Research Paper

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Powermac: A New Protocol Design for Location Based Ad-Hoc Networks

Engineering

KEYWORDS :

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ABSTRACT

A mobile ad hoc network (MANET) is one consisting of a set of mobile hosts which can operate independently without infrastructure base stations. Power saving is a critical issue for MANET since most mobile hosts will be operated by battery powers. We can apply power conservation methods in all layers; but most of the power control mechanisms are working in MAC layer.

Media access control is an essential part of the wireless communication stack and it has obtained intensive research attention. In this paper I will try to design a MAC protocol for reducing the power consumed by each and every node. This is achieved by position based routing with the help of GPS system of the nodes.

I. Introduction

The world is becoming more *wireless* as technologies have given us lot of options in communication [1]. From the time of inception of radio receivers or transceivers for use in wireless telegraphy early on; and now the term *wireless* is used to describe technologies such as the cellular networks and wireless sensor [2] network and Internet. Wireless has its own limitations like limited bandwidth and some other constraints as compared to physical guided media but it is the only way to do *mobile communication*. Power conservation is a major challenge in wireless networks [3]. In order to facilitate untethered communication, most wireless network devices are portable and battery- powered and thus operates on an extremely constrained energy budget. However, progress in battery technology shows that only small improvements in battery capacity can be expected in the near future. Furthermore, since recharging or replacing batteries is costly or, under some circumstance, impossible, it is desirable to keep the energy dissipation level of devices as low as possible.

A mobile ad hoc network is a collection of two or more nodes equipped with wireless communications and networking capabilities without central network control, i.e. an infrastructureless mobile network. Energy-efficient design in MANETs [4] is more important and challenging than with other wireless networks due to following reasons.

At the wireless interface, energy consumption in idle mode is only slightly less than transmit mode and almost equal to receive mode. Many protocols have been proposed to deal with this challenge.

II. IEEE 802.11 background

There is several power saving protocols created for wireless communication by IEEE 802.11 committee. Basically they are divided into Topology based routing protocols and Position based routing protocols.

A. Topology Based Routing Protocols in Manet

There are again sub types of Topology based routing protocols as Proactive routing protocols, Reactive routing protocols and Hybrid protocol. Proactive protocolas themselvs search for route and update the route on periodic basis and Reactive protocols does the same only if route is required i.e. if route is demanded. The examples of reactive protocol is AODV and DSR[5]. Examples of proactive protocol is OLSR and DSDV. Hybrid protoocol is the combination of both proactive and reactve protocols. ZRP is the example of Hybrid protocol.

B. Position Based Routing Protocols In Manet

This type of protocols comes with some additional information about the devises i.e. their geographical location. Mobile nodes use some location system like GPS or any other to locate Mobile nodes. Mobile nodes preserve position information with the help of location system and to find out route. Position based routing protocol do not require to maintain route information in table nor it require to update information in routing table. It does all route searching with the help of location service and some kind of forwarding strategy. The biggest advantage of position based protocol is that you can send packets to the particular location for restricted area known as Geo-casting. LAR (Location Aided Routing) and DREAM (Distance Routing Algorithm for Mobility) are the example of position based routing protocol [5].

III. related work

From its inception MANET is a centre of research in wireless technology. Most of the research work has been done in the field of power saving as it is a critical topic MANET.

Most of the existing power control MAC protocols use the maximum power to send the RTS and CTS packets and minimum power for the DATA and ACK packets. I consider these schemes as the BASIC power control protocol. The protocol discussed in [6], The PCMA protocol, allows different nodes to send packets with different transmission power levels. PCMA uses the busy tones instead of RTS-CTS scheme to avoid the hidden terminal problem. If a node wants to transmit a packet, it senses the channel for busy tones from other nodes. The strength of busy tones received by that node is used to determine the highest power level with which a node can send without interfering other transmissions. Some principles for the design of a power control MAC protocol is discussed in [7]. Different factors that affecting the power control are also discussed in this paper.

Due to asymmetric links, there may be chance for collisions at transmitter and receiver. The protocol discussed in [7], ALCA reduce it by conveying the CTDI through physical duration of carriers that transport RTS/CTS frames. ALCA provides a discrete se of n different carrier durations for RTS and CTS frames. Terminals located in carrier sensing zone use the carrier duration information to extract CTDI and hence avoid collision. In the PCM protocol [8], the authors make some modifications in the basic power control protocol. Here source and destination node transmit the RTS and CTS using maximum power. Nodes in the carrier sensing zone set their NAV for EIFS duration when they sense the channel busy and cannot decode it correctly. The source node will send the DATA using the required power only.

To avoid the collision with the ACK, the source node will transmit DATA at maximum power periodically for enough time F-PCM protocol have used the fragmentation technique. A large DATA packet is fragmented into several small fragments and the ACK packet corresponding to each fragment is transmitted at maximum power. For each fragment transmission, maximum power for duration at the beginning of fragment trans-mission thus reduces collision at the sender. ACK for each fragment transmitted with maximum power will reduces collision at receiver.

A power controlled dual channel (PCDC) MAC protocol proposed in [9] allows the MAC layer to indirectly influence the routing decision at the network layer by controlling the power level of the broadcasted RREQ packets to produce power efficient routes. PCDC uses the signal strength and the direction of arrival of the overheard RTS or CTS packets to build a power-efficient network topology. PCDC enables simultaneous interference-limited transmissions to take place in the vicinity of a receiver by allowing a receiver-specific, dynamically computed interference margin.

In [10], the authors have proposed a novel MAC scheme with power control in wireless ad hoc networks. They divide the total channel into three parts: main channel for RTS and data packets, transmitter busy tone channel and receiver busy tone channel. Other two channels are separated with enough spectral intervals.

All of the above protocols uses topology based routing to search routes. Lot of research has been done in area of position based routing. Following are few researches done in position based routing.

In [11], LBPAR is proposed approach to provide QoS with the help location aware environment. Mathematical equations have been provided by author to locate next hop.

In [12], the paper presents new Global Positioning System based route discovery algorithms for on demand routing in MANET called position based selective flooding.

In [13], author proposes an energy aware reactive approach by introducing energy and distance based threshold criteria. Cross layer interaction is exploited the performance of physical layer which leads to significant improvement in the energy efficiency of network.

In [14], A new GPS based protocol suggested by author called LACBER: A new Location Aided Routing Protocol for GPS Scarce MANET.

In [15], another new approach ILCRP: Improved Location Cluster based Routing Protocol which is GPS enabled MANET has been evaluated for performance metrics such as end to end delay, control overhead and packet delivery ratio.

IV. The Proposed Protocol:

In this paper we have proposed a system which is a kind of Hybrid MANET protocol; which uses functionality of both topology based routing and position based routing protocols. For topology based on on-demand routing search we are using existing 802.11 protocols like AODV and for position based routing LAR protocol. We are proposing a new design for 802.11 MANET protocol which is hybrid of features from AODV and LAR protocols and some extra information of NAV (Network Allocation Vector) value of mobile nodes.

Lower NAV value of a forwarding intermediate node will result in to less delay in packet forwarding and loss of packet due to TTL field and resending of packets will save power of mobile nodes.

AODV chooses root on demand and searches root up to TTL field is alive and LAR has location table for request zone and Expected zone to forward the packet. By combining these features we are proposing new protocol called 'PowerMac' protocol.

Following two algorithms are the basis of PowerMac protocol. First with the help of GPS system we are creating table of geographic location for mobile nodes and second is algorithm for searching route in MANET with the help of proposed PowerMac protocol.

1. *Routing Table Algorithm flowchart:*

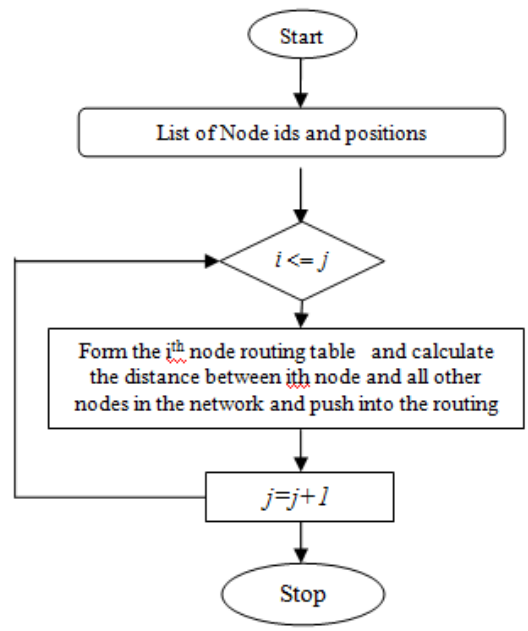

Fig: Flowchart for Routing Table Algorithm.

Where; i= total no. of node ids

J= current node

The protocol uses GPS system inbuilt in mobile nodes to know the location of the device in MANET. To build routing table of MANET, device GPS system consumes much amount of less energy as compared to topology based algorithm as it do not require any route updating frequently.

2. *Routing Search Algorithm:*

The Proposed Routing Algorithm is used to find the route from the source node to destination node.

1. Source Node, Destination Node, coverage area and Threshold count are the inputs.
2. First the source node finds the set of nodes which are within the range which acts like a neighbor set and send a REQ packets
3. The neighbors will send information about the CTS by embedding the NAV value.
4. If the neighbors have the destination node then the process will be stopped.
5. The next forward node that will be picked will have the lowest NAV value.
6. TTL period is decremented.
7. If the TTL period does not expire and the destination has

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not reached then step2 to step 6 is repeated until destination is reached or the TTL expires.

8. If TTL expires then the next forward node is chosen among the neighbor nodes in such a way that it is very much closer to destination.
9. Repeat the process until the destination is reached.

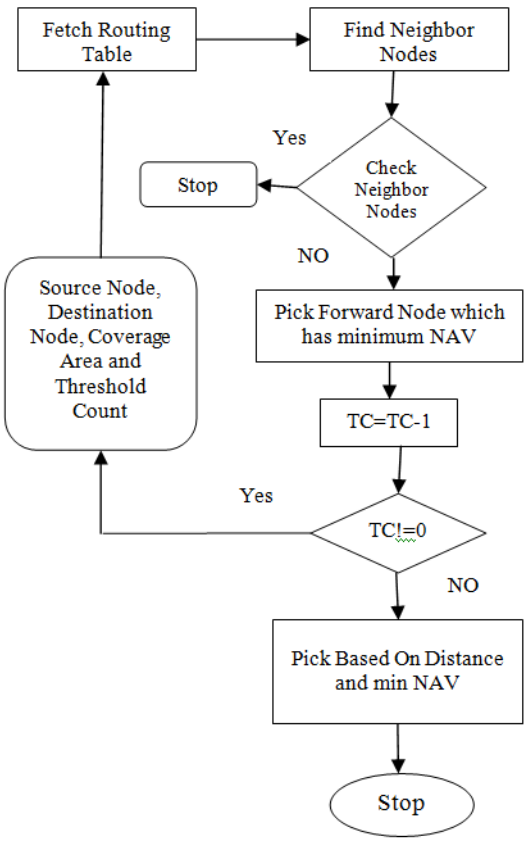


Fig1: Flowchart for Routing Search Algorithm.

V. EVALUATION OF PROPOSED PROTOCOL:

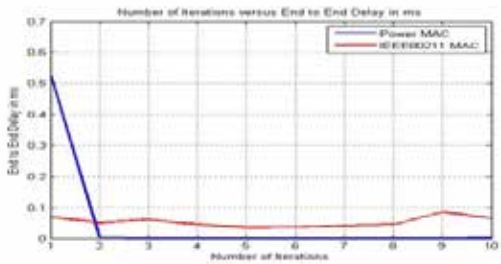
We have evaluated proposed protocol with the help of MATLAB network simulation. In the current approach system will require number of inputs for IEEE 802.11 MAC such as total number of nodes in MANET area, Different packets time for MAC for RTS, CTS, DATA and ACK. The VCS schema inter-frame spaces time; in this case it's SIFS. Source node, Destination node and Coverage area for wireless node. The system uses Omni directional antennas to communicate through radio waves. Simulation includes DCF (Distributed Coordination Function) of 802.11 to model contention of nodes with wireless medium. The simulation is run for 10 iterations with 50 nodes in 50x50 meter of area.

After giving all the inputs system will generate series of graphs giving all necessary information as below.

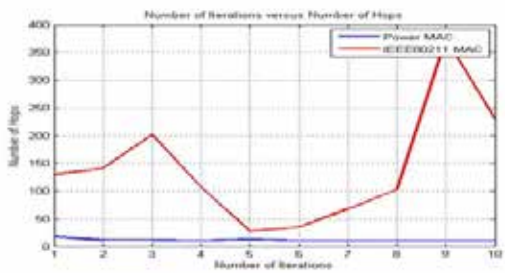
Parameter Name	Parameter Value
No of Nodes	50
RTS packet time in ms	100
CTS packet time in ms	200
DATA packet time in ms	300
ACK packet time in ms	50
SIFS packet time in ms	150
Source Node	38
Destination Node	30
Coverage Area	30
Time To Live	4

TABLE 1: IEEE802.11 MAC ALGORITHM INPUTs

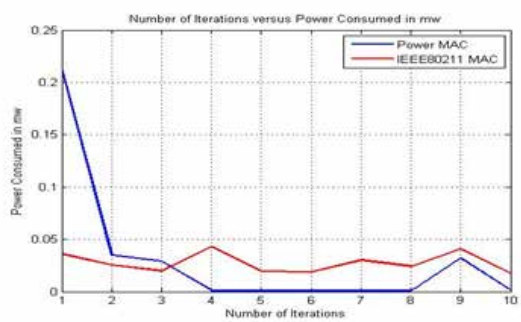
The Inputs will provide us result graph which compares existing IEEE 802.11 protocol for MANET with Proposed PowerMac protocol.



Graph 1: Number of iteration versus End to End delay.



Graph 2: Number of iteration versus number of hops.



Graph 3: Number of iteration versus Power consumed MANET.

After passing all inputs we will get 3 graphs showing advantage of proposed protocol over existing system. One can clearly distinguish that; proposed protocol for power on serving at each node is working better than existing 802.11 MAC protocol.

Graph 1 shows the sudden decrease in RDT time over 802.11 MAC. Graph 2 gives us the number of hops used for each iteration by the system for 802.11 MAC and proposed PowerMac protocol. Similarly we can understand from Graph 3 that due to selection of minimum NAV node there is a less amount of power is consumed by each node and also the overall energy required by route discovery in a MANET area is also less as compared to the current 802.11 MAC approach.

VI. CONCLUSION:

In this paper we have designed a power control MAC protocol for Mobile Ad Hoc Networks. I considered a network environment where every node participate in data transmission and applied a power control protocol in that environment. The main goal of this work was to understand the different power conservation techniques in MANET and propose a protocol to achieve this goal.

Here I have proposed a power control MAC protocol for mobile

ad hoc networks which reduce the power consumption as it hits less number of hops in MANET to deliver packet from source to destination. We have modified the 802.11 MAC protocol AODV & LAR to achieve our goal with the help of GPS based location system.

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