Reducing energy consumption with AODV protocol modification

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1. Introduction

MANETs are multi-hop wireless networks. One of the major features in MANETs is that mobile nodes in MANETs are operated by constrained power. Therefore, previous researches were focused on decreasing power consumption. Power exhaustion of a mobile node does not affect the node itself but also the network lifetime. Energy efficient routing protocols are designed to evaluate energy efficient operative transmissions. Therefore, operative transmission energy efficient routing protocols are categorized into two; transmission power control method and load distribution method.

With transmission power control method, the operative transmission energy can be reduced by altering each node's transmission power just enough to get the receiving node but not more than that. Transmission power control method can be extended to determine the ideal routing path that lessens the total energy required to deliver data packets to the destination node. The objective of the load distribution method is to balance the energy usage of all mobile nodes by selecting a route with underutilized nodes rather than the shortest route. Therefore both approaches increase the network life time in different methods.

2. Related Works

Various routing protocols have been adopted to form a reliable and latest route between a source and destination (S-D). Because of the power limitation of each node, the chosen route cannot continue for a long time so that the S-D pair can use it to communicate each other. We should reduce nodes energy not only during operative communication but also when they are in inoperative state to extend network lifetime.

Energy efficiency means increasing the time length in which any network keeps certain level of performance [2]. The route discovery and maintenance of each routing protocol is more effective than other for different energy efficient aspect. AODV outperforms other by consuming less energy per packet. AODV has very fast adaptation to routing changes and frequent host movement. AODV shows better performance at low and average movement level scenarios than AODV. It is possible because at low and average movement cases, there is delay in Route discovery as the route caches of the nodes are the newest in AODV.

The Ad hoc On-demand Distance Vector (AODV) [3] is an uncomplicated and efficient routing protocol originally designed for using in MANETs. AODV is one of most popular on-demand reactive routing protocols which help from frequent mobile node movements and very speedy conversion to route topology changes. Send node of the packet knows the whole sequence of nodes through which packets has to transmit to the destination node. AODV is designed for ad hoc networks with no periodic router updates and notifications. One of the main characteristics of AODV is that it is a source routing protocol instead of being forwarded step by step data packets contain strict source routes that designate each node along the path to the destination. Route request (RREQ) and route reply (RREP) packets accumulate source routes so that once a route has discovered, the source node discovers the entire source-destination route and can place that route into subsequent data packets [5].

3. Proposed Algorithm

The working mechanism of proposed algorithm is consists of following 7 steps.

Step 1: If the Source node S desires to send data to the destination node D, it will first send REQ message to all its neighbor nodes.

Step 2: When neighbor nodes receive REQ message they will check their Route_Cache, if this packet's ID is already in their Route_Cache then packet will be discarded.

Step 3: Otherwise, node will calculate its power and send this value as a reply to source node.

Step 4: Source node will calculate the mean value of all the values of P_{new} of all the nodes and send a RREQ message to the node whose P_{new} value is nearest to the mean value.

Step 5: When the node receives a RREQ message it will send REQ message to its neighbors and this process will be repeated until the destination node receives.

Step 6: When destination node will receive the RREQ message it will return the RREP message along the same route.

Step 7: RREP process is same as in original AODV protocol.

4. Simulation Results

The proposed algorithm is applied and evaluated with ns-2 network simulator. The simulation result shows that the proposed method is more efficient than the original AODV algorithms. The table 1 shows the parameters used in simulation.

[Table 1] Simulation profile

Parameter	Value
Simulation duration	500 seconds
Number of nodes	20, 40, 60, 80, 100
Topology	1,500 m * 1,500 m
Traffic type	UDP-CBR
Data payload	256 bytes

Simulation of original AODV protocol and proposed algorithm are performed with 20 to 100 mobile nodes. The initial locations of mobile nodes are same in each simulation scenarios. The mobile nodes transmit their routing table information to nodes that are covered under their range of communication.

Network throughput is the average rate of successful message. The throughput is usually measured in bits per second. Throughput refers to how much data can be transferred from one node to another in a given time. The figure 1 shows the better performance of proposed algorithm as compare to AODV and graph show the values of throughput on different number of nodes like after 20, 40, 60, 80, 100 nodes. The solid line depicts the variations in the values of throughput of proposed algorithm and dotted line depicts AODV.

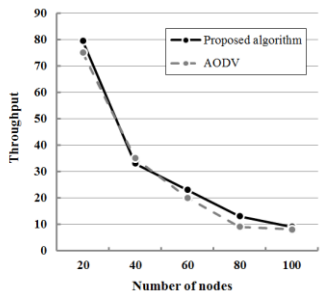

Figure 1. Comparison of throughput

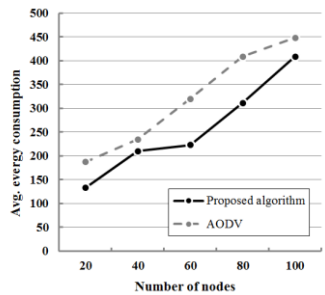

Figure 2. Comp of avg. energy consumption

Average energy consumption is the ratio of total energy consumed by all the nodes in the network by the number of nodes. The figure 2 shows the average energy consumption and the nodes in proposed algorithm will require less energy as compare to the nodes in original AODV. The solid line shows the average energy consumption of proposed algorithm and solid line shows the average energy consumption of original AODV.

5. Conclusion

Every routing protocol operated in a different way in an aspect of energy consumption. This is due to the route discovery and maintenance mechanism of the each protocol. The causes of power drain are transmitting data packet and computation. In contrast to basically establishing proficient routes between pair of nodes, a routing protocol has to keep the network working as long as possible. This goal can be achieved by reducing mobile node's energy consumption during data transmission. Transmission power control and load balancing are two methods to reduce the operative communication energy. Less energy consumption does not lengthen the network lifetime at all time. So, the energy efficient routing protocols must include battery energy level aware load balancing. We resolved AODV algorithm and proposed algorithm to decrease energy consumption which leads to increase in network lifetime. The simulation results show that the performance of proposed algorithm is better than AODV in throughput and average energy consumption criteria.

6. References

[1] T.P. Singh, S. Dua, V. Das, "Energy Efficient Routing Protocols in Mobile Ad hoc Networks", International Journal of Advanced Research in Computer Science and Software Engineering, Vol. 2, Issue 1, PP: 1-7, Jan 2012.
[2] A. Kumar, M.Q. Rafiq, and K. Bansal, "Performance Evaluation of Energy Consumption in MANETs", International Journal of Computer Applications, Vol. 42, No. 2, PP: 7-12, March 2012.
[3] C. Perkins, "Ad hoc On-Demand Distanced Vector (AODV) Routing", http://www.ietf.org/rfc/rfc3561.txt
[4] E. Ahvar and M. Fathy, "Performance Evaluation of Routing Protocols For High Density Ad Hoc Networks based on Energy Consumption by GlomoSim Simulator", World Academy of Science, Engineering and Technology, Vol. 23, August 2007.
[5] P. Sivasankar, C. Chellappan, and S. Balaji, "Performance of Energy Efficient Routing Protocol for MANET", IJCA, Vol. 28, Issue 8, PP: 1-6, Aug. 2011.