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An Approach to Energy efficiency and better Throughput for Improved AOMDV

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Abstract :

The increase in availability and popularity of mobile wireless devices has lead researchers to develop a wide variety of Mobile Ad-hoc Networking (MANET) protocols to exploit the unique communication opportunities presented by these devices. The increase in availability and popularity of mobile wireless devices has lead researchers to develop a wide variety of Mobile Ad-hoc Networking (MANET) protocols to exploit the unique communication opportunities presented by these devices. The performance of AODV and AOMDV routing protocols are compared with different performance metrics. We define an energy factor as that we will use the products of the energy factors of all the nodes along different paths as the selection criteria. The energy factor informs about the status of energy then here we evaluate the performance of AOMDV[2]. Since the nodes have limited battery resources and multi-hop routes are used over a changing network environment due to behavior of the node mobility, it requires energy aware efficient routing protocols to limit the power consumption, make longer the battery life time and to improve the robustness of the system[3]. The protocols are implemented using Network Simulator (NS2).

Keywords: Energy efficiency, Mobile ad-hoc network, Throughput, AOMDV

I. INTRODUCTION

Mobile Ad Hoc Networks (MANET) has several transmission protocols, one of which is the UDP transmission protocol. The AOMDV routing protocol for distributing route request packets (RREQ) from source to destination establishes several paths at both the intermediate and destination nodes. Many route reply packets (RREP) traverse this path to return to the source from destination and also intermediate nodes[4].

Mobile Ad hoc Networks is a robust infrastructure less wireless network having mobile nodes. A MANET can be created either by mobile nodes or by both static and dynamic mobile nodes. A mobile node has arbitrarily associated with each other forming uniformed topologies[3]. In this paper we find out an energy efficient routing protocol with limit power consumption of mobile nodes in the network in order to extend the network life time. The main purpose of this paper is to investigate AOMDV protocol for ways it could be improved and it has done by measuring energy with respect to varying network size. We proposed a new routing algorithm which is based on node residual energy and it is applied on AOMDV[3].

Ad hoc networks are crucial in the evolution of wireless networks, as they are composed of mobile nodes which communicate over wireless links without central control. The traditional wireless and mobile communication problems like bandwidth optimization, transmission quality enhancement and power control are directly inherited by ad-hoc wireless networks. Many routing protocols have been developed during the last years to increase the lifetime of a route and in turn the lifetime of the network. One of these developments is multipath routing protocols. Multipath routing protocols enable the source node to choose the best route among many routes during a single route discovery process. This process in multipath routing will decrease the number of route discovery processes since there are backup routes already available and in case one route fails will reduce the end-to-end delay, energy consumption and the network lifetime[6].

To summarize, this paper is organized in 6 sections where Section 2 describes Survey of Routing Protocols in MANET. In Section 3 describes Background Theory . The performance evaluations of our method require scenario of simulation parameters setup is presented in Section 4. In Section 5 describes the simulation analysis description & results using NS2. Finally, In Section 6 describes conclusion and future plan.

II. LITERATURE SURVEY

Research by T. Sivaraman, Dr. E. Karthikeyan [5] entitled "Maximum Minimal Bandwidth Aware Multipath Routing protocol (BWA-AOMDV) in MANET" related to carrying out the AOMDV routing protocol simulation, with the presence of energy that can find out how much energy is used in the simulation, the output parameters are also displayed graphically.

Baolin Sun, Chao Gui, Pengyuan Liu [7] a multipath routing optimization algorithm in MANET based on genetic algorithm. The main idea behind the algorithm is to find the node with minimum remaining energy in each route when selecting the routes. It can balance energy consumed by individual nodes and enhances the entire network's lifetime and energy variation.

The proposal by [10] has 3 phases: RREQ (Route Request) phase, RERR (Route Errors) phase and local repair phase. Power related function occurs with RREP (Route Reply) only because in the beginning all the nodes will be in fresh mode so there is a full power to find the route and send the request message and also all the nodes which are not participating in route request go to sleep mode.

There is also another research by Nitya Thagele, Priyanka Tripathi [9] entitled "A Critical Review of AODV, DSDV and DSR Protocol Presence of Malicious Nodes in Mobile Ad-Hoc Networks" related to performed AODV, DSDV, and DSR routing protocols with the influence of malicious nodes, output parameters are also displayed with a graph.

Prasanta Kumar Manohari, Niranjan K proposed a protocol named EAOMDV. It depends on AOMDV but choose routes between sender and destination based on RCF.

This section represents the work that has done in this field. This paper [2] presents a congestion adaptive multipath routing protocol to increase the throughput and avoid congestion in MANETs. In this approach when the average load of an existing link increases beyond a defined threshold and the available bandwidth and residual battery energy decreases below a defined threshold, traffic is distributed over fail-safe multiple routes to reduce the traffic load on a congested link.

The proposal by [2] has 3 phases: RREQ (Route Request) phase, RERR (Route Errors) phase and local repair phase. Power related function occurs with RREP (Route Reply) only because in the beginning all the nodes will be in fresh mode so there is a full power to find the route and send the request message and also all the nodes which are not participating in route request go to sleep mode.

The factors that affect the choice of the optimum route are:

- The remaining energy functions for each node
- The distance functions of the links connecting the neighboring nodes
- Energy consumption of the nodes
- Communication delay of the nodes

Rajaram & Sugesh addressed the issues of energy consumption and path distance from the source to the destination in MANET. They proposed a multipath routing protocol based on AOMDV called as, Power Aware Ad-hoc On Demand Multipath Distance Vector (PAAOMDV). The proposed protocol updates the routing table with the corresponding energy of the mobile nodes. As this was a multipath protocol, it shifts the route without further overhead, delay and loss of packets[8].

III. BACKGROUND & RELATED WORK

A. AODV Routing Protocol

AODV stands for Ad-hoc On-demand Distance Vector which self-adapts quickly and dynamically for different link conditions of the network. Figure 1 shows AODV routing table format. New route between two nodes will be discovered with the use of Route Request (RREQ) control message. Route Reply (RREP) confirms the path, and is received by sender after the predetermined amount of time once the RREQ's have been spread over the network. If a particular RREQ has been already spread over the network, and if it is broadcasted again then such RREQ will be discarded. If fresh requisition is received by any node which does not contain a strong route to the receiver, then RREQ hop-count is increased and route requisition is forwarded to the neighbors. It finds out routes only when a node needs to deliver data over the network. AODV protocols have the ability of both unicast and multicast routing before transmitting the data packet by source node, AODV creates a link from source node to destination node by the assist of routing table which is maintained by every intermediate node present in the network.

B. Route Discovery & Maintenance

Route discovery and route maintenance involve finding multiple routes from a source to a destination node. Multipath routing protocols can try to discover the link-disjoint, node-disjoint or non-disjoint routes. AOMDV's primary idea is in discovering multiple routes during the process of route discovery.

AOMDV utilizes three control packets: RREQ; RREP; and RERR. Initially, when a source node is required to transmit data packets to a specific destination, the source node broadcasts a RREQ [4]. Because the RREQs are flooded network-wide, several copies of the same RREQ may be received by a node. In the AOMDV, all duplicate copies undergo an examination to determine the potential alternate reverse path.

Protocols like AODV, AOMDV and improved AOMDV (FF-AOMDV) are compared. The algorithm and working principles for AODV and AOMDV routing protocol implementation are as stated below.

Algorithm for AODV routing protocol:

Step 1 : Declaration of source and destination node.

Step 2 : every RREQ.

Step 3 : Now it find next node.

Step 4 : Then process every RREQ

Step 5 : It transmit every packet with AOMDV.

Step 6 : Select node with higher throughput.

Step 7 : If node found with same throughput, Packets will be transmitted according timestamp value otherwise, Continue until the destination is found.

Step 8 : If both node with same throughput then, packets transmitted according to their timestamp value otherwise, packet from higher energy will be transmitted first.

Step 9 : Packets successfully received by the destination.

Now by using energy consumption rate between two time slot instead of just taking the remaining energy of the node at a particular time, the algorithm is modified. Compared the energy consumption rate of the nodes in the route discovery, route reply, and route maintenance processes.

IV SIMULATION AND ANALYSIS

The performance of AODV and AOMDV protocols are compared based on the parameters such as number of packets sent, packets received, Packet Delay Rate (PDR), throughput, average E2E delay and normalized routing overheads are formulated

PROBLEM STATEMENT : Multipath protocol are provided the alternative path from source to destination by the load in network distributed but only multipath routing are not essential for load distribution. if the load are not distributed properly then in that case the limited life of node i.e. energy are wasted for retransmission then the proposer load balancing and efficient energy consumption are the main issue in this research[2].

The tool used for implementing the project is NS2. I have installed ns2. 35 in ubuntu 1.04. Energy consumption and network lifetime is calculated by varying node speed, simulation time, and data rate. As the energy conservation and the network lifetime is a critical issue in the MANET, we take the amount of energy left at neighbor nodes into consideration when selecting one route from multiple paths route. To achieve this, each node needs to report its energy level to its neighbors. The current energy level is normalized to the

maximum battery capacity and leveled up to 100. maximum battery capacity and leveled up to 100. The multi-path selection thus takes all the next hops from available paths, and checks the associated normalized remaining energy levels known to the node. The next hop with the highest energy level is selected. It is possible that the energy information collected at a node is not accurate.

Energy consumption: It refers to the amount of energy that is spent by the network nodes within the simulation time. It is obtained by calculating each node's energy level at the end of the simulation, factoring in the initial energy of each one . The following formula will produce the value for energy consumption:

$$\text{Energy Consumption} = \sum_{i=1}^n (\text{int}(i) - \text{ene}(i))$$

Packet delivery ratio: It means the ratio of the data packets that has to be delivered to the destination node to the data packets that were generated by the source. The performance metrics shows that the routing protocols qualify in its delivery of data packets from source to destination . The ratio will be higher; Performance of the routing protocol is improved better. PDR is calculated using the below formula:

$$\text{PDR} = \frac{\text{Number of Packet received}}{\text{Number of Packet sent}} * 100$$

End-to-End delay: It refers to the average time taken by data packets in successfully transmitting messages across the network from source to destination . It includes different types of delays, like queuing at interface queue; retransmission delays; and buffering during the time of route discovery process. Stated below is the formula to calculate the E2E delay:

$$\text{E2E} = \sum_{i=1}^n (R_i - S_i)$$

Table 1 Simulation Parameters

Parameters	Value	Unit
Operating system	Ubuntu	
Simulator	NS 2.31	
Number of nodes	20	Nodes
Routing Protocol	AOMDV	Channel
Packet size	512 bytes	
Other protocols	AODV	Protocol
Type of data traffic(TCP & UDP)	CBR(3pkts/s)	
Sleep Energy Consumption	007.0 joules	Watts
Simulation time	100 sec.	
Dimension of simulated area	800m×600m	

Table 2 Performance evaluation

Metrics	AOMDV protocol
Network size	40 nodes
Number of packets sent	1045 bytes
Number of packets received	1031 bytes
PDR	98.79%
Average throughput	120.70 kbps
Average E2E delay	154 ms

Performance metrics

We use four metrics to evaluate the performance of the routing protocols, in which the first two metrics are the most important for best effort route and transmit protocols.

- 1) *Packet delivery ratio*: or packet throughput, the fraction of the data packets delivered to destination nodes to those sent by source nodes.
- 2) *Average end-to-end latency*: the average time taken by the data packets from sources to destinations, including buffer delays during a route discovery, queuing delays at interface queues, retransmission delays at MAC layer and propagation time.
- 4) *Throughput*: Number of packets sends or receives in per unit of time in network.

Simulation

At this stage, the authors conducted a simulation using the Ubuntu operating system 16.04. The simulation is done with NS2 (Network Simulation 2) version 2.35 all-in-one application that is used as a compiler syntax that has been created in the .tcl format file containing input node and command settings that are carried out during the simulation. When the simulation of the .tcl format file is complete, the simulation will output files of the type .nam and .tr. The NAM (Network Animator) application will run a .nam file to run the animation during the simulation.

Verification and Validation

At this stage, the simulation will check the data and assess whether the results of the simulation can be used for the next stage. At this stage, the simulation configuration is tested by checking the simulation configuration, whether it is by what was determined in the previous stage. Verification is done. using the NS2 application on the Ubuntu operating system, NS2 is used to compile the .tcl file that has been created.

V. Conclusion and Future work

In this research, the proposed protocols are tested for different performance metrics using NS2 simulator. Simulation results showed that the AOMDV routing protocol outperforms AODV protocol under majority of network parameters. The issue with the energy consumption in AOMDV is solved with design of improved AOMDV protocol. These scenarios were tested by thres performance metrics

(packet delivery ratio, throughput, end-to-end delay). In this research, the proposed protocols are simulated using NS-2 with respect to simulation time. These scenarios were tested for different performance metrics.

As a future work, there are several scenarios that could be implemented with this study to enhance the energy consumption and network lifetime. Further the same idea can be applied to the nodes with mobility. The fitness function can be applied to cluster based network, so that the performance of the network can further be enhanced. Along with the fitness parameters considered in the work, the bandwidth can be added as a new fitness parameter. The fitness function can be applied to other protocols in MANET and their performance can be analyzed.

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