

# QoS Routing Algorithm with Sleep Mode in MANETs

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**Abstract** MANET became the focus of researchers as an assurance technology for a broad range of due to their self-managing and self-configuring multi-hop wireless networks since the nodes are mobile, the network topology may change rapidly and unpredictably over time. An ad hoc network, or MANET (Mobile Ad-hoc Network), is a network contain only of nodes, with no Access Point. One significant area of research within ad hoc networks is energy consumption concern. The primary aim of ad hoc networks is to call for the energy-constrained protocols. Energy consumption evaluation methodology is set up for the protocol consideration in different mobile network. AODV routing protocol carry out well on assessment of energy consumption for the mobile ad hoc network with high node mobility. Nodes in MANET networks are basically battery operated, and thus have way in to a limited amount of energy. This process recommended an Energy based Ad-Hoc on-Demand Routing algorithm that balances energy among nodes so that a minimum energy level is maintained among nodes and the lifetime of network is enhanced. This paper, aim on increasing the prolonged existence of node in the network in our proposed algorithm, QS (QoS Scheme for MANET's), addresses the issue of energy consumption in a manner fair to all network nodes. In our proposed scheme "energy aware routing" QS is suggested to use. The QS makes sure the connected and neighboring nodes to use it as forwarding node. Also, it checks the node with higher energy to make it applicant for forwarding purpose. From a functional point of view, QS can be consisting of two main units: One of these units deal with the energy conservation operation. This is done through uphold the nodes' threshold energy levels to minimize the packet loss due to link breaks. The other aspect of the algorithm takes care of connectivity using routing protocol. It helps to guarantee the routing protocol makes routing decisions that serve a specific goal. The construct of network scenarios and performance study is done on NS-2.34 to simulate both the AODV and AODV-Sleep under the similar scenario. This paper also compares and analyzes the simulation results with a popular on-demand routing protocol AODV to show the utility of this algorithm. From this simulation one finds that the overall MANET's efficiency is maximized.

**Keywords:** mobile ad-hoc networks, AODV routing protocols, energy consumption, sleep mode, mobility models, simulation analysis

## 1. Introduction

Mobile Ad Hoc Networks (MANETs) stand for the decentralized paradigms where clients themselves sustain the network in the absence of a central infrastructure. MANET does not operate under permanent topology means they are self-organizing, self-administrating, self-healing type of network. In MANET, each mobile node operate as both a router and a terminal nodes which is a source or destination, thus the failure of some nodes operation can greatly hinder the performance of the network and also affect the basic accessibility of the network, i.e., energy exhaustion of nodes has been one of the main harm to the connectivity of MANET. Since the mobile nodes in MANET have limited battery power, so it is required to efficiently use energy of every node in MANET In a mobile ad hoc network, all the nodes cooperate with each other to forward the packets in the network, and hence each node is actually a router. Thus one of the most important issues is routing. Since the topology of the network is constantly changing, the issue

of routing packets between any pair of nodes becomes a challenging task. Most protocols should be based on reactive routing instead of proactive. Multicast routing is another challenge because the multicast tree is no longer static due to the random movement of nodes within the network. Routes between nodes may potentially contain multiple hops, which is more complex than the single hop communication. The implementation of DSDV [1] introduces large amounts of overhead to the network due to the requirement of the periodic update messages, and the overhead grows at the quantity of  $O(N^2)$ . DSR [2] is that it uses broadcast for route discovery at the same time it broadcast causes too much message forwarding traffic and energy consumption, especially when the network is large. AODV [3] AODV is based on both DSDV and DSR algorithm. It uses the route discovery and route maintenance training of DSR. DSR packet carries the comprehensive route information, while the packet of AODV only carries the destination address, it has a smaller amount of routing overhead than DSR. At the same time, AODV makes use of routing messages and sequence numbering. AODV protocol is a reactive routing protocol which finds route to destination when demanded.

AODV consists of routing table which helps to differentiate between close and fresh routes. The routing table at node consists of the sequence number and next hop information. The working of protocol is consists of two phases[4]:

1. Route discovery and
2. Route maintenance.

In route discovery process, RREQ packets are transmitted by the source node in a way similar to DSR. As RREQ travels from node to node; it automatically sets up the reverse path from these entire nodes back to the source. When a RREQ packet is received by an intermediate node, it could either forward the packet or prepare a Route Reply (RREP) packet if there is an available valid route to the destination in its cache. To verify if a Particular RREQ has already been received to avoid duplicates, the (SId, BId) pair is used. While transmitting a RREQ packet, every intermediate node enters the previous node's address and its BId. If an intermediate node has a route entry for the desired destination in its routing table, it compares the destination sequence number in its routing table with that in the RREQ. A timer associated with every entry is also maintained by the node in an attempt to delete a RREQ packet in case the reply has not been received before it expires. Once the RREP is generated, it travels back to the source, based on the reverse path that it has set in it until traveled to this node. As the RREP travels back to source, each node along this path sets a forward pointer to the node from where it is receiving the RREP and records the latest destination sequence number to the request destination. Thus the path is established among source and destination node. The Following control packets are used: Route Requests (RREQs), Route Replies (RREPs), and Route Errors (RERRs) are the message types defined by AODV and these message types are received via UDP[5]. This is called Forward Path Setup. Thus the path is established among source and destination node. In route maintenance process, the source node is being informed by RERR (Route Error) message in case of link break. Also the connectivity between the nodes is upholding using Hello messages. There are two main factors that cause link failures are:

1. Battery life time
2. Mobility

Taking energy in account, there are three approaches that are usually used to achieve the energy-efficiency in MANETs [6]: Power-Control, Power-Save and Maximum-Lifetime routing. The Power-Control method is allowing nodes to decide the least amount of transmission power level which is sufficient to uphold network connectivity and to pass the traffic with least energy; the goal is to increase network capacity and sinking energy consumption. The Power-Save approach deals with the energy loss during the idle mode and this can be minimized by increasing the amount of time a node use up in the sleep mode. Lastly, the Maximum-Lifetime routing procedure looks for the nodes that have minimum energy so that they can be avoided from the path. When the node reaches at minimum threshold level it goes into sleep mode [7].

The paper is organized as follows. Section II survey the related work to judgment of energy based Ad hoc routing protocols for MANET. Section III briefly describes the

idea and mechanism of AODV routing protocols which get better the energy efficiency of MANET. Section IV introduces the design of the byte-based energy consumption formula. Section V makes the energy consumption assessment underneath our proposed mobility models. Section VI draws the conclusion of the paper.

## 2. Related Work

Several routing algorithms use the link lifetime as well as the nodes' battery life time as routing parameter to allow the most reliable and energy efficient route to be selected for data transmission.

**Alternate Link Maximum Energy Level Ad Hoc Distance Vector Scheme for Energy Efficient Ad Hoc Networks Routing** [8] has described the improvement of the conventional routing protocol by exploiting higher energy path and backup route. The proposed algorithms adapt the existing AODV routing protocol to decide the optimal route based on the basis of the maximum energy of each route. The simulation arbitrarily models the node initial energy between 2 to 50 Joules. Different numbers of nodes are placed arbitrarily within the 500m × 500m rectangular region. The result shows that ALMEL-AODV attains better performance because it decreases the number of rebroadcasting and thus reduces the overall energy wastage.

**An Energy-Efficient On-Demand Routing Algorithm for Mobile Ad-Hoc Networks** [9], has proposed an energy efficient metric for MANETs to minimize energy consumption and increase the network's stability. Earlier works mainly focused on the shortest path method to reduce energy, which might result into network failure because some nodes might weaken fast as they are used repetitively, while some other nodes might not be used at all. This can lead to energy disparity and to network life reduction. The paper proposed an Energy Efficient Ad-Hoc on-Demand Routing (EEAODR) algorithm that balances energy load between nodes so that a minimum energy level is maintained among nodes and the network life is improved. The work focused on increasing the network long life by distributing energy consumption in the network.

**LSEA: Link Stability and Energy Aware for Efficient Routing in Mobile Ad Hoc Network** [10] proposed a new routing protocol called Link Stability and Energy Aware (LSEA) is proposed, which is a modified version of Ad-hoc On Demand Distance Vector (AODV) protocol. LSEA utilize a novel route discovery process that takes into account the links constancy and the nodes residual energy to perform data routing. This paper, focus in showing how to look up the route discovery process whenever a source node attempts to communicate with another node for which it has no routing information. This uses Random Waypoint to model node mobility. The simulation results show that LSEA cut down the routing overhead by 17% and increases the network life time by 20%, as compared to the traditional AODV.

**Energy saving potential of cyclic sleep in optical access systems** [11] this initiated the load adaptive techniques where network elements/subsystems are powered off during periods of reduced network load. Such

techniques are particularly interesting for the entrance segment which is characterized by low utilization. The combination of large contribution to the overall network power consumption and low utilization involves large potential for exploiting such load adaptive techniques. This approach is only feasible to a certain level and in contrast to another principle for increased energy efficiency which is increased integration. Integration (e.g. electronic and photonic integration) can decrease the maximum power consumption of network elements by increasing the sharing of subunits within the network element. The finite wake-up time of systems and components reduces the energy savings of cyclic low power modes. A calculation of average power consumption at 50% traffic load as a function of average off-period length taking into account the penalty from the wake-up time.

**Energy Efficient Integrated Routing Protocol for MANETs** [12] has an Energy Efficient Integrated Routing Protocol (E2IRP) for Mobile Ad Hoc networks used in remote surveillance systems. Remote surveillance system is the use of cameras to monitor properties and resources from a remote location. It is used as an asset protection device for region where it is not possible or practical to install a cable network. The integration of MAC and routing layers can successfully reduce the amount of control information being exchanged for discovery and upholding of the route in the network. This in turn diminishes the energy and time consumed for the processing of these packets. Though the number of packets and processing is less, the protocol provides a better reliability and throughput. The nodes are structured in concentric tiers around the gateway. The event information is routed towards the gateway from one tier to another and the reply is routed back to the source, in the same manner. All simulations of E2IRP have been achieved with the NS-2.33 discrete event simulator.

**Performance of Ad hoc Network Routing Protocols in IEEE 802.11** [13] author's approach must take into account the ad-hoc networks specific characteristics: dynamic topologies, limited bandwidth, energy constraints, and limited physical security. Two main routing protocols class are studied in this paper: proactive protocols (e.g. Optimized Link State Routing - OLSR) and reactive protocols (e.g. Ad hoc On Demand Distance Vector - AODV, Dynamic Source Routing - DSR). This paper judged qualitative and quantitative criterion. The first one concerns distributed operation, loop-freedom, security, sleep period operation. The second are used to measure the performance of different routing protocols presented in this paper. Results record end-to-end data delay, packet delivery ratio, routing load. Comparative study will be presented with numeral networking context consideration and the results show the appropriate routing protocol for two kinds of communication services (data and voice).

### 3. Proposed Work

Finally, most of the research works in the literature have addressed the link lifetime and the energy information as routing metrics to improve the route selection mechanism of the routing protocol. Network partitioning interrupts communication sessions and can be

caused by node movement or by node failure due to energy depletion. Whereas the former cannot be controlled by the routing protocol, the latter can be avoided through appropriate routing decisions. Operational lifetime is therefore defined in this survey as the time until network partitioning occurs due to battery outage.

#### 3.1. Active Mode (or Transmit Mode)

This is the mode using the large amount of power. It permits both the transmission and reception of messages and consumes 3000 to 3400mW.

#### 3.2. Doze Mode (or Receive Mode)

The CPU is able to process the information and is also capable of receiving notification of messages from other nodes and listening to broadcasts. 1500 to 1700mW are consumed in this mode.

#### 3.3. Sleep Mode (or Standby Mode)

The CPU does no processing and the node has no capability to send/receive messages. The node is inactive and consumes only 150 to 170mW. Initially the energy of nodes is set to any random value. And the transmission power, receiving power, idle power and sleep power is also set to a specified value. As per the proposed model, a process is set to check whether the node is participating? The participating node means the node taking part in communication and left with some energy. In this work, a threshold value of energy is taken. The algorithm checks to see the energy of node and if the node energy falls to threshold then the algorithm starts looking for connected nodes i.e. the nodes in range. After determining connected nodes two-step process finds the nearest hop node which is having specific (in our case 50J) or highest remaining energy. Out of these connected nodes, first the nearest hop node is determined because it saves energy of individual nodes. The node found after this process will become the participating node and provide alternate path to destination node.

## 4. Simulation Model

To simulate the real behavior of the nodes in a mobile ad hoc network this uses NS-2. In simulation model, one took 10 nodes that are arbitrarily scattered in an area of 800m X 600m square region with 50 numbers of links. This uses the random mobility model. These factors are taken as the vital scenario. Energy model comprise the radio range of 250m, 2Mbps of data rate. Initially each node in network is assumed to have random energy. The power utilization during transmission and reception is 1.5W and 1.0W respectively. Each of the objects can move at a random direction, stop for some time (per the pause time), and afterward change its direction at random and move again. In this paper one focuses on Constant Bit Rate (CBR) sources (i.e. voice sources) and ftp sources (i.e. file transfer). The source-destination pairs are chosen arbitrarily over the network. The simulation is done with the help of NS-2 and traffic model is generated using energy.tcl.

The metrics used to assess the performance of QAS-AODV against AODV are the:

1. Packet Delivery Ratio
2. Network Routing Load
3. Average End-End Delay
4. Jitter
5. Routing Packet Overhead

NS2 simulator is take on in this paper to evaluate the performance of the proposed methodology and compare the conventional AODV based wireless ad-hoc network with the proposed sleeping node methodology. The parameter values of simulation are as shown in table.

## 5. Results

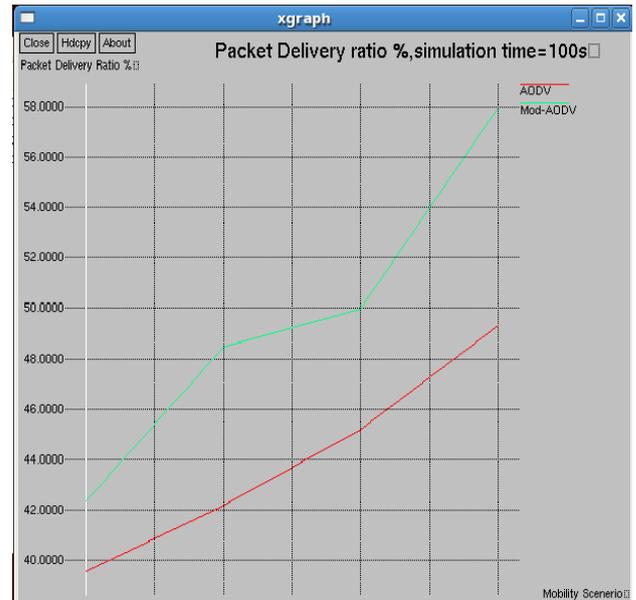
The simulation results are as shown in table below. From the result summary one can depict a conclusion that the proposed methodology performs well compare to traditional AODV.

**Table 1. Simulation Parameter**

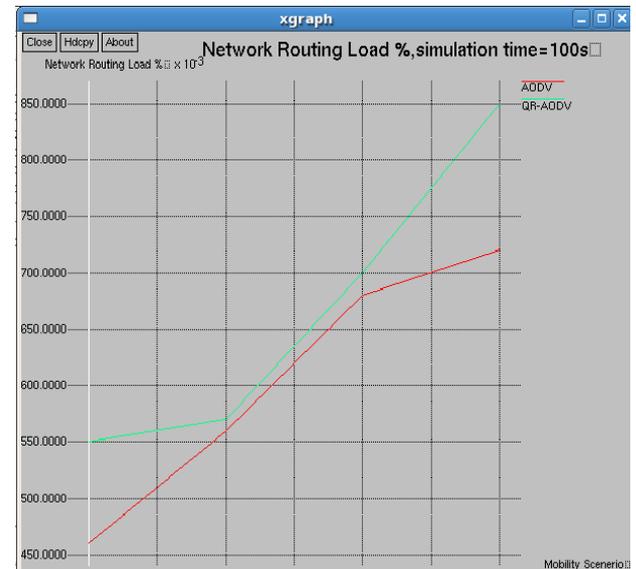
Type	Values
Channel	Channel/Wireless Channel
Radio Propagation Model	Propagation/TwoRayground
Network Interface	Physical/Wirelessphy
MAC	MAC/802_11
Interface Queue	Queue/Droptail/Priqueue
Antenna	Antenna/Omniantenna
Link Layer	LL
Interface Queue Length	50
Routing Protocol	AODV
Simulation Time	100s

The results of our simulations represent the average of 5 runs each with different mobility scenario. We used the same traffic pattern for all simulation experiments. Our movement scenarios are characterized by a pause time. It then moves to a selected random destination at a speed that is uniformly distributed between zero and the maximum speed that we selected for the simulation. This pattern then repeats itself over and over until the end of the simulation. This ran the simulations for different pause times for each of the mobility scenarios. We selected CBR for traffic instead of TCP to be able to perform the comparison between the algorithms under equal conditions since TCP changes the load (the number of packets it sends) based on the network conditions, which would prevent a direct comparison between the algorithms. With these simulation conditions, we obtained results that are plotted in Figure 1.

The packet delivery rate has been increases and packet drop rate decreases. And also delay has been decreases using the proposed methodology. We have estimated (i) Routing overhead and (ii) Delivery ratio for Comparison between AODV and QR protocols and following results was observed. Several simulations are performed using NS2 network simulator and using parameters shown in Table 1. NS2 makes a name trace files analyzed using an AWK scripting. The performance study takes in AODV routing protocol.



**Figure 1. Packet Delivery Ratio vs Node Mobility**



**Figure 2. Network Routing Load vs Node Mobility**

## 6. Conclusion and Future Work

The above mention technique proposes adapted -AODV protocol which enhances the network lifetime in an Ad-hoc network situation and simulated in NS2. Most of all, each node's energy has a huge impact on the entire network lifetime. The proposed scheme ensures significant improvement in power aware system. For this reason, the effectiveness of method for the systems ultimately depends on the selection of the alternate node. As mentioned earlier, the performance of QAS-AODV is compared with AODV. We vary the number of nodes and the traffic load (data sending rate) to change the degree of overhead of the routing and data transmission in the network. The main focus of this thesis is to suggest a modification to the existing IEEE 802.11 MAC so as to make it suitable in multi-hop ad-hoc networks, especially in the real life centralized networks. The results presented in the thesis are applicable for dynamic scenario.

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