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Power Aware Reliable Routing (PARR) In Mobile Ad-HOC Network

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Abstract: ***A Mobile Ad-hoc Network (MANET) is a self configuring network composed of mobile nodes without any fixed infrastructure. A very important and necessary issue for mobile ad-hoc networks is to find the route between source and destination due to the dynamic topology of the network. Power failure and the energy consumption of the nodes is a critical factor in the operation of a mobile ad hoc network. More efficient algorithm is proposed here that is PARR (Power Aware Reliable Routing), which tries to maximize the lifetime of network by minimizing the power consumption during the route establishment from source to destination. The proposed algorithm is incorporated with the route discovery phase of AODV (Ad-hoc On Demand Distance Vector Routing). The combination of AODV and PARR offers efficient and reliable routing mechanism. The simulation results illustrate that PARR achieves good performance in terms of end-to-end delay and data throughput, packet delivery ratio, packet drop.***

Keywords: MANET, Ad-Hoc network, AODV, routing, NS2 simulator.

1. Introduction

Communication has become very important for exchanging information between people from and to anywhere at any time. We have different types of networks for communication. They are wired and wireless. Our concentration is on wireless networks. Wireless networks are classified into four different types. The first and foremost class is cellular networks. Another class of wireless networks is wireless local area networks (WLANs). These networks are truly and entirely wireless, but require only single-hop transmission. Typical wireless LANs involves laptops with Bluetooth. The third class consists of networks that utilize satellite links. The fourth and most interesting class is ad hoc networks.

The wireless network can be broadly classified into two types: Infrastructured and Infrastructure less [1]. In Infrastructured wireless networks, the base stations are fixed and the node may go out of the range of a base station while it is in mobile and gets into the range of another base station. In Infrastructure less or Ad Hoc wireless network, the mobile node can move while communicating, there are no fixed base stations and all the nodes in the network act as routers. The mobile nodes in the Ad Hoc network dynamically establish routing among themselves to form their own network and there is no predefined infrastructure.

The nodes in ad hoc network have routing capabilities and forward traffic for other communicating parties that are not within each other's transmission range. They are characterized by lower computing and energy resources. Therefore, ad hoc routing is challenged by power and bandwidth constraints, as well as by frequent changes in topology, to which it must adapt and converge quickly.

The one of the most important objectives of MANET routing protocol is to maximize energy efficiency, since nodes in MANET depend on limited energy resources. Devices used in the ad hoc wireless networks in most cases require portability and hence they also have size and weight constraints along with the restrictions on the power source. Increasing the battery power may make the nodes bulky and less portable. The energy efficiency remains an important design consideration for these networks. Routing is the process of establishing path and forwarding packets from source node to destination node. It consists of two steps, route selection for various source-sink pairs and delivery of data packets to the correct destination.

Objectives of MANET Routing Protocols:
- To maximize network throughput
- To maximize network lifetime
- To minimize delay.

The network throughput is usually measured by packet delivery ratio while the most significant contribution to energy consumption is measured by routing overhead which is the number or size of routing control packets. A major challenge that a routing protocol designed for ad hoc wireless networks faces is resource constraints.

2. Classification of Routing Protocols

Many protocols have been proposed for MANETs. These protocols can be mainly divided into two categories.
- Reactive/On-demand Routing Protocols
- Proactive/Table-driven Routing Protocols

2.1 Reactive/On-demand Routing Protocol

In reactive or On-demand protocols, the routing information is maintained only for active routes. That is, the routes are determined and maintained by a node only when it wants to send data to a particular destination. A route search is needed for every unknown destination. Some reactive protocols are Ad hoc On-Demand Distance Vector (AODV), temporally Ordered Routing Algorithm (TORA) and Dynamic Source Routing (DSR).

2.2 Proactive/Table-driven Routing Protocols

In proactive or table-driven routing protocols, the routing tables are used. Each node maintains up-to-date routing information to every other node in the network in the routing tables some highly used proactive routing protocols are Optimized Link State Routing (OLSR), Destination Sequenced Distance Vector (DSDV) and Wireless Routing Protocol (WRP) [2].

3. Experimental Setup

Scenarios have been setup for 50 nodes in an area of 1670m*970m in figure 1 which is visualized the source node sends the packets with the help of intermediate nodes having highest energy level [3]. The proposed scheme is simulated using network simulator NS-2 [4] with version NS-2.34.

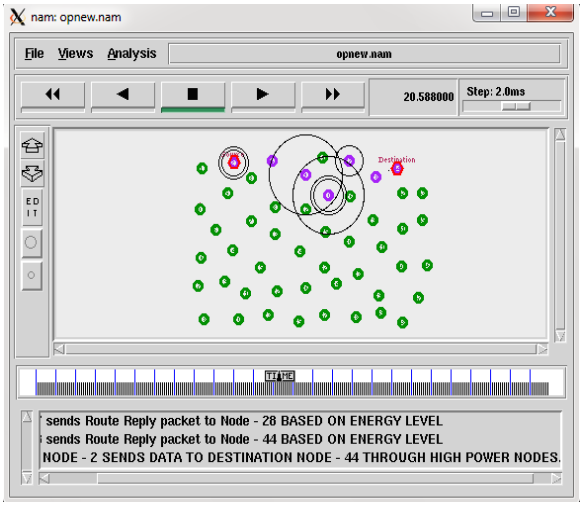

Figure 1: A snapshot of the simulation topology in NAM for 50 mobile nodes

3.1 Flowchart

Step 1: A signaling packet (RREQ/RREP) is received by node (A) from Node (H) looking for a Path for destination (N).
Step 2: Node (A) extracts target (S/D) from signaling packet (If the signaling packet is a RREQ Then the target is the source, if the signaling packet is a RREP, then the target is the Destination).
Step 3: Node (A) searches in routing table for another node (H) having a fresh route to the Target.
Step 4: If the node (H) is not found or if the route is not fresh enough, an entry for the target Node is added to the routing table of node (A).
Step 5: If the node (H) is found in the routing table, and has a route to the target the following should be verified:

a) How many times node (A) has used node (H) as a next hop (R1).
b) How many times node (A) has used node (N) as a next hop (R2).
c) Compare EXm and EM.
d) Compare EXm > ETH.
e) Compare R1 > R2.
f) Update Routing table.
g) Add node (A)'s cost to the signaling packet & forward it to the target node.

3.2 Simulation Parameter

The simulation parameters are listed in Table 1

Table 1: Simulation parameters

Channel type	*Channel/Wireless channel*
Network interface type	Phy/WirelessPhy
MAC Type	Mac /802.11
Interface queue Type	CMUPriQueue
Link Layer Type	LL
Antenna	Antenna/Omni Antenna
Maximum packet in ifq	300

4. Practical Output

The objective of this paper is establishment of route in MANET using reactive protocol "Ad-hoc on demand distance vector routing" (AODV). Addressing various problems due to limited power in the mobile nodes. Combination of energy on every path contributing node (PARR) with AODV to decide energy efficient routing.

4.1 Throughput

Throughput is the number of packet that is passing through the channel in a particular unit of time. This performance metric show the total number of packets that have been successfully delivered from source node to destination node and it can be improved with increasing node density. Figure 2 shows that the performance of PARR when the time is varies and the node speed is constant. Then see that throughput of PARR is increased.

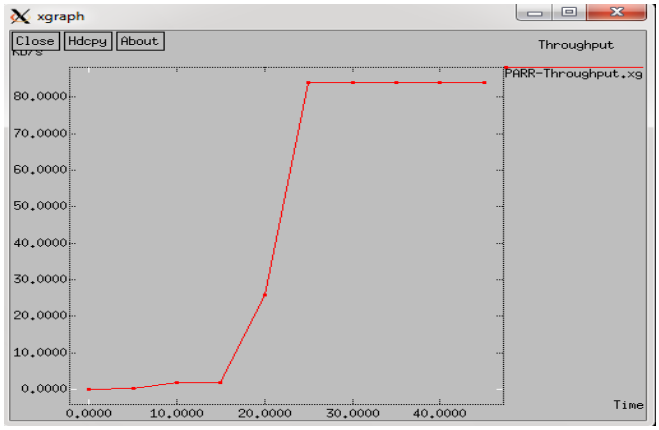

Figure 2: Transmission throughput (UDP)

4.2 The average end to end Delay

End-to-End delay is the average overall delay for a data packet to traverse from a source node to a destination node. It is the measure of time elapsed between data packet origination from the source and successful receipt by receiver. Figure 3 shows that the average End-to-End delay of PARR continuously decreased in different number of nodes.

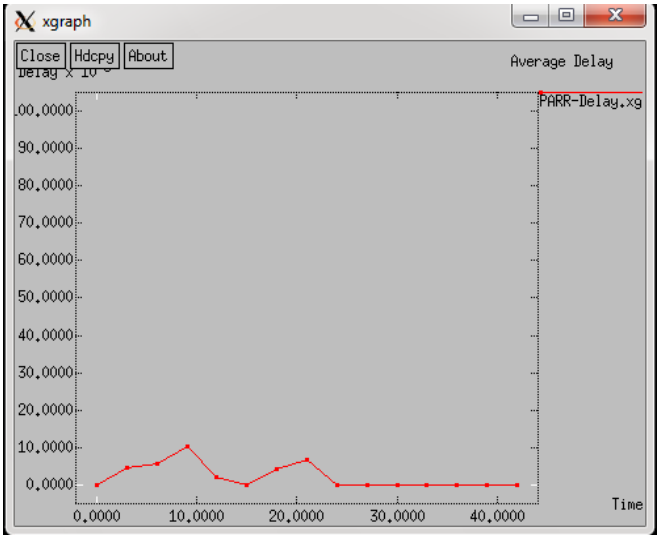

Figure 3 Delay graph between Send Time Vs Delay

4.3 Packet Delivery Ratio(PDR)

PDR is defined as a percentage of data packets delivered at receiver end compared to that of number of data packets sent for that node. It is used to measure the reliability, effectiveness and efficiency of routing protocols. Generally the reliability, effectiveness and efficiency of routing protocols can be improved by improving the PDR. Figure 4 Initially packet fraction was very less when time was zero but later on as time increased performance of PARR in much better.

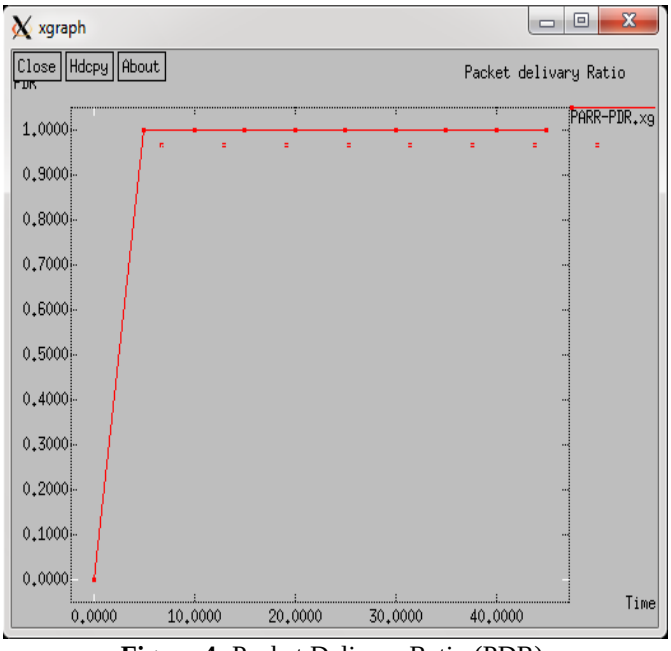

Figure 4: Packet Delivery Ratio (PDR)

4.4 Energy Model

Energy consumption of a node after time t is calculated

$$Ec(t) = Nt * \alpha + Nr * \beta$$

Where Ec(t) = energy consumed by a node after time t. Nt, = no. of packets transmitted by the node after time t. Nr = no. of packets received by the node after time t. α and β are constant factors having a value between 0 and 1. If E is the initial energy of a node, the remaining energy Er (t) of a node at time t

$$Er(t) = E - Ec(t)$$

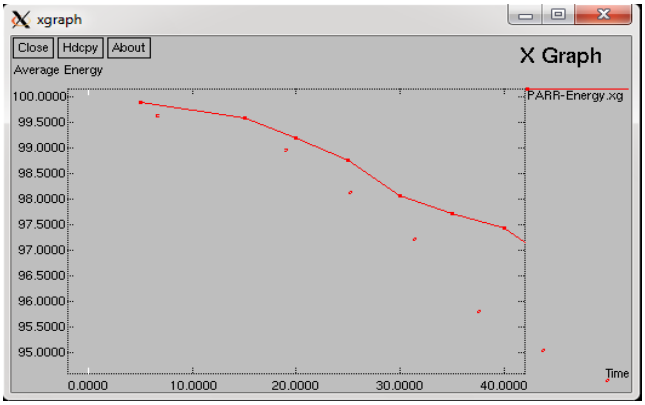

Figure 5: Average energy

5. Conclusion

Energy efficiency is one of the main problems in a mobile ad hoc network, especially designing a routing protocol. Simulation result shows that the proposed scheme PARR is delivering more number of packets and increase in throughput. Average End-to-End delay is continuously decreased in different number of nodes. Hence increases the network lifetime and minimize the power consumption during the source to destination route establishment.

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