# Evaluation Of Energy Efficiency Of MANET Routing Protocols

Methaq jasam, Dr.salman bin yussof

**Abstract -** Now days network is becoming an important part in varying area and demand of users, with the rapid development of the wireless device has motivated the emergence of the mobile ad hoc network. MANET (Mobile ad hoc Network). It is a collection of nodes that is connected through a wireless medium forming rapidly changing topologies. MANETs don't need of any centralized base station and can be set up anytime, anywhere. In MANETs, the nodes are mobile and battery operated. As the nodes have limited battery resources and multi hop routes are used over a changing network environment due to node mobility, it requires energy efficient routing protocols to limit the power consumption, prolong the battery life and to improve the robustness of the system. This research presents a comparison and evaluation study of Reactive routing protocols; Ad Hoc On-Demand Distance Vector Routing (AODV), Proactive routing protocols; routing information protocol (RIP2) and Position-based routing protocol; Location- Aided Routing (LAR1). And the evaluation of their performance was based on energy consumption metric. The evaluation study performed using QualNet v5.1 simulator. This research showed that AODV has the best evaluation performance in energy usage in all most scenarios.

**Keywords-** MANET, AODV, RIP2, LAR1, energy consumption analysis.

## 1. INTRODUCTION

The growth of wireless networks is developing rapidly in the industry. The roles of wireless communications are expanding across the globe because it is practical and simple. In addition, under certain settings, having cables is becoming impractical and even impossible thus requiring a substitute. For this reason, wireless networking comes to mind Wireless networks can be divided into two types, whereby the first relates to [1], a stagnant architecture comprising a station base for the purpose communication of inter-nodes, whereas the second is a wireless communication depicting a single hop, this network also needs an infrastructure for support process [2] .Infrastructure networks have a number of benefits, namely reliability, usually unaffected by topological changes and the presence of base stations simplifying routing and management of resources. This is due to the fact between nodes routing decisions are made from the central. In contrast, MANETs is organized by itself with a multi-hop wireless network built for only short time and use categories as wireless networks known as Infrastructure less. In MANETs node movements are randomly done and communications were utilizing wireless connections. They are usually used in conditions where centralized management or support from networking infrastructure (e.g. Routers is not present). Thus, nodes should play the role as both routers, end-systems and are self organized as a network.

## 2 MANET ROUTING PROTOCOLS

Here we go to illustrate the suggest protocols reactive protocol AODV, proactive protocol RIP2 and position – based routing LAR1.


- Methaq jasam masters in information technology in uniten university , malaysia,. E-mail: metho_only@yahoo.com
- Dr.salman bin yussof network department in uniten University, malaysia,. E-mail: Salman@uniten.edu.my


### 2.1 Hoc On-Demand Distance Vector (AODV)

One of the popular reactive protocols is ad- hoc On-Demand Distance Vector (AODV) In these types of protocols the scours don't need to maintenance a route to the destination when there is no data to send. And if the scours want to determent path to the destination to send data first must broadcast a route request packet (RREQ) to all closer neighbors and this neighbors broadcast to their neighbors and this forward process continues until to thinks accrue the route request packet reach to the destination or the intermediate node recognize path to destination new enough [3][4].

### 2.2 Location-Aided Routing (LAR1)

The location information is used in LAR1 protocol whereby the goal of the protocol is to reduce the search space to find the route to the destination node [5]. Once the position of the destination node and mobility characters (e.g. The direction and speed of movement of the destination node) are sorted out, requests for route are sent to nodes in the specified expected zone'. Moreover, the control packet overhead is significantly reduced they are flooded with the nodes in the zone. If there is no information in the source node about the speed and the direction of the destination node, the entire network may be called the expected zone. As Source node S tries to send a packet to a certain destination node D and a new route is needed, as it is the first step it attempts to give a reasonable guess about the D's location. This is right in the expected zone. If node S knows the D's position is P at the time t0 and the existing time is t1. Scan figure out the expected zone of D from the position of node S via time t1 as depicted in Figure 2.6. For example if D moved at an average speed v, the source node S expects D to be in a circle at about the old position P with a radius v (t1− t0). This is however, only an estimation by S of the expected zone to arrive at possible locations of D. D's travel is higher than the expectation of S, the positioned of the destination node may be the outer part of the expected zone at time t1. It must be noted that if the source node has no knowledge of the position of D at time t0, it cannot be possible to arrive at an estimation of an expected zone for D. In this setting, the whole Ad- hoc network is selected as the expected zone and the routing algorithm is reduced to a simple flooding[6].

### 2.3 Routing Information Protocol (RIP)

Since the late 60's, RIPv2 is has become an update of the old RIP protocol whereby it is according to the Distance-Vector, or Bellman-Ford, algorithm [7]. RIP has been in existence since the initial days of the ARPANET and till today is still aiding routing in a few Internet domains. It is a table-driven routing protocol that is each router constantly maintains an up-to-date routing table with information on how to reach all possible destinations in the network. For each entry the next router to reach the destination and a metric to the destination are recorded, when the router receives a routing update that include to an entry that is already within the router's routing table. It updates the routing table to reflect the change. RIP only maintains the best or lowest metric to destination. As a router has finished updating its own table immediately begins transmitting routing update to inform other routers about the change[8] .

## 4 RELATED WORK

There have been a behavior evaluation of DSR, AODV, TORA and DSDV routing protocols created according to energy wastage are done in [9]. They found reactive protocols such as DSR; AODV behaved more efficient than DSDV and showed superior performance than TORA. The authors in [10] measured the energy wastage in different traffic models in their research ( CBR, Pareto , exponential) by utilizing AODV OLSR and AOMDV routing protocols and the energy consumed in transmitting and received mode by the use NS-2 simulator. They discovered that AOMDV used less energy than AODV AND OLSR in CBR traffic whereas in pare to and exponential traffic, AODV consumed less energy than AOMDV and OLSR. Researcher in [11] has also arrived at comparative routing overhead for AODV, DSDV and DSR routing protocols as it was shown that for the three protocols the energy overhead varies with the transmuting power in distinct and non- obvious approaches. In different network scales, they evaluated four ad-hoc network protocols (AODV, DSDV, DSR and TORA) in [12], the findings of the performance of AODV, DSDV and DSR in small size networks were comparable but it was not the case in medium and large size networks as the AODV and DSR showed commendable results . In [13] their research showed a performance comparison of the DSR AND OLSR in energy consumption. The findings revealed that reactive protocols use to their benefit their routing policy when the traffic load is low, however at increased traffic rates, proactive routing protocols can do better with a suitable refreshed parameter. In different settings,

## 5 PERFORMANCE EVALUATION

To study the act of MANET routing protocols researchers have focused mostly on Throughput, end to end delay and packet delivery ratio, jitters, hop count metrics etc. However, energy consumption in MANET not properly addressed nor presented with greater accuracy. Considering the importance in this paper we evaluate the energy consumption of AODV, RIP2 and LAR1at different number of nodes, area size, packet size, pause time.

### 5.1 Simulator

For this study a parallel discrete event driven simulator, Qualnet, was used to compare the routing protocols. It is a holistic collection of tools following big wired and wireless networks which uses simulation and emulation to make predictions of the character and performance of networks to enhance their design, operation and management [14]

### 5.2 Performance Metric

In an ad hoc network for every packet, the node transmits and receives some power and each packet consumes it. Transmission power utilizes more power than getting information and is subsequently awarded a better value. As the energy level of the node reaches zero point, no more packets can be transmitted by the node and it is eventually switched off [15]. By MANET network, energy is wasted in different mode active (translation and receive) mode, idle mode and sleep mode[16]. The total energy consumption E to send k bits can be formulated as in [17]:

$$E = P_{on} \times T_{on} + P_{sp} \times T_{sp} + P_{tr} \times T_{tr} + P_{Idle} \times T_{Idle}$$

$$= (P_t \times P_{CO}) \times T_{on} + P_{sp} \times T_{sp} + P_{tr} \times T_{tr} + P_{Idle} \times T_{Idle}$$

Where:

$P_{on}$: power in active mode

$P_{sp}$: power in sleep mode

$P_{Idle}$: power in idle mode

$P_{tr}$: power transient mode

T: represent the duration that the transceiver stays at each condition.

In this study We consider energy model "user specify" whose Transmit circuit current load consumptions is taken as 280 mAmp and receive circuit current load consumption is 204 mAmp. Idle current load consumption is considered as 178 mAmp and supply voltage is 3V.. The radio model uses bit rate of 2 Mbps and has a radio range of 250 meters.

### 5.3 Network Environment

In this study to evaluate the performance of reactive ,proactive ,position –based in term of energy consumption we simulate four scenarios namely number of node which used varying number of node (10,20,30,40,50), packet size which used varying packet size (200, 400, 600, 800, 100), area size which used varying area size (250*250, 250*500, 500*500, 500*1000) and pause time which used varying pause time (0s ,30s ,120s ,600s, 900s).other simulation parameters that apply in all the scenarios called basic scenario is based on J.C .Cano et al. in there study [10] , as shown in theTable 1 .

**TABLE 1**
**PARAMETERS OF BASIC SCENARIO**

| Parameter | Value |
|---|---|
| Number of nodes | 25 |
| Simulation time | 900s |
| Simulation area | 500 m× 500 m, |
| Routing protocol | AODV, RIPv2, LAR1 |
| Mobility model | Random way point |
| Packet size | 512 |
| PHY | 802.11b |
| No of CBR traffic | 20 |
| Traffic rate | 4 packets/Sec |
| Type of traffic | CBR |
| Speed | 15 m/s |
| Pause Time | 0s |

## 6 RESULT DISCUSSION

After the results of these four scenarios from Qualnet analyzer file are obtained, in three modes (transmission, receive, idle) suitable statistical analysis are conducted to arrive at the total energy consumed by each protocol in different scenario as shown bellow.

### 6.1 The effect of number of nodes (scenario 1)

As the network varying from 10 to 50 nodes the energy consumption for the three routing protocols ineacrese as depicted in fig.1. This is due to as the number of nodes ineacrese these nodes have to process all the routing packets. As such, the total power consumption of the network will increase. As shown in fig.1 RIPv2 has larger energy consumption as compared to LAR1 and AODV. It suffers from quickly increment when the network varying from 10 to 50 nodes .While, AODV has superior energy consumption as compared to RIPv2. Also AODV shows better energy consumption than LAR1.

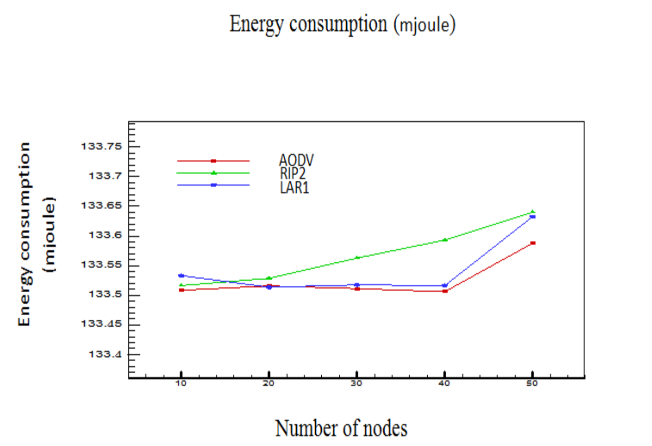


**Fig.1. Energy consumption functions with number of nodes**

### 6.2 The effect of packet size (scenario 2)

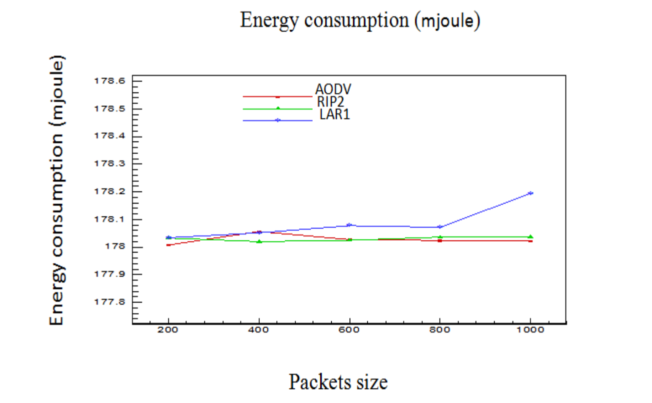


**Fig. 2 .Energy consumption functions with packet size**

In this scenario we observed that as the packet size ineacrese the energy consumption by each protocol increase too as shown in fig.2. We can explain that observation by saying that energy required to transmitting or receiving data packet increase as the size of the packet increase. Also we observed different increasing in energy consumption for these three protocols. LAR1 has higher increment rapidly in energy consumption as compared to AODV and RIPv2, while AODV shows better performance in energy consumption than the other protocols. On the other hand, RIPv2 shows steady performance in energy consumption compared to LAR1.

### 5.3 The effect of area size (scenario 3)

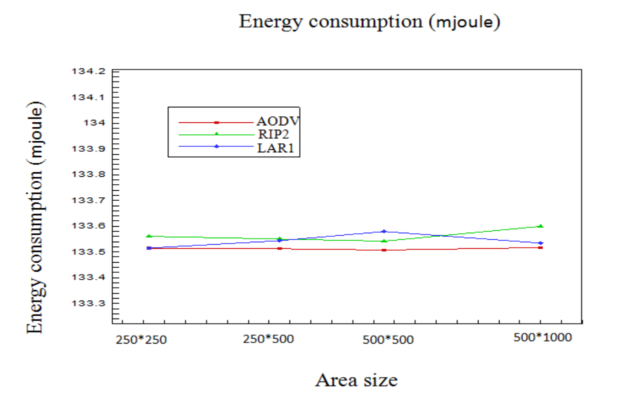


**Fig.3. Energy consumption functions with area size**

From fig.3 we observed that as the area size varying from 250x250 to 500x1000 it slightly effect the energy consumes by each protocol. AODV performance was quite stable despite varying area size from 250x250 to 1000x500. In [46] the researchers found AODV is better performance in energy consumption in varying area size. While RIPv2 suffer from slightly increased in energy consumption compared to AODV and LAR1. In case of LAR1 as the area size varies from 250 x250 to 500x1000 it shows moderate increment in energy consumption.

### 6.4 The effect of pause time

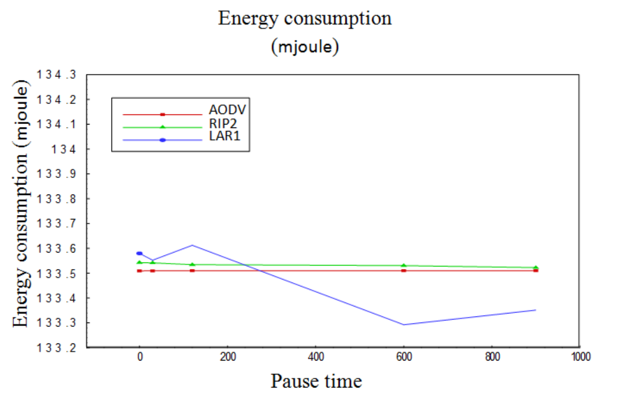


**Fig.4. Energy consumption functions with pause time**

In this scenario we observed that there is different in energy consumption as the network varying from dynamic to static motion as shown in fig. 4. It shows that AODV has better performance in high mobility environment (0 pause time) compared with LAR1 and RIPv2. Also, it is observed that as the scenario span from constant motion node (0 pause time) to stationary ones (900 pause time) the AODV depicted regular behaviors in term of energy consumption. In case of RIPv2 whereby it depicts slightly decreased in energy consumption in the static network (pause time 900 s) compared to dynamic network (pause time 0s). While, LAR1 suffers from high increase in energy consumption at the time the node's mobility is higher (pause time 0s) and in the lower mobility (pause time 900s) LAR1 shows a very significant decrease in energy consumption.

## 7 Conclusion

In this paper, analysis and evaluation of three routing protocols (AODV, RIP2, and LAR1) in term of energy consumption was done based on four different scenarios. (AODV) protocol is evaluated as the best choice in all most the scenarios compared to the RIPv2 and LAR1 protocols. While LAR1 shows better performance than AODV in static motion as the pause time increase in the fourth scenario. On the other hand, AODV shows better performance than RIPv2 in all the scenarios. This is because of AODV as reactive protocol does not need to maintain route to the destination if there is no data to send.

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