A Performance Enhancement of an Optimized Power Reactive Routing based on AODV Protocol for Mobile AD-HOC Network

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***Abstract*—Mobile Ad-hoc network is a collection of two or more node equipped with wireless communication and it's a low power device for data transmission. Many Proactive based power aware routing protocol was implemented by many researchers. In this paper, we described an optimized power reactive routing based AODV protocol by using concept of cognitive function. It ensures data packet is transferred in the shortest and most reliable mode. In order to that improve the scalability of network management and provide a way of transmission with an energy efficient manner in the path of every node. We propose a novel way of transmission with stability using a technique called Optimized Power Reactive Routing (OPRR) and for more splendid performances. This proposed protocol avoids new route discovery process in AODV with low power consumption and maintain the stability of node and to improve scalability of the network. Preliminary the simulation using GloMoSim simulator were provided and the result shows the performance enhancements of the Optimized Power Reactive Routing.**

***Keywords*—MANET, Cognitive routing, AODV protocol, Power Aware Routing protocol, Stability, reliability, Scalability, GloMoSim Simulator.**

I. INTRODUCTION

In wireless networks, networking grows rapidly because of the increase in the interest for mobility and freedom from limitation. Since the wireless network create many problems. So the successful connectivity is still challenge in the network goal and many protocols have been proposed for overcome this problem. Here we wish to find a reliable with adaptive and stability routing method based on future cognitive mobile Ad hoc network. Ad hoc wireless networks is the group of multi hop radio relaying and are capable of working without the support of any fixed base station, they are self organizing and adaptive[1]. Ad hoc nodes or devices should be able to detect the presence of other such devices and to perform the necessary handshaking to allow communication and sharing of information and services. The performance of Mobile Ad hoc networks (MANET) is highly depended on routing protocol. Ad Hoc On Demand Distance Vector Routing (AODV) is a popular route protocol for MANET. It uses an on-demand mechanism and discovers routes only when a source node needs them [2]. It's able to maintain routes even when the topology of the network is dynamic. AODV is well suited for MANET in that it has low processing and less memory overhead and low network utilization [3]. Additionally, AODV provides loop freedom for all routes through the use of sequence numbers.

Cognition method of mobile Ad hoc network is used to improve the network resources by discover the present network condition and then plan, decide and act on those condition [4]. The network can learn from these adaptations and use them to make future decisions, all while taking into account to achieve goal of process [5]. This paper is to investigate a new cognitive routing metrics by analyzing the node energy and stability of every node with cognitive process for providing an efficient data transfer for a long time.

Power limitation in mobile devices is a serious factor. Because of the mobility characteristic of the network, devices use battery as their power supply. In MANET each node has a limited battery power. Each node will broadcast its power consumption cost of weight to its neighbors. These weights are used to discover the path in the network for end-to-end communication.

This research is organized as follows: Section II summarizes a Power Aware Routing (PAR). In Section III and IV describes the Optimization Power Reactive Routing (OPRR) and Node management. The simulation environment and results are evaluated in section V. Finally, the conclusions are given in the last section.

II. POWER AWARE ROUTING PROTOCOL

Mobile ad hoc devices can take many different forms and some will have higher power demand than others. In power aware routing, battery life is taken as the routing metrics. The protocol selects routes that have longer over all battery life. Power aware routing advocates for minimizing the energy consumed per packet and minimizing the variances in node power levels and then maximizing the time before the network is partitioned [7,8]. Power is one of the most important design criteria for ad hoc networks as batteries provide limited working capacity to the mobile nodes. Power failure of a mobile node not only affects the node itself but also its ability to forward packets on behalf of others and hence affects the overall network lifetime. All Packets are routed through the path established by the base station. The based stations perform the tasks of tracking, routing and route maintenance. In ad-hoc networks, all these tasks are performed by the nodes themselves, in additional to their personal tasks. This causes additional drain on the batteries leading to a diminished lifetime.

Transmission and reception parameters may also impact the topology very difficult to find and maintain an optimal power aware route. Therefore it is the efficient power aware protocol is one of the most needed functions in today's ad hoc networks. Although developing battery efficient systems that have low cost and complexity, remains a critical issue. In order to facilitate communication within a mobile ad hoc network, an efficient routing protocol is required to discover routes between mobile nodes.

III. OPTIMIZED POWER REACTIVE ROUTING

The topological structure of Ad hoc network has dynamic characteristics, a power failure is predictable. Due to power loss it cause link failure then the process of data transfer is terminate. So it over all diminishes the network performances and will cost a large amount of network resources by finding a new route discovery process [9]. To resolve this problem, this paper proposes a new routing protocol is "Optimized Power Reactive Routing (OPRR)" with cognitive policy. That means that the data package could be transferred through the shortest path with more stability and reliability manner which it follows the concept of AODV protocol. There is no link breakage due to power loss because of by using back up route in source. The proposed protocol consists of two phase:

Phase 1:- (i) Finding Node Stability using Relative Mobility

In the mobility metric uses the ratio of received power levels of successive transmissions at any node from all its neighboring nodes [10]. RxPr denotes the received power level i.e. the strength of signal. Based on the ratio of RxPr between two successive "hello" messages from a neighboring node that whether that node comes closer or go far. ($RM^{rel)}$ denotes the pair wise relative mobility metric. RM^{rel} (X), at a node Y with respect to X_i(i=1,2,3…,m) is measures as:

$$RM^{rel}(X_i) = 10\log10\ New_{RxPr} / Old_{RxPr}$$

Now, a negative value of RM^{rel} denotes that corresponding nodes are moving away from each other. On the other hand, a positive value of RM^{rel} denotes that nodes are coming closer to each other. Another important consideration is to see whether a node Y is less mobile or highly mobile corresponding to its neighboring nodes for the purpose to be selected as node which is stable.

To measure that an aggregate local mobility value RM at any node Y is calculated by calculating the variance (with respect to zero) of the entire set of pair wise relative mobility values RM^{rel}(Xi), where Xi is a neighbor of Y.

$$RM(X) = var\ (RM^{rel}(X1), RM^{rel}(X2), RM^{rel}(X3)\ldots\ldots\ldots RM^{rel}(Xm))$$

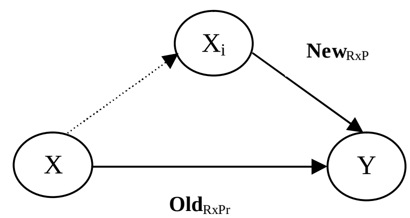

Fig. 3.1 Successive power measurement

Thus, any node can calculate the value of aggregate relative mobility metric for that node by calculating the variance (with respect to zero) relative mobility metric values with its neighboring nodes as shown in Fig 3.1. By proposing this idea it could improve the network resources with stability and reduce the burden of network caused by new route discovery process, It provide long time data transmission with in reliable and less latency.

(ii) Network initialization

In the Figure 3.2 Shown the procedure of aggregate relative mobility metric as

Step 1: All the nodes in the network exchange 'Hello' messages among their Neighbors.

Step 2: Each node calculates the pair wise relative mobility metric using the ratio of the two successive received power levels from every neighbor. It first receives the old power level from X to node Y.

Step 3: After the mobility of the node it receives new power level from node X_i to Y.

Step 4: Calculates the pair wise relative mobility metrics for all node.

Starting a node undecided state a node broadcasts its aggregate relative mobility metric to its next hop neighbors. As a process every node receives the aggregate mobility metric values of its neighboring nodes and able to compare that of its own value. A node with the lowest mobility metric value i.e.: a highly stable node relative to its neighbors, elected to become the node is in stability node. If the value of mobility metric of two node is same, in that case a node with the lowest ID gets the status of stability node.

Phase 2:- Finding node which has more power and minimum hop count

The protocol selects a route that has a longer overall battery life [11, 12]. This could be implemented by adding the POWER (P) field in RREQ message along with Relative Mobility (RM) field as shown in Fig 3.3

Step 1: A new field named power (all-neighbor) is added after a RREQ, which is used to record the sum of all power available neighboring nodes in a whole link. When intermediate nodes receive RREQ messages it adds the number of its current neighboring nodes power to the field POWER (all-neighbor). When RREQ messages arrival at the destination node, the value of the field POWER (all-neighbor) is the number of all powers available in the neighboring nodes in the whole link.

Step 2: This algorithm don't allow intermediate nodes return RREP messages even if they get the information of the destination node in their local route table, and must continue to transfer the RREQ messages along the path known until reaching the destination node. This strategy could avoid the returned RREP messages which don't contain enough information to accurate, and ensure that the destination node knows the whole network information along the link well to make a wise decision.

Step 3: The destination node is allowed to receive more than one RREQ message, calculate the power level at every route RREQ message at the destination.

a) When the destination node receives the first RREQ message, it reads hop count (H) and the power available in the neighbor number of all nodes in this link Number (all-neighbor), and calculates the Average Power of Neighbors(AP) of every link($L_{i=1,2,3,\ldots,N}$), which is Power(all neighbors)/ HN. Then the destination node records hop count N of this link and the average power of neighbors of every node Power (all neighbor)/ HN. The same process is followed in every RREQ message at the destination. Instead of calculates the relative mobility for all links. Finally the destination node returns the RREP messages which have the minimum hop count or the maximum average neighbors of every node and maximum average powers of neighbors of every node with minimum Relative mobility.

b) If the destination node received other RREQ messages later, it reads and calculates in the same manner, and gets their hop counts N and the average neighbors of every node. Then the destination node compares them with the records. If it is found that a new path, which has a smaller hop count N or a larger average neighbors of every node with maximum power available node of minimum Relative mobility and it will be stored in the destination node.

c) When the source node receives the RREP message from the destination node, a route with the minimum hop count and maximum powered node is established between source and destination and data transmission stage can be started. The route with the maximum power level and largest average neighbors will be stored. When a new RREP message returns to inform the source node to update the route, it will switch to a new route or stored the new route.

d) If the reliable route breaks before the transmission of data passages completes, local repair stage is started. Because it is a reliable route with the maximum average number of neighboring nodes and maximum power level of minimum mobility metrics Therefore, it is ensure that there are the enough neighboring nodes around the broken node to replace it. So it ensures the highest success rate of local repair and reduces the cost of new route discovery.

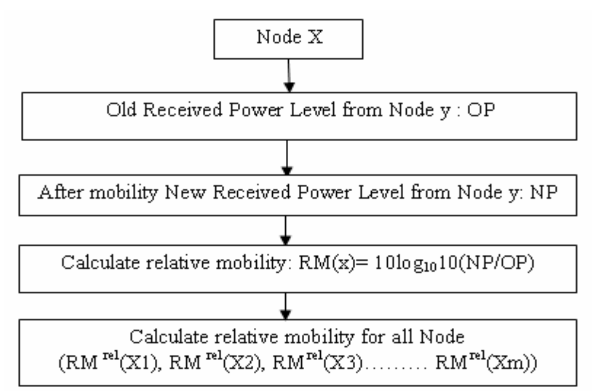

Fig. 3.2 Network initialization

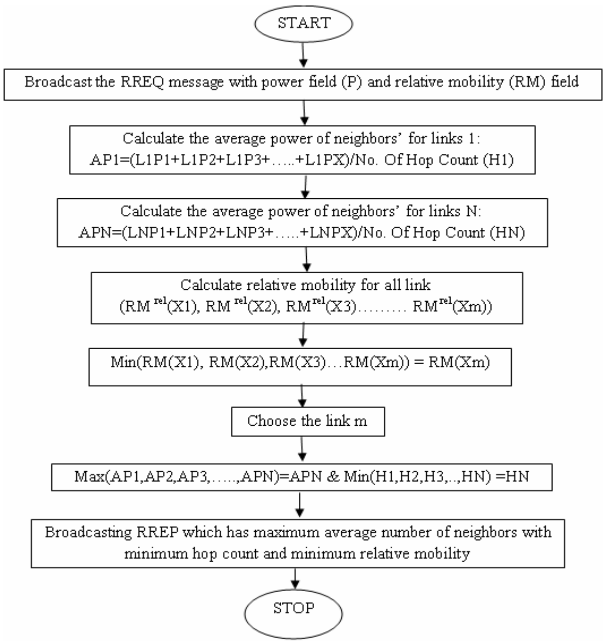

Fig. 3.3 : Optimized Powers Reactive Routing Protocol

IV. NODE MANAGEMENT

In the network Node Management is an important resource. Due to mobility of the network some new nodes enter or leaves in the network and some node will activate as null due to the node failure and the performances of the network is diminish. In this senses the topology of the network change rapidly so the node management is applied. It has to monitor the node status, and perform management actions in nodes [13].

Joining Node

The new nodes whose status is "unassigned" will join in the network it broadcast "hello" message to its neighboring node and specific mark that it presents in the network. The mark will inform neighboring nodes to let the node join in the network. Using this way, unassigned node that newly comes will have a chance to join the nearby node when it has data to send.

Leaving Node

In the ordinary node member, the topology of the network change dynamically. Due to this random mobility some node will leaves out of the network or node may get failure it is in null position. Because of this it significantly degrades the performance of the network. In this case, while in the processing of data some node leaves from the path means it has to disconnect the link from the network.

Changing Network

The change of network is not occurred immediately. When the node leaves or add new node its status become change in the network.

Scalability is defined as the amounts of work are done in a graceful manner which a routing protocol can extend to cover a large network area. Due to node management process, scalability of network will increase in Mobile adhoc network. It also increases the stability of the networking by increasing the network life time by node management process.

V. SIMULATION AND RESULT

A. Simulation Model

The GloMoSim simulator is used to implement our method and create simulation model to compare it with PAR protocol [12]. We simulated an Ad Hoc network comprised of some mobile nodes in a 1000m x 1000m area. The number of nodes is between 10 and 100. During the simulation, nodes move freely towards a random spot with a random speed which is distributed between 0 and maximum speed within this area. The maximum speed value varies 5m/s, 10m/s, 15m/s and 20m/s. The simulation time is 10000m/s. The nodes which produce or receive the CBR data flow are selected randomly from all nodes. And CBR packet size is fixed at 512 bytes.

B. Simulation Result and Analysis

To estimate the reliable of optimized power reactive routing protocol, we choose the following key parameters:

Throughput: This denotes the Average rate of successful messages delivered over the channel (bps).

Average Path Length: This is the average length of the paths discovered by the protocol. It was calculated by averaging the number of hops taken by each data packet to reach the destination.

Network lifetime: is the time interval from the start of operation of the network till the death of the last node, beyond which the network not usable.

Power Consumption: The amount of energy spent by a normal node is to transmit a packet of unit length to reach the destination.

Packet Delivery Ratio: This is defined as the ratio of number of packets received to the total number of packets transmitted.

Fig 4.1: Shows that the Packet delivery ratio in optimized PAR is higher than PAR. It means that optimized PAR achieves more data packet delivery than PAR. Because of the stability of the node can achieve more data. Fig 4.2 shows that the average path length is less in optimized PAR than PAR. It means that optimized PAR achieves less hop count than PAR. Because of the stability of the node can achieve more data.

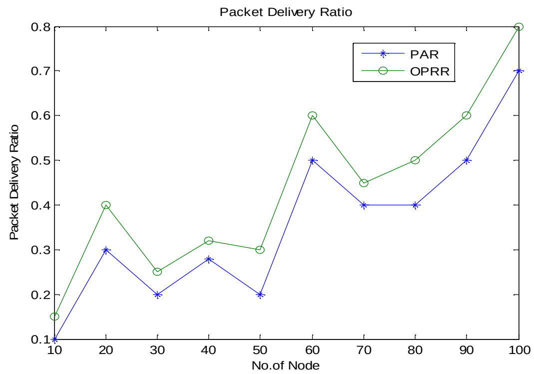

Fig. 4.1 Packet delivery ratio Vs No. of Node

Fig 4.3 we can see that using a Power field related routing metric significantly reduces the power consumption in optimized PAR than PAR. The performance is improved by finding the stability of node.

Fig 4.4 shows that the Throughput in optimized PAR is higher than PAR. It means that optimized PAR achieves more data packet than PAR. Because of the increasing numbers of data packet it need to with stand in the battery sources, so it can achieve in the optimized PAR.

Fig 4.5 shows that the network lifetime of network where number of rounds to transmit the data increases as number of node increase due to more end to end delay in optimized PAR is less than PAR. It means that optimized PAR achieves less delay than PAR as node speed increases.

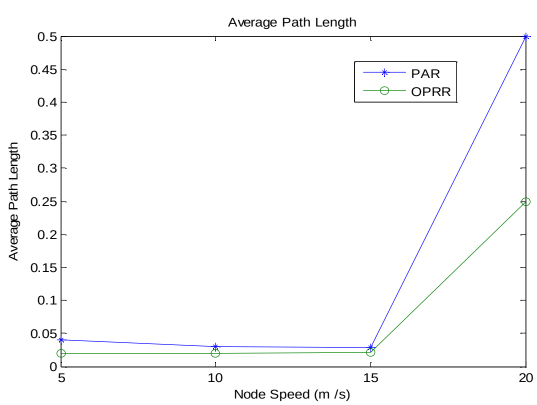

Fig. 4.2 Average path length Vs Node Speed

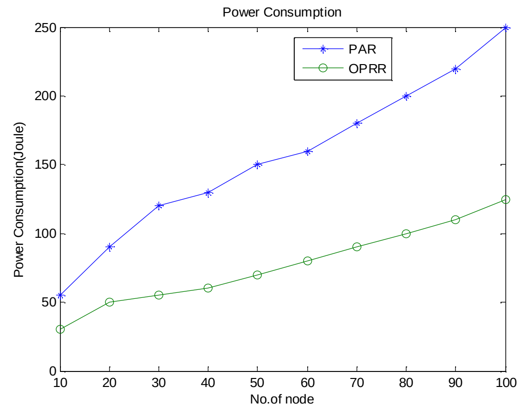

Fig. 4.3 Power Consumption

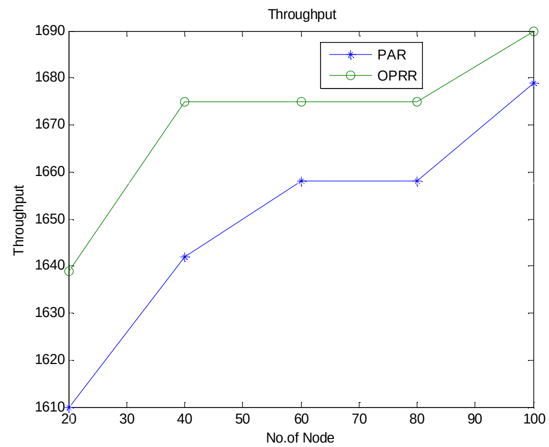

Fig. 4.4 Throughput

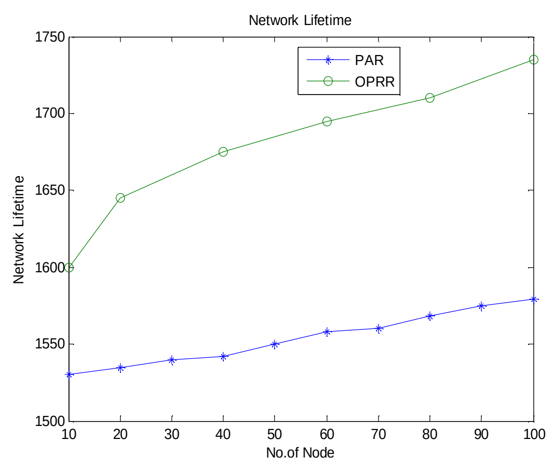

Fig. 4.5 Network Lifetime

VI. CONCLUSION

This paper proposes an optimized power reactive routing protocol based on cognitive routing metrics had implemented and combined with the performances of OPRR protocol which has POWER field in RREQ message along with relative mobility field as mention above. Then the protocol select route that have a longer overall battery life and also avoid new route discovery that improve the scalability of network management and provide a way of transmission with an energy efficient manner in the path of every node.. Finally compare the performance analysis of existing Power Aware Routing algorithm with optimized routing algorithm. According to the result of simulation, this optimized Power Reactive Routing reduces the burden of network resources and improved the stability, scalability and reliability of the network.

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