An Enhanced Route Discovery algorithm to maximize network life time in MANET

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ABSTRACT- **A MANET is a type of ad hoc network that can change places and configure itself on the fly. Because MANETS are mobile, they use wireless connections to connect to different networks. This can be a standard Wi-Fi connection, or another medium, like as a cellular or satellite communication. Some MANETs are restricted to a local area of wireless devices (such as a group of laptop computers), while others may be linked to the Internet. A different approach in the design of the routing protocol is to compute a path only when it is necessary for data transmission. These types of protocols are named as the on-demand or reactive protocols routing protocols. A reactive protocol is characterized by a path discovery procedure and a maintenance procedure. Main objective of this paper is to analyze Minimum Battery Cost Routing (MBCR) to expand Energy Efficient Power Aware Multipath Dynamic Source Routing based on DSR. The cost function in MBCR is defined such that the lesser the remaining battery capacity By using residual power as a cost metric, MBCR prevents nodes from being overused, and attempts to evenly distribute battery capacity over the network to increase network lifetime.**

General Terms

Dynamic Source Routing (DSR), multihop, , loop free paths, Routing, Route Request (RREQ) and Route Replay (RREP).

Keywords

Vehicular Ad-hoc Networks (VANETs), (Imanet) Internet Based Mobile Ad-hoc Networks, Multi-hopping, Dynamic source routing**.**

I. INTRODUCTION

(MANET) A mobile ad hoc network is a collection of wireless mobile nodes which have the ability to interface with each other without having fixed network infrastructure or any central base station. A MANET is a type of ad hoc network that can change positions and configure itself on the fly. Because MANETS are mobile, they imply wireless connections to connect to different networks. This can be a standard Wi-Fi connection, or another medium, like as a cellular or satellite transmission. The term MANET (Mobile Adhoc Network) mention to a multihop packet based wireless network group of a set of mobile nodes that can communicate and move at the same time , without using any type of fixed wired infrastructure[1]. MNET are actually self organizing and adaptive networks that can be deformed and formed on-the-fly without the requirement of any centralized administration. Routing in MANET is challenging due to the restrictions existing on the transmission bandwidth battery power and CPU time and the requirement to cope with the repeated topological changes resulting from the mobility of the nodes. A different approach in the design of the routing protocol is to evaluate a path only when it is necessary for data transmission [2]. These types of protocols are named as the reactive protocols or on-demand routing protocols. A reactive protocol is characterized by a path discovery method and a maintenance procedure.

1.2 MANET v/s WLAN

MANETs are dynamically created and maintained by the individual nodes comprising the network. MANET comprises a special subset of wireless networks since they do not need the existence of a centralized message-passing tool. Simple wireless networks require the existence of access points or static base stations, which are accountable for routing messages to and from mobile nodes within the specified transmission area [3]. A MANET may both work as a self-configured stand-alone network or may be connected to the Internet, through gateway nodes we define protocol which support unipath traffic from the source node to the destination node, where the stress is on Dynamic Source Routing (DSR) protocol[4].

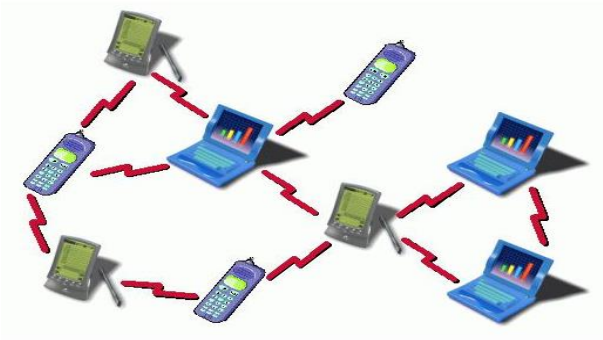

Figure 1.1 MANET

WLAN has been widely deployed in a range of network situation such as enterprise and home networks.

1.3 Types of MANET

1.3.1 Vehicular Ad-hoc Networks (VANETs)

Vehicular Ad-hoc Networks (VANETs) are used for communication among vehicles and between vehicles and roadside equipment

1.3.2. (InVANETs) Intelligent vehicular ad-hoc networks

(InVANETs) Intelligent vehicular ad-hoc networks are a kind of artificial intelligence that helps vehicles to function in an intelligent manner during vehicle-to-vehicle collisions, accidents, drunken driving etc.

1.3.3. (iMANET) Internet Based Mobile Ad-hoc Networks

Internet Based Mobile Ad-hoc Networks are ad-hoc networks that connect mobile nodes and fixed Internet-gateway nodes. In such type of networks normal adhoc routing algorithms don't apply straightly.

1.4 Protocol requirements in MANET

1. Self starting and self organizing

2. Loop free paths, Multi-hop

3. Dynamic topology maintenance

4. Low memory-bandwidth consumption

5. Scalable to large networks

6. Minimal overhead for data transmission[5]

1.5 Different types of proposed protocols in MANET

1) Proactive approach

2) Reactive approach

3) Hybrid approach

1) Proactive protocols

Adaptive system of routing based on the exchange of control packets.

Continuously modify the possible information in the nodes routing tables.

2) Reactive protocols

Do not take responsibility for finding a route.

Try to find out route only on demand by flooding its Query.

3) Hybrid protocols

A composition of proactive and reactive schemes or a derivative of one.

Optimization of either of two routing technique s[6]

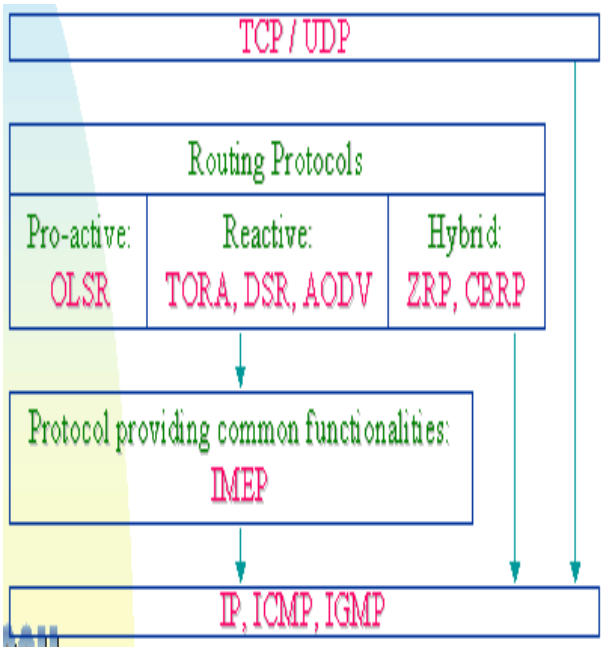

Figure 1.2 Hierarchy of MANET routing protocols

1.6 Power Aware

Ad hoc networks are the autonomous systems consist of mobile nodes that interface with each other using wireless transmission. Here a node can be a laptop, a mobile phone , a PDA or another communication device with some properties that are limited storage capacity, restricted bandwidth and ,limited battery power. An ad hoc network commonly refers to any set of networks where all devices have equal status on a network and are free to link with any other ad hoc network devices in link range[7].

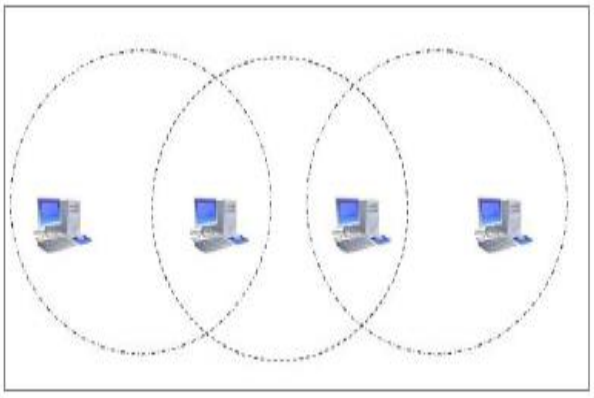

Figure 1.3 Ad hoc net with four nodes[7]

1.6.1 Multi-hopping:

Multi-hopping is a method which allows virtual extension of the communication range for each node. This means to say that a node can remit a packet to another node not in its range.

Figure 1.4 Multi Hoping in Ad hoc network

1.6.2 DYNAMIC SOURCE ROUTING

Mobile networks have attracted significant attention in recent years because of their improved flexibility and reduced costs. In contrast to wired networks, mobile networks have unique characteristics like frequent network topology changes, different link capacity because of the impacts from transmission power, receiver sensitivity, noise, fading, and interference. Furthermore, wireless mobile networks have a high error rate, power restrictions, and bandwidth limitations [1]. Routing is the method of selecting paths in a network along which network traffic can be sent. [2]. The routing protocols that come under this category do not maintain the network topology information. They obtain the necessary path when required. Hence they do not periodically interchange any routing information. [6]. A. Route discovery Route discovery consists of two sub-procedures: (RREQ) Route Request and Route Replay (RREP). Route discovery is the mechanism by which a node willing to send a packet to a destination node finds a route. Route discovery is used only when a node attempts to send a packet to another node and does not before know a route to that node. [7]

1.6.2.1 Route maintenance: Route maintenance is the methodology by which node S is able to detect, if the network topology has changed such that it can no more use its path to D because a link along the route no longer works [8].

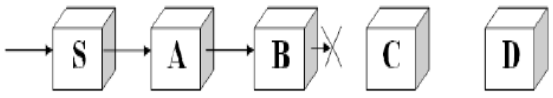

Figure 1.6.4 Route maintenance: node C is unable to forward a packet from S to D

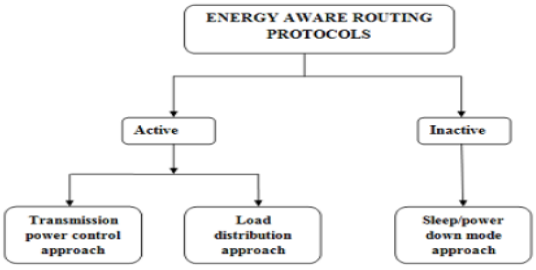

Figure 1.5 Energy Aware routing protocols[8]

II. RELATED WORK

The research work performed in this field by different researchers is presented as follows:

Palak et al.(2014) mobile ad hoc network is a self organizing temporary network. It contains mobile nodes roaming here and there. Routing in these networks is a challenging job. Various routing protocols have been proposed since the origin of MANETS. DSR is the most popular routing protocol build on source routing. This paper is an study of DSR taking various performance parameters. Effect of these parameters on energy utilization is studied in this paper. Efficient DSR is one which gives best route with minimum energy consumption and maximizes network lifetime.

Kavita Sharma et al.(2014) This paper proposed an Energy effective power aware multipath dynamic source routing protocol by modifying one of the most popular routing protocols that is (DSR) Dynamic Source Routing protocol which is not at all concerned about power consumption. The proposed Dynamic source routing-Power Aware routing DSR-PSR uses the initial concept of traditional DSR and implements energy efficient routing through which it not only increases the life time of the network but also increases the overall performance of the networks.

NANDINI PRASAD K S (2013) This paper presents a power aware routing protocol designed for wireless sensor networks. The suggested routing protocol is an extended and enhanced version of Dynamic Source Routing protocol. It sums energy awareness to the existing implementation of DSR protocol. Energy metric is considered during route selection process to select an optimal path in terms of overall energy of the nodes along the path, and “low energy notification” method is used during route maintenance process to increase the lifetime of the 'bridge' nodes to avoid network subdividing. The performance of DSR protocol and (EADSR) Energy Aware DSR protocol are compared through NS2 simulation under various scenarios. In all the cases, it is viewed that EADSR protocol out-performs DSR protocol by energy saving in efficient manner.

Md Shahid Akhter et al.(2013) In this paper, there are two enhancements proposed in DSR protocol to

maximize the lifetime of MANET. It is simulated in ns2 and the results are found useful. The algorithm of DSR protocol is remould on the basis of initial energies of nodes. Both improvements are done in DSR to save the energy of nodes so that they can function effectively in low power as well. There is remarkable improvement in the performance of DSR and finally the lifetime of MANET increases.

P.S. Patheja et al.(2012) Many routing protocols for Ad hoc networks have been proposed so far, the most famous of which are the Dynamic Source Routing Protocols (DSR In the suggested work, the destination will accept at most first three path request packets from the same source for the same communication (i.e. same ID). This gives the source, various paths from source to destination for transmission. It then utilizes all the discovered routes for data transmission. These multiple paths permit load balancing and faster delivery.

Vinay Rishiwal et al.(2009) Much research efforts have been dedicated to develop energy aware routing protocols. In this paper we propose an efficient algorithm, which enhances the
network lifetime by minimizing the power consumption during the source to destination route organization. As a case study suggested algorithm has been incorporated along with the path discovery procedure of AODV and by simulation it is observed that suggested algorithm's performance is better as compare to AODV and DSR in terms of different energy related parameters like Total Energy utilization, Node Termination Rate , Average Energy Left Per Alive Node, , and Network Lifetime for different network scenarios.

III. PROPOSED WORK

3.1Problem Formulation

The complete lifetime of the entire ad hoc network can be increased by improving the power consumption balance among nodes and the connection of the network. In most existing protocols, a mobile node may consume all its energy to participate in the operation without assuming the remaining energy. Some of the problems analyzed from the past study are:

1. Route discovery - Route discovery compose of two sub-procedures: Route Request (RREQ) and Route Replay (RREP). Route discovery is the procedure by which a node willing to send a packet to a destination node finds a route. **.**

2. Route maintenance - Route maintenance is the procedure by which node S is able to identify, if the network topology has changed such that it can no longer use its path to D because a link besides the route no longer works.

At the time of route discovery, (RREQ) a route request packet broadcasted by the source. The header of the RREQ packet includes <source-id, destination-id, T_B_S (Total Battery Status), WNs (number of weak nodes) and Node IDs.

a) Calculation of Total Battery Status (*T_B_S)*

b) Route Maintenance Phase

3.2 Proposed Work

Main objective of this paper is to analyze Minimum Battery Cost Routing (MBCR) to develop Energy Efficient Power Aware Multipath Dynamic Source Routing based on DSR.

1. To propose a new route discovery algorithm that assumes the remaining energy for each node and uses a cost function to choose the best power saving route.

2. To suggest a new route maintenance algorithm that deals with the broken routes due to the nodal energy depletion and node mobility.

IV. RESULTS AND ANALYSIS

4.1 Simulation Flow

There are five states or steps of modeling the desired system represented by each rectangular box above. The horizontal arrows depict the actions to be taken in order to move from a state to another, while the bent dashed arrows represent where the validation, verification and credibility concepts are prominently established.

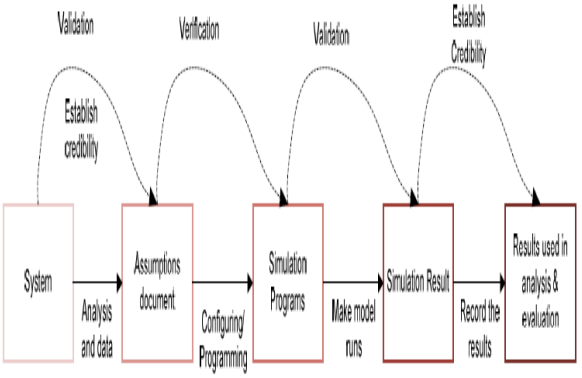

Figure 4.1 - A valid, credible and appropriate simulation model workflow

4.2 Simulation Model

Our simulation model was carried out using the NS2 network simulator. NS is an event driven network simulator program, invented at the University of California Berkley, which includes many network objects like as protocols, applications and traffic source behavior. The NS is a part of software of the VINT project that is supported by DARPA since 1995.

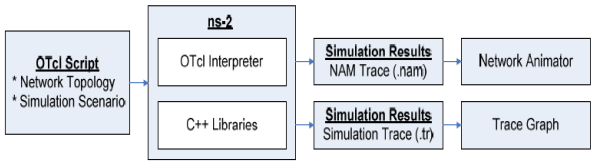

Figure 4.2 NS-2 Schemas

At the simulation layer NS uses OTcl (Object oriented Tool Command Language) programming language to explain user simulation scripts. As shown in Figure 5.2 an OTcl script written by a user is explained by NS. While OTcl script is being interpreted, NS creates two main analysis reports concurrently. One of them is NAM (Network Animator) object that presents the visual animation of the simulation. The other is the trace object that contains the behavior of all objects in the simulation. Both of them are created as a file by NS.

4.2.1 Tcl Language in NS

TCL is a powerful interpreted programming language. NS-2 simulator is used for performance evaluation. The network is a collection of 50 nodes deployed on square area of 1500mx1500m. transmission range of each node is 250 m. The medium access control (MAC) protocol based on IEEE 802.11 with 2 Megabits per second raw capacity. For radio propagation model, a two-ray ground reflection pattern is used. In all simulations, we will use the RWP (Random waypoint) mobility model . Each node moves with a maximum speed randomly selects from the interval [5 m/s, 15 m/s]. The duration of every simulation is 0-1200 seconds, executed with different mobility scenarios characterised by different pause times.

Communication between nodes is designed by CBR (Constant Bit Rate) traffic over UDP. A source generates with a rate of five packets per second ,packets of 512 bytes. A total of 8 connections were generated. They start at a time randomly selects from the interval [0s, 100s] and still active till the end of simulation.

As the remaining energy level of a node minimizes, the link cost of the node increases. This stresses new routing decisions in the network by invalidating its own cache entries to different destinations. However, if a path was recently added to the cache table, the node will not force (route finding step) a new decision unless the node's remaining energy is depleted by a certain normalized amount due to messages passing through that path.

The key parameter of study is the network lifetime. We vary the various parameters and study their reaction on this metric. The network lifetime can be defined in many ways:

1. It may be defined as the time taken for % of the nodes in a network to die.
2. It might be the time taken for the first node to expire.

3. It can also be the time for all nodes in the network to die.

For analysis the first & third definition is adopted. Network lifetime of DSR and DSR-PSR are compared.

Simulation Time	Number of dead nodes in DSR	Number of dead nodes in DSR-PSR
0	0	0
50	3	1
100	7	2
150	10	3
200	14	3
250	17	4
300	20	5
350	23	6

Table 4.1 First dead nodes with simulation time

In the table 4.1 there is a comparison between the number of dead nodes in the simple DSR and the modified DSR. Table 4.1 depicts that at simulation time 50 the number of dead nodes in simple DSR is 3 whereas the number of dead nodes in modified DSR is only 1. Later on as the simulation time increases the number of dead nodes in simple DSR is more compared to the number of dead nodes in modified DSR

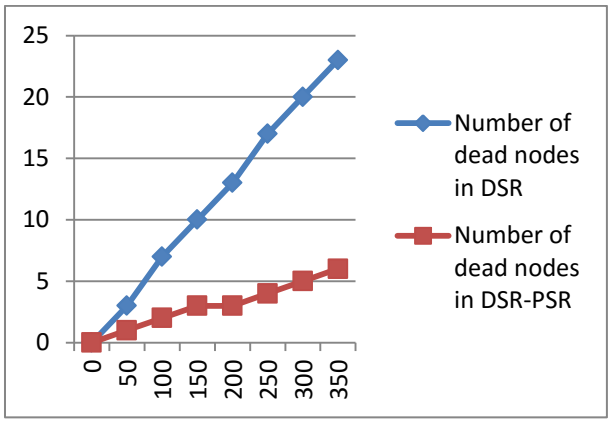

Figure 4.3 Graph for dead nodes with simulation time

The figure 4.3 depicts the graphical view of comparing of number of dead nodes between the old i.e simple DSR and the modified DSR-PSR.

Simulation Time	Dead Nodes In DSR	Percentage Of Dead Nodes In DSR	No Of Dead Nodes In DSR-PSR	Percentage Of Dead Nodes In DSR-PSR
400	17	34	2	4
450	19	38	3	6
500	21	42	3	6
550	23	46	4	8
600	24	48	4	8
650	26	52	4	8
700	28	56	5	10
750	31	62	5	10
800	33	66	5	10
850	37	74	5	10
900	38	76	6	12
950	41	82	6	12
1000	43	86	8	16
1050	46	92	8	16
1100	48	96	8	16
1150	50	100	9	18

Table 4.2 Comparison for all dead nodes with simulation time

The above table 4.2 shows that in the simple DSR at simulation time of 1150 secs the 100% node dies i.e 50 node dies taken at the starting of simulation for testing whereas in the modified DSR the 82% of nodes are still alive i.e the number of dead nodes are only 9, the remaining 41 nodes are still alive. There is a simulating correlation across the numbers of all expired nodes for the system taken for 50 nodes 4ith simulation time varies from 0-1200secs in the table 4.2.

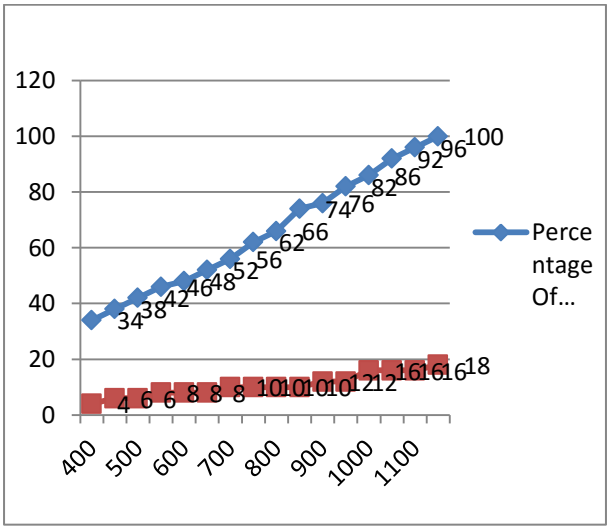

Figure 4.4 Graph for all dead nodes with simulation time

The figure 4.4 depicts the graphical view of comparing of number of all dead nodes between the old i.e simple DSR and the modified DSR taken for simulating 50 nodes for the system.

V. CONCLUSION AND FUTURE SCOPE

A MANET is a kind of ad hoc network that can change locations and framing itself on the fly. Routing in MANET is challenging due to the restrictions existing on the transmission bandwidth battery power and CPU time and the requirement to manage with the recurrent topological changes resulting from the mobility of the nodes.The overall lifetime of the complete ad hoc network can be increased by improving the power utilization balance among nodes and the connection of the network. In most existing protocols, a mobile node may utilize all its energy to take part in the operation without considering the remaining energy. In the proposed energy efficient DSR protocol each node will only use part of energy to dispatch the data packets. This is done through a route discovery procedure. The new protocol uses a cost function to decide path selection instead of using the traditional shortest hop algorithm. The cause that DSR is used as our base model is basically due to the fact that it is a typical on demand protocol with less bandwidth and energy use.

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