Performance Evaluation of Power Efficient Protocol in MANET

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Abstract--As reliability is a major factor in Mobile Adhoc Networks (MANET), many protocols have been designed for efficient power consumption with minimizing the delay. This paper presents the design of a truthful routing protocol with delay optimization and power competence for MANET. The scheme is based on the routing technique of Adhoc On demand Distance Vector Routing (AODV) protocol which is a prominent reactive routing protocol of MANET. In the proposed method, performance analysis of energy efficient protocol has been carried out that has been designed considering the remaining battery power of the forwarding node and its rate of packet processing. After simulation, the result shows considerable improvement in the power consumption, throughput, delay, and network life time when compared with conventional AODV protocol.

Keywords: *Real Time,MANET,QoS,AODV, PDR*

I. INTRODUCTION

MANET is a special type of network that does not require any definite infrastructure or footing for its establishment due to high efficiency of their autonomous and self-governing nodes. Due to multi-hop relay proficiency in distributed manner these MANETs are very important in disaster situations such as battle field for communication, military environment and natural disasters. Advancement of technology with MANET scenario has been emerged in many forms in current wireless communication. Due to unstable network topology and movements of nodes always change dynamically in multiple ways, it is certainly difficult to control and manage such an impulsive situation and interacting with neighbor nodes with propose co-operation is another tedious issue. Management of Quality of Service and its fair control is also stimulating. During data communication from sender to receiver, there are many constraints in the path containing path finding, node selecting, and detection of link failures, route maintenance, route repair, retaining routing tables and to take correct decision of packet accelerating towards the direction of exact destination.

II. RELATED WORK

Based on MANET Routing protocol design many researchers have proposed and implemented many novel ideas to upgrade the network standard with enhancement of performance. Analysis and survey about the existing network standards have been presented in paper [1] which gives enough information and opportunity for the new researchers to further investigate new possibilities in this magnificent world of MANETs. Energy consumption and its proper utilization plays a key factor in routing technology, detail about this concept and detailed review has been offered in paper [2] which focuses useful research done till date on this area and how data transmission successfully takes place from the local station to Base station through different gateways in multiple heterogeneous network. Underwater sensor networks with their operational mechanism is studied in [3] with high light on the urgency of power efficient schemes for these type of surveys and technology. A LAL (Learning Automata Like) technique has been implemented in paper [4] to prevent congestion and its control in a network in order to increase efficiency of the communication system. Another improved scheme for MAC (Medium Access Control) has been offered in [5] for channel access in more efficient way which is named as Semi-DCF. This method senses the detection of collision in the channel from the receiver node and it announces about the collision to the rest of the network so as to prevent other stations from communicating information in the same time. Learning automata based procedures and Bayesian Game theory is applied in vehicular MANET systems to study and analyze network behavior. As real time transmission in a Mobile Adhoc Network is a challenging problem, paper [7] and [8] highlight on numerous real time protocols with their analysis based on power consumption methodology and routing behaviour in MANET. As security measures are also equally important to save the protocol information from Intruders over a wireless network, idea of a mobile agent based Intrusion Detection System has been proposed by Dr.B. Pattanayak and M.Rath in [9]. A detail survey on useful protocols that operate on delay management and efficiency of energy has also been presented in [10] with suggestions for new resourceful protocol design. Based on the Power efficiency of the nodes, the routing path selection strategy has been implemented in [11] which is a similar approach of our proposal and in this strategy even load distribution among all nodes of the path are done intelligently in routing logic.

III. DESCRIPTION OF PROPOSED PROTOCOL

In our proposed Power and Delay Optimized AODV Protocol, there is a core module called Routing Engine installed at every node of the MANET. In the routing engine core, there are separate modules operated for periodically sensing the channel, handling the routing database and an intelligent module called transmission decision. Status information of a node and its data related to localization are broadcasted in channel sensing module. The database module stores information about the last happened events by the node since last 50 number of events along with power consumption information in every event and the intelligence based module to take routing decision takes decision according to result of threshold value which is calculated based on the function of power consumption, bounded delay (maximum tolerable delay).

A. Service Model of Proposed Protocol

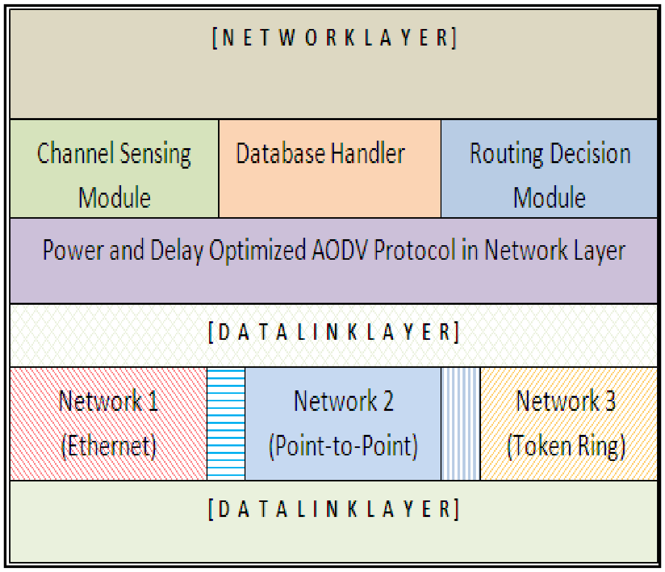

Fig.1. Basic Service Model Architecture

Fig.1 Describes the Service Model Architecture of our proposed protocol. It solves the scalability and heterogeneity problem by receiving different packets of different formats from the lower level link layer. An improved mechanism is employed in IP Protocol that operates according to our proposed module and works proportionally with all type of heterogeneous network under the network layer. It is a very complicated and challenging task to handle heterogeneous network (such as Ethernet LAN, Point-to-Point or Token Ring) and their different packet formats with different system of coding. Our improved Mechanism handles all the conditions such as bounded delay condition of one network, jitter condition of other network by enforcing interconnecting service level at the IP protocol, which is actually implemented at the aodv.cc source file of NS2.We can see from the diagram that the Data Link Layer of corresponding networks with different technology handles the packets in their own network format. Ethernet handles all the Network 1 related issues, PPP will handle all the network related issues in Point to point network and Token ring handles the related issues. But when the packets come to the network layer, a single IP protocol takes care of all the issue related to heterogeneous networks.IP handles all interconnecting issues related to packet forwarding towards the next hop in the route. Depending on the node selection using the load balanced path, the node having a cost function higher than the required cost function and which is not a overloaded node (as per algorithm), a node sequence no. is added to the OPTION field in the specified packet format.

The TOS field contains Type Of service for Data Packets whether it should use Best Effort Service or Real-time Service as per the Quality of Service Requirement. The Packet type can also be specified here which may be an audio packet. According to type, priority will be given to the service or bounded delay will be considered strictly for data delivery. Packet format in the proposed protocol design include the OPTION field which contains three important information. (i) Node Identification No# - That Stores the sequence number of the node for identification. (ii). Time Stamp – It refers to the time at which the packet was captured by the selected node. This information helps us to calculate the processing time of the packet and the queuing delay at the router. (iii) - Node Centrality – This refers to the burden of load (number of packets to be processed by the node) currently at the node. The said three fields are important for our proposed protocol as these values are stored in the routing engine mini database and calculation of threshold value for node selection is carried out using this information. At the core of the Network layer, the IP Protocol uses PDO AODV node selection process and the proposed algorithm is given below. Our proposed algorithm uses a new and different approach of node selection intelligently by calculating the required power to be consumed by the node. This calculation is done based on the average power consumption by a node according to no of packets received for processing and multiplying it with the packet size. Then the Current Residual Power of the station along with the tolerable delay level is calculated to get the cost function of the node. Depending on the magnitude of the cost function, the Routing decision module decides if this node will be selected or not. During packet forwarding process, the IP Protocol manages other related issues such as Topology Change, Quality of Service, Congestion, Security, Queuing, Link failure and Resource Reservation.

IV. Simulation And Performance Evaluation

We have used Ns 2.35 simulation tool to simulate our protocol. Simulation parameters are given in Table 1.

Table 1: Network Parameters considered in Simulation

Parameter Name	**Parameter Value**
Channel Type	*Wireless Channel*
Radio Propagation Model	*Two Ray Ground*
Network Interface Type	*Wireless Phy*
Link Layer Type	*LL*
Type of Traffic	*C B R*

Simulation Time	*10 Minutes*
MAC Type	*Mac/802_11*
Max Speed	*100 Kbps*
Network Size	*1600 x 1600*
Mobile Nodes	*60,100,120*
Packet Size	*512 Kb*
Interface queue Type	*Queue/Droptail*
Protocol	*Proposed AODV*
Simulator	*Ns2.35*

Average end to end delay is the difference between time at which the sender generated the packet and the time at which the receiving station received the packet. After simulation ns2 generates a trace file. Average delay has been calculated using awk script which takes the trace file as input, processes it and produces the output file contacting the average delay numerical values. We have used the data in the output file for producing the result in gnu plot utility available in ns2 for plotting the graph. Following command generates the data file for average delay values.

exec awk -f Delay.awk end_delay.tr > output.tr

Similarly PDR (Packet Delivery Ratio) has been calculated as the ratio between the number of packets received at the destination station and the number of packets generated at the source. From the trace file generated after executing the tcl script in ns2, packet delivery ratio has been calculated based on the received packets and generated packets, which are the fields available in the trace file after being generated and recorded during simulation process. Following awk script has been written to process the trace file and to produce the data file for plotting the graph in gnuplot.

exec awk -f Packet_Delivery_Ratio.awk pdr.tr > output.tr

V. Comparative Analysis

PHAODV which has been proposed as Power Aware Heterogeneous AODV protocol in [11] considers the battery power status of the nodes while creation of the routing table. If multiple routes are available between a pair of source and destination, then it considers the route which consumes least residual power and details of the nodes under this particular route are listed in the routing table. This approach is very much similar to our proposed concept as it also takes into account fair load distribution of the load among all the nodes. Therefore we have compared performance of our protocol PDO AODV with this protocol and presented the results in this section. We have presented the performance of three protocols AODV, PHAODV and the proposed PDOAODV in three different network sizes first with 24 nodes, then with 60 nodes and then with 120 numbers of nodes taking into account the metrics average end to end delay and packet delivery ratio.

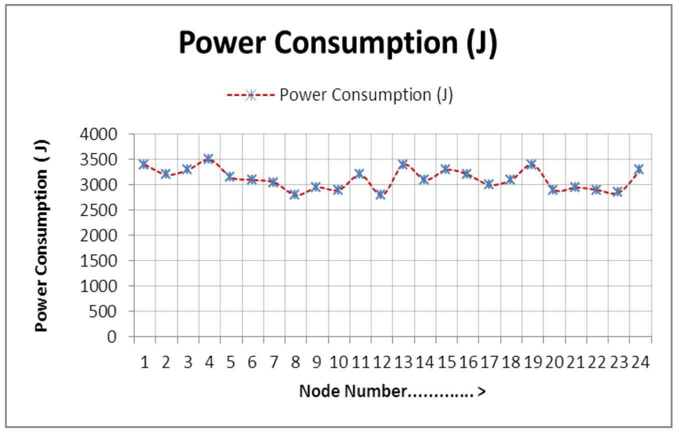

Fig.2 Power Consumption in Proposed Protocol

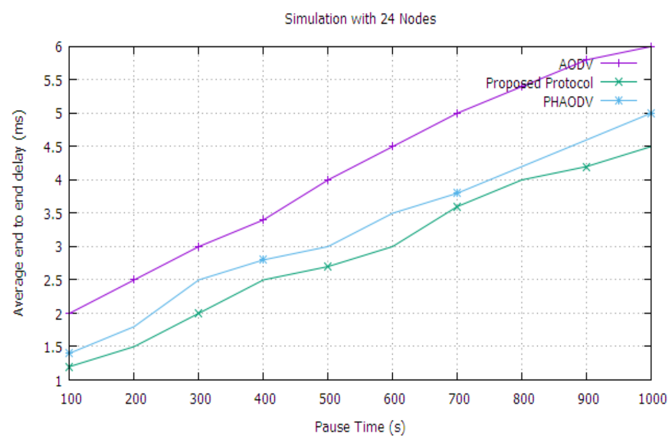

Fig. 3 End to end delay comparison with 24 nodes.

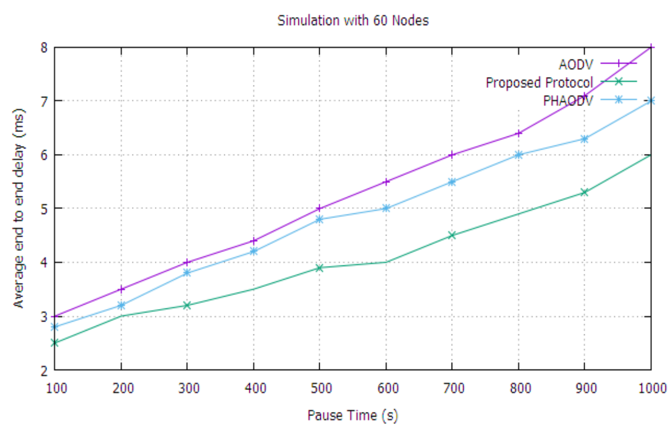

Fig. 4 End to end delay comparison with 60 nodes

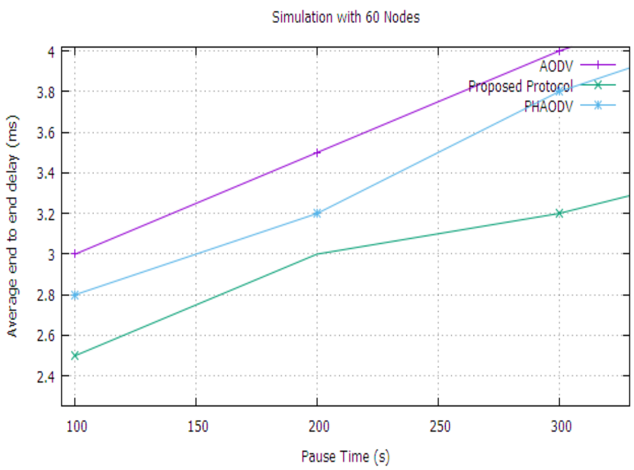

Fig. 5a Delay Comparison at Pause Time 100 - 300 Sec.

Fig. 2 shows the average power consumption by our using our proposed protocol. It can be observed that some nodes consume more energy due to type of processing they perform during communication. Mobility, packet loss and link failure also play a great role in power consumption by the nodes. Fig.3 shows the average end to end delay in 24 node scenario. We can see that in Fig 4. The average delay in proposed protocol has increased to 5 ms in comparison to an average of 2.5 ms in 24 nodes scene due to the increase in congestion due to more number of nodes in the network. Fig. 5a and 5b shows the difference in delay at the beginning of simulation and at time 500 sec. respectively.

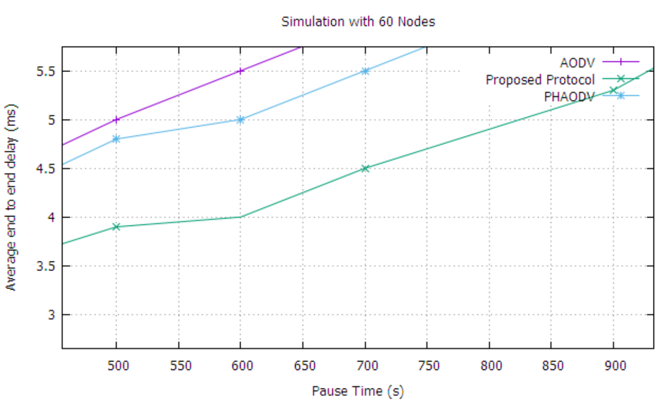

Fig. 5b. Delay increase with 60 nodes at Pause time 500 – 900 Sec

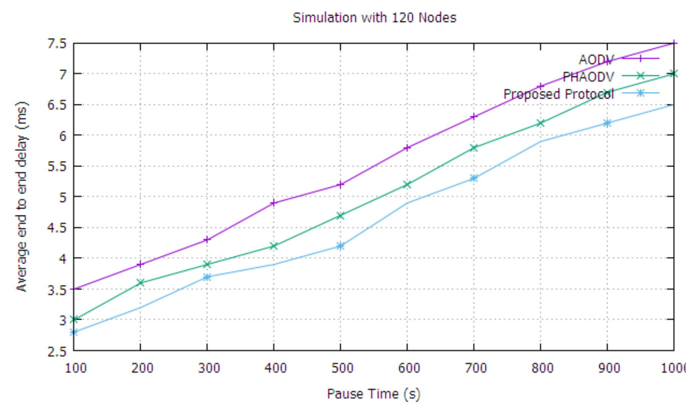

Fig. 6 Delay analysis with 120 nodes

Fig.6 depicts the average end to end delay in 120 node scenario. It can be observed that the delay rate has slightly increased in comparison to 24 and 60 nodes cases due to the dense traffic with more nodes and high mobility. But in this case our proposed protocols perform better than both PHAODV and AODV protocol.

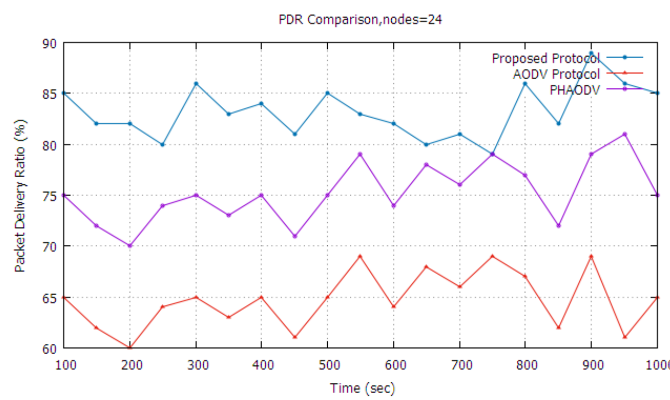

Fig.7 PDR Comparison with 24 nodes

Fig.7, Fig8 and Fig.9 illustrates the packet delivery ratio of the proposed protocol in 3 scenario considering 24,60 and 120 nodes. It can be detected that with 24 nodes, the proposed PDO AODV protocol shows 85 % PDR in average , which is in an average 10% more than PHAODV and approximately 20% more than AODV in an average. When simulated with 60 nodes, the proposed protocol shows 80 % PDR in average due to increase in processing task with increase of nodes. Similarly in 120 nodes situation the overall PDR remains between 80 % to 90% which is again an encouraging figure when compared to AODV and PHAODV Protocols.

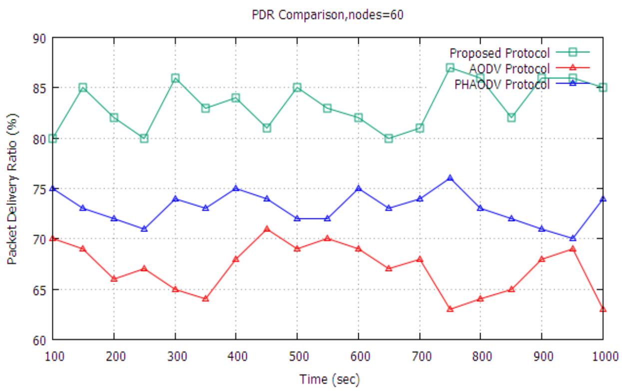

Fig.8 PDR Comparison with 60 nodes

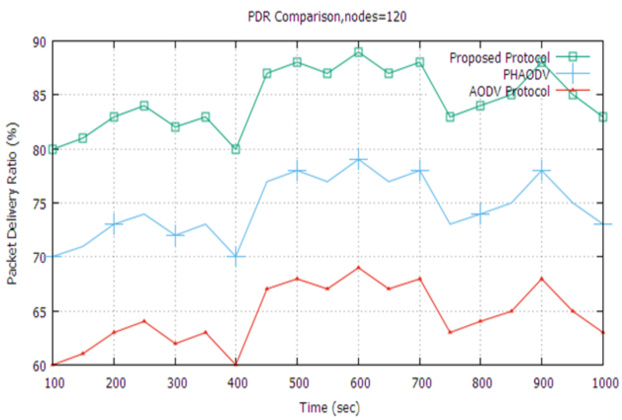

Fig.9 PDR Comparison with 120 nodes

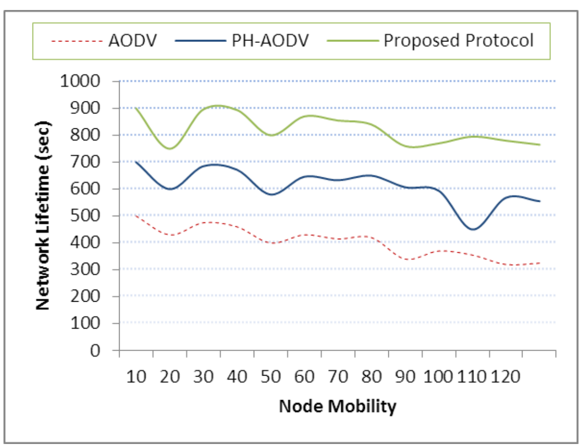

Fig.10 Comparison of Network Life Time

Fig.10 shows a comparative analysis of three ptotocols for their network lifetime. It can be perceived that the proposed protocol is able o retain the life time of the network for far more period than the conventional AODV and proposed protocol PH AODV in [11].

VI. CONCLUSION

An extensive simulation has been carried out in the above research work in order to evaluate the performance of Power efficient protocol. Appropriate selection of nodes for forwarding the packets in such a path which takes care of the power efficiency and delay optimization has been implemented here and the performance has been checked by comparing with one of the leading MANET protocol and another proposed energy efficient protocol based on similar approach. This research work aims to do performance analysis of load balancing protocol as well as compares with other similar protocols and presents the simulation results which ensure better performance of the energy efficient protocols in terms of throughput, delay and network life time.

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