EEDSR

Energy Efficient Dynamic Source Routing protocol

For Mobile Adhoc Networks

Anwesha Dash
Karishma Jain

Department of Computer Science and Engineering
National Institute of Technology Rourkela
Rourkela-769 008, Orissa, India

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by

[Anwesha Dash]

[Roll: 109CS0005]

[Karishma Jain]

[Roll: 109CS0147]

under the guidance of

Prof. Suchismita Chinara

Department of Computer Science and Engineering
National Institute of Technology Rourkela
Rourkela-769 008, Orissa, India

Computer Science and Engineering
National Institute of Technology Rourkela
Rourkela-769 008, India. www.nitrkl.ac.in

Dr. Suchismita Chinara
Assistant Professor

May 10, 2013

Certificate

This is to certify that the work in the thesis entitled *EEDSR (Energy Efficient Dynamic Source Routing protocol)* by *Anwesha Dash and Karishma Jain*, bearing roll number 109cs0005 and 109cs0147, is a record of an original research work carried out by him under my supervision and guidance in partial fulfillment of the requirements for the award of the degree of *Bachelor of Technology* in *Computer Science and Engineering*. Neither this thesis nor any part of it has been submitted for any degree or academic award elsewhere.

Suchismita Chinara

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Anwesha Dash(109cs0005)
Karishma Jain(109cs0147)

Abstract

In a MANET, there is no Base Station i.e no fixed infrastructure and the nodes are free to move, thus network topology changes dynamically in an unpredictable manner. In this network each node acts both as a router and its job as an ordinary device. The major constraint of a network is the network parameters. These parameters are crucial in determining the network stability and reliability. Hence a better algorithm than the existing DSR algorithm is proposed to make the network transmission energy efficient. The major parameters on which the selection of the path depends is :

(1) Node type and energy

(2) Packet size

(3) Delay in the network channel

(4) no of hop counts required to reach the destination

(5) Energy loss during transmission

The conventional DSR algorithm uses any arbitrary path between the source and the destination pair. There is no parameter to judge the effectiveness of the path and this even floods the route cache with lengthier and multiple paths for the same source and destination.

The EEDSR algorithm selects a node as a source node n then selects a set of node as destination. For each source and destination pair the best path is selected and then the parameters are collected. The average value of the parameters are taken over al the source and destination pair. This process is repeated for all the network of different dimension and a graph was plotted between no of nodes and the average parameter value. This algorithm not only enhances the network life but also minimises the effort required during the route maintenance phase. It even prevents back flooding of the packets and thus reduces the network congestion.

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Chapter 1

INTRODUCTION

1.1 Mobile Ad-Hoc Networks

"Ad Hoc" is a Latin phrase which means "for this purpose". Individual nodes comprising the network dynamically created and maintained. The network does not depend on a preexisting infrastructure, e.g routers in wired networks and therefore it is Ad-hoc.
MANETs are a kind of wireless ad hoc networks. It is a communication network formed by the union of autonomous aggregation of mobile nodes (computers, mobiles, PDAs etc.) and they are connected by wireless links. The network is modeled in the form of an arbitrary communication graph. In a MANET, there is no Base Station i.e no fixed infrastructure and the nodes are free to move, thus network topology changes dynamically in an unpredictable manner. In this network each node acts both as a router and its job as an ordinary device.

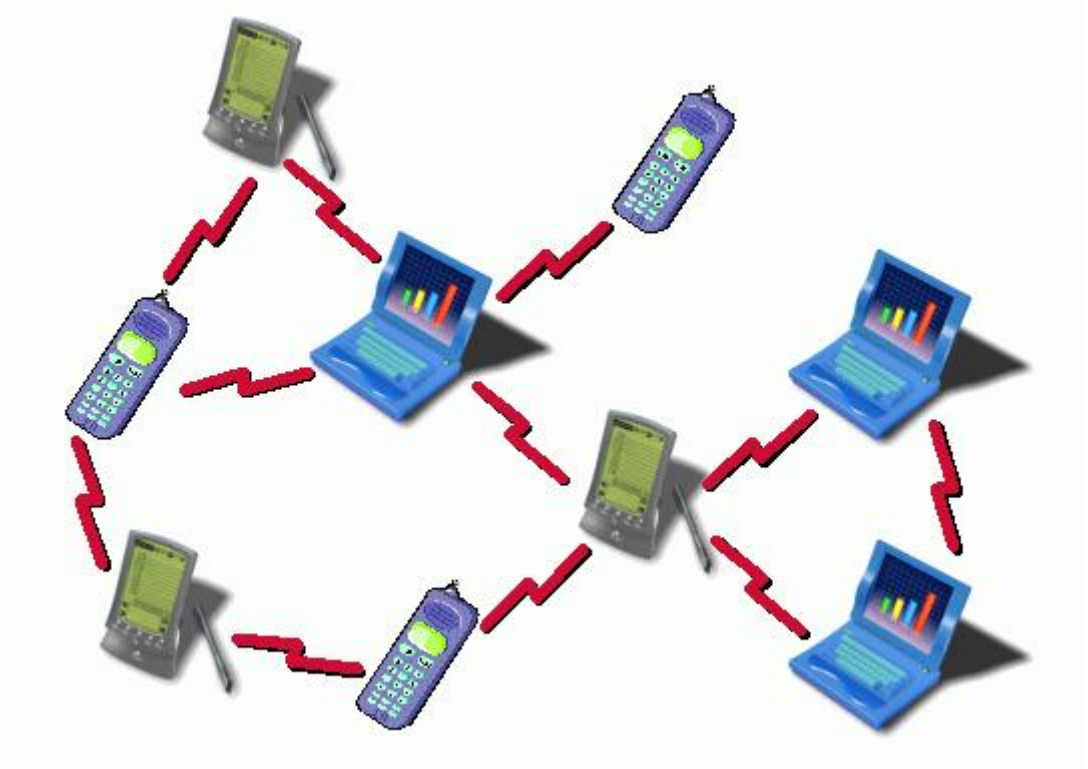

FIGURE 1.1: MOBILE AD HOC NETWORK CONNECTED BY WIRELESS LINKS

The nodes are mobile and any change in network topology must be communicated to other nodes. The topology change information should be updated or eliminated. All nodes in the network are not within the range of each other and thus

they communicate within radio range. Ad hoc networks is organized as a peer-to-peer multi hop. The information packets are relayed in a store-and-forward mechanism, packets are transferred from a source to any arbitrary destination via intermediate nodes.

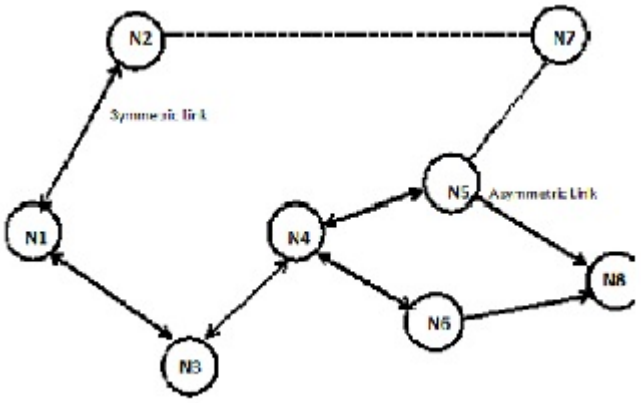

figure 1.2 NETWORK TOPOLOGY OF MANET

1.1.1 Characteristic Features of MANET

Wireless:
The nodes are connected by wireless links.

Ad hoc based:
Network is formed by the union of nodes and connected in an arbitrary fashion. Also the network is temporary and dynamic.

Multi hop Routing:
There is no dedicated router and every node in the network acts as a router to pass packets from one hop to another hop.

Autonomous and infrastructure less:
Network does not need any fixed infrastructure or centralized control and thus is self-organizing. Individual nodes are generating their own independent data and the operation mode of each node is distributed peer-to-peer capable of acting as an independent router.

Dynamic Topologies:
Due to arbitrary movement of nodes at varying speed, the topology of network changes randomly.

Limited Bandwidth:
As compared to the infrastructure based network, Infrastructure less networks have lower capacity or bandwidth as well as less throughput.

Energy Constraint:
Nodes in the MANET rely on batteries or some other exhaustible source of energy thus energy conservation becomes the major design issue.

Security Threats:
Unlike wired networks , there are much higher chances of physical security threats like eavessdropping, spoofing and denial of service in wireless networks.

1.2 Design Issues and challenges

Regardless of such a long history and the variety of applications of mobile ad hoc network, there are still some issues and design challenges that is to be overcomed. This is the reason why MANET is one of the elementary research field. Some of the major traditional issues are :

- The channel is unprotected from outside signal.
- The channel has time varying and asymmetric propagation properties
- The wireless media is unreliable as compared to the wired media.
- Hidden terminal and expose terminal phenomenon may occur.

With these Issues some of the challenges are :

- Scalability : it is required in MANET because the network grows according to the need and thus scale of ad-hoc network changing all the time.
- Power Consumption, Battery Life and Spatial Reusability : The nodes in mobile ad-hoc network need to consider restricted power supply, which will cause several problems.
- Quality of Service (QoS)
- Symmetric (bi-directional) and Asymmetric (unidirectional) links

- Lack of centralized management: MANET doesnt have a centralized monitor server. It makes the detection of attack difficult.
- Mobility pattern of nodes
- No predefined Boundary: A precise physical boundary is not defined. The nodes work in a nomadic environment where they are allowed to join and leave the wireless network. As soon as an outsider comes in the radio range of a node it will be able to communicate with that node. This gives rise to attacks such as tempering, replay, Eavesdropping impersonation and Denial of Service (DoS) .

1.3 APPLICATIONS

The range of applications for MANETs is diverse, it ranges from small, static networks, to large-scale, mobile highly dynamic networks. For example MANET has become wide and varied from email and ftp to web services. Network topology is flexible and for this reason MANETS are seen as important components in 4G architectore. A significant part in the next generation will be played by ad hoc networks for their functionalities and capabilities. MANET have given rise to many applications like Tactical networks, Wireless Sensor Network, Data Networks, Device Networks, and so on. Some of the common application areas where MANETs are used are :

Personal Area Network (PAN) : The Short-range MANET can simplify the intercommunication between various mobile devices. Personal devices like laptops, PDAs and cellular phone create temporary network and share data among themselves.

Military environments : MANET supports tactical network for military communications and automated battle fields. an information network is maintained between the soldiers, vehicles, and military information headquarters as it is not possible to install base station in the enemy territories. Here the soldiers act like nodes.

Rescue operations : It provides Disaster recovery, means replacement of fixed infrastructure network in case of environmental disaster. Example of disaster are fire, flood or earthquake. Information is relayed from one rescue team member to another over a small hand held.

Sensor Networks : devices used have capability of sensing ,computation and wireless networking . Wireless sensor network combines the power of all three of them, like smoke detectors, electricity, gas , etc.
Local Level : Ad hoc networks are self directed thus they can link an instant and temporary multimedia network using laptops to spread and share information among participants at e.g. conference or classroom. Similarly it have many applications in other civilian environments like taxicab, sports stadium, boat and small aircraft, mobile ad hoc communications.

1.4 Routing

Routing is the process of choosing a path in a network along which to send the network traffic. It is performed by many kinds of network like telephone network, transportation network, electronic data networks. Routing is a key feature of the Internet because it enables messages to pass from one computer to another and eventually reach the target machine. In routing forwarding takes place on the basis of routing tables. It maintains a record of the routes to various network destinations.

1.4.1 Routing protocols

A routing protocol is the software or hardware implementation of a routing algorithm. Routing algorithms determine the specific route to be chosen. It specifies how routers communicate with each other and enables them to select routes between any two nodes on a computer network. Routing protocols perform several activities such as:

- Network discovery
- Updating and maintaining routing tables

Some of the metrics used by routing protocols are :

- Load
- Number of network layer devices along the path (hop count)

- Bandwidth
- Delay
- Maximum Transmission Unit (MTU)
- Cost (in terms of Energy Consumption and Time)

1.4.2 Types of routing protocols

Routing protocols are classified on two types:

- Based on the information used to build routing tables:
  - **(a)** distance vector algorithms: These type of algorithms uses distance information to build routing tables.
  - **(b)** Link state algorithms: These algorithms uses connectivity information to build a topology graph that is used to build routing tables.
- based on when the routing tables are built
  - **(a)** Pro-active routing: This type of protocols periodically distributes routing tables throughout the network and thus maintains a lists of destinations and their routes. Example : DSDV (Destination Sequenced Distance Vector) and OLSR (Optimized Link-State Routing)
  - **(b)** Reactive routing: In this protocol routes are discovered on-demand when packet must be delivered to an unknown destination and floods the network with Route Request packets Example : Ad-hoc On-demand Distance Vector) and DSR (Dynamic Source Routing)
  - **(c)** . Hybrid routing : both pro-active and reactive protocols These type of protocols combines the advantages of proactive and of reactive routing. Examples : ZRP (Zone Routing Protocol)

1.5 Routing Protocols in MANET

In mobile ad-hoc networks a routing procedure is always needed to find a path because there is no infrastructure support as is the case with wireless networks,

and since a destination node might be out of range of a source node transmitting packets. The packets are also needed to forward appropriately between the source and the destination. According to the routing strategy the routing protocols can be divided as flat routing, hierarchical routing and geographic position assisted routing depending on the network structure. Under flat routing table driven and on demand routing comes the table driven and on demand protocols.

The table driven protocols maintain the routing information even before it is needed and hence follows proactive approach. Routes information is generally kept in the routing tables and is periodically updated due to the change in network topology to make the network consistent.

The on demand protocols dont maintain routing information or routing activity at the nodes if there is no need of communication. If two nodes want to communicate then this protocol searches for the route and establishes the connection in order to transmit and receive the packet. Flooding technique is used for route discovery.

1.6 Energy Efficient Routing

A network that can function as long as possible is an ideal network. In an adhoc system the main limitation is the availability of power. Power is consumed on resources such as running the onboard electronics, the number of processes running and overheads required to maintain connectivity. The computing devices consist of mobile batteries in a adhoc network that communicate over the wireless medium. the memory space and the processing capacity of the nodes increase at a very fast speed, the battery technique lags far behind. Hence, energy efficient protocols are derived to conserve energy and to increase the network life time as well as increase the device and network operation time. In particular, energy efficient routing may be the most important design criteria for MANETs, since mobile nodes will be powered by batteries with limited capacity . overall network lifetime decreases because of the power failure of a mobile node. Also the ability to forward packets on behalf of others decreases . For this reason, many research efforts have been applied to develop energy-aware routing protocols. Instead of average case the worst case i.e when a first node dies out is maximized.

The main aim of energy efficient routing is to minimize the energy required to transmit or receive packets also called as active communication energy. Inactive

energy is the energy which not only tries to reduce the energy consumed when a mobile node stays idle but also listens to the wireless medium for any possible communication requests from other nodes. Transmission power control approach and load distribution approach are the two approaches which minimizes active communication energy . the sleep or power-down mode approach minimizes inactive energy. Both the protocol has definite advantages and disadvantages and therefore is applicable for certain situations . thus it is not clear that which particular algorithm or a class of algorithms is the best for all scenarios. To conserve energy, many energy efficient routing protocols have been proposed. Many researches are being made to carry out to develop energy aware routing protocols. Some are designed to search for the most energy efficient path from the source to the destination while some attempt to balance the remaining battery-power at each node when searching for the energy efficient path.

Some of the proposed energy efficient routing protocol includes Local Energy-Aware Routing based on AODV (LEARAODV), Power-Aware Routing based on AODV (PAR-AODV), and Lifetime Prediction Routing based on AODV (LPR-AODV).

Chapter 2

Literature Review

In this chapter we will present some review of the literature studied.

2.1 Summary of Routing Protocol in Mobile Ad-Hoc Network

Mobile ad hoc network (MANET) is an infrastructure-less multihop network where each node communicates with other nodes directly or indirectly through intermediate nodes. Thus, all nodes in a MANET basically function as mobile routers participating in some routing protocol required for deciding and maintaining the routes.

Manet has many features and therefore research of the routing protocol is one of the most concerned topic in manet. For wired networks the traditional routing algorithms are not efficient for dynamic changes. In recent years people have developed a lot of routing protocols and here are the summaries of some of the typical routing protocols.

Unipath routing protocols are DSDV, AODV, OSLR, DSR. Multipath routing protocols are APR (Alternative Path Routing), AODV BR, SMR(Split Multipath Routing), etc. we discuss here only the unipath routing protocols along with their characteristics.

The DSR is a reactive unicast routing approach that uses source routing algorithm where each data packet consists total routing information to reach its destination. Also, in DSR, each node uses caching method to maintain route information.

The Ad Hoc On-demand Distance Vector Routing (AODV) protocol is a reactive unicast routing approach for mobile ad hoc networks. AODV only has to maintain the routing information about the active routes. Opposed to DSR which uses the source routing, AODV uses hop by hop routing by maintaining the routing tables entries at intermadiate nodes. A routing table entry expires or drop dead if not used for a predefined expiration time. Additionally, AODV assumes the destination sequence number mechanism as used in DSDV but in an on-demand way.

Like DSR, In AODV a source node initiates a route discovery procedure before sending a packet. The source node broadcasts a route request (RREQ) packets which contain source and destination addresses, broadcast ID, which acts as its identifier, the last visited destinations sequence number as well as the source nodes sequence number. Flooding overhead in AODV is reduced by a node discarding RREQs by a node if it has seen before. Tthe route discovery operation is done

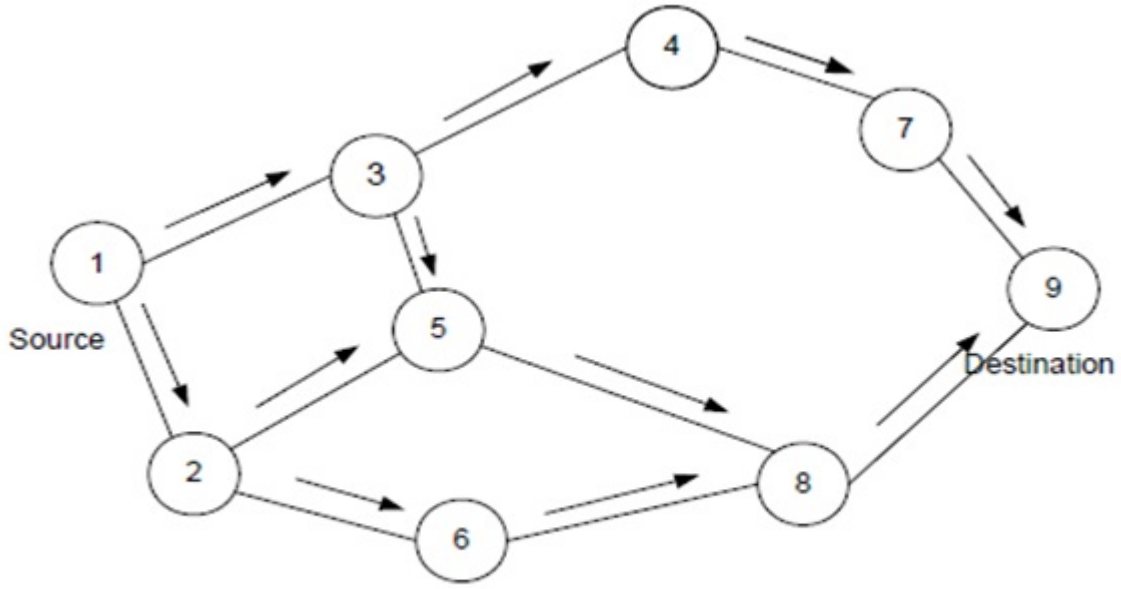

FIGURE 2.1: RREQ packets flooding from source

by expanding ring search algorithm. The RREQ initiates with a small TTL value which is increased in the next RREQ if destination is not found. Each node along the reverse path sets up a forward pointer to the node it received the RREP from. Thus the packet is transferred from source to destination.

The Opimized linked state routing (OSLR) is a proactive routing protocol. It inherits the stability of a link state algorithm. It has the advantage of having the routes immediately anialble when needed . It is an optimization of a pure link staee protocol for MANET. First it reduces the size of the control packets i.e instead of all links it declare only a subset of link with its neighbour called multipoint relay sectors. Secondly it minimizes the flooding by contrilling the traffic to diffuse its message in the network in nodes called multipoint relays (MRP). This scheme significantly reduces the number of retranmissions in a flooding or broadcast procedure.
Only the MPRs of a node retransmit the packrt from the node. For this reason each node maintains a set of its neighbour which are called MPR selectors of the node.

2.2 Dynamic Source Routing protocol (DSR)

[David B. Johnson and David A. Maltz , Dynamic Source Routing protocol for multihop wireless adhoc network Networks ,1994]
The dynamic source routing is the simple and efficient routing protocol. It follows the sourcr routing technique. Here the sender of the packet determines the complete sequence of nodes through which the packet is forwarded. This route is listd in the packet header and each hop is identified by the address of the next node and the packet is transmitted to the destination host.
DSR is completely self-organizing and self configuring and requires no existing network infrastructure. The DSR protocol allows to dynamically discover a source route across multiple network host to any destination in the network. Two mechanisms that make up the operations of DSR are Route Discovery and Route Maintenance. But before continuing some assumptions are made.

Assumptions made are

- all nodes wishing to communicate with other nodes within the ad-hoc network are willing to participate fully in the protocols of the network. In other words nodes should be willing to forward packets to other nodes.
- the diameter of the ad-hoc network is the minimum number of hops travelled by a packet from any node loacated at one end to node located at the other extreme end. Thus the diameter will often be small(e.g perhaps 5 to 10 nodes) but may often be greater than 1.
- the speed with which the nodes move is moderate with respect to the packet transmission latency. Nodes should not move continuously as to make every individual packets the only possible routing protocol.
- the nodes may be able to enable promiscuous receive mode on their wireless network interface hardware. The hardware should deliver each and every packet to the network driver software without filtering based on link layer destination address.

2.2.1 Route Discovery

Route discovery allows to dynamically discover a route to any other host in the ad hoc network. The source initiating a route discovery broadcasts a route request packet. The route request packet identifies the destination host, referred to as the target of the route discovery, for which the route is requested. If the route discovery is successful the initiating host receives a route reply packet . Packet contains a list of a sequence of network nodes through which it may reach the target. Each route request packet also contains a unique request id, set by the initiator from a locally-maintained sequence number. The original route request packet is received only by those hosts within wireless transmission range of the source host. Each hosts receiving the packets transfers the request if it is not the target node.

For example, in the below figure node A is attempting to discover a route to node E. For the route discovery A broadcasts a RREQ message packet which is received by all nodes within the transmission range of A. RREQ message identifies the target. It also contain sthe record listing the each intermediate node through which the particular RREQ message has been forwaded. The RREQ flooding terminates when it reaches either the destination or an intermediate node with a route to the destination. When the packet gets to the destination the node will return a route reply message containing the series of accumulated addresses is sent back to the source. upon receiving the RREP, the source node can start transmitting the data packets towards the destination using the route recorded in the RREP.

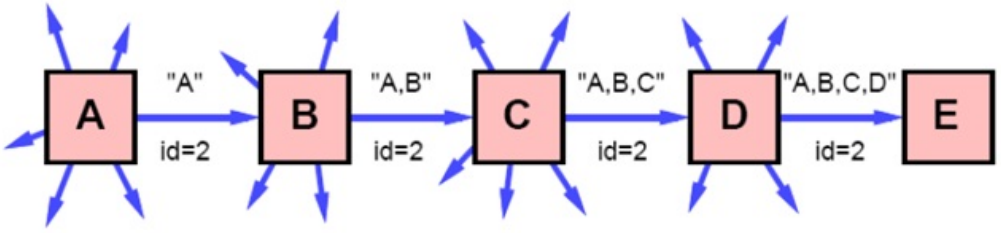

FIGURE 2.2: Roue discovery from node A to node E

2.2.2 Route Maintenance

route maintenance is carried out by continuously sending periodic routing updates. If the status of a link or router changes the changes will be reflected to all other routers, presumably resulting in the computation of new routes. the route maintenance procedure monitors the operation of the route and informs the sender of any routing errors.
wireless networks are inherently less reliable than wired networks. many wireless networks follow a hop-by-hop acknowledgement in order to provide early detection and retransmission of lost or corrupted packets. In these networks, route maintenance can be easily provided, since at each hop, the host transmitting the packet for that hop can determine if that hop of the route is still working.
If a transmission problem is reported for which a node cannot recover this host sends a route error packet to the original sender of the packet encountering the error. The route error packet contains the addresses of the hosts at both ends of the hop in error: the host that detected the error and the host to which it was attempting to transmit the packet on this hop. On receiving the route error packet the node in error is removed from this hosts route cache, and all routes which contain this hop must be truncated at that point.

2.3 Energy Issues of DSR

- the routing overhead generated by DSR routing algorithm still leaves substantial amounts of energy being wasted.
- Route Request (RREQ) generate overhead control packets that occupy bandwidth, consume energy and may overwhelm a network if not controlled.
- protocol will not be very effective in large networks, as the amount of overhead carried in the packet will continue to increase as the network diameter increases.

2.4 Strength and Flaws of DSR

2.4.1 strengths

Allows communication over multi-hops between nodes not directly within wireless transmission range of one another and Communication is faster and cheaper.
Nodes can store multiple path in route cache and very beneficial as the routes stored in the route cache will be valid for a longer period of time

2.4.2 flaws

Amount of overhead increases with increase in network diameter
Back flooding of packets increases the overhead

Chapter 3

Proposed Algorithm

3.1 Basics of Algorithm

The major constraint of a network are the network parameters. Any network can be visualised as a directed graph where the stations or the systems are compared with the nodes and the edges signifying the connections between them. In simple adhoc network the distance between any two nodes is always the same where as in the manets the distance changes during each of the simulations. Adhoc networks are characterised by their smaller size and the transmission within a range. When the mobile nodes moves out of the range then there cannot be any transmission. Adhoc networks themselves do not contain any routing facility as the network is very small but to reach from a source to a destination there is a multihop transmission taking place where intermmidiate nodes acting as the routers. Every node in the network maintains a routing cache where the path from each of the source and destination pair is stored. EEDSR is an on demand routing protocol where distance, delay , energy are the major factors for determining the entries to the routing cache. This is a multipath approach where before actual transmission there is a forward flooding of RREQ packets for the route discovery. The RREQ packets are duplicated and sent over all possible paths for a given source and destination pair. After reaching the required destination , the packets are then unwrapped for accessing their transmission parameters. The channel through which the packets are travelled is considered to be a delay channel as this parameter determines the energy loss during transmission. Most importantly , of all these parameters we are interested in the minimum energy loss and hop count path. Therefore a statistical collection is made for each of the path present and then their minimum is calculated. Here the back flooding of packets is also taken into account as once a node has been added to a particular path then its not travelled again. Thus based on this algorithm we can say that a particular node can either be a sender , receiver or an idle one whose job is to transmit the packets to the next hop.
Energy loss is directly proportional to :

(1) number of hops

(2) delay

(3) packet size

Therefore for calculation purpose :
E=(no of hops* delay)+(m*packet size)+const
Here the const value is the value associated with the node type where it can be either a sending , receiving or idle node. It is highest for the sending node and lowest for the receiving node.
The above formula can be divided into two parts:

(1) The energy consumption of each node

(2) The total distance of the path from source to destination.

Hence energy differs if the total hops differs as well as if the nodes differ in characteristics.

3.2 Motivation for work

DSR is a very simple routing methods for manets where no infrastructure is required for the network. Two other major characteristics of this algorithm are:

(1) Loop free routing

(2) No routing cache information stored in the intermediate nodes.

(3) Routing is on demand

(4) The status of the link is not checked

(5) The neighbours are also not detected in periods

There two main components of the algorithm.

(1) Route discovery :
Here the different paths between the given pair of source and destination is first identified and then RREQ packets are flooded throughout the network. When these packets reaches the required destination then they store the path present in the packet along with the source and the destination id also. Then

a RREP packets are sent from the destination to the source back in order to acknowledge the transmission. These messages can also be piggybacked with not only the path but also some data needed to be sent from the destination to the source. Route discovery is the major and most time taking part of the DSR algorithm as it explores the paths between two nodes. But is doesnt guarantee reliability as once the discovery is done then in order to keep up the connection maintainance of the network is very important.

(2) Route Maintenance

Here the discovered paths are maintained in the sense they are checked on demand to look out for failures or defects or losses. Whenever a connection is loosed then the node just before the failure sends back the negative acknowledgement informing the sender that from that point there has been failure. Then again after getting this message the sender urges for route discovery to find out another path from the source to destination and hence the routing cache is updated properly with the new entry.

Here as the discovery phase is the most comprehensive phase in the algorithm several mechanisms are proposed for its effectiveness. The major factor being flooding loss and hoping delay. Whenever there is a flooding of packets then back flooding is detrimental because it decreases the packet life as well as increases the unnecessary energy loss. The major motive of design is to minimise this loss by proposing an algorithm which always chooses the best paths among the available and thus helps to increase the network life.
For mobile networks it is quite difficult to get minimum in a network at a particular instant of time but if transmission calculation is done using the actual distance between the two nodes then it gets little easier. More over adhoc networks deal with a smaller dimension network where no of nodes are limited hence there are many assumptions followed.

3.3 Proposed Algorithm EEDSR

The main aim of the algorithm is to provide an energy saving concept for the mobile adhoc networks. Energy saving concept depends on several other factors like delay in the network, no of hps between source and destination. These techniques are implemented in the network layer of the protocol which takes care of the routing

concept. As there are no routers here the intermediate hoping acts like routing and thus this algorithm tends to decrease all the parameters applied in the network layer. DSR only stores an arbitrary path between a source and destination pair during its route discovery phase. Whenever a RREQ packet is sent by a source then it is flooded till it reaches the destination and on reaching the packets are destroyed and the path traversed is simply cached there. But in this algorithm al the multipaths are first analysed and their energy loss and transmission delay along with energy loss and the path is collected statistically. From there the minimum and the best path on the basis of hop count and energy loss is calculated. Hence the destination stores only this path in its cache for the chosen source.
Hence based on this two important factors and the formula mentioned above for calculation a better energy efficient algorithm was developed. Sometimes in a manet, the no of hops proves negative in determining the minimum energy path as the nodes are mobile and infrastructure less, so distance parameter clearly overcomes the difficulty with the hop counts here. But still comparison between algorithms of DSR and EEDSR can be done on the basis of hop counts.
There are several general assumptions taken during establishment of an adhoc network.

(1) All the nodes participate in the transmission

(2) The diameter of manets should be very small(mostly within 30 hops)

(3) The speed of the nodes should be moderate

(4) Link must be unidirectional with two proper in gates and the out gates for each node.

(5) Only one node can be sending and one receiving node during a transmission in the network.

In this project thus a detailed comparison is made between DSR and EEDSR taking 5, 10,15,20,25,30 nodes in the network respectively. In each network a fixed node was chosen as the source node and then a set of destination was chosen. Then for each source and destination pair the minimum energy loss path was calculated an stored. Then the average of all the stored value is calculated. This procedure was repeated for all the networks both for DSR and EEDSR respectively. After this comprehensive and exhaustive work a graph was plotted between the values of

DSR and EEDSR so as to compare their performance and check whether EEDSR is really effective in reducing the energy consumption during transmission.

3.4 Pseudo Code

The pseudo code for the proposed algorithm for EEDSR is as follows:
Initialisation parameters:

(1) Set up a network with N nodes and E edges

(2) Select a node A as the source node

(3) Select a set of nodes from N apart from A to act as destination nodes.

(4) Set up the delay parameter in the channel.

(5) Initialise the type of the packet with parameters like hop count, energy and path.

(6) The edges E or the connections are unidirectional as per the assumptions. Hence two distinct types of gates are taken for input and output

(7) Initial packets hop count set as 0 and also energy =0.0mW

For (each destination node in the set) {
Start from the source node
$While(packet->path[]isnotnull)$
If(node==destination node)
collect packet parameters for further calculation
else {
Int gatesize= count for the no of out gates for the node
Copy the RREQ packets
$Packet(hopcount) = packet(hopcount) + 1$
Calculate energy E with the following formula
$E = (packet(hopcount) * delay) + (m * packetsize) + const$
(here m required for calculation will b that of the sending as well as of the intermediate nodes.)
$Packet->energy = E$

$For(eachgate <= gatesize)$
{
Get node connected to gate
$If(packet- > pathdoesntcontainnode)$
{
$Addnodetopacket- > path$
Send copy packets to node through gate
}
} } $Getnextnodefrompacket- > path$ }
Hop[i]= minimum hop count from the collected data
Energy[i]= minimum energy loss from the collected data
i=i+1
Select another node from the set as destination node }
Calculate average of hop[] and energy[] values and plot them.
This process was repeated for all the network of different dimension or no of nodes. This algorithm provides the best path for transmission between the source and destination pair as it takes into account both the node energy as well as the delay and hop counts. Hence the network life is automatically increased with effective path calculation.

Chapter 4

SIMULATION AND RESULT

We have taken the simulation environment as omnet++. This simulation IDE is freely available for academic purposes.

4.1 Omnet++

This simulator is a freely available IDE where all the codes are written using c++ concepts. This IDE includes several standard header files which in turn contain several built in classes and functions. This code can also be written using simple c++ editor and complier therefore easy to use and handle the networks. The structure of any project in omnet++ consists of the following components.

(1) A simple module file
This file contains the structure of each node in the network and the parameters like their id, energy, communication gates, display icon etc. This file is imported in the network file if the network to be set up requires node of this type.

(2) A network file
This file consists of the network parameters like the nodes and their type, their position in the network, connections between the nodes, channel types and their parameters like data rate , delay etc, network parameters like distance between the nodes, transmission speed etc.

(3) Header file
This file contains the structure of the c++ executable file such as the identifiers used, methods used showing their prototype or signature and the method of their use in the c++ file.

(4) C++ executable file
This file can also be merged with the header file but for simplicity this is declared separately and here all the identifiers declared and the functions defined are used to write the required code for the network simulation. For every module we create in the project there is a corresponding header and c++ file

(5) Initialisation file
This file contains the initialisation parameters for the network. Hence this file acts as the user input for the parameters in the network.

(6) Message file

This file contains the packet definition that gets sent in the network among the nodes. The parameters that the packet needs to carry can also be defines explicitly by the programmer.

4.2 Coding and simulation

The network of particular dimension was created in the omnet++ IDE and the different component of the project is as follows:

(1) Ned file

parameters: int id; icon= laptop; gates: input in[]; output out[];

(2) Network file

Parameters: distance; Submodules: nodes of ned type and number depends on the requirement. Each node is given a unique id here. Connections: based on the requirement

(3) Header file

Identifiers: cStdDev energyStats; cStdDev hopStats;(for collecting the hop and energy values for further statistical calculations) Methods : protected: virtual void initialize(); virtual void handleMessage(cMessage *msg); virtual void forwardMessage(M *msg); virtual void finish();

(4) C++ file

The above mentioned pseudo code for EEDSR is implemented here. The code for each of the methods declared in the header is written here.

(5) Message file Parameters: int hop; double energy; int path[];

This structure was repeated for networks of dimension 5,10,15,20,25,30 . Every time the simulation returns the average minimum hop count and energy loss as mentioned in the pseudo code. Similar process was followed for calculating the average minimum hop count and energy loss for simple DSR algorithm just with the slight modification of implementing the algorithm of DSR instead of EEDSR in the c++ executable file. All other parameters assumed for EEDSR remained the same in case of DSR as well.

4.3 Simulation of EEDSR:

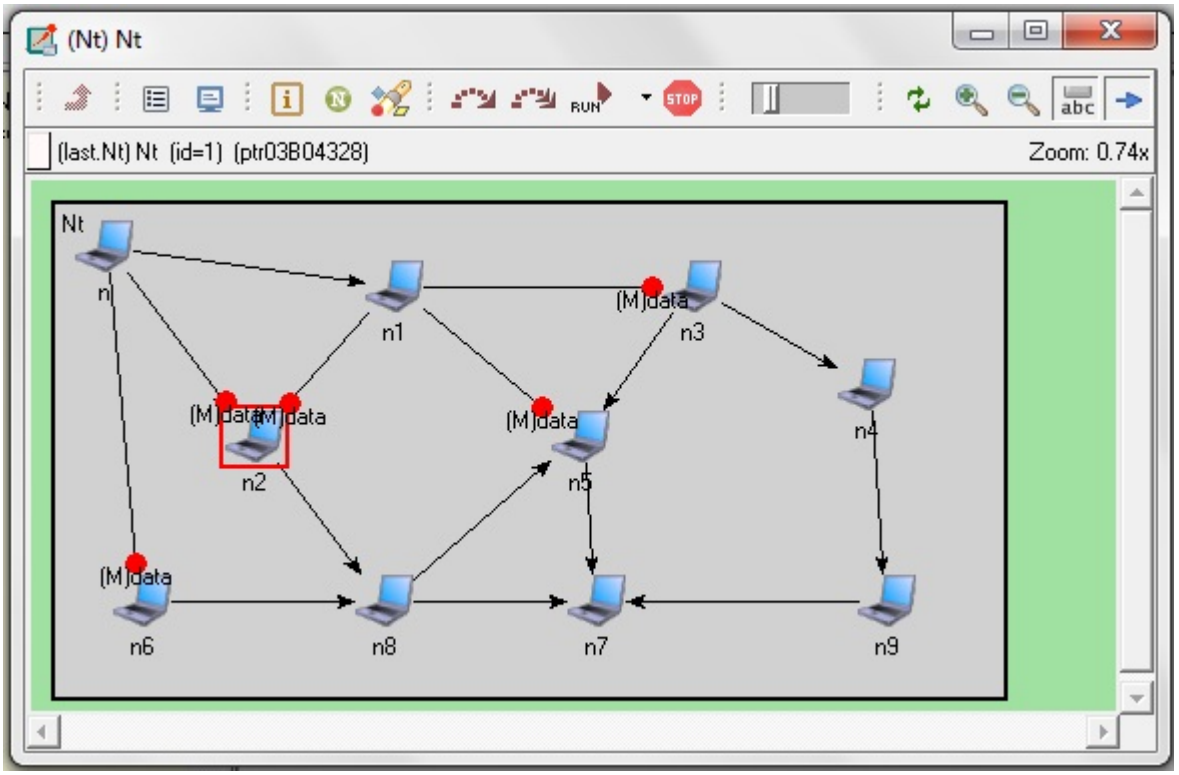

FIGURE 4.1: FOR 10 NODES

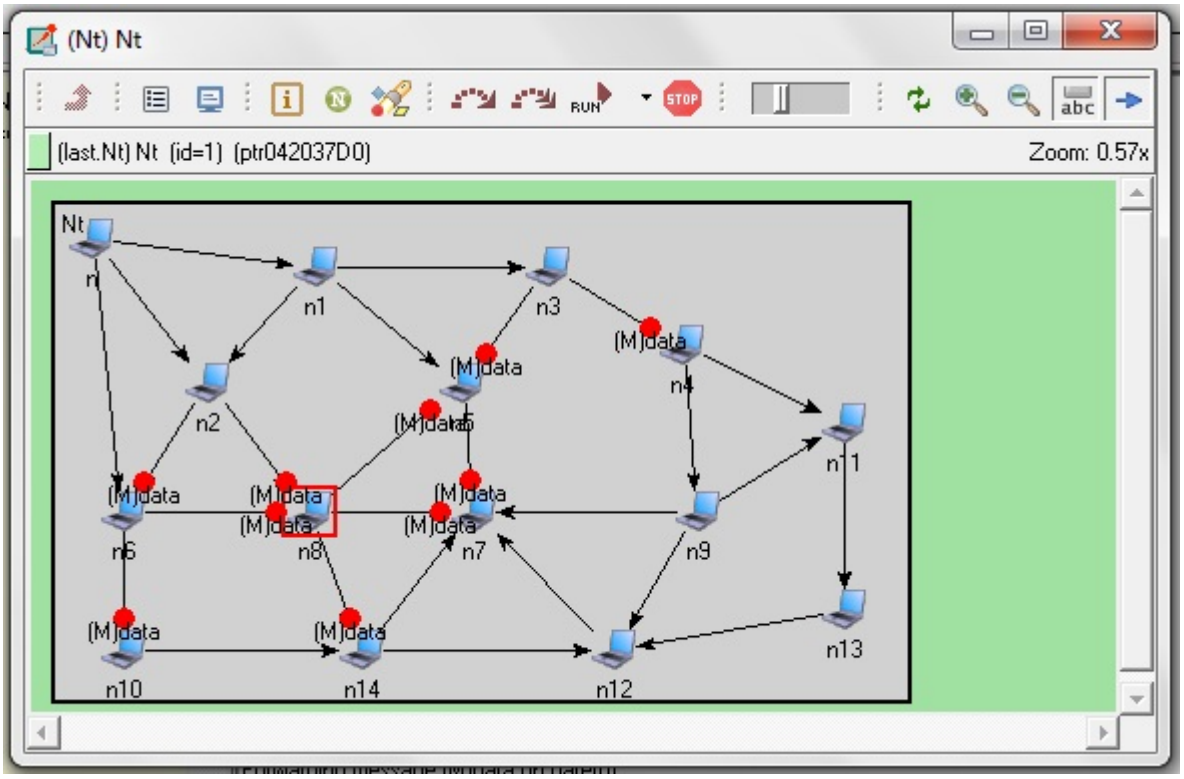

FIGURE 4.2: FOR 15 NODES

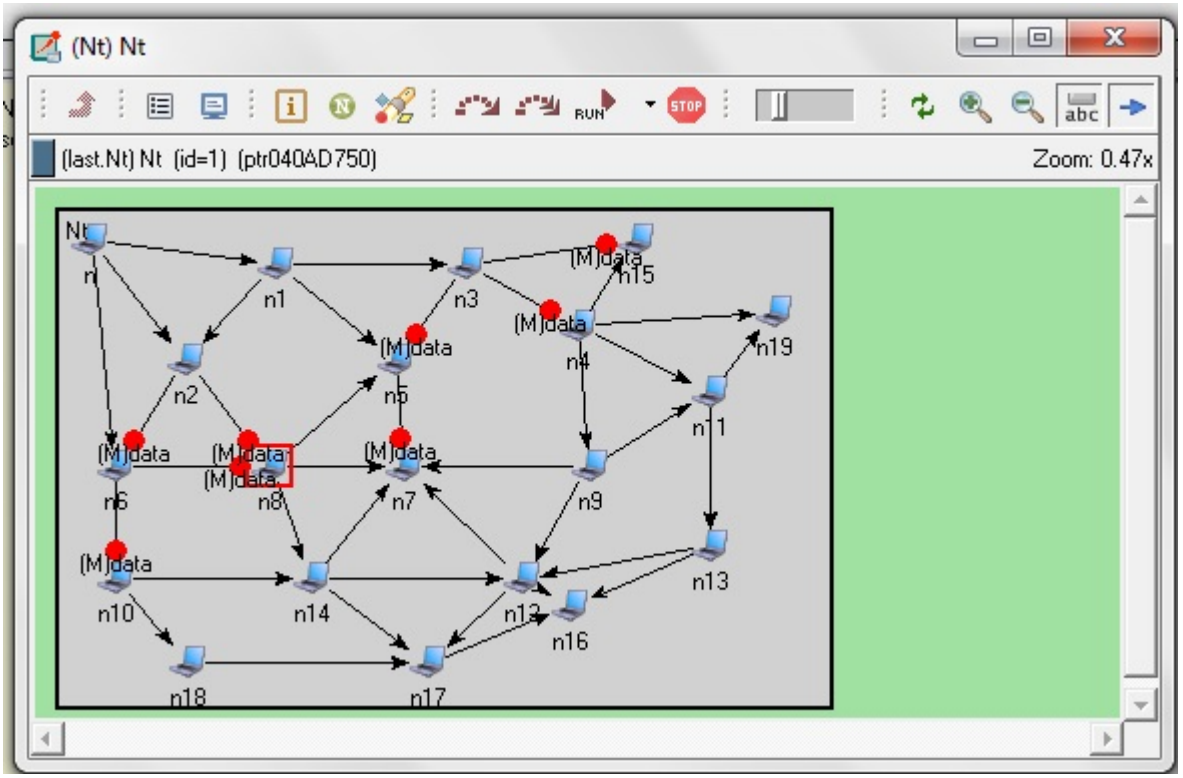

FIGURE 4.3: FOR 20 NODES

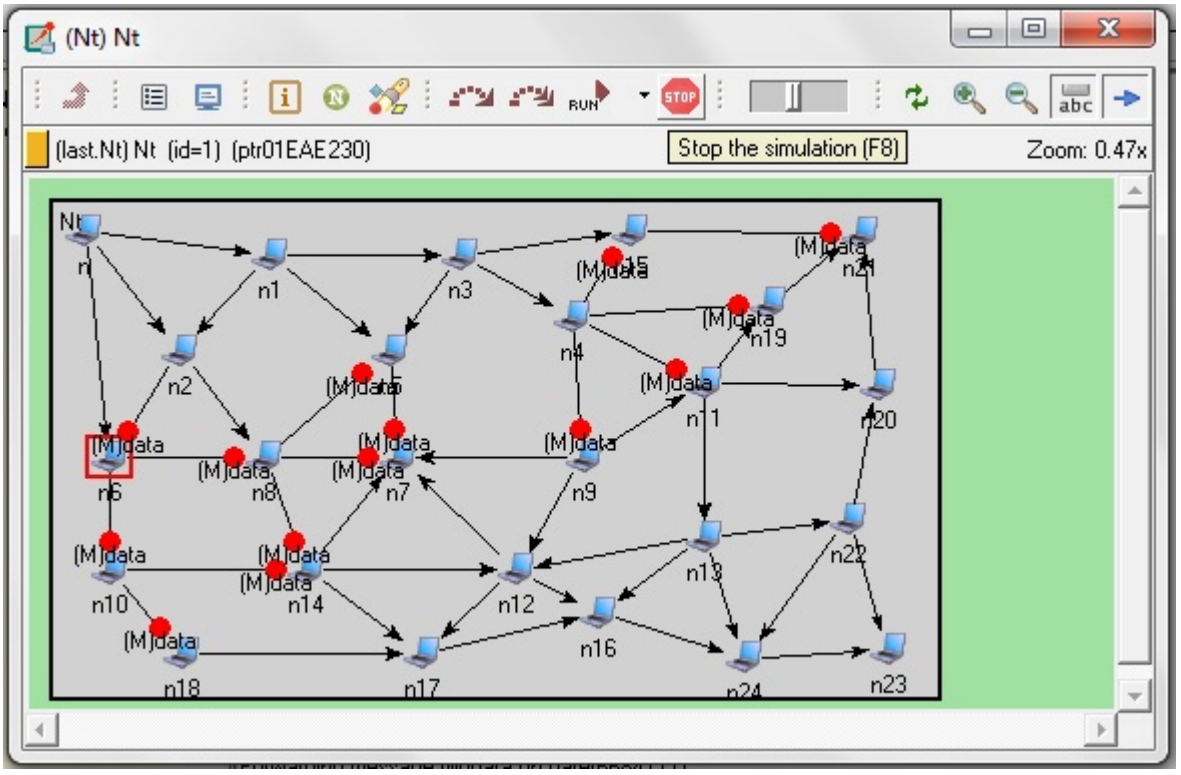

FIGURE 4.4: FOR 25 NODES

4.4 Results:

All the values were recorded in a table after every simulation for each size of network for both DSR and EEDSR in order to make a comparative study of the parameters. The tables are as follows:

No Of nodes	destination id	Hop Count	Energy Loss
5	5	3	500
	3	2	200
	4	2	300
10	8	5	1500
	6	3	400
	9	4	500
15	13	5	1500
	12	4	1000
	8	7	2800
20	16	4	1000
	17	7	2800
	18	6	2100
25	22	8	3600
	24	10	5500
	25	9	4500
30	28	8	3600
	29	9	4500
	27	8	3600

TABLE 4.1: RESULTS FOR DSR

No Of nodes	destination id	Hop Count	Energy Loss
5	5	2	300
	3	1	100
	4	2	300
10	8	3	600
	6	2	300
	9	2	300
15	13	3	600
	12	4	1000
	8	4	1000
20	16	3	600
	17	4	1500
	18	5	1000
25	22	6	2100
	24	7	2800
	25	4	1000
30	28	7	2800
	29	9	4500
	27	6	2100

TABLE 4.2: RESULTS FOR EEDSR

Thus from the above observation it is quite clear that the hop count and energy loss values for the EEDSR algorithm is less than that of the DSR algorithm. In DSR algorithm any arbitrary path from source to destination is chosen irrespective of any parameters and constraints where as in EEDSR algorithm always the shortest and the best path between any two source and the destination pair is chosen. This concludes that EEDSR is always the best case of DSR algorithm without any failure. More over the network life is also improved as the packets are not back flooded and all the multiple paths from source to destination is traversed in order to collect the best among them. For making this illustration more visually appealing a graph was plotted taking the average hop count and energy loss value for each network both for DSR and EEDSR algorithms. The x axis contained the no of nodes in the network and the y axis contained the average hop count and energy loss respectively. The two graphs so obtained is as follows:

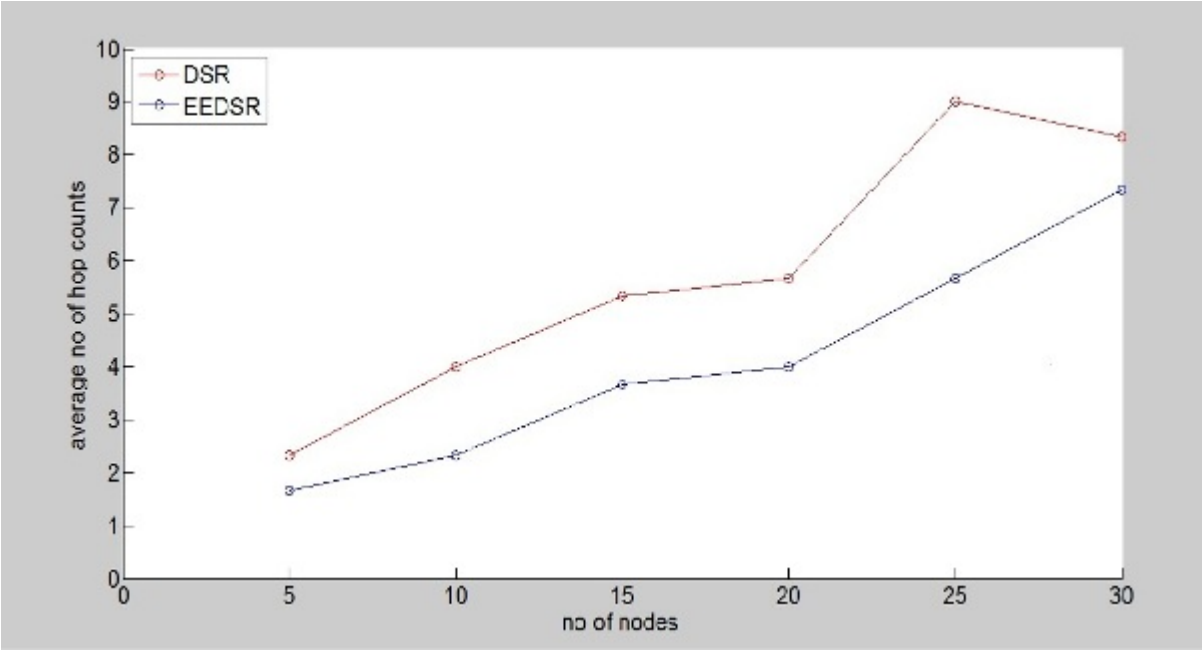

FIGURE 4.5: Comparison between DSR and EEDSR based on the average hop counts:

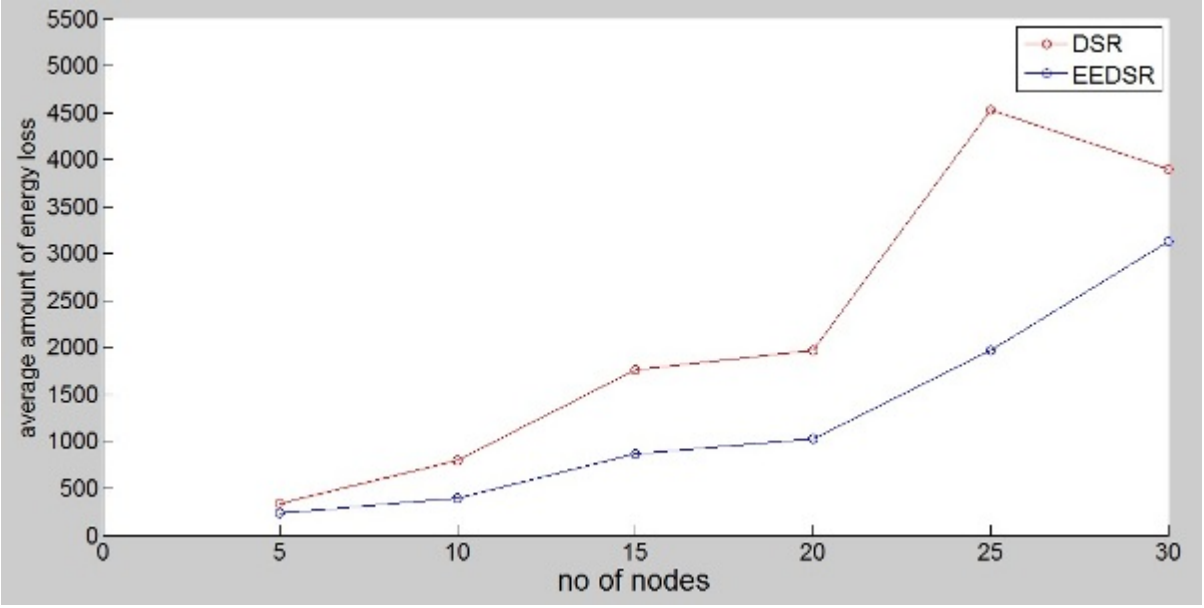

FIGURE 4.6: Comparison between DSR and EEDSR based on the average energy loss:

Chapter 5

Conclusion

5.1 Conclusion

Thus from the graph its clear that the algorithm EEDSR is better as compared to the performance of DSR. This improvised algorithm based on multipath routing is an advanced form of DSR where the performance parameters are taken into account to choose the best path among the different paths. As the DSR algorithm says that the route discovery part is the most exhaustive part, therefore it takes the major attention while setting up of manet. This process also includes the route cache updating. Hence a better algorithm solves the purpose better. There is no doubt that the improvised algorithm so proposed is even lengthier but it helps a lot during route maintenance phase as the best path is always stored in the cache reducing its size and thus increasing its speed and reliability. Suppose a connection fails during maintenance phase, still it can covey the error message to the source and then run this discovery phase to explore other existing paths in the network and find the best among them.

Another major advantage of this algorithm is that it prevents back flooding of the packets. If a node is already added to the packet path then no more flooding of packets occur to that particular node. This not only saves the network congestion but also increases the life span of the packets and the network. The major disadvantage of this algorithm is that it follows breadth first search approach for the path discovery or intermediate node discovery. Hence all the child nodes of a particular node added to the path is also traversed even if they lead to a dead end after some iterations.

Hence this algorithm is no doubt a better approach for a mobile adhoc network route discovery rather than the DSR algorithm as it provides the best path between any two source and destination pair.

Bibliography

[**1**] BOOK
prashantha mahapatra and srikant krishnamurthy
Adhoc networks technologies and protocols
Springer; 2005 edition (September 23, 2004)

[**2**]Duncan Naigenda and Tonny E. Bulega. An Energy-Efficient Dynamic Source Routing Protocol for Mobile Ad Hoc Networks. International Journal of Computing and ICT Research, Vol. 6 Issue 2, pp 23-32.

[**3**]David B. Johnson David A. Maltz , Dynamic Source Routing in Ad Hoc Wireless Networks Computer Science Department Carnegie Mellon University 5000 Forbes Avenue Pittsburgh, PA 15213-3891

[**4**]D.Kim, J.J.Garcia-Luna-Aceves, K.Obraczka, J.Carlos Cano, P.Manzoni, Power Aware Routing Mechanism Based on the Energy Drain Rate Metric in Mobile Ad Hoc Networks, 11th IEEE International Conference on Computer Communications and Networks (IC3N), 2002.

[**5**]A. Ariza-Quintana E. Casilari A. Trivio Cabrera Implementation of MANET routing protocols on OMNeT++ Dpto. Tecnologa Electrnica, University of Mlaga Campus de Teatinos, 29071 Mlaga (Spain)

[**6**]www.omnetpp.org