Modified Adhoc on Demand Routing Protocol in Mobile Ad hoc Network

Thesis submitted in partial fulfillment of the requirements for the degree of

Master of Technology

in

Computer Science and Engineering

(Specialization: Computer Science)

by

Aashish Choudhary

Department of Computer Science and Engineering
National Institute of Technology Rourkela
Rourkela, Odisha, 769008, India

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Aashish Choudhary

(Roll- 211CS1068)

Under the guidance of

Prof. Suchismita Chinara

Department of Computer Science and Engineering
National Institute of Technology Rourkela
Rourkela, Odisha, 769008, India

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Department of Computer Science and Engineering
National Institute of Technology Rourkela
Rourkela-769008, Odisha, India.

Certificate

This is to certify that the work in the thesis entitled "***Modified Adhoc on Demand Routing Protocol in Mobile Adhoc Network*** " submitted by ***Aashish Choudhary*** 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 Master of Technology in Computer Science and Engineering with the specialization of Computer Science in the department of Computer Science and Engineering, National Institute of Technology Rourkela. Neither this thesis nor any part of it has been submitted for any degree or academic award elsewhere.

Place: NIT Rourkela
Date: 3 June 2013

Prof. Suchismita Chinara
Dept. of Computer Science and Engineering
National Institute of Technology, Rourkela
Odisha-769008

Acknowledgment

First, and foremost I would like to thank my supervisor Prof. Suchismita Chinara for giving me the guidance, encouragement, counsel throughout my research. Without her invaluable advice and assistance it would not have been possible for me to complete this thesis. She was a constant source of encouragement to me and helped like my father with his insightful comments on all stages of my work thesis work.

I am very much indebted to Prof. Ashok Kumar Turuk, Head-CSE, for his continuous encouragement and support. He is always ready to help with a smile. I am also thankful to all the professors of the department for their support.

I am very thankful to my Parents, brother and sister who supported and suffered me for the successful completion of my thesis work.

Finally, I would like to thank all of them whose names are not mentioned here but have helped me in any way to accomplish the work

Aashish Choudhary

Email : aashishbkw@gmail.com

Abstract

In Ad hoc network there no any central infrastructure but it allows mobile devices to establish communication path.Since there is no central infrastructure and mobile devices are moving randomly ,gives rise to various kinds of problems, such as security and routing. here we are consider problem of routing.

Routing is one of the key issues in MANET because of highly dynamic and distributed nature of nodes. Especially energy efficient routing is most important because all the nodes are battery powered. Failure of one node may affect the entire network. If a node runs out of energy the probability of network partitioning will be increased. Since every mobile node has limited power supply, energy depletion is become one of the main threats to the lifetime of the ad hoc network. So routing in MANET should be in such a way that it will use the remaining battery power in an efficient way to increase the life time of the network.

In this thesis, we have proposed Modified Adhoc on Demand Routing (MAODV) which will efficiently utilize the battery power of the mobile nodes in such a way that the network will get more lifetime. Multiple paths are used to send data and load balancing approach is used to avoid over utilized nodes. Load balancing is done by selecting a route which contains energy rich nodes.

Keywords: Load Balancing, Lifetime, Mobile ad hoc Network(MANET).

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List of Abbreviations

MANET	Mobile ad hoc Network
AODV	Ad hoc On Demand Distance Vector
DSR	Dynamic Source Routing
DSDV	Destination Sequenced Distance Vector Routing Protocols

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Chapter 1

Introduction

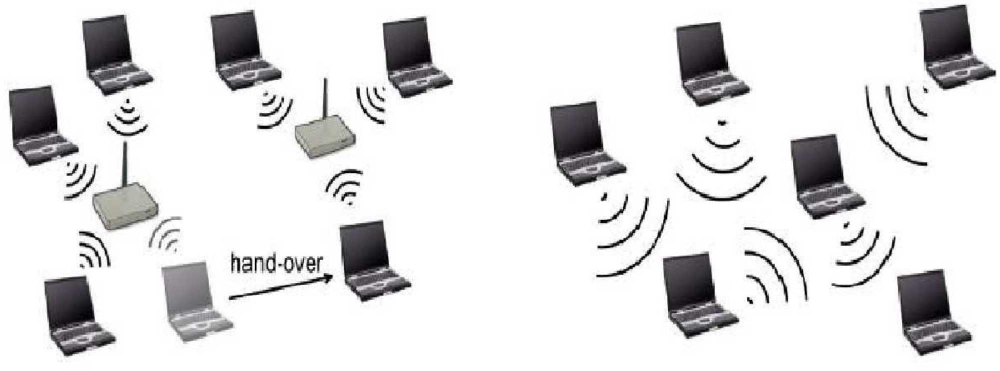
Mobile Ad hoc networks (MANET) are considered as promising communication networks in situations where rapid deployment and self-configuration is essential. In ad hoc networks, nodes are allowed to communicate with each other without any existing infrastructure. Typically every node should also play the role of a router. This kind of networking can be applied to scenarios like conference room, disaster management, battle field com- munication and places where deployment of infrastructure is either difficult or costly.

Many routing protocols exist to enable communication in ad hoc networks like, AODV[8], DSR[9] , DSDV[10] , etc. All these protocols assume that the source and destination nodes can reach each other using a single or multi-hop path. But, there exist situations when connectivity between source and destination cannot be guaranteed always.

1.1 Mobile ad hoc Network

With the advancement in technologies and relatively low cost, there is a rapid rise in the use of personal communication devices like mobile phones, personal digital assistants (PDAs) and mobile computers. These devices easily get access to network through wireless interfaces.

There exist three types of mobile wireless networks: infrastructured networks,



(a) An infrastructured network with two base stations. (b) A mobile ad-hoc network

Figure 1.1: Infrastructured and ad-hoc networks

ad-hoc networks and hybrid networks which combine infrastructured and ad-hoc aspects. An infrastructured network (Figure 1.1) comprises of wireless mobile nodes and one or more connecting bridges (called as base stations) to connect the wireless network to the wired network. A mobile node within the network looks for the nearest base station (e.g. the one with the best signal strength), connects to it and communicates with it. In this type of network, all communication takes place between the wireless node and the base station and not between different wireless nodes.

When any mobile node gets out of range of the current base station, a handover to a new base station occurs and that will let the mobile node communicate seamlessly with the new base station. These wireless interfaces also allow the devices to interconnect directly with each other in a decentralized way and self-organize into Ad Hoc Networks. An ad-hoc network does not have any infrastructure. It is devoid of base stations, routers and centralized administration. Nodes may move randomly and connect dynamically to one another. Thus all nodes act as routers and must be capable of discovering and maintaining routes to every other node in the network and to forward packets accordingly. Mobile Ad hoc Networks (MANET) is a communication network formed by the union of autonomous aggregation of mobile nodes (computers, mobiles, PDAs etc.) and connecting wireless links. The network is modeled in the form of an arbitrary communication graph. In a MANET, there is no fixed infrastructure (Base Station) and since nodes are free to move, the network topology may dynamically change in an unpredictable manner. MANET is decentralized and self-organizing network where the functions from discovering the network topology to delivering the message are carried out by the nodes themselves; In this network each node acts as a router along with its job as an ordinary device. The organization of Ad hoc networks is peer-to-peer multi hop and information packets are relayed in a store-and-forward mode from a source to any arbitrary destination via intermediate nodes. As the nodes are mobile, any change in network topology must be communicated to other nodes so that the topology information can be updated or eliminated. It is not possible for all mobile nodes to be within the range of each other. However, all the nodes are close by within radio range.

1.2 Design Issues/Challenges

MANET raises some issues while designing the network topology. Some of the major considerations include:

- Power Consumption, Battery Life and Spatial Reusability
- Symmetric (bi-directional) and Asymmetric (unidirectional) links
- Mobility pattern of nodes
- Scalability
- Quality of Service (QoS)

1.3 Characteristics of a MANET

MANET is characterized by some specific features as follows:

- **Wireless:** The nodes are connected by wireless links and the communication among nodes is wirelessly.

- **Ad hoc based:** A MANET is a need based network formed by the union of nodes and the connecting links in an arbitrary fashion. The network is temporary and dynamic.

- **Autonomous and infrastructure less:** Network is self-organizing and is independent of any fixed infrastructure or centralized control. The operation mode of each node is distributed peer-to-peer capable of acting as an independent router as well as generating independent data.

- **Multi hop Routing:** There is no dedicated router and every node acts as a router to pass packets to other nodes.

- **Dynamic Topologies:** Due to arbitrary movement of nodes at varying speed, the topology of network may change unpredictably and randomly.

- **Energy Constraint:** Energy conservation becomes the major design issue as nodes in the MANET rely on batteries or some other exhaustible source of energy.

- **Limited Bandwidth:** Infrastructure less networks have lower capacity as well as less throughput than the infrastructure based network.

- **Security Threats:** There are higher chances of physical security threats like eavesdropping, spoofing and denial of service (DoS) in wireless networks as compared to wired networks.

1.4 Applications of MANET

Because of their flexibility, MANETS are seen as important components in 4G architecture and ad hoc networking capabilities are believed to form a significant part of overall functionalities of next generation. The application of MANET has become wide and varied from email to ftp to web services. Some common MANET applications are:

- **Personal Area Networking:** Devices like laptops, PDAs, mobile phones create a temporary network of short range to share data among each other called the personal area network (PAN)[11].

- **Military Environments:** Since it is not possible to install base station in the enemy territories or inhospitable terrain MANET provides communication services where soldiers act like nodes. The required coordination among the soldiers and in military objects can be seen as another application of MANET in military services.

- **Civilian Environments:** MANET finds its use in many civilian activities like taxi cab network, meeting rooms, sports stadiums, boats, small aircraft, etc.

- **Emergency Operations:** Because of its easy deployment, the use of MANET in situations like search and rescue, crowd control, disaster recovery and commando operations, the use of mobile ad hoc networks is very much suitable. MANET can also be established when conventional infrastructure based communication is damaged due to any calamities.

1.5 Routing Protocols in MANET

Routing is one of the major challenges in MANETs due to their highly dynamic and distributed nature. The routing protocols for MANETs are broadly classified as table-driven and on-demand driven based on the timing of when the route tables are built / updated. Table-driven routing protocol is a proactive approach for the reason that when a packet is to be forwarded the route is known in priori and can be used immediately. Each node tries to maintain a consistent, up-to-date routing table containing information of every other node in the network.

The routing table contains a list of all the destinations, the next hop, and the number of hops to each destination. Each node updates its routing table in response to the change in network and communicates the updates to all its neighboring nodes. The table is created using either link-state or distance vector algorithmic approach. popular routing protocols like Destination-Sequenced Distance Vector (DSDV) [8] protocol belong to this category. These protocols differ in the number of routing tables and the procedures used to exchange and maintain routing tables.

In on-demand driven routing, routes are found only when a source node requires them. Route discovery and route maintenance are two basic procedures for these kind of routing algorithms.

In route discovery route-request packets are sent from a source to all its neighbor nodes. These neighboring nodes forward the request to their neighbors, and so on. On arrival of the route-request to the destination node, it responds back by sending a unicast route-reply packet to the source node through the neighboring nodes through which it first received the route-request. Once the route-request reaches an intermediate node that has sufficiently up-to-date route, it ceases forwarding and sends a route-reply message back to the source.

Route establishment is followed by route maintenance process which maintains internal data structure called a route-cache, of each node till the destination is inaccessible along the path. The nodes along the path from source node to destination node, are aware of the routing paths with passage of time.

As opposed to table-driven routing protocols, not all up-to-date routes are maintained at every node. Dynamic Source Routing (DSR)[9] and Ad-Hoc On-Demand Distance Vector (AODV)[10] are popular examples of on-demand driven protocols.

1.6 Multipath Routing

Typically, nodes in MANET are characterized by their limited power, limited processing, limited memory resources but high degree of mobility. The wireless mobile nodes, in such networks, may dynamically enter as well as leave the network. These nodes have limited transmission range and therefore, multiple hops are usually required for message exchange among nodes in the network. For this reason, routing becomes a crucial design issue of a MANET.

Routing protocols in MANETs like AODV and DSR, usually intend to find a single path between a source and destination node. Multipath routing is finding multiple routes between source and destination nodes. It comprises of three components: route discovery, route maintenance, and traffic allocation. These multiple routes between a source node and a destination node compensate for the dynamism and unpredictability of ad hoc networks.

There are basically two existing Multipath Routing Models: MPDV (Multi-Path Distance Vector) and MPLS (Multi-Path Link State). These models consist of two different routing algorithms based on extensions of the traditional routing algorithms.

The concept of multipath routing came into existence to assist in a variety of applications in MANETs that supports load balancing, fault-tolerance (reliability data transmission), energy conservation, minimization of end-to-end delay and higher aggregate bandwidth. Because of the limited bandwidth between the nodes, load balancing is very important in MANETs and it can be achieved by spreading the traffic along multiple routes. Multipath routing can provide route resilience that aims to solve the fault tolerance problem. When multiple paths are used simultaneously to transmit data, the aggregate bandwidth of the paths may fulfill the application bandwidth requirement. Increased available bandwidth may contribute to a smaller end-to-end delay. Multipath routing also finds its application to support energy-conservation and Quality-of-Service (QoS).

Better throughput is achieved by using multipath routing than using unipath routing in high density ad hoc networks. However, there are some disadvantages of using multi path routing over unipath routing; the primary being complexity and overhead. Maintaining multiple paths to a destination, in multipath protocols, results in greater number of routing tables at intermediate nodes. Also the method by which packets are allocated to the multiple routes has to be considered. It can result in packet reordering. Again traffic allocation is not an issue in unipath routing, since only one path is used. A comparative analysis of both advantages and disadvantages of multipath routing over unipath routing suggests multipath routing is desirable for MANET.

1.7 Thesis outline

Thesis is organized as follows. Chapter one gives a brief introduction to MANET and routing protocols . Chapter two describes literature review. Chapter three describes the AODV and proposed Modified AODV. Chapter four includes simulation result and finally chapter five conclusion and future work.

Chapter 2

Literature Survey

Chapter 2

Literature Survey

Chen Jie and Chen jiapin reduce the energy consumption by dynamically controlling the transmission power [1],Jin Man Kim and jong Wook Jang Maximize network lifetime by calculating mean energy of node[2],Thomas Kunz and Ed Cheng use multicasting and compare AODV and ODMRP[3].

2.1 Itroduction

Mobile nodes are highly dynamic in natures these cause frequent and unpredictable network topology changes. This dynamic nature of mobile nodes increases the routing complexity in the network. There for routing is one of the challenging works in MANET. Routing in a MANET not only depend on depends on finding the path quickly and efficiently but also it depends on many other factors including selection of routers, topology, and location of request initiator. In MANET routing area is the most active research area. Especially over the last few years, number of routing protocols and algorithms has been proposed and closely studied and compared. MANET routing protocols are mainly categorized into three:

- Topology based approach
- Location based approach
- Power/energy aware approach

2.2 Topology based approach

In this approach a mobile node uses its knowledge about recent connectivity of the network including the state of network links4[4]. Based on the time at which the routes are discovered and updated, these type of routing protocol are classified into three categories

- Proactive Routing Protocol
- Reactive Routing Protocol
- Hybrid Routing Protocol

2.2.1 Proactive Routing Protocols

Proactive protocols also known as "table driven" approach because routing information is maintained in tables. In this approach nodes in the network regularly discover path to all nodes which are reachable and tries to keep consistent and up-to-date routing information in the routing table, These makes it easier for a source node to get a routing path immediately when required. The proactive routing protocol is derived from the traditional routing protocol. In proactive routing protocol each node maintains a route to every other node in the network. In proactive routing protocol nodes periodically sends route updates for route creation and maintenance. [5]These routing tables are periodically exchange between nodes in network at set time interval. No matter whatever be the mobility and traffic characteristics of network, the routing updates must occur at specific intervals. On the other hand Event-triggered updates occur whenever some changes takes place in the network, such as link addition or removal. Since the link changes are directly depend on mobility, thats why the mobility rate directly impacts the rate of event-triggered updates. Since each node stored route to the entire nodes in the routing table so it can find route to any node at any moment. So whenever a node wants to transmit data it simply check its routing table and from table it finds the route to the destination and begin packet transmission. However, the disadvantage of these protocols is that since the mobility rate directly impacts the rate of event-triggered updates these cause the control overhead in large networks with moving nodes. Some of the typical proactive routing protocols for MANET are Wireless Routing Protocol (WRP), Destination Sequence Distance Vector (DSDV) and Fisheye State Routing (FSR).

In DSDV each nodes in the network regularly discover path to all nodes which are reachable and tries to keep consistent and up-to-date routing information in the routing table with the number of hops to reach each destination. Here the route entries are marked with a number known as sequence number to overcome the loop problem. Routing tables are periodically exchange between nodes in network at set time interval in order to maintain table consistency.

OLSR is an optimize version of DSDV. The key idea of OLSR protocol is to reduce duplicate broadcast packets transmission in the same region. To achieve this we use so called multipoint relay nodes. Each node in the network selects a set of multipoint relay nodes from among its neighbors which are one hope away. So instead of flooding the node message it sends the message only to the nodes in MPR, which in turn forward the message to their MRP nodes and so on. So if a node already received the message before it wont retransmit it again.

WRP protocol uses four tables to maintain link cost, distance, routes, and message retransmission information. Here for each destination distance and second-to-last hop information are also included in route updates which are sent among neighboring, resulting in faster convergence.

The FSR protocol uses the fisheye technique. On the basic of distance with the neighbor FSR[14] will propagate link state information to other nodes in the network based. So the nodes with less distance will receive link state information more frequently as compared to the nodes that are further away. This means that the accuracy of the route will be less if the node is far away, but the accuracy increases, as soon as the message gets closer to the destination.

2.2.2 Reactive Routing Protocol

This approach is also known as on-demand routing, its a different approach for routing than proactive protocols. In proactive protocol each node need to maintain a route to every other node at all times this is not required in reactive routing protocol. The main advantage of reactive routing protocol is that whenever we need a route, it is immediately available. Previously the control overhead is costly because of frequently changes in link connectivity. Reactive routing approach is better because it does not continuously maintain a route between all pairs of network nodes. In this approach routes are only discovered when they are actually needed.Whenever a node has data to send to some destination, first it checks its route table to know whether it has a route. If the route doesnt exist in table, then it will find a path to the destination this procedure is called as route discovery procedure. Hence, route discovery becomes on-demand.

In route discovery phase, route-request packets are sent from a source to all its neighbor nodes. These neighboring nodes forward the route request to their neighbors, and this goes on until route request reach the destination node. When route-request reaches to the destination node, destination node responds back by sending a unicast route-reply packet to the source node through the neighboring nodes through which it first received the route-request. Once the route-request reaches an intermediate node that has sufficiently up-to-date route, it ceases forwarding and sends a route-reply message back to the source. Once the route establishment is over it is followed by route maintenance process which maintains route-cache, of each node till the destination is not accessible along the path [7].

Some of typical Reactive routing protocols for MANET are Dynamic Source Routing (DSR)[9] protocol, Ad hoc On-demand Distance Vector (AODV)[10] protocol, and Temporally Ordered Routing Algorithm [12](TORA).

The DSR is a reactive routing approach, DSR uses source routing algorithm each data packet in DSR consists total routing information from source to destination. Each node in DSR maintains a cache which has route information from source to destination. It includes two phases: Route discovery and Route maintenance. In

route discovery phase, route-request packets are sent from a source to all its neighbor nodes. These neighboring nodes forward the route request to their neighbors, and this goes on until route request reach the destination node. When route-request reaches to the destination node, destination node responds back by sending a unicast route-reply packet to the source node through the neighboring nodes through which it first received the route-request. Once the route establishment is over it is followed by route maintenance process which maintains route-cache, of each node till the destination is not accessible along the path. AODV is the improvement of the DSDV protocol. AODV reduces the number of route broadcasts by not maintaining the complete list of routes as maintained by the DSDV algorithm, Here routes are available on on-demand basis. Like DSR, AODV also has two phase route discovery, and route maintenance.
TORA is an on-demand source-initiated routing approach based on the link reversal concept Directed Acyclic Graph (ACG). TORA is loop-free and bandwidth-efficient routing protocol. TORA provides multiple routes from source to destination pair. These features of TORA make it suitable for the environment which is highly dynamic or where the population of the node is dense. The only limitation of TORA comes from its dependency on synchronized clocks. This algorithm cannot be used if a node does not have an external time source or GPS positioning system.

2.2.3 Hybrid Routing Protocols

These protocols are the combination the proactive and reactive approaches thats why they known as hybrid routing protocol. Zone Routing Protocol (ZRP)[15] is an example of such type of protocol is the. ZRP first partition the entire topology of the network into zones and then based on the strengths and weaknesses of routing protocols it apply different routing protocols between and within the zones. We can use any routing protocol between and within the zones. Here the size of each zone is decided by a parameter r which describes the radius in hops. Since the proactive routing protocols keep an up to date view of the zone topology, thats why the Intra-zone routing means routing within zone is done by a proactive protocol, so when communication takes place between nodes of the same zone these proactive routing protocol causes no initial delay. The routing between different zone routing is done by a reactive protocol. So the node does not require to keep the fresh state of the entire network.

2.3 Location based approach

To make routing decision this type of approach uses the geographic position of nodes. We can use GPS or some other mechanism to obtained Location information. One of geographical-based routing protocols is location-aided routing (LAR) [7]. Here route request packets are limitedly flooded in a small group of nodes which belong to a request zone. To obtain this request zone, we have to obtain first the expected zone of the destination node.
In route discovery phase, route-request packets contain the location information of source and destination and then this packet is broadcasted to all the nodes within the request zone. Or we can say that the nodes which are in the request zone forward the message, and the nodes which are not in the request zone discard the message. When a route request packet reach to the destination, the destination replies with a route reply packet which contains the current location of the destination node. These neighboring nodes forward the route request to their neighbors, and this goes on until route request reach the destination node. The procedure of route discovery in LAR is: The source puts the location information of itself and the destination in the routing request packet. Then routing request packet is broadcast within the request zone. In other words, the nodes within the request zone forward the message, others discard the message. When a route request packet reach to the destination, the destination replies with a route reply packet which contains the current location of the destination node. If LAR is unable to find the route to the destination due to some error, then the routing protocol will flood a routing message throughout the network.

2.4 Power or energy aware approach

Common power (COMPOW) is based on power aware approach. In this approach every node maintains a routing table at each power levels that is available on the wireless card. Routing tables at different power level is built by exchanging hello messages at each power level Pi, so the routing table RTi correspondence to the routing table at ith power level[17]. Thus, the number of entries in routing table RTi of node u directly depends on the number of nodes that are reachable from u at power level Pi. So clearly, number of entries in routing table RTmax (RTmax is the routing table at maximum power level) gives the information about total number of network nodes that can be reach at Pmax. So Pi is the optimal power level which is defined as the minimum power level i , such that the number of entries in the routing table RTmax equals the number of entries in RTi. Once we find the optimal power level i, table RTi is declared as the master routing table, which is later can used to route packets between nodes.

The CLUSTERPOW protocol is an improvement over COMPOW protocol as COMPOW is limited to the homogenous network where CLUSTERPOW can be used in non-homogenous networks also. CLUSTERPOW protocol uses proactive as well as reactive routing protocol. It finds the lowest optimal transmit power at which the network is connected.

2.5 Problem Statement

I had study the literature review and find that most of routing protocols are find the route from source node to destination node and send packet via single path.In my present work i proposed Modified AODV in which we are use multiple path to send packet. By doing this lifetime of network in extends.

Chapter 3

Modified Ad hoc on Demand Routing Protocol

Chapter 3

Modified Ad hoc on Demand Routing Protocol

3.1 Introduction

Energy efficient routing is very essential in MANET. We have observed the different approaches used to bring energy efficiency in routing. These approaches make them efficient but then also it can not go beyond a limit. This makes us for the search of new innovative approaches.

3.2 Motivation

There are many existing MANET routing protocols , each one is having its own advantages as well as disadvantages. After looking through this existing protocol, we decided to design an energy efficient routing protocol which reduces the total energy consumption in the network and thus maximize the life time of the network. We proposed a new energy efficient routing protocol which is modified version of AODV.

3.3 Ad hoc on Demand Routing Protocol (AODV)

The Ad hoc On-Demand Distance Vector (AODV) algorithm enables dynamic, multihop routing between participating mobile nodes wishing to establish and maintain an ad hoc network[6]. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication.

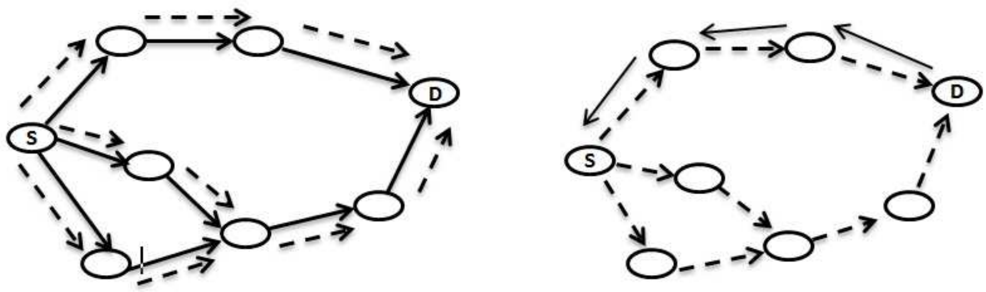


Figure 3.1: Route discovery by AODV

3.3.1 AODV Terminology

- **a**ctive route

  A routing table entry with a finite metric in the Hop Count field. A routing table may contain entries that are not active (invalid routes or entries). They have an infinite metric in the Hop Count field. Only active entries can be used to forward data packets. Invalid entries are eventually deleted.

- **b**roadcast

  Broadcasting means transmitting to the IP Limited Broadcast address, 255.255. 255.255. A broadcast packet may not be blindly forwarded, but broadcasting is useful to enable dissemination of AODV messages throughout the ad hoc network.

- **d**estination

  An IP address to which data packets are to be transmitted. Same as "destination node". A node knows it is the destination node for a typical data packet when its address appears in the appropriate field of the IP header. Routes for destination nodes are supplied by action of the AODV protocol, which carries the IP address of the desired destination node in route discovery messages.

- **o**riginating node

  A node that initiates an AODV route discovery message to be processed and possibly retransmitted by other nodes in the ad hoc network. For instance, the node initiating a Route Discovery process and broadcasting the RREQ message is called the originating node of the RREQ message.

- **r**everse route

  A route set up to forward a reply (RREP) packet back to the originator from the destination or from an intermediate node having a route to the destination.

- **s**equence number

  A monotonically increasing number maintained by each originating node. In AODV routing protocol messages, it is used by other nodes to determine the freshness of the information contained from the originating node.

3.3.2 AODV Operation

This section describes the scenarios under which nodes generate Route Request (RREQ), Route Reply (RREP) and Route Error (RERR) messages for unicast communication towards a destination, and how the message data are handled. In order to process the messages correctly, certain state information has to be maintained in the route table entries for the destinations of interest.

Maintaining Sequence Numbers

Every route table entry at every node MUST include the latest information available about the sequence number for the IP address of the destination node for which the route table entry is maintained.

A destination node increments its own sequence number in two circumstances:
- Immediately before a node originates a route discovery, it MUST increment its own sequence number. This prevents conflicts with previously established reverse routes towards the originator of a RREQ.
- Immediately before a destination node originates a RREP in response to a RREQ, it MUST update its own sequence number to the maximum of its current sequence number and the destination sequence number in the RREQ packet.

A node may change the sequence number in the routing table entry of a destination only if:
- it is itself the destination node, and offers a new route to itself, or
- it receives an AODV message with new information about the sequence number for a destination node, or
- the path towards the destination node expires or breaks.

Route Table Entries

When a node receives an AODV control packet from a neighbor, or creates or updates a route for a particular destination or subnet, it checks its route table for an entry for the destination. In the event that there is no corresponding entry for that destination, an entry is created. The route is only updated if the new sequence number is either
- higher than the destination sequence number in the route table, or
- the sequence numbers are equal, but the hop count (of the new information) plus one, is smaller than the existing hop count in the routing table, or
- the sequence number is unknown.

Generating Route Requests

A node disseminates a RREQ when it determines that it needs a route to a destination and does not have one available. This can happen if the destination is previously unknown to the node, or if a previously valid route to the destination expires or is marked as invalid. The Destination Sequence Number field in the RREQ message is the last known destination sequence number for this destination and is copied from the Destination Sequence Number field in the routing table. If no sequence number is known, the unknown sequence number flag MUST be set. The Originator Sequence Number in the RREQ message is the nodes own sequence number, which is incremented prior to insertion in a RREQ. The RREQ ID field is incremented by one from the last RREQ ID used by the current node. Each node maintains only one RREQ ID.

Processing and Forwarding Route Requests

it first increments the hop count value in the RREQ by one, to account for the new hop through the intermediate node. Then the node searches for a reverse route to the Originator IP Address , using longest-prefix matching. If need be, the route is created, or updated using the Originator Sequence Number from the RREQ in its routing table. This reverse route will be needed if the node receives a RREP back to the node that originated the RREQ (identified by the Originator IP Address). When the reverse route is created or updated, the following actions on the route are also carried out:

- the Originator Sequence Number from the RREQ is compared to the corresponding destination sequence number in the route table entry and copied if greater than the existing value there
- the valid sequence number field is set to true;
- the next hop in the routing table becomes the node from which the RREQ was received ;
- the hop count is copied from the Hop Count in the RREQ message;

Generating Route Replies

A node generates a RREP if either:

- it is itself the destination, or
- it has an active route to the destination, the destination sequence number in the

nodes existing route table entry for the destination is valid and greater than or equal to the Destination Sequence Number of the RREQ

1. **Route Reply Generation by the Destination**
If the generating node is the destination itself, it MUST increment its own sequence number by one if the sequence number in the RREQ packet is equal to that incremented value. Otherwise, the destination does not change its sequence number before generating the RREP message. The destination node places its sequence number into the Destination Sequence Number field of the RREP, and enters the value zero in the Hop Count field of the RREP.

2. **Route Reply Generation by an Intermediate Node**
If the node generating the RREP is not the destination node, but instead is an intermediate hop along the path from the originator to the destination, it copies its known sequence number for the destination into the Destination Sequence Number field in the RREP message.

3.4 Proposed method

In our proposed method, we use two approach one is Load Balancing and second is multiple path approach.
In load balancing, we select route which is rich in energy to ensure that packet will send without failure. By selecting this route, every node will have energy greater than threshold level.

In multiple path approach , we use more than one path.We are selecting multiple path because, if we send via single path ,nodes in that path will use more energy or it will possibly discharge the energy of the nodes present in that path completely and can not be part of the network. This may break link between source and destination.there is a possibility of network dis-joint.

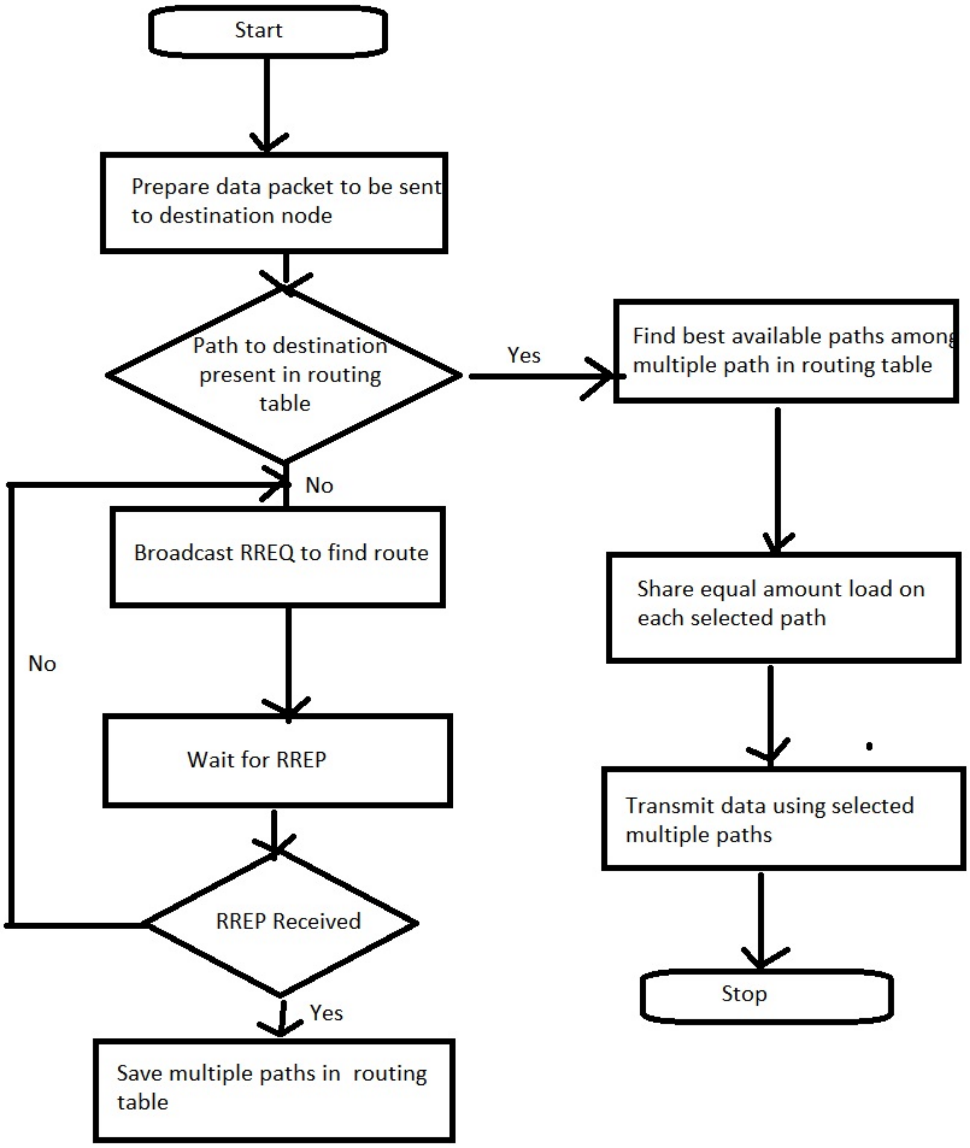


Figure 3.2: Flow chart of Proposed method

Chapter 4

Simulation of modified AODV

Chapter 4

Simulation and Results

4.1 Results

In our model ,a network with 50 mobile nodes which are randomly and uniformly distributed in a rectangular region of 800x800 unit square.we simulate our proposed AODV (New-AODV) protocol by comparing the traditional AODV(Original-AODV).

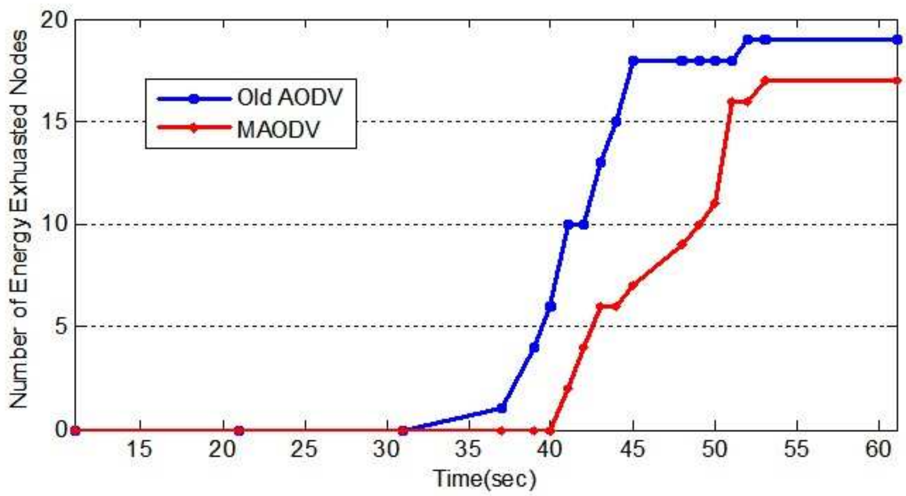


Figure 4.1: Network Lifetime for Modified AODV under Maximum Speed 2 m/s

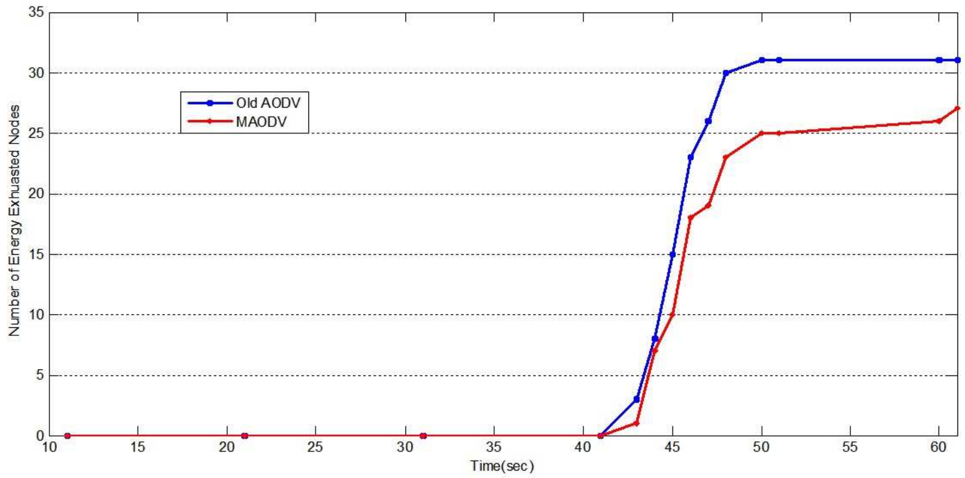


Figure 4.2: Network Lifetime for Modified AODV under Maximum Speed 10 m/s

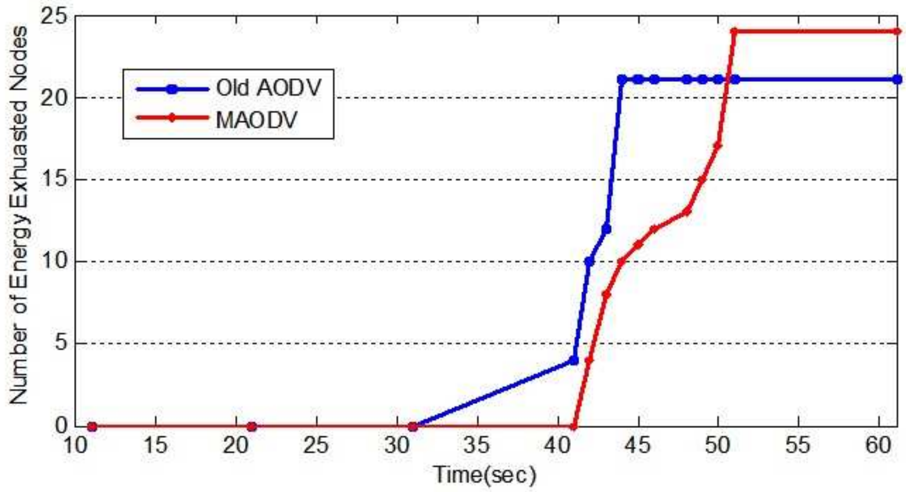


Figure 4.3: Network Lifetime for Modified AODV under Maximum Speed 20 m/s

Figure 4.1 compared the network activity time of the modified AODV and existing AODV when the maximum moving speed was 2 m/s. Here, in existing AODV the 18 nodes participating in the path consumed all energy within 45 seconds of simulation and as a result the network was divided and became unable to transmit packets, but in the modified AODV the network did not divide, but continued its activities for 61 seconds of simulation.

Figure 4.2 compared the network activity time of the modified AODV and existing AODV when the maximum moving speed was 10 m/s. In this case as well, the network continued activities longer in modified AODV than in existing AODV.

Particularly in Figure 4.3 in existing AODV 21 nodes consumed all energy within 44 seconds and, as a result, they could not participate and the network could not work. On the other hand, in the new AODV, the number of nodes consuming all energy increased, forming a mild curve of 51 seconds. This shows that the modified AODV distributes energy consumption in nodes evenly throughout the network and the life of the network is extended by around 10 seconds compared to existing AODV. Ten seconds in the entire simulation time of 60 seconds means the improvement of network life by 16.7The results show that the improved ADOV (modified AODV) extending network lifetime.

Chapter 5

Conclusion and Future work

Chapter 5

Conclusion and Future work

5.1 Conclusion

In this thesis ,we have compared two protocols namely AODV and modified AODV. AODV uses single path to send packets because of this, node which comes in the route gets low on power or discharges completely. Because of this,there is possibility of network death. if we use modified AODV which use multiple path to send data, lifetime of the network is extends.
results show that, if we use modified AODV network lifetime is extended and it depends on the speed of mobile nodes.

5.2 Future Work

In AODV, RREQ and RREP both take some energy to transmit. if we increase waiting time for RREP then, there is possibility that network lifetime will increase.

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