Scenario based performance and comparative simulation analysis of routing protocols AODV LEACH & TORA

Shilpi Sharma

Department of Software systems
Gyan Ganga Institute of technology, Jabalpur, M.P, India

Prof. Sourabh Jain

Department of Computer science
Gyan Ganga Institute of technology, Jabalpur, M.P, India

Prof. Sharda Prashad Patel

Department of Computer science
Gyan Ganga Institute of technology, Jabalpur, M.P, India

Abstract- –MANET (Mobile Ad hoc Network) is an infrastructure less collection of mobile nodes which can anytime change their position. With MANET a new era of technology introduced around us, we can see many wireless devices around us as mobile, laptop, PDAS etc. MANET is a collection of wireless nodes which work together in sending data packets in multi hope fashion. All the MANET devices are very useful light weight but there is a limitation that all of them are dependent on the batteries associated with it. The life of the node is directly dependent on the battery in the device operating at the node. There are many efforts going on both in the industry and the academic research community to design mechanisms to save battery-life in these low powered devises. Mainly battery   power of devices used in two things1) Processing on node 2) On sending data packets. MANET works in multi hope fashion that is there may or may not any predefined path so most of the energy of a node is being involved in sending data packets rather than being a source or a target .So somehow routing plays an important role in sending data packets because by these algorithms only route can be selected .

There are many routing algorithms each one is having their own properties. In this study Comparison of three protocols has been discussed in different conditions. In this work we tried to analyze performance of three routing protocols AODV, LEACH and TORA in 5 different   parameters like average end to end delay, packet loss, packet delivery fraction, routing overhead and remaining node energy in a simulation environment. And in result we can analysis their performance.

I. INTRODUCTION

MANET is a collection of wireless nodes which work together in sending data packets in multi hope fashion .These networks are independent, predefined topology less, centralized administration less and faster than previous types of networks . MANET plays an important role in today's life because with the help of these devices information can be exchanged more frequently and easily .There are many examples of these Networks like cell phone network , Wi-Fi local Networks and terrestrial microwave networks .

There are three things 1) MANET is independent that is all devices work individually within the range of network .while transferring data they make temporary connection or network with other devices .2) MANET is infrastructure less means there is no predefined path or topology every time.3) MANET is centralized administration less means there is no requirement of any base station .each device works as an individual router and plays an important role.

REPRESENTATION OF MANET

Routing in MANET –Routing is very important factor because it decides the path of a network so life time of a network is directly proportional to effective routing technique. In MANET there are many protocols .Each protocol has its own features .These protocol used in different conditions. When there is a communication between numbers of mobile nodes then routing takes place to find an optimal path and send data packets. As we know mobile nodes depends on battery power and limited range of antenna, there are many routing protocols in MANET we can broadly classify them into two types
Topology based
1) Flat routing,
2) Hierarchical routing and

Position based
1) Geographic position routing.

Description of Topology based protocols

1) Flat routing protocols-it is a basic and important type of routing and it can also be divided in to three categories reactive, proactive and hybrid routing type.

I) Proactive routing protocols –in simple words proactive means pre-prepared .so when the data is needed to be send route is already known .it's also called table driven routing. Example Destination sequenced distance vector (DSDV).

Ii) Reactive routing protocol-reactive that is reaction when required or demanded, it's also called On demand routing protocol because it determines route when required. Examples are Ad-hoc On-demand Distance Vector Routing (AODV), Dynamic Source Routing (DSR) etc.

iii) Hybrid routing protocol-hybrid routing protocols are the protocols which overcome all type of delays and overhead related with reactive and proactive protocols. The protocol is suitable for highly versatile networks, characterized by a large range of node mobility and large network diameters. An example of it is ZRP (Zone Routing Protocol) etc.

2) Hierarchical Routing Protocols- Hierarchical-network is referred as the tremendously high size of network in MANET, examples of the protocol are, Zone Routing Protocol (ZRP), Land-Mark Ad-Hoc Routing Protocol (LANMAR) Cluster-head Gateway Switch Routing Protocol (CGSR), Hierarchical State Routing (HSR) etc.

Description of Position based protocol

1) Geographical Routing Protocols –Geographic routing works on the concept of geographic position of nodes, basically in this each node has to determine its geographic position and with the help of this information messages can be sent to source or destination without any topological requirement.

There are two approaches in geographic routing are i) actual geographic coordinates can be find by Global Positioning system GPS and other is ii)Reference Points with respect to some fixed coordinates .examples are GPSR (Greedy Perimeter Stateless Routing) , DREAM (Distance Routing Effect Algorithm for Mobility), Geo-Cast (Geographic Addressing and Routing) etc.
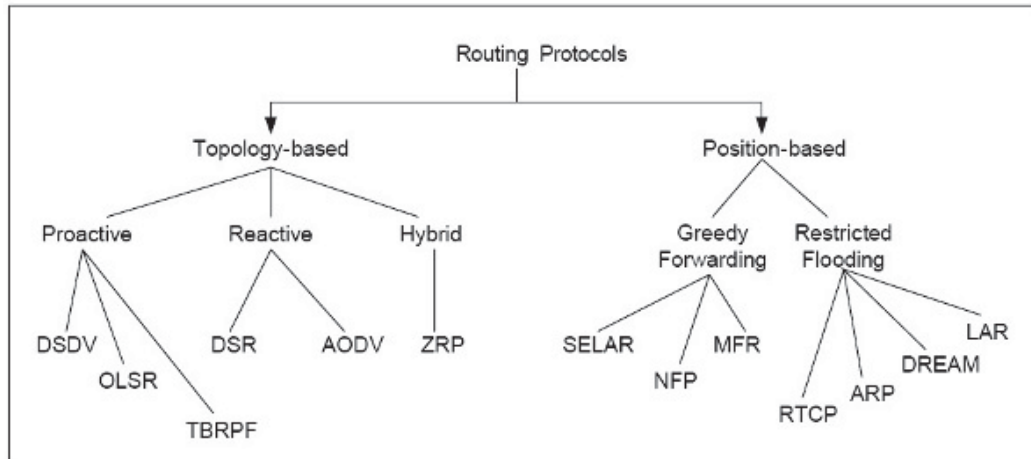
CLASSIFICATION OF ROUTING PROTOCOLS

II. COMPARISION ANALYSIS OF THREE ROUTING PROTOCOLS AODV, LEACH and TORA –

This research work is based on the simulation analysis of three protocols with the help of NS2 simulator, And performance of protocols will be evaluated on five parameters Packet delivery fraction, Average end to end delay, Packet loss, Routing overhead, Remaining node energy.

*Introduction and Evaluation of protocols AODV, LEACH and TORA:*

AODV- AODV is a reactive or on demand distance vector routing protocol and it creates route when there is requirement to send data packet. It maintains these paths as long as they are needed. Nodes that do not participate in active path neither maintain any routing information nor participate in any periodic routing table exchange. AODV creates route with the help of a cycle of Route Request (RREQ) and Route Reply (RREP) packet message.
In this cycle Source node send Route request packet to all the other nodes of the network to accomplish route, then all the nodes which receives this request massage checks whither they have the path to desired route or itself is a destination node if yes then they will send route reply message to source node otherwise will not participate in communication.
The main advantage of AODV that it avoids the counting-to-infinity problem unlike other distance vector protocols by using sequence number for each route.
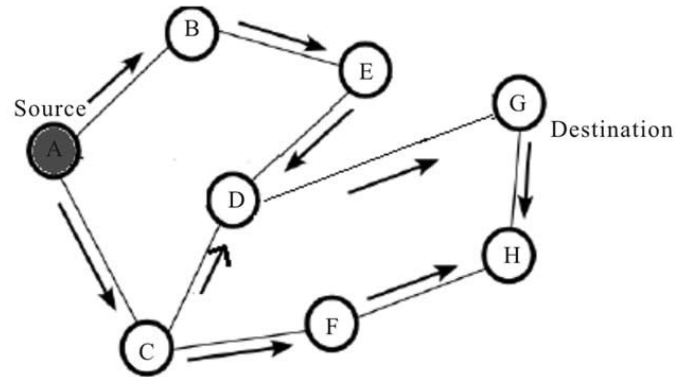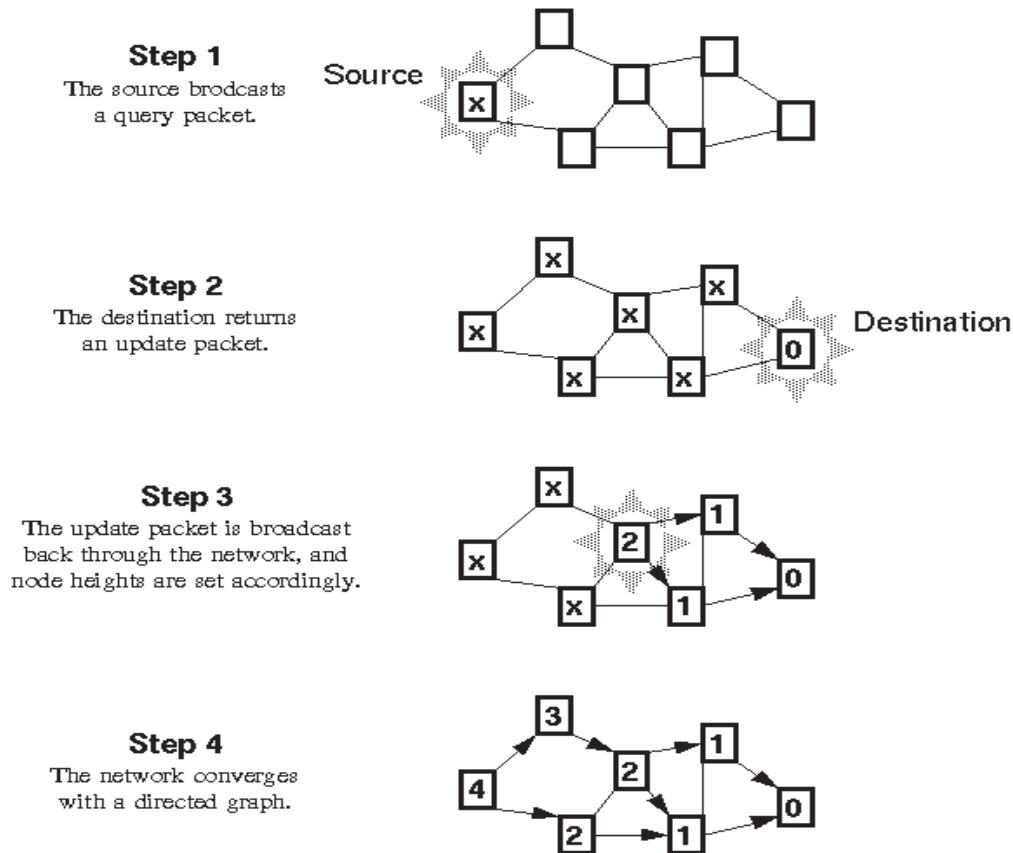
(a) RREQ Broadcast
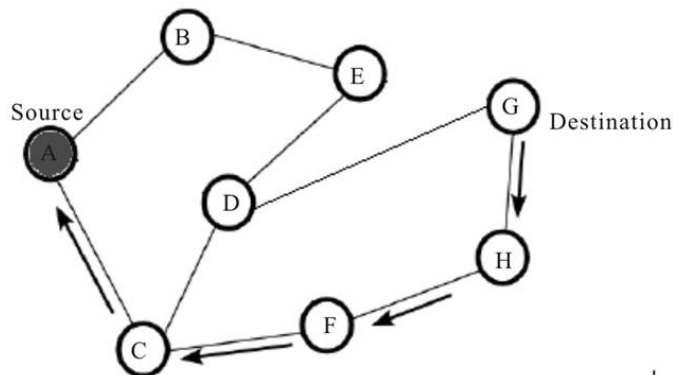
(b) RREP Forwarded Path

TORA-TORA is also a source initiated on demand routing protocol which was designed for highly dynamic mobile networks it is based on the concept of link reversal. TORA is highly adaptive because it provides loop free paths at all instants and multiple routes so that if one path is not available, other is readily available. It establishes routes quickly so that they may be used before the topology changes.

TORA creates and maintains a Directed Acyclic Graph (DAG), which is having root as a destination node .every node will have different height and no one will have same height,, so information always flow from high height to low height and if TORA maintains heights of this graph properly it can provide loop free routing. There are three steps of route establishment in TORA.

There are three basic operation of TORA-Route Creation, maintenance and ensure.

In route creation it makes a directed graph taking destination as a root on the basis of height metric, Thereafter links are assigned based on the relative height metric of neighboring node

Route maintenance is useful at the time of mobility because we know when nodes move graph need to be updated so this operation takes care of updating of graph. Route ensures is responsible for insurance of valid routes.

Step 1

The source brodcasts a query packet.

Step 2

The destination returns an update packet.

Step 3

The update packet is broadcast back through the network, and node heights are set accordingly.

Step 4

The network converges with a directed graph.

LEACH–LEACH is an energy efficient protocol work in wireless sensor network. It is based on the concept of hierarchal routing; the main aim of LEACH is to increase the life time of the network.

In this protocol node creates a cluster and selects a cluster head and then rely on cluster head for further communication. Each node uses an algorithm at each round to determine can it become a cluster head this time. Nodes that have already been cluster heads cannot become cluster heads again for M rounds, where *M* is the desired percentage of cluster heads. That is why each node has a $1/M$ probability of becoming a cluster head in each round.

At the end of each round, each node that is not a cluster head selects the closest cluster head and joins that cluster. The cluster head then creates a schedule for each node in its cluster to transmit its data and when cluster head notify all the non-cluster head nodes transmits their data to cluster head , cluster head perform aggregation and compression of all data and then send it to the base station .

Diagrammatic representation of LEACH
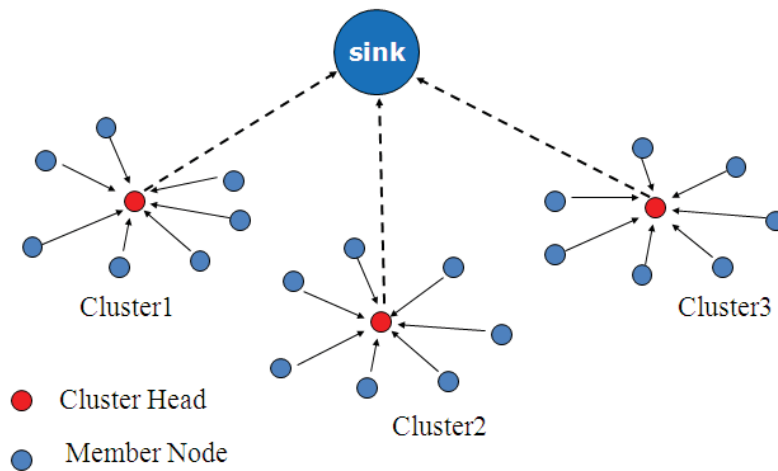
Related work –

Routing is always been a very important topic for all the research workers because it plays a vital role in sending information .A lot of work has been done in comparisons of routing protocols on the basis of different parameters. Some of them are -

IN [1] Comparison analysis of DSR and AODV is discussed. DSR shows less routing overhead than AODV. DSR is based on a source routing mechanism whereas AODV uses a combination of DSR and DSDV mechanisms. DSR shows less frequent route discovery processes than AODV.AODV gives high performance than DSR in dynamic environment. DSR shows less frequent route discovery processes than AODV.

IN[3] performance comparison of AODV, DSR, DSDV, and TORA is discussed on the basis of the parameters like effect of speed, no. of packets transmitted, no. of packets lost, bytes, bit rate, packet delay. By that comparison they showed that DSR, TORA shows the better performances as compared to AODV, DSDV. Using NS2 they presented simulation

In [4] AODV, DSDV both the protocols analyzed by using NS2 simulator. AODV shows high delay in start but gradually it shows low delay, but DSDV gives high delay. For jitter performance DSDV performs better because of low node mobility and free channel. But packet arrival time and jitter was high in AODV due to high node mobility and availability of free channel. Therefore performance of AODV is better than DSDV routing protocol for real time application. Jitter performance.

In [5] comparison of protocols in MANETs and WSN is discussed. AODV, DSDV, and TORA protocol. Are compared in MANETs and as result AODV shows good performance and TORA dint perform well .on the other side in WSN, AODV, DSDV, TORA, LEACH. Performance of AODV, LEACH was better. AODV is less reliable than LEACH because the result of AODV is fluctuated but that of LEACH is not. Performance of AODV was better in both MANETs and WSNs.

In[9]In this paper comparison of the three on- demand routing protocols for wireless sensor networks namely-AODV, LEACH and LEACH energy with respect to simulation time. Simulation results show that under different simulation time, LEACH-E protocol has least energy consumption and highest node lifetime than the LEACH and AODV protocols. While the AODV protocol has the least node lifetime because of high energy consumption per node. This makes AODV unsuitable for sensor networks, where lifetime is a primary metric for evaluating the performance.

In [7] this paper introduction of on demand distance vector protocol AODV is described. AODV route creation, maintenance and data packet communication is there. Advantages disadvantages and overall effect of AODV is there and with this paper I got the basic and required information of the protocol.

In [8] in this paper introduction, functions application and working of LEACH is discussed .Basic function of leach is to save energy and increase the life time of network uses. With the Help of this paper overall concept of leach can be easily understood.

In[21]In this paper performance evaluation of AODV ,LEACH and TORA is described on the basis of three parameters average ,end to end delay , packet delivery fraction and packet loss.

And they simulated protocols by using ns2.

Simulation analysis and result

Basically Network simulation is a method by which a network performance or behavior can be analyzed by calculating the interaction between the different network entities like host ,router ,data link and packets or by using any mathematical formulas or actually capturing and playing back observations from a production network. For simulating any network the behavior of the network and all the application and programs can be observed in the lab and many of the changes can be made in the various attributes of environment to see in what manner network behaves. So we can conclude network simulator is a software or hardware program which predicts the behavior of the network

Simulation tool -For this research work we used NS-2 as a simulator and ns2 is suitable for designing new protocols, comparing different protocols and traffic evaluations. NS-2 is developed as a collaborative environment. It is distributed freely and open source. A large amount of institutes and people in development and research use, .maintain and develop NS-2

Simulation parameters – we evaluated three protocols AODV, LEACH and TORA in five different parameters given below –

1) Packet delivery fraction –it is a ratio of data packet delivered to the destination to those generated by the constant bit rate (CBR) sources.

2)Average end to end delay -This includes all the possible delays caused by buffering during route discovery, latency, queuing at the interface queue, retransmission delay at the MAC, and propagation and transfer times.

3) Packet loss - a packet is dropped in two cases: the buffer is full when packet needs to be buffered and the time that the packet has been buffered exceeds the limit.

4) Routing overhead - The routing overhead is measured as the total number of routing
Packets transmitted. As for calculation, Routing overheads = (Total number of bytes of control packet transmitted by routing protocol) / Total Bytes transmitted.

5) Remaining node energy - The remaining node energy defines the amount of remaining energy of all sensors at the end of simulation.

Tabular representation of simulation environment

Simulation tool	NS2
No of nodes	350
Name of protocols	AODV, LEACH and TORA
Parameters for comparison	5

Simulation model	Two ray model
Mac type	802.11
Link layer type	LL
Interface type	Queue

*Simulation result -*

Packet delivery fraction

As we know packet delivery fraction shows the ratio of number of packets delivered to destination generated by constant bit source .So as per the characteristics we can easily see in the graph that AODV when works with limited number of nodes ,delivers at very good rate of PDF but it decreases as we increase the number of nodes. TORA gives better performance for Packet Delivery Fraction because it is very highly adaptive and TORA is based on the concept of link reversal and selection process of a route includes three steps route creation, route maintenance and route ensure .So TORA provides loop free paths at all instants and multiple routes so that if one path is not available, other is readily available. It establishes routes quickly so that they may be used before the topology changes. But when we used leach protocol the ratio of PDF goes down as number of nodes increases. So we can conclude by our analysis that AODV and TORA gives better performance than LEACH.
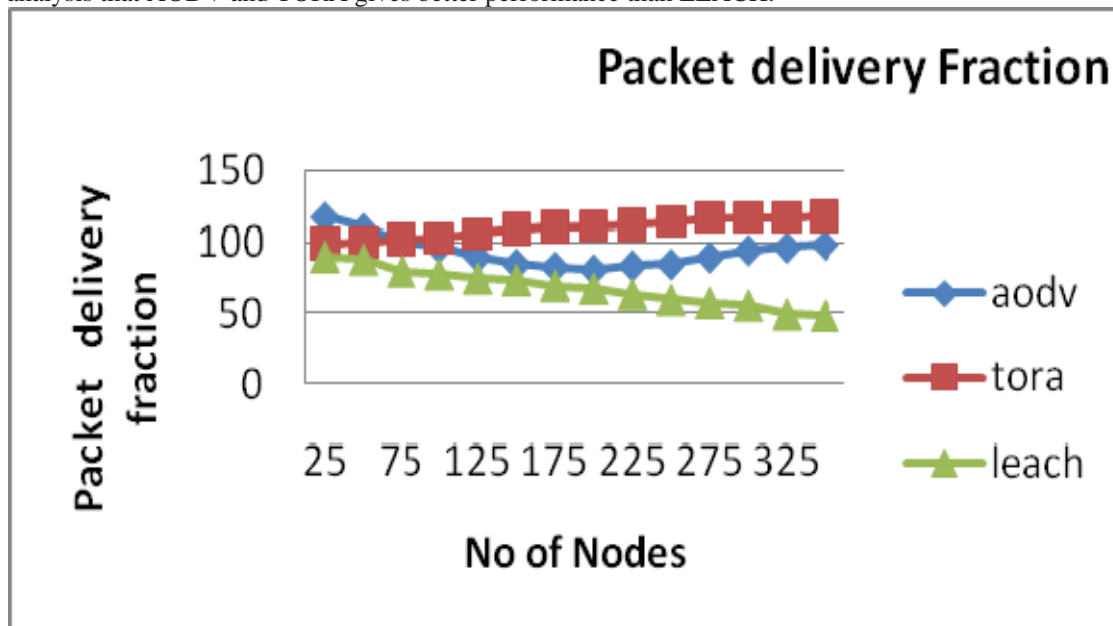

Average end to end delay

Average end to end delay includes all the possible delays caused by buffering during route discovery, queuing at the interface queue, retransmission delay at the MAC, and propagation and transfer times. We analyzed that in starting LEACH gives high number of delay because of complex routing selection procedure but once route selection is done, it gives less no of delays. TORA gives less no of delays because in this if one link of connection fails, another

one is ready to send data so it's always be consistent in sending data without unnecessary delay But AODV gives higher no of delay because at the time of routing each time it sends request and reply messages and it creates unnecessary delay .
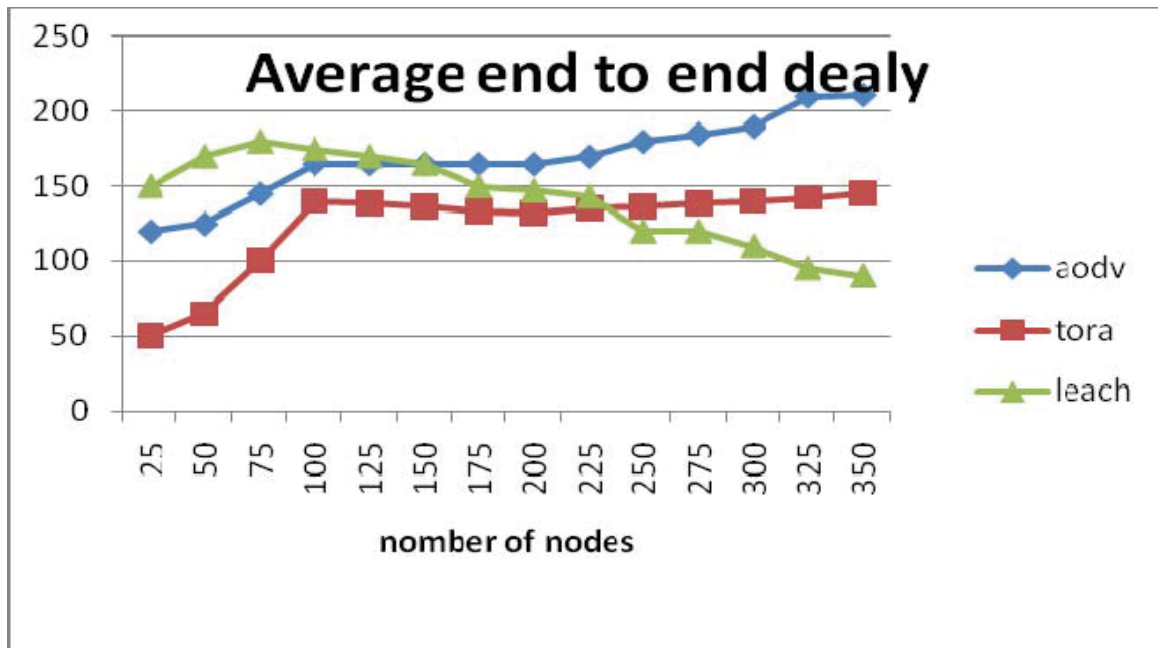
3) Packet loss is the concept which shows the no of packets which has been dropped because of any reason. A packet drops in two cases: buffer becomes full when packet needs to be buffered and the time that the packet has been buffered exceeds the limit. As we can see in the experimental scenario that AODV and TORA gives higher number of packet loss as compared to leach because of delay.
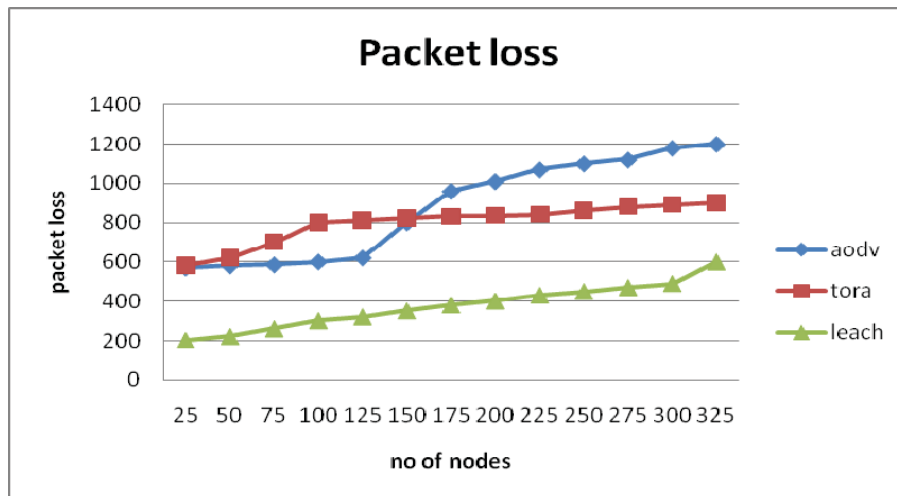

Routing Overhead
The routing overhead is measured as the total number of routing packets transmitted. As per calculation,
Routing overheads = (Total number of bytes of control packet transmitted by routing protocol) / Total Bytes transmitted.
AODV has lower routing overhead as compared to both of the protocols because AODV only sends request and replay messages during route selection process. AODV gives less routing overhead than routing protocols which

need to have all the information from source to destination node and AODV is also relatively quick to the topological changes in the network, and maintenance of route is also quite simple then other protocols.
Leach and TORA gives higher routing overhead because of its route selection procedure.
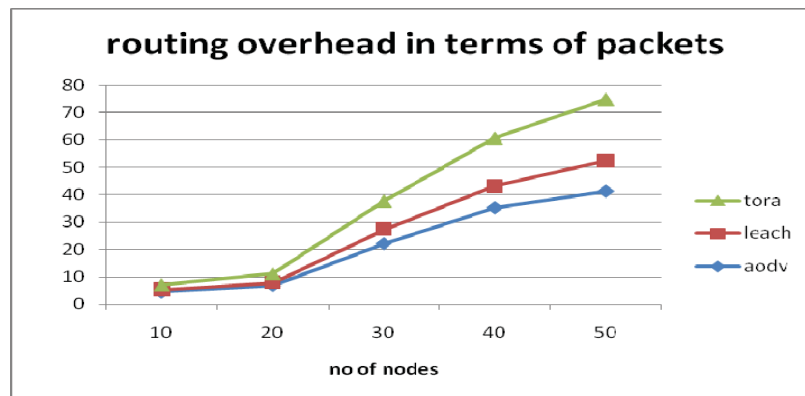
Remaining node energy

With the help of this study we can see performance of all three protocols in terms of remaining node energy. Where we analyzed protocol AODV performed good at starting but when no of nodes get increased it does not perform consistently. Protocol TORA performs better than AODV rather it is also not consistent .but when we analyzed protocol Leach we saw that it perform good consistently because LEACH itself made for saving energy of node and its main aim is to optimized the energy requirement during path selection and establishment of route .
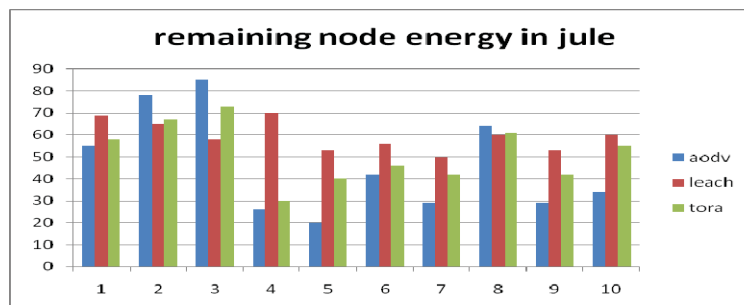
III. CONCLUSION

For this study we took Routing Protocols AODV, LEACH and TORA. Using NS2. We evaluated them for five: Routing overhead, Packet deliveries fraction and Packet loss, Remaining node energy and Average end to end delay where each protocols performed as they are designed to be.
For packet delivery fraction (PDF) AODV and TORA performances better than LEACH. The main reason behind TORAs good performance is the way it establishes its route, TORA creates A Directive Graph based on the height, having root as its Destination and information flows from high height root from low and no nodes can have same height in the graph and so links can have a direction to work for .with TORA synchronization of clocks is also there and its very adoptive because it can easily give more options of route if one link is fails.
 For average end-to-end delay LEACH gives less delay as compared to AODV, TORA. Because Leach is   based on concept of creating clusters and once a cluster is mad cluster head takes care of all the data transmission so communication takes place between cluster head and base station.

For The packet loss AODV shows higher no of packet loss rather than TORA and Leach because most of the time because AODV has to maintain Route request /replay cycle and AODV also expects/requires that the nodes in the

broadcast medium can detect each other's broadcasts and every time it takes time .

In case of Routing overhead TORA gives high Leach shows balanced and AODV shows less routing overhead because of difference of route selection procedure.

For Reaming node energy LEACH performed better than TORA and AODV .Because the overall concept of LEACH is to reduce the use of energy and increase the life time of network. Clusters are made to reduce energy consumption.

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