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Implementation of Energy Efficient AODV Protocol for Manet

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***Abstract*— A Mobile ad hoc network (MANET) is continuously self-configuring and infrastructure-less network of mobile devices connected without wires. Each node in a MANET is free to move in any direction independently, and will therefore change its links frequently to other devices which results in power failure of a node. In order to increases the power efficiency of the AODV, we proposed an Energy Efficient AODV protocol(EEAODV) which works based on Received signal strength (RSS) of a node. Suppose the RSS is high enough than the threshold , then the nodes are closer and thereby lesser transmission power is required to send the data which in turn increases the life-span of the node. Therefore maximizes the network lifetime. Simulation using NS-2 and results show that the proposed EEAODV is better in energy efficiency than the existing AODV protocol.**

Keywords- ad-hoc networks, throughput, jitter, end-to-end delay, AODV, EEAODV.

I. INTRODUCTION

Mobile Ad-hoc network (MANET) is one type of the wireless network in which it may form temporary network by a collection of network interfaces without using fixed infrastructure. Each node acts like a router as well as host in MANETs. The applications of MANET are in decision making in the field of battle, emergency search and rescue operations, and data acquisition operations in hostile terrain, etc., and features are Multi-hop communication, limited resources such as bandwidth, cpu, battery, etc., dynamic topology (infrastructure-less) and limited security. AODV protocol[6], only optimize the routing with lowest delay but does not consider the power usage of node so the main objectives of MANET is to maximize the energy efficiency, because nodes in MANET are depends on limited energy resources. Therefore from the perspective of energy, the shortest path is not always the efficient and best path. If the same paths are being used repeatedly then the nodes energy will be consumed quickly and they may exhaust their batteries faster along these routes. To overcome this, we proposed an energy efficient AODV (EEAODV) protocol which increases the battery lifetime of MANET nodes by reducing the transmission power of the nearby nodes which in turn reduces the total energy consumption by all nodes compared to existing AODV. In recent years, reducing power consumption in ad-hoc networks has been increased more attention among researchers. In order to implement energy efficient routing protocol for MANET, many researchers has been done literature review for energy aware routing protocols for MANETs.

The work in [1], proposed a new protocol EERP (energy efficient routing protocol) which reduces the transmission power of a node if the nodes are closer based on received signal strength (RSS). Simulation has been carried out using Qualnet 5.0.2.

In paper [2], proposed algorithm which tries to establish balance energy among the nodes and the proposed routing protocol is EEAODR (Energy efficient Ad-hoc On-Demand routing) and it also provides a mechanism by which an Administrator can adjust parameters of energy and time saving. For example, at the start the Administrator may have a routing policy for time saving and after some duration, they might switch to energy saving. The simulation results show that EEAODR consumed less energy compared to AODV but EEAODR does not perform well in the beginning as compared to AODV.

In paper [3] surveys and classifies an energy efficient routing protocols and this work classifies a number of energy aware routing schemes.

The work done in [4], used an Energy Mean Value Algorithm which works based on node energy in order to improves the networks lifetime in MANET and the proposed protocol is Enhanced AODV. The simulation has been carried out using NS-2 with comparison of network lifetime of the Enhanced AODV with existing AODV at different speeds.

In [5], the proposed work based on setting the minimum energy threshold limit of a mobile node, when a node reached up to the threshold limit the node goes to sleep mode, save energy and join in the event as long as possible. A wireless Ad-hoc network consumes less power in sleep mode in idle mode. While in sleep mode, no packets can be sent or received.

In [6], used hello packet broadcast mechanism in order to reduce the routing overhead and also improve the efficiency. The proposed EEAODV protocol is an another attempt to provide an

energy efficient mechanism in mobile ad hoc network and in this protocol, the transmission power of the nearby nodes are reduced which in turn increased the battery lifetime of MANET nodes.

II. Routing Protocols

A. Table driven (Proactive) Routing Protocol

Table driven protocols also called as proactive protocols in which, the route to all the nodes is maintained in routing table. Packets are transferred based on the predefined route and specified in the direction-finding table. In this protocol, the routing overhead is greater and lower latency because of all the routes have to be distinct before transferring the packets and all the routes are maintained at all the times. For Example: DSDV (Destination sequence distance vector)[8], WRP (Wireless routing protocol), etc.

B. Reactive (On-Demand) Routing Protocol

In this protocol there is a route discovery mechanism from the source node to the destination node in order to find the route when the source node has to send the data packets. If a route is found, then this route is initiated to maintain until it is no longer required. The main advantage of this protocol is overhead messaging is reduced. The types of reactive routing protocols are Dynamic Source Routing (DSR)[7], Ad-hoc On-Demand Distance Vector routing (AODV). AODV has more advantage than DSR protocol but it has one main disadvantage is AODV consumes more energy during route discovery process so in order to overcome this EEAODV is proposed in this paper.

C. Hybrid Routing Protocol

A hybrid protocol is based on combinations of both reactive and proactive protocols and in this protocol routes are found quickly based on routing zones. Example: ZRP (Zone routing protocol).

III. ROUTING ALGORITHM

A. Existing AODV routing algorithm

Three phases of operation in AODV routing protocol are

A(a). Route establishment:

In this phase, it will generate the route request (RREQ) packet to discover the best shortest path. It consists of two processes:

Generate RREQ's

Processing and forwarding RREQ's.

A(b). Route handling:

This phase handles the generated route request packets. After establishing the route all the packets will be sent to the destination through the same route. It consists of two processes:

Generating RREP's.

Receiving and forwarding RREP's.

A(c). Route Termination:

It will explain about when the route will terminate. If there will be any error in the route then route error packet is sent to the sender and intermediate nodes will indicate alternative path to recover from the error. This is explained in the route error message, route expiry and route deletion process [3].

B. Proposed AODV routing algorithm (EEAODV)

In order to make AODV energy efficient, all the three phases of AODV protocol have been modified for this purpose.

B(a). Route establishment:

In route establishment phase, the modifications has been done in processing and forwarding RREQ's which includes comparison of current threshold value of RSS with the received signal value. This comparison will decide whether this node will work as forwarding node or not.

B(b). Route handling:

In route handling phase, changes have been made in processing and forwarding route reply process. Here, the current RSS value of signal is compared with the threshold value. On the basis of it, transmission power of nearby node is reduced in the route reply phase.

B(c). Route Termination:

In the route termination phase, modifications have been made in route expiry process which in turn resets the transmission power of node [3].

IV. Results

The performance of EEAODV is evaluated using NS2 and compared with existing AODV. Here first we describe how to calculate the RSS value and then the simulation environment is described and the simulation results are discussed with comparison. The RSS value is calculated with the help of two ray ground model and the performance parameters viz. residual battery, throughput, end to end delay and jitter, packets received, energy consumed of existing AODV and EEAODV are compared. The simulation parameters are listed in Table 1.

Table 1: Simulation Parameters

Parameter	Value
Coverage area	1500m x 1500m
Mac layer protocol	IEEE 802.11
No. of nodes	20
Packet size	512 bytes
Routing protocol	AODV/EEAODV
Simulator	NS-2(2.35)
THRSS	-75(dbm)
Simulation Time	1000sec

To evaluate the performance of proposed algorithm a scenario of 20 nodes with 2,4,6,8 and CBR (constant bit rate) links have been created. In order to enhance the AODV protocol, here we set the RSS threshold (THRSS) to -75(in dbm) an extensive and rigorous simulation has been performed to evaluate this threshold value for RREQ and RREP phase for the proposed EEAODV algorithm.

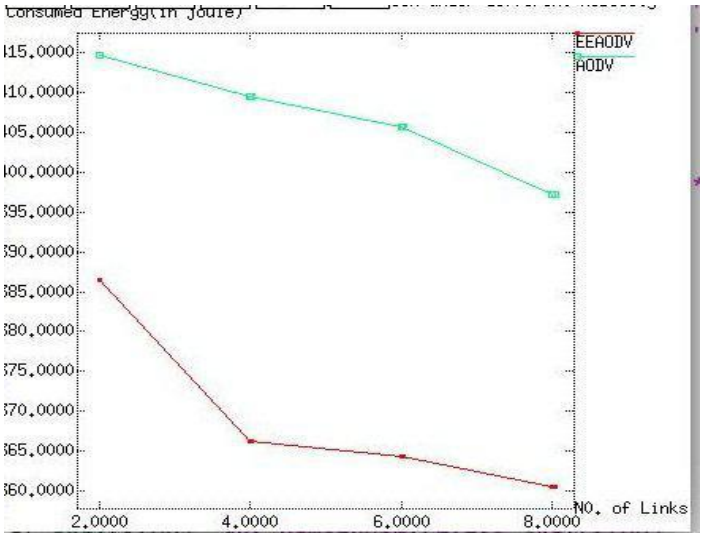

Fig 1.Consumed energy (joule) versus Number of links

Fig 1 shows Consumed Energy as a function of number of links. It is found that as the number of links increases the consumed energy of the network is lesser in EEAODV as compared to existing AODV. In case of EEAODV, lesser transmission power is used to send data if the node is closer, therefore consumed energy is lesser as compared to AODV.

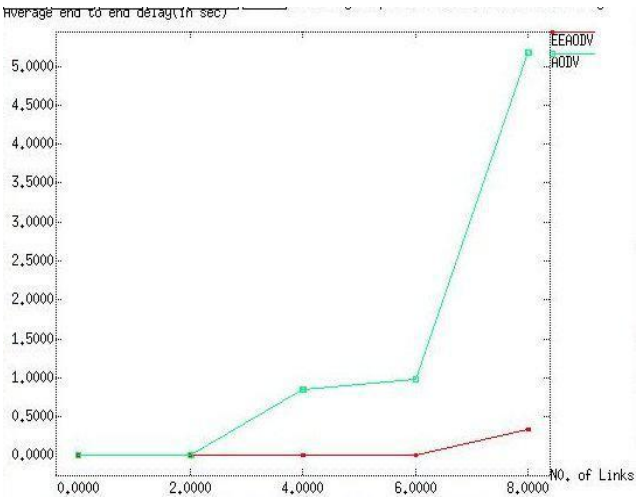

Fig 2. Average End-to-End Delay(sec) Vs Number of Links

Fig 2 illustrates the result for average end-to-end delay as a function of number of links. It is observed that delay in EEAODV is decreasing as compared to existing AODV. This is due to fact that the node in the EEAODV uses lesser transmission power for transmission. This result in decreased interference in the network hence the channel will remain idle for more time and the other network nodes will be able to transfer the packet at faster rate and they can reach up to the destination with lesser delay or at a faster rate.

The Fig 3 depicts the throughput with the number of links. It clearly shows that throughput of EEAODV is better as compared to AODV. As we conclude from Fig 3 that EEAODV offers lesser delay and a low delay in the network translates into higher throughput.

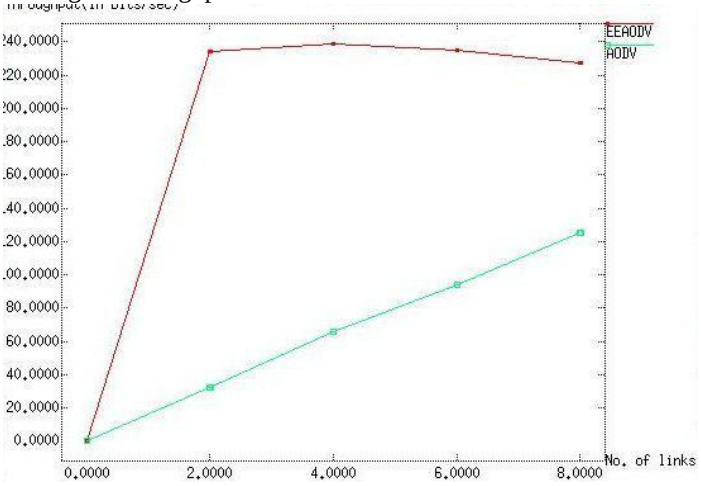

Fig 3. Throughput (in bits/sec) versus Number of Links

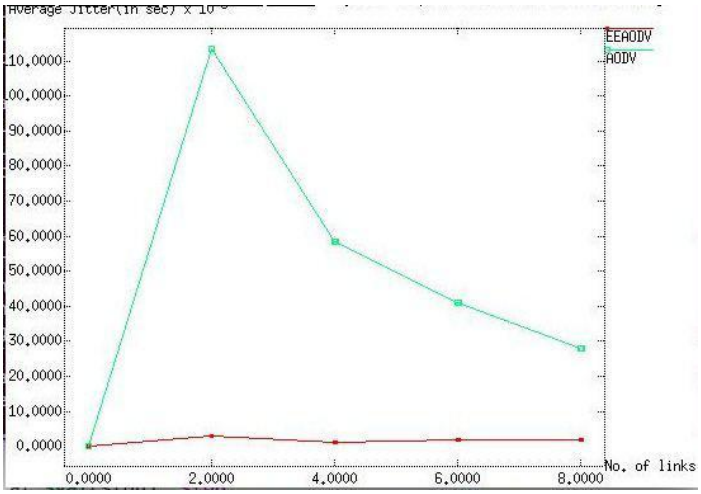

Fig 4. Average Jitter (sec) versus Number of Links

Fig 4 shows the graph for average jitter versus the number of links. It depicts that the time interval between two successive packets is greater in AODV as compared to EEAODV. In case of EEAODV, due to less interference the availability of Bandwidth or channel is more. It results in lesser time difference between packets arrival at the receiver which, in turn reduced jitter.

V. CONCLUSION

Power consumption reduction in ad-hoc networks have been increased attention among researchers in recent years. Since a node is used as a host and as well as a router, so design of an

energy efficient routing protocols must address reducing of power consumption from the view point of the node and the network. Although energy efficiency is not the design goals of MANET routing protocols, each routing protocol reacted in a different way with energy aware metrics. This is mainly due to the route discovery and maintenance mechanisms of these routing protocols. we evaluate the energy efficiency of existing well known MANETs routing protocols viz. AODV. We propose mechanism which provides energy efficient algorithm for AODV routing protocol. The mechanism reduces the transmission power of a node which is part of an active route if next hop node is closer. The received signal strength can be calculated based on distance calculation between two succeeded nodes. In request phase, suppose the RSS is higher than the threshold value then that node will consider as forwarding the packet. In reply phase, suppose the RSS is high enough than the threshold , then the nodes are closer and thereby lesser transmission power is required to send the data which in turn reduces the battery consumption. This power efficient routing mechanism is incorporated into AODV and provided EEAODV. Transmission power control which reduces interference extend the battery lifetime of the network. The simulation has been done in NS-2 and the performance parameters values have been evaluated. For evaluation analysis, some parameters are being considered to compare both AODV and proposed EEAODV such as residual battery and throughput which is increasing. Average jitter and delay is decreasing. Consequently EEAODV is better than existing AODV. EEAODV improves the performance of route selection of AODV due to the fact that it minimizes the interference as a result of transmission power control.

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