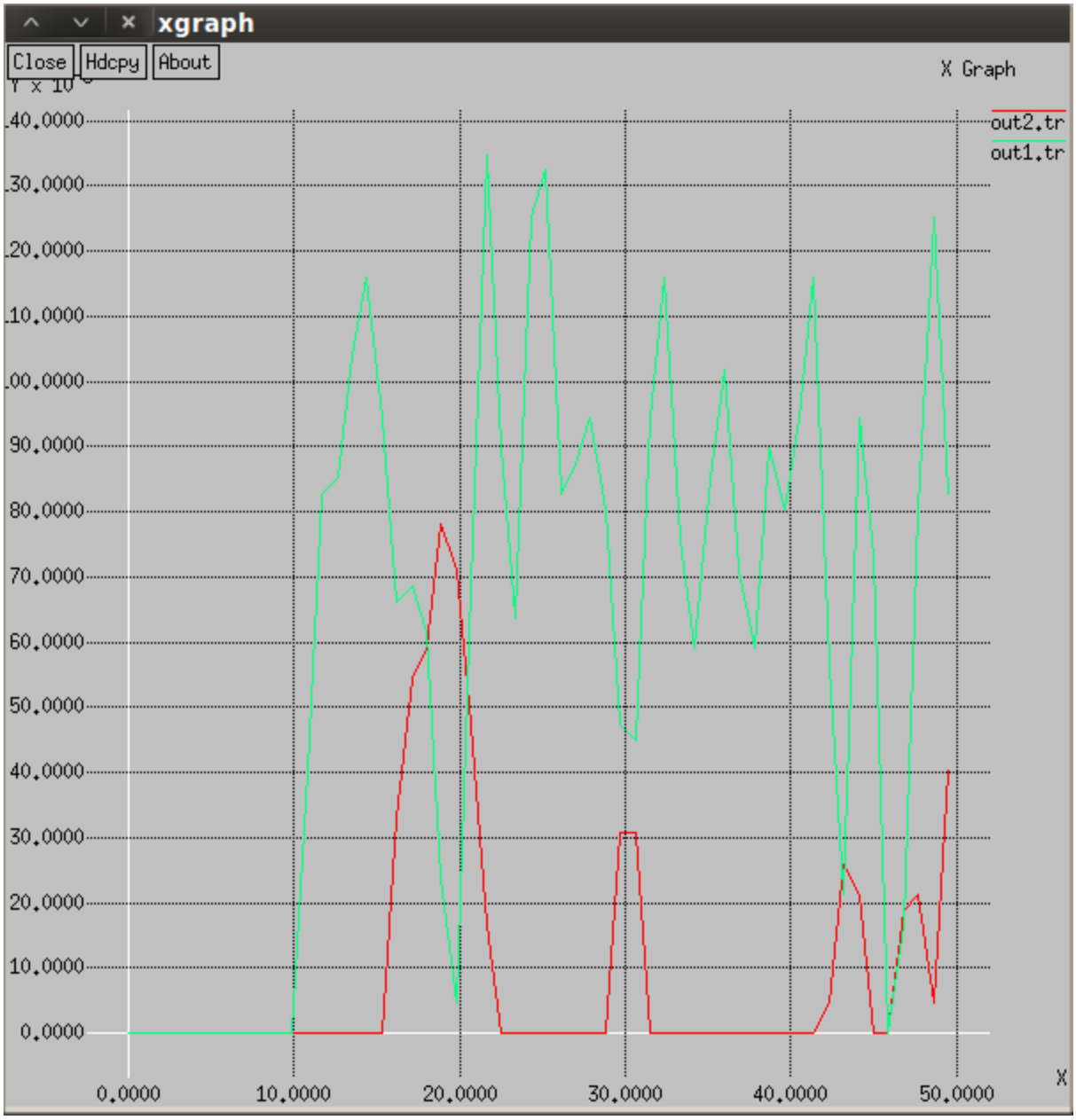
1.1000
1.0000
0.9000
0.8000
0.7000
0.6000
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
0.0000
10.0000
20.0000
30.0000
40.0000
50.0000
X

FIG-1.6


xgraph
Close
Hdcpy
About
X Graph
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out1.tr
40.0000
30.0000
20.0000
10.0000
90.0000
80.0000
70.0000
60.0000
50.0000
40.0000
30.0000
20.0000
10.0000
0.0000
0.0000
10.0000
20.0000
30.0000
40.0000
50.0000
X

FIG-1.7

CHAPTER-5: CONCLUSION AND FUTURE WORK

CONCLUSION:

FROM ALL THE ABOVE GIVEN GRAPHS AND TABLES , WE FOUND THE RESULT THAT THE PROPOSED PROTOCOL EMAODV IS BETTER AMONG THE FOUR ALGORITHMS IN TERMS OF PDR AND THROUGHPUT WITH MINIMUM DELAY OF TIME. DSR PROTOCOL IS NOT GOOD AS THE CALCULATED THROUGHPUT IS LOW AS COMPARED TO DSDV, AODV AND EMAODV. AODV PERFORMED WELL AFTER DSR.

PUBLICATION :

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