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RESEARCH ARTICLE

An Approach to Enhance Energy Efficient Position Based DSR Routing Protocol

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Abstract— ***A mobile ad hoc network (MANET) is a continuously self-configuring, infrastructure-less network of mobile devices connected without wires. MANET is a combination of mobile nodes communicating and transferring data with each other to route a packet from source to their destinations. MANET is used to support dynamic routing techniques in absence of fixed wired infrastructure and centralized control. In MANET less power in mobile communication nodes is a big matter of concern. Due to this some energy efficient techniques should be implemented with existing routing protocols to increase life time of network and reduce network failure and energy. This paper is presenting an Enhanced Energy-Efficient Position Based DSR Routing protocol. The protocol deals with various parameters as Residual Energy, Bandwidth, Load and Hop Count for route discovery. It will improve overall energy of network.***

Keywords— ***Load, Residual Energy, Bandwidth, Hop Count***

I. INTRODUCTION

Mobile Ad Hoc Network consists of wireless mobile communicating nodes where each node acts as a router that forwards the packets from one node to another node. In MANETs every node can move freely so this uses dynamic topology. Due to this characteristics MANET is used in many today's applications. This makes routing in such networks more challenging, especially when certain Quality of Service (QoS) requirements are to be guaranteed during the routing. There is no fixed infrastructure in the MANET. While transmitting a packet from source to destination it passes through some intermediate nodes. In such a network, it may be necessary for one mobile host to enlist the other hosts in forwarding a packet to its destination, due to the limited range of each mobile host's wireless transmissions. This type of wireless network is known as mobile ad hoc network [1].

Mobile ad hoc networks (MANETs) are composed of a set of mobile nodes which can move anywhere freely and communicate with each other using a wireless data transfer medium .So, limited energy capacity, absence of fixed infrastructure, dynamic topology and unstable links are special features for MANET when compared to other wired networks. MANET does not have centralized controllers, which makes it different from other wireless

networks [2]. MANET can be used in several areas. Some of them are: wireless mesh networks, wireless sensor network, military applications, hybrid wireless network architectures, collaborative and distributed computing, emergency operations[2].

A. Introduction to Routing Protocols Routing protocols between any pair of nodes within an ad hoc network can be difficult because the nodes can move randomly and can also join or leave the network. This means that an optimal route at a certain time may not work seconds later. Routing in a MANET depends on many other factors including topology, selection of routers and location of request initiator and specific underlying characteristics that could serve as a heuristic in finding the path quickly and efficiently. This makes the routing area perhaps the most active research area within the MANET domain. Especially over the last few years, numerous routing protocols and algorithms have been proposed and their performance under various network environments and traffic conditions closely studied and compared. Discussed below are three categories that existing ad hoc network routing protocols fall into three parts:

- Table Driven Protocols
- On Demand Protocols
- Hybrid Protocols

B. Classification of Routing Protocols

a. Table Driven Routing Protocols: The Table Driven Routing Protocol, also known as Proactive Protocols, work out routes in the background independent of traffic demands. Each node uses routing information to store the location information of other nodes in the network and this information is then used to move data among different nodes in the network. These protocols keep a constant overview of the network and this can be a disadvantage as they may react to change in the network topology even if no traffic is affected by the topology modification which could create unnecessary overhead. Even in a network with little data traffic, Table Driven Protocols will use limited resources such as power and link bandwidth therefore they might not be considered an effective routing solution for Ad hoc Networks. Fisheye State Routing and DSDV are the examples of a Table Driven Protocol.

b. On Demand Routing Protocols: On Demand Routing Protocol, also known as Reactive Protocols establish routes between nodes only when they are required to route data packets. There is no updating of every possible route in the network instead it focuses on routes that are being used or being set up. When a route is required by a source node to a destination for which it does not have route information, it starts a route discovery process which goes from one node to the other until it arrives at the destination or a node in between has a route to the destination. On Demand protocols are generally considered efficient when the route discovery is less frequent than the data transfer because the network traffic caused by the route discovery step is low compared to the total communication bandwidth. This makes On Demand Protocols more suited to large networks with light traffic and low mobility. Examples are: AODV and DSR.

c. Hybrid Routing Protocols: Hybrid routing protocol combine Table Based Routing Protocols with On Demand Routing Protocols. They use distance vectors for more precise metrics to establish the best paths to destination networks and report routing information only when there is a change in the topology of the network. Each node inthe network has its own routing zone, the size of which is defined by a zone radius, which is defined by a metric such as the number of hops. Each node keeps a record of routing information for its own zone.

II. RELATED WORK

A. Energy Efficient Routing Protocol

Different routing protocols have been used to establish a correct and efficient route between a pair of nodes. But because of the limited available power of each node, the selected route cannot remain for a long time so that the source-destination pair can use it for its successful communication. To achieve the goal of getting longer lifetime for a network, we should minimize nodes energy not only during active communication but also when they are in inactive state. Two approaches to minimize the active communication energy are:

- Transmission power control approach
- Load distribution approach and to minimize energy during inactivity the following approach is used
- Sleep/Power-Down mode

a. Transmission Power Control Approach: A routing algorithm essentially involves finding an optimal route on a given network graph where a vertex represents a mobile node and an edge represents a wireless link between two end nodes that are within each other's radio transmission range. When a node's radio transmission power is controllable their direct communication ranges as well as the number of its immediate neighbors are also adjustable. While stronger transmission power increases the transmission range and reduces the hop count to the destination, weaker transmission power makes the topology sparse which may result in network partitioning and high end-to-end delay due to a larger hop count. There has been active research on topology control of a MANET via transmission power adjustment [10,11] and the primary objective is to maintain a connected topology using the minimal power. Energy efficient routing protocols based on transmission power control find the best route that minimizes the total transmission power between a source-destination pair.

b. Load Distribution Approach: The specific goal of the load distribution approach is to balance the energy usage of all mobile nodes by selecting a route with underutilized nodes rather than the shortest route. This may result in longer routes but packets are routed only through energy rich intermediate nodes. Protocols based on this approach do not necessarily provide the lowest energy route but prevent certain nodes from being overloaded and thus ensures longer network lifetime. This subsection discusses two such protocols: Localized Energy-Aware Routing (LEAR) and Conditional Max-Min Battery Capacity Routing (CMMBCR) protocols.

c. Sleep/Power-Down Mode Approach: The sleep/power-down mode approach focuses on inactive time of communication. Since most radio hardware supports a number of low power states, it is desirable to put the radio subsystem into the sleep state or simply turn it off to save energy.

B. Power Consumption Modes

The mobile nodes in wireless mobile ad hoc network are connected to other mobile nodes. These nodes are free to transmit and receive the data packet to or from other nodes and require energy to such activity. The sources of power consumption are communication and computation with communication often being the chief power consumer. An ad hoc (or "spontaneous") network is a local area network or other small network, especially one with wireless or temporary plug-in connections in which some of the network devices are part of the network only for the duration of a communications session or in the case of mobile or portable devices, while in some close proximity to the rest of the network. Although significant in terms of reducing the power consumption in the wireless transmitter of a sender, it does little to conserve power among the other nodes receivers, forwarders and nodes not involved in this communication. The total energy [12, 13] of nodes is spent in following modes: Transmission Mode, Reception Mode, Idle Mode and Overhearing Mode. These modes of power consumption are described as:-

a. Transmission Mode: A node is said in transmission mode when it sends data packet to other nodes in network. These nodes require energy to transmit data packet, such energy is called Transmission Energy of that nodes. Transmission energy is depended on size of data packet (in Bits), means when the size of a data packet is increased the required transmission energy is also increased.

b. Reception Mode: When a node receives a data packet from other nodes then it said to be in Reception Mode and the energy taken to receive packet is called Reception Energy.

c. Idle Mode: In this mode generally the node is neither transmitting nor receiving any data packets. But this mode consumes power because the nodes have to listen to the wireless medium continuously in order to detect a packet that it should receive so that the node can then switch into receive mode from idle mode. Despite the fact that while in idle mode the node does not actually handle data communication operations it was found that the wireless interface consumes a considerable amount of energy nevertheless. This amount approaches the amount that is consumed in the receive operation. Idle energy is a wasted energy that should be eliminated or reduced.

d. Overhearing Mode: When a node receives data packets that are not destined for it, then it said to be in overhearing mode and it may consume the energy used in receiving mode. Unnecessarily receiving such packets will cause energy consumption.

Unlike other routing protocols, our protocol uses no periodic routing overhead messages, so by reducing bandwidth of network; it uses dynamic source routing to route packets in an adhoc network. According to source routing technique the source node determines the entire sequence of nodes through which a packet has to pass from source to destination. The source node puts the list of addresses of all the intermediate nodes in the header of the packet, so that the packet is reached at destination through those specified nodes. Source routing is done using a technique called route discovery. Whenever a node want to send a packet to some other node, the

sending node initiates the route discovery. Each node maintains a cache called route cache to store the information about all routes it has gathered to different destinations. To support efficient routing in energy constrained ad hoc networks, power aware routing policies can be integrated and evaluated with existing features of routing protocol [3]. The routing mechanism basically involves two activities first, to find optimal routing routes and secondly, transferring data packets through network.

There are various Energy-Efficient routing protocols which deal with this technique but in this paper DSR is used as base protocol. The DSR protocol is a type of reactive routing protocol for MANET. It uses source routing which means that the sender must know the complete hop-by hop route sequence to the destination node. These all routes are stored in a route cache. DSR is composed of two passes that work together to perform the route discovery and route maintenance of source routes in the ad hoc network. When a node in an adhoc network attempts to send a data packet to a destination for which it does not already know the route, it uses a route discovery mechanism to dynamically find such a route. Route discovery works by flooding the network with route request RREQ packets. Each node that receive a request rebroadcasts it, unless it is the destination or it has a route to the destination in its route cache. Such a node replies to the request with a route reply RREP packet that is routed back to the original source. Route request and reply packets are also source routed. The request builds up the path traversed so far. The reply routes itself back to the source by traversing this path backward. The route carried back by the reply packet is cached at the source for future use. If any link on a source route is broken detected by the failure of an attempted data transmission over a link, route error RERR packet is generated. Route error packet is sent back toward the sender which erases all entries in the route caches along the path that contains the broken link. A new route discovery must be initiated by the source, if this route is still needed and no alternate route is found in the cache. But sometimes an alternative path is selected from already available routes if source still want to interact with destination and another path should not have that error causing node. Route Maintenance is performed by each node that originates or forwards a data packet along a source route. Each such node is responsible for confirming that the packet has been received by the next hop along the source route given in the packet; the packet is retransmitted until this confirmation of receipt is received [4].

C. Energy Efficient Position Based Routing Protocol

This approach selects a route that contains nodes having maximum available residual energy so that the energy usage among all nodes can be balanced because underutilized nodes usually have more energy than utilized nodes. The approach compares not only energy but all the parameters such as bandwidth, load and hop Count for the route selection so this may result in small, best and energy-rich routes for routing packets. Thus, ensures long network lifetime.

In this protocol the method of broadcasting the RREQ packet for Route Discovery is same as the DSR, only the difference is in the RREQ packet format. The intermediate node which receives the RREQ packet performs the following task:

1) It checks in its Route Cache for the availability of a route for the destination node, if it found then it attach that route in a RREP packet and sends back to the source node.
2) If the node finds its own address as actual destination, then the packet reached the final target.
3) Otherwise, that node appends its own address in that Route Record and its available residual energy in RREQ and rebroadcasts it to all its neighbour nodes.

All the routes are defined along with number of intermediate nodes from source to destination called hop count. Then minimum value of all parameters like hop count, bandwidth, residual energy and load is calculated. Then position count is calculated in final position table on the basis of next mentioned four rules.

A specific route is selected having minimum value of position count. That specific route will be best suitable from all aspects like having maximum available residual energy and bandwidth etc.

The best route is selected on the basis of following rule set on the basis of minimum value of all parameters [3]:

Rule 1: If the routes are of equivalent Energy (routes have same energy value) then Route with maximum available Bandwidth will be considered.

Rule 2: If the routes are of equivalent Energy and equivalent Bandwidth (same value for energy and bandwidth): then Route with minimum Load will be considered.

Rule 3: If the routes are of equivalent Energy, equivalent Bandwidth and equivalent Load (same value for energy, bandwidth, load) also then Route with minimum Hop Count will be considered.

Rule 4: If all the routes are not of equivalent Energy: Then Route with maximum Energy should be given preference.

One best route having minimum value of position count is considered and all other remaining routes are taken as backup and used later on in case of failure of transmission of data packets in first best route.

III. ENHANCE ENERGY EFFICIENT POSITION BASED DSR ROUTING PROTOCOL

The selection of best route from all available routes is dependent upon given rule set. In enhanced energy efficient position based routing protocol while selecting a route instead of using energy first rule a combination of residual energy and hop count is used. This will increase the overall energy of network and improve lifetime of network.

If a route is selected according to old rule set then hop count is considered at last. A route having maximum available residual energy is selected that have hop count is not equal to minimum available hop count. When a packet will transfer from source to destination through intermediate nodes, for transmitting packet to final node in route cache energy of every intermediate will be consumed. So as the number of intermediate nodes will increase (hop count) the energy consumed for one transmission will also increased. So it is necessary to select a route having maximum residual energy but minimum hop count .In new proposed technique while selecting a route combination of energy first rule and minimum hop count is used.

New proposed rule set is as follows:

1) If routes are of equivalent energy and equal hop count then route with maximum available bandwidth will be considered.
2) If routes are of equivalent energy, equal hop count and equal bandwidth then route with minimum load is considered.
3) If the routes are not of equivalent energy and equal hop count then route with maximum energy and minimum hop count is considered.
4) If route has equal load then select the route with maximum energy and minimum hop count.

This will save the overall energy of network. As per previous technique when a route is selected with greater hop count as compared to minimum hop count, while transmitting a packet from source to destination more energy will be consumed because every individual node will consume some energy to transmit data to next hop. But when same packet will sent through a route having minimum hop count then less energy will be consumed.

DSR is taken as basic protocol for implementing new Enhanced Energy Efficient Position Based Routing Protocol (Named as Protoname in simulation process). Simulation scenario shows energy gap between existing technique and Protoname.

IV. SIMULATION RESULTS

The simulation work for the new technique is done in NS-2. The simulation result shows that the new method is more efficient than the existing method. Table 1 shows the parameters used in simulation. In this simulation, first we set NS-2 parameters like simulation area, time, number of nodes and set initial energy, receiving energy and idle energy etc.

Table 1. Simulation Environment

Parameter	Parameter Values
Simulator	NS-2.35
Simulation Area	500*400
Number of Nodes	5
Simulation Time	150 Seconds

Antenna type	Omni directional
Interface queue type	Queue/Drop Tail
Radio-propagation model	Propagation/ Two Ray Ground
MAC type	Mac/802.11
Source type	TCP
Traffic type	CBR
Initial Energy (E)	10 joules
Transmission Power (TP)	0.5
Receiving Power (RP)	0.2
Idle Power Consumption (IPC)	0.001

The result of comparison between EEPBP and new enhance energy position based DSR routing protocol (Prortoname) is shown in Fig.1.

Simulation time is represent by X-axis and energy by Y-axis. This graph shows that the new technique consumes less energy than EEPBP. Therefore, there is less chances of network failure or packets loss in new technique as compared to EEPBP.

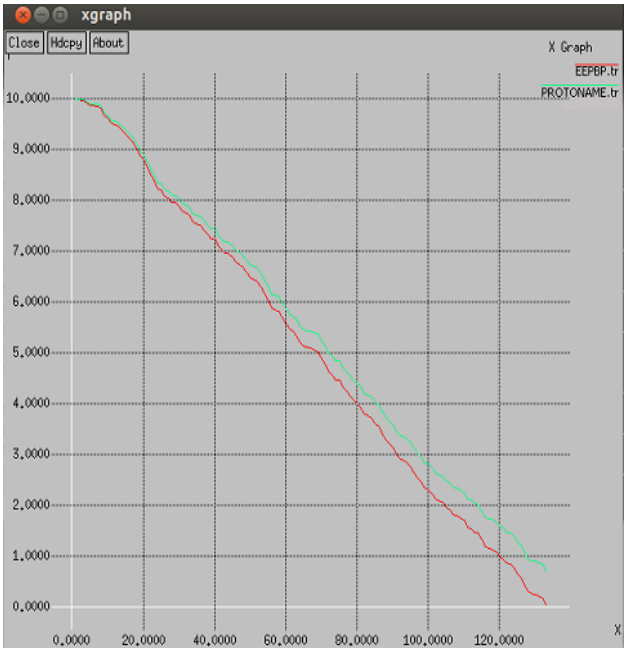

Fig.1. Simulation result of EEPBP & PROTONAME (Energy vs. Simulation Time)

V. CONCLUSIONS

In this paper, we presented an Enhanced Energy Efficient Position Based Routing Protocol (PROTONAME) for MANET with an emphasis on selecting an optimal route on the basis of combination of residual energy and hop count. If number of nodes in a route will be more, then energy consumed at each intermediate node will increase the overall energy consumption of that route. But limited battery power is also a main matter of concern in MANET. So new technique PROTONAME is helpful for selecting best route having minimum hop count, maximum residual energy, minimum load and maximum bandwidth and this increase the overall energy of network. Due to any reason if that selected optimal route stop transferring data then another alternative route is selected from final route table that is without sinking node if sender still want to communicate with destination. If not a such route is available in final route table then again RREQ packet is transmitted to all neighbour nodes as mentioned previously that find all routes to transmit data from source to destination.

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REFERENCES

[1] Supriya Srivastava, A.K. Daniel, R. Singh and J.P. Saini "Energy-Efficient Position Based Routing Protocol for Mobile Ad Hoc Networks" IEEE 2012.

[2] C.Jinshong Hwang , Ashwani Kush, Sunil Taneja " Making MANET energy Efficient" IEEE 2011.

[3] Kanika Lakhani Chaudhary , Himani Bathla " A Power Efficient technique to Avoid Packet Loss in MANET" IEEE 2011.

[4] Shipra Gautam, Rakesh Kumar "Modified Energy Saving DSR Protocol for MANETs" IJECSE.

[5] Tanu Preet Singh ,Shivani Dua ,Vikrant Das " Energy-Efficient Routing Protocols In Mobile Ad-Hoc Networks" IJARCSSE 2012.

[6] Ashish Kumar , M. Q. Rafiq , Kamal Bansal " Energy Efficient Routing Protocol Avoiding Route Breaks based on DSR" IJCA 2012.

[7] Gopinath.S, Sureshkumar.N, Vijayalakshmi.G, Natraj.N.A, Senthil.T & Prabu.P "Energy Efficient Routing Protocol for MANET" IJCSI 2012.

[8] Md Shahid Akhter, Vijay Prakash Singh "Power Aware Dynamic Source Routing Protocol To Increase Lifetime Of Mobile Ad Hoc Networks" IJIRD 2013.

[9] K. Arulanandam, Dr. B. Parthasarathy "A New Energy Level Efficiency Issues In MANET" IJRIC 2009.

[10] Jangsu Lee, Seunghwan Y, and Sungchun Kim "Energy aware Routing in Location based Ad-hoc Networks" IEEE 2010.

[11] Shivashankar, Varaprasad.G, Suresh H, Devaraju G, Jayanthi.G " Performance Metrics Evaluation of Routing Protocols in MANET" IJARCCE 2013.

[12] Ya Xu, John Heidemann, Deborah Estrin " Geography Informed Energy conservationfor Ad Hoc Routing" IEEE 2001.

[13] Ivan Stojmenovic "Position-Based Routing in Ad Hoc Networks" IEEE 2002.

[14] D. B. Johnson, D. A. Maltz, Yih Chun Hu and Jorjeta G. Jetcheva, "The Dynamic Source Routing for Mobile Ad Hoc Wireless Networks", May 17, 2007.

[15] Santashil Pal Chaudhuri and David B. Johnson, "Power Mode Scheduling for Ad Hoc Networks", IEEE International Conference on Network Protocols, 2002.

[16] Pinki Nayak, Rekha Agarwal and Seema Verma, "Effect of Mobility on Energy Consumption in DSR and AODV protocols in Mobile Ad hoc Networks", Journal of Computer Science and Engineering, Vol. 9, Issue 2, PP: 25-29, Oct. 2011.

[17] Sunil Tanejaa, Ashwani Kushb, Amandeep Makkarc, and Bharat Bhushand, "Power Management in Mobile Adhoc Network" International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies, Vol. 2, No. 2, pp.45-53, 2011.

