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# PERFORMANCE COMPARISON AND IMPLEMENTATION OF MPRAODV AND AODV IN MOBILE ADHOC NETWORK

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**ABSTRACT**

A mobile ad hoc network (MANET) has no fixed networking infrastructure, and consists of mobile nodes that communicate with each other. Since nodes are mobile, routing in ad hoc networks is a challenging task. Efficient routing protocols can make better performance in such networks. Many protocols have been proposed for ad hoc networks and the most common types are: Ad hoc on-demand Distance Vector (AODV), Dynamic Source Routing (DSR), Optimized Link State Routing (OLSR). AODV is one of the most popular routing protocol dedicated for ad-hoc networks; it uses the flooding technique for locating the destinations, and so, possibly cause an overhead in the network(Perkis 2003). To overcome this problem we have introduced the MPR (Multi Point Relay algorithm(ZHU. W 2009)(B. Mans et al.,2004) in the AODV protocol in order to reduce the number of messages broadcasted during the flooding phase. The extended AODV (MPRAODV) using MPR, reduces the overhead and enhances the packet delivery performance.



## INTRODUCTION

A mobile ad hoc network is a self-organized network of mobile nodes. Without base station support, mobile nodes communicate with each other over a shared wireless channel. Mobility is one of the most important characters of MANET. That means the nodes in a MANET can dynamically join or leave the network frequently, thus the network topology changes rapidly.

In order to keep the routing information available, all the nodes need to know the topological changes occurring anywhere in the network. This implies that the topology information must be updated regularly, which raises the traffic of the whole network.

A MANET is a peer-to-peer network, which allows direct communication between any two nodes, if both nodes are within their radio range. But, unfortunately, often not all the nodes of network are in the radio range of each other to communicate directly, within one hop. Thus multi-hop is used. We call those nodes "intermediate nodes", by which the message sent by source node are relayed to the destination node.

### FLOODING SCHEME IN THE NETWORK

Flooding is one of the most fundamental operations in MANETs. Most of the major routing protocols, like DSR, AODV , LAR, ZRP , etc., rely on flooding for disseminating route discovery , route maintenance, or topology update packets. Flooding is a very frequently invoked function in MANETs. Therefore, an efficient implementation of the flooding scheme is crucial in reducing the overhead of routing protocols and improving the throughput of networks.

Efficient flooding schemes are different from the broadcast mechanisms. The broadcast mechanism is used in transmission of a large amount of data or stream media data. These applications require an efficient broadcast route before the actual transmission of data, so that data can be transmitted efficiently along the pre-found route. In contrast, flooding is usually used in dissemination of control packets, which is a one-off operation and it does not need routing beforehand.

This paper surveys the current works on efficient flooding schemes in mobile ad hoc networks. We classify them according to the information each node keeps when the flooding occurs: 1) no need of neighbor information; 2) 1-hop neighbor information; 3) 2-hop neighbor information. The rest of the paper is organized as follows. Section 2 discusses the pure flooding method .Section 3 discusses routing protocols and Section 4 discusses AODV protocol .Section 5 discusses proposed MPRAODV protocol and MPR algorithm and section 6 discusses performance analysis of MPRAODV and AODV protocol and in Section 7 we conclude the paper.

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## PURE FLOODING

Pure flooding also called blind flooding, is the simplest flooding technique. The basic idea of this approach is every node in the network retransmits the flooding message when it is the first time to receive it. A node, on receiving a broadcast message for the first time, has the responsibility to rebroadcast the message. It costs n transmissions in a network with n nodes. This simple scheme guarantees that a flooding message can reach all nodes if the network is connected and there is no collision.

However, this algorithm will generate excessive amount of redundant network traffic when all nodes in the network are transmitting the flooding message. This will consume a lot of energy of the mobile nodes and also cause congestion in the network. Furthermore, due to the broadcast nature of radio transmissions, there is a very high probability of signal collision when all nodes flood the message in the network at the same time, which will cause more re-transmissions or some nodes to fail to receive the message. In other words, pure flooding can result in some drawbacks in MANETs as following:

- **Redundant rebroadcasts**: When a mobile node decides to rebroadcast a message to its neighbors, all its neighbors already have the message.
- **Contention**: After a node broadcasts a message, if many of its neighbors decide to rebroadcast the message, these transmissions (which are all from nearby nodes) may severely interfere with each other.
- **Collision**: Because of the deficiency of back off mechanisms and the absence of collision detections, collisions are more likely to occur and also cause more damage.

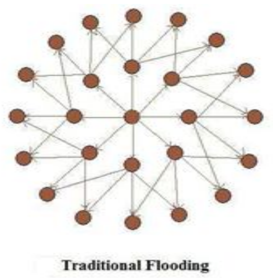


**Fig 1** Traditional Flooding

### Routing in ad hoc networks

The ad hoc routing protocols are divided into two groups: proactive and reactive protocols.

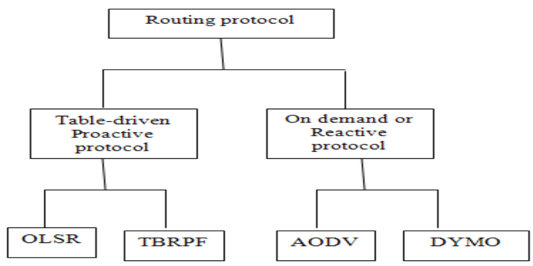


**Fig 2** Types of routing protocol

## PROACTIVE PROTOCOLS

Proactive or table-driven protocols are similar to the ones used in the wired networks. Routes to all destinations are updated periodically. The family of proactive protocols includes basically Destination Sequenced Distance Vector Routing (DSDV),Optimized Link State Routing Protocol (OLSR) and Topology Broadcast Based on Reverse Path Forwarding (TBRPF) DSDV is based on a Distance Vector approach. It associates to each route entry a sequence number indicating its freshness. Routes for each destination are preferred if they have:

1. a newer sequence number, or
2. a best cost metric, in the case that two routes have the same sequence number.

### OLSR Optimized Link State Routing Protocol)

A proactive link state protocol uses the concept of Multipoint Relays (MPR) to reduce broadcasting overhead. Each node chooses a subset of nodes in its neighborhood as its MPRs which forward his broadcast messages during the flooding process. In OLSR, topology information messages are generated only by nodes elected as MPRs (T. Clausen et al.,2003). Only MPR nodes are allowed to forward broadcast messages.

### TBRPF (Topology Broadcast Based on Reverse Path Forwarding)

This is another proactive link state protocol. Each node running TBRPF computes the shortest path tree based on partial topology information (R. Ogier et al.,2004). To minimize overhead, TBRPF nodes use periodic and differential updates to flood only part of their source trees. In order to maintain changing network graph due to incoming, moving or failing nodes, proactive protocols require continuous updates, which may consume large amounts of bandwidth. Moreover, some routes are never used, but they exist in the routing table.

## ON-DEMAND PROTOCOLS

In contrast, reactive (On-demand) protocols determine the route to a destination only when it is required. Thus, a node floods the network with a route request and waits for the route reply message to establish a route to the destination node. This reduces the routing load as compared to the proactive protocols. This technique does not require constant broadcast messages, but causes additional delay since the routes are not usually available. Ad hoc On demand Distance Vector Protocol (AODV) and Distributed Source Routing Protocol (DSR) are the two most popular reactive routing protocols for Ad hoc networks. AODV and DSR include the same two routing phases (route discovery and route maintenance).

### AODV (Ad hoc on demand Distance Vector Protocol)

It uses sequence numbers for every node, in order to ensure that the selected paths will not include loops and the routing information is still valid. DSR employs source routing: the sender of a packet determines the list of nodes which will be traversed by the packet. The sender adds this path in the packet header. Each node in the path should transmit the packet to the next node in this path until it reaches the destination node.

**The Dynamic MANET On-demand (DYMO)**

This routing protocol is another reactive protocol. DYMO similar to AODV protocol but it uses a path accumulation mechanism: each node appends its own IP address to the control packets. The main idea of this paper is to modify AODV taking into account the most interesting and promising features used in the above mentioned routing protocol such as MPR and Multipath. It is an attempt to achieve protocol convergence.

**AODV PROTOCOL**

The Ad hoc On Demand Distance Vector (AODV) routing algorithm is a routing protocol designed for ad hoc mobile networks (Perkis 2003). AODV is capable of both unicast and multicast routing. It is an on demand algorithm, meaning that it builds routes between nodes only as desired by source nodes. It maintains these routes as long as they are needed by the sources. Additionally, AODV forms trees which connect multicast group members. The trees are composed of the group members and the nodes needed to connect the members. AODV uses sequence numbers to ensure the freshness of routes. It is loop free, self- starting, and scales to large numbers of mobile nodes.

AODV builds routes using a route request / route reply query cycle. When a source node desires a route to a destination for which it does not already have a route, it broadcasts a route request (RREQ) packet across the network. Nodes receiving this packet update their information for the source node and set up backwards pointers to the source node in the route tables. In addition to the source node's IP address, current sequence number, and broadcast ID, the RREQ also contains the most recent sequence number for the destination of which the source node is aware.

A node receiving the RREQ may send a route reply (RREP) if it is either the destination or if it has a route to the destination with corresponding sequence number greater than or equal to that contained in the RREQ. If this is the case, it unicasts a RREP back to the source. Otherwise, it rebroadcasts the RREQ. Nodes keep track of the RREQ's source IP address and broadcast ID. If they receive a RREQ which they have already processed, they discard the RREQ and do not forward it. As the RREP propagates back to the source, nodes set up forward pointers to the destination.

Once the source node receives the RREP, it may begin to forward data packets to the destination. If the source later receives a RREP containing a greater sequence number or contains the same sequence number with a smaller hop count, it may update its routing information for that destination and begin using the better route. As long as the route remains active, it will continue to be maintained. A route is considered active as long as there are data packets periodically traveling from the source to the destination along that path. Once the source stops sending data packets, the links will time out and eventually be deleted from the intermediate node routing tables. If a link break occurs while the route is active, the node upstream of the break propagates a route error (RERR) message to the source node to inform it of the now unreachable destination(s). After receiving the RERR, if the source node still desires the route, it can reinitiate route discovery.

**PROPOSED PROTOCOL**

In this paper we implement and optimize an alternative flooding control mechanism, called Multipoint Relay (MPR)(B. Mans et al.,2004), which was first introduced in the Optimized Link State Routing Protocol (OLSR), a proactive routing protocol. In order to use this optimized mechanism, the nodes must perform a proactive control in order to know their two-hop neighborhood. This can be done via the reception of hello messages generating by the nodes and containing their neighbors list. Since two nodes are neighbors when they can see each other address in their respective hellos, this is a very straightforward procedure. In this paper, we will do some comparisons between AODV and AODV with modified MPR under different situations.

We propose, as an extension of the AODV protocol, the introduction of MPR (Multi Point Relay) mechanism. MPR is a flooding mechanism used to reduce the number of broadcasted message for the control; in order to limit the flow on the network by selecting a small number of nodes which will be the only ones allowed disseminating messages on the network (ZHU. W 2009) (B. Mans *et al.,* 2004).

**MULTIPOINT RELAY FLOODING**

Multipoint relay flooding is a broadcast mechanism used in the ad hoc routing protocol AODV. The principle is that each node has computed a multipoint relay set, and only these selected neighbors, will retransmit a packet broadcasted by the node. Obviously, the smaller this set is, the more efficient the mechanism will be (i.e., the greater the optimization).

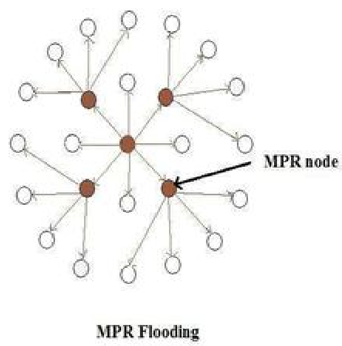


**Fig 3** The MPR flooding algorithm

Fig. 3 shows both a traditional flooding algorithm and the MPR flooding algorithm. Here we see that there is a reduction in the number of transmissions by using MPR flooding.

**1. Using the traditional flooding**:

• A source node u broadcasts message M.

• Each node v that receives the message forwards M unless it has been previously forwarded.

**1. Using MPRs for flooding leads to scoped flooding.**

In this case:

• A source node u broadcasts its message M.

• Each node v that receives M re-broadcasts it only if:

(a) v is a multipoint relay of the previous hop of the message;

(b) The message was not previously received by v.

In MANETs, packets can be forwarded on the same interface that it arrived on. Instead of pure flooding where all nodes retransmit all packets, with Multipoint Relays (MPR) packets are forwarded only by the node's MPRs in order to reduce the number of transmissions that are needed to successfully deliver the packets. A MPR set is a subset of a node's one-hop neighbors, such that together these subsets are able to reach all the two-hop neighbors. In order to calculate the MPR set, the node must have link state information about all one-hop and two-hop neighbors (B. Mans *et al.,* 2004).

Let N1 (u) denote the set of one-hop neighbors of u, and N2(u) denote the set of 2nd-hop neighbors of u.

1. Start with an empty MPR set MPR(u).
2. Select those one-hop neighbor nodes in N1(u) as multipoint relays which are the only neighbor of some node in N2(u), then add these one-hop neighbor nodes to the multipoint relay set MPR(u).
3. While there still exist some nodes in N2(u) which are not covered by the multipoint relay set MPR(u):
   - For each node in N1(u) not in MPR(u) compute the number of the nodes that it covers among the uncovered nodes in the set N2(u).
   - Add that node of N1(u) in MPR(u) for which this number is maximum.

While introducing the MPR mechanism, we make three changes on the AODV protocol:

**Hello-message function**

In this part, a node determines its one-hop neighbors, and regroups them in a table to be used once it wants to send a message, so we have introduced a small program to calculate or group node's two-hop neighbors; each time a node adds a neighbor, it must insert the neighbors to that neighbor in the table to represent these two-hop neighbors. Also, the node uses HELLO message to inform neighbors which are elected as MPR.

**Send request function**

It represents the most important change to make, because here we introduce the MPR algorithm. The algorithm is performed just before sending the route discovery request. When a node needs to obtain a route to a destination, must first calculate its own MPR points then launch the request, following the next three steps.


1. Start with an empty MPR set MPR(u).
2. Select those one-hop neighbor nodes in N1(u) as multipoint relays which are the only neighbor of some node in N2(u), then add these one-hop neighbor nodes to the multipoint relay set MPR(u).
3. While there still exist some nodes in N2(u) which are not covered by the multipoint relay set MPR(u):


- For each node in N1(u) not in MPR(u) compute the number of the nodes that it covers among the uncovered nodes in the set N2(u). .
- Add that node of N1(u) in MPR(u) for which this number is maximum.

**Forwarding request block:**

This is a small change done by adding a simple condition in the block transmission request. Once a node receives a route discovery request, it will check if it is the requested destination or not. If it isn't the destination, and there is no direct route in its possession to the destination, then instead of broadcasting the request to all its neighbors, it will first check if it is MPR node and it will broadcast only if it is MPR node.

Below is an outline of the forwarding mechanism:

**Receive request**

```
If receiver is the destination node then
        Reply request
Else
      If receiver is a MPR node then
            Broadcast request to this neighbors
      end
end
```

## PERFORMANCE ANALYSIS RESULTS

**Simulation environment**

The simulation experiment is carried out in LINUX (FEDORA 6). The detailed simulation model is based on network simulator-2 (ver-2.34), is used in the evaluation. The NS2 instructions can be used to define the topology structure of the network and the motion mode of the nodes, to conFig. the service source and the receiver, to create the statistical data track file and so on.

The studied scenario consists of 25 mobile nodes. The topology is a rectangular area with 800 m length and 500 m width. A rectangular area was chosen in order to force the use of longer routes between nodes than would occur in a square area with equal node density. All simulations are run for 25 seconds of simulated time. All mobile nodes are constant bit rate traffic sources. They are distributed randomly within the mobile ad hoc network. The sources continue sending data until one second before the end of the simulation.

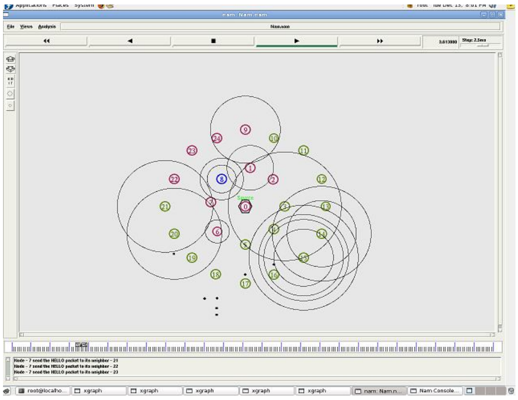

**Fig 4** Screenshot for AODV

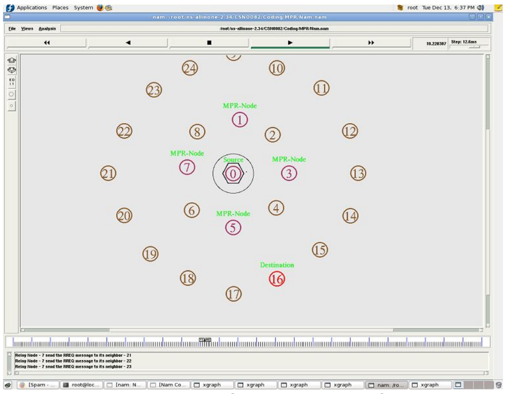


**Fig 5** Screenshot for Creation of MPR Node

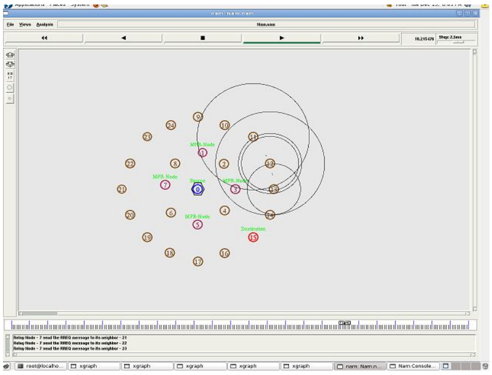

**Fig 6** Screenshot for MPRAODV

**Parameters**

The parameters that are common for all simulations and the parameters that are specific for some simulations are shown in table.

**Table 1** Parameter Value

| Transmission range | 250 m |
|---|---|
| Simulation time | 25s |
| Topology size | 800m x 500m |
| Number of nodes | 25 |
| Number of source | 1 |
| Traffic type | CBR(Constant Bit Rate) |
| Packet rate | 5 packets/s |
| Packet size | 512 bytes |
| Maximum speed | 20 m/s |

## PERFORMANCE METRICS

The performance of MPRAODV protocol is evaluated based on the following metrics:-

**Packet delivery ratio:**

It is the ratio between the numbers of packets received on those sent. .ie It is the ratio of data packets delivered to the destination to those generated by the sources. It is calculated by dividing the number of packet received by destination through the number packet originated from source.

$$PDR = (Pr/Ps)*100$$

Where Pr is total Packet received & Ps is the total Packet sent.

**Average Delay:**

It is the average time of packet delivery from source to destination; with a smaller time, the network performances will be better. It is defined as the time taken for a data packet to be transmitted across the MANET from source to destination.

$$D = (Tr - Ts)$$

Where Tr is received Time and Ts is sent Time

**Throughput**

Throughput refers to how much data can be transferred from one location to another in a given amount of time. Unit of throughput is bits/sec or packets/sec. Throughput in aspect of MANET is affected due to topology change, bandwidth etc.

It is the rate at which network send or receive data. It is rated in term of bits or packets per seconds. It is the sum of data rates that are delivered to all nodes in MANET.

$$Throughput = Pr/Pf$$

Where Pr is the total number of received packets and Pf is the total number of forwarded Packets.

**Packet Loss**

It occurs when one or more packets fail to reach to their destination.

$$Packet\ Loss\ \% = (1-Pr/Ps)*100$$

Where Pr is total number of received packets and Ps is total number of sent packets.

**Energy**

When a node sends or receives a packet, the network interface of the node, decrements the available energy according to the Following parameters: (a) the specific

NIC (Network Interface Card) characteristics, (b) the size of the packets and (c) the used bandwidth.

Transmitted Energy: Tx Energy = (Tx Power* Packet Size)/$2\times10^{6}$

Total energy consumed by each node is calculated as sum of transmitted and received energy for all control packets.

**Packet delivery ratio**

PDF is the ratio between the numbers of packets originated by the application layer sources and the number of packets received by the sinks at the final destination. It will describe the loss rate that will be seen by the transport protocols, which in turn affects the maximum throughput that the network can support. In terms of packet delivery ratio, MPRAODV performs well .However its performance declines with increased number of nodes due to more traffic in the network.. The performance of AODV is better at the beginning and decreases slightly with increase in number of nodes.

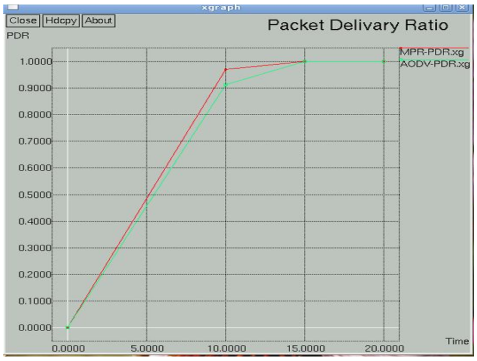


**Fig. 7** Packet Delivery ratio

**Average Delay**

The delay is affected by high rate of CBR packets as well. The buffers become full much quicker, so the packets have to stay in the buffers a much longer period of time before they are sent. For average end-to-end delay, the performance of MPRADOV decreases and varies with the number of nodes. However, the performance of AODV is degrading due to increase in the number of nodes the load of exchange of routing tables becomes high and the frequency of exchange also increases due to the mobility of nodes. The performance of MPRAODV decreases and remains constant as the number of nodes increases.

**Packet Loss**

It is the number of data packets that are not successfully sent to the destination. In terms of dropped packets, AODV's performance is the worst. The performance degrades with the increase in the number of nodes. As the number of nodes increases the number of packets dropped increases which means that number of packets not successfully reaching the destination has also increased.

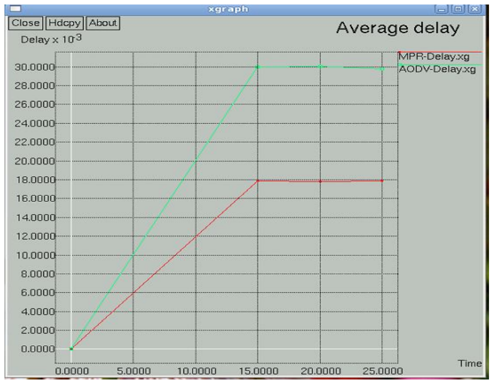


**Fig. 8** Average Delay

**Throughput**

Another important quality of communication networks is the throughput. It is defined as the total useful data received per unit of time. Fig.s 9 illustrate the comparison of throughput for MPRAODV and AODV, 25 nodes in specific are spaces. In this metric, the throughput of the protocol in terms of number of messages delivered per one second (Mbps) is analyzed. In Fig. 9 the MPRAODV provides highest throughput than AODV. More routing packets are generated and delivered by MPRAODV than AODV.

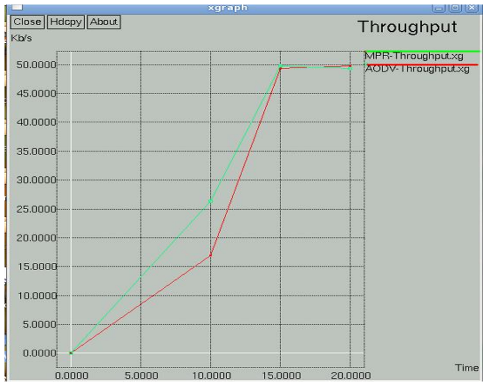


**Fig.9** Throughput

MPRAODV performs consistently well with increase in the number of nodes. The number of packets dropped is negligible which means that almost all packets reach the destination successfully. The packet dropped is much less compared to performance of AODV.

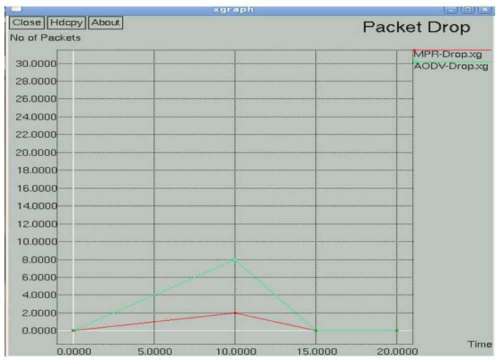


**Fig.10** Packet Loss

**Energy**

Fig. 11 shows the total transmission and receiving energy. The energy consumed mainly due to receiving process. When number of nodes is low, the transmitting energy is more. When number of nodes is high, all traffic type consumed similar amount of energy.

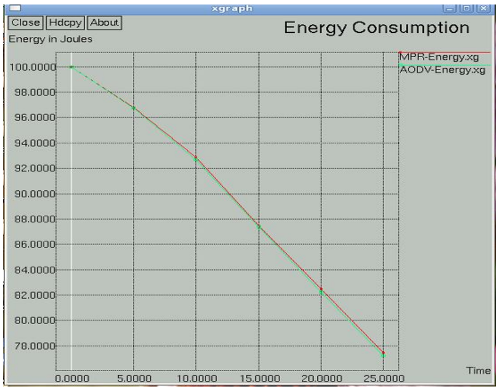


**Fig. 11** Energy Level

## CONCLUSION

In this paper, we proposed an improvement of the AODV routing protocol for MANETs by the introduction of MPR mechanism. Compared to the performance of AODV, our solution called MPRAODV performs much better than AODV in case of high density networks. Considering great speeds, MPRAODV operates better than AODV. In this paper, we found that the current AODV protocol has major control overhead which is caused by "Route Query" flood packets. We have improved the AODV routing protocol by reducing routing overhead using an efficient flooding technique – multipoint relay. This technique selects the dominated nodes through out the entire network to forward route query flood packets. From the results of our simulations, we found that MPR technique optimized the original AODV protocol.

## References

Perkins. C, Belding-Royer E., and Das S. Ad hoc On-Demand Distance Vector (AODV) Routing , Network Working Group, July 2003.

ZHU. W.Multipoint Relay flooding Master of Science Thesis Stockholm, Sweden TRITA-ICT-EX- 2009

HAAS, Z., PEARLMAN, M and SAMAR, M. The Zone Routing Protocol (ZRP) for Ad Hoc Networks IETF Internet draft, draft-ietf-manet-zone-zrp-04.txt, July 2002.

Johnson, D. B., Maltz, D. A., Hu, Y and Jetcheva, J. G. The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks (DSR) Feb 2002.

Chakeres, D., Belding-Roye, E., Perkins., C. Dynamic MANET On-demand Routing Protocol (DYMO), 2005.

Perkins, C. E and Bhagwat, P. Highly Dynamic Destination Sequenced Distance-Vector Routing (DSDV) for Mobile Computers. In Proc. of ACM SIGCOMM, pages 234244, 1994.

Clausen, T and Jacquet, P. Optimized Link State Routing Protocol (OLSR). http://www.ietf.org/rfc/rfc3626.txt, 2003, RFC 3626.

Ogier, R., Lewis, M and Templin, F. Topology Dissemination Based on Reverse-Path Forwarding (TBRPF). 2004, RFC 3626.

Mans, B and Shrestha, N. Performance Evaluation of Approximation Algorithms for Multipoint Relay Selection. In Proc. Of Med-Hoc-Net, pages 27-30, June 2004.

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