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Performance Analysis of Optimize AODV and AODV Routing Protocol

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Abstract: An Ad-hoc mobile network is a collection of wireless mobile hosts forming a temporary network without the aid of any established infrastructure or centralized administration hence lacking of permanent source of energy. To fulfill the energy requirement independent mobile devices are entirely dependent on battery power. One of the most widely used reactive protocols is AODV. In AODV there is two phases called route discovery and route maintenance.
In the conventional AODV routing protocol, in the route Discovery phase, source node forward the route request message (RREQ) to find out path to the destination node. The intermediate nodes having less lifetime or energy also forward RREQ but after expiring their lifetime they are unable to send route reply message which results unnecessary RREQ rebroadcast, less packet delivery ratio (PDR) as well as throughput & more end to end delay. Solution to above problem is given in this paper, in optimize-AODV routing protocol the node does not forward RREQ unless there is sufficient energy (battery lifetime), and until the node density in its surrounding exceeds a particular threshold. The Result obtained using the network simulator NS-2 demonstrates how little changes in the principle of the AODV protocol can completely balance utilization among mobile devices of the network which increases the packet delivery ratio as well as increase the throughput.

Keywords: Mobile Network, AODV, Energy Efficient routing protocol, battery lifetime, QoS.

I. INTRODUCTION

A mobile Ad-hoc Network (MANET) is a kind of infrastructure less wireless ad-hoc network, and is the collection of mobile nodes where the nodes will self-configure and self-optimize themselves of mobile routers connected by wireless links. In infrastructure less wireless networks, there is no need to use a base station each node acts as a router. These routers are free to move randomly and organize themselves arbitrarily; thus the network's topology may change rapidly and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger internet. It is also expected to play an important role in civilian forums such as campus recreation; conferences, electronic classrooms, military; earthquake etc. due to mobility of nodes, the topology of the network may changes hence conventional protocol for wired network is not suited for ad hoc networks. There is need to design new protocol to work in wireless medium. MANET routing protocols could be generally classified into two main categories based on the routing information update methods. **Proactive Protocol** are called table driven routing protocols in which, all the route information is maintained in routing table. The packets are transferred over the network in the manner of specified and predefined route in the routing table. In this method, the packets forwarding is done faster but the routing overhead is greater because all the routes have to be defined before transmitting the data and control packets.

Reactive Routing Protocol are based on a number of sort of query-reply dialog. In this protocol network maintain only the route that is currently in use at any time. This type of protocol is also called on demand routing protocol where the routes are not before defined for routing. MANET is becoming popular because of simple deployment and less cost of IEEE802.11 standard. Mobile node can be PDA (personal digital assistant), laptops, digital camera, mobile phones etc. which operate on finite and decreasing battery life. Therefore these node need to be energy conserved to maximize the battery life. Reactive protocol has gained more significance as they decrease routing overhead and use less energy. AODV is a reactive routing protocol which usually use in Mobile ad-hoc networks.

2. RELATED WORKS

In 1996, David Johnson and David Maltz [1] proposed DSR which is a reactive routing protocol. Unlike DSDV, DSR starts path finding process only when there is a demand. Source routes are carried out in each data packet. Two mechanisms are involved i.e. route discovery and maintenance.
In the early 2000s, researchers focused on the development of basic functions or services of the AODV protocol, such as shared channel, route discovery, and dynamic nodes. The purpose of their studies was to manage an ad hoc network topology that always change and answer the problem of disconnected route (route error) caused by the level of mobility [2].
In 2001, C. E. Perkins, E. M. Royer and S. Das [3] proposed Ad hoc On Demand Distance Vector (AODV) routing protocol which functions similar to DSR protocol.

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But, instead of carrying out source routes in each packet as in DSR, AODV maintains route table entries at intermediate nodes. AODV also maintains destination sequence number to avoid loop problem. AODV works efficiently for large number of nodes which is not the case for DSDV.

This paper tells that, reducing power consumption and efficient battery life of nodes in an ad hoc network requires an integrated power control and routing strategy. The power control is achieved by new route selection mechanisms for MANET routing protocols. In 2005, K. Murugan and S. Shanmugavel [4] proposed Energy Based Time Delay Routing (EBTDR) and Highest Energy Routing (HER). These algorithms try to increase the operational lifetime of an ad hoc network by implementing a couple of modifications to the basic DSR protocol and making it energy efficient in routing packets. The modification in EBTDR is such that if the nodes' remaining energy is less, then packets are forwarded after some time i.e. delay is introduced. If nodes' remaining energy is high then packets are forwarded immediately i.e. there is no concern of delay. In HER, the route selection is based on the energy drain rate information in the route request packet. It is observed from the simulation results that the proposed algorithms increase the lifetime of mobile ad hoc networks, at the expense of system complexity and realization.

In 2008, Thriveni and et al. [5] proposed an algorithm to improve the flooding performance of an Ad Hoc on Demand Distance Vector (AODV) routing protocol called, Probabilistic Mean Energy Flooding (PMEF) which periodically performs an averaging. As the word Mean Energy is there, algorithm calculates average energy say Eavg. Remaining energy is also calculated called Er. Route selection depends on the probability which is drawn on the basis of difference between residual energy Er and mean energy Eavg. This algorithm is used in route discovery process to make a rebroadcast decision by the node. If, nodes does not have sufficient energy, then rebroadcasting of packet is not done. As compared to the existing AODV, proposed schemes in forwarding a route request are more effective in reducing the flooding overhead and increase the network lifetime and throughput thereby decreasing the network latency.

In [7], Yumei Liu, LiliGuo, Huizhu Ma and Tao Jiang propose a multipath routing protocol for mobile ad hoc networks, called MMRE-AOMDV, which extends the Ad Hoc On-demand Multipath Distance Vector

(AOMDV) routing protocol. The key idea of the protocol is to find the minimal nodal residual energy of each route in the process of selecting path and sort multi-route by descending nodal residual energy. Once a new route with greater nodal residual energy is emerging, it is reselected to forward rest of the data packets. It can balance individual node's battery power utilization and hence prolong the entire network's lifetime.

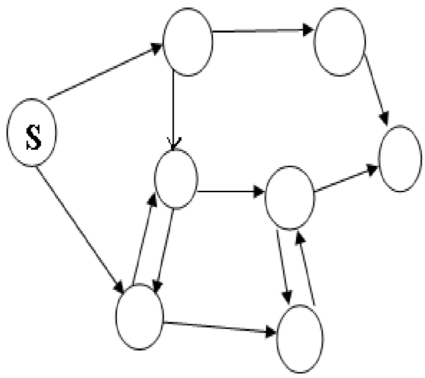
In [8], Zhang Zhaoxiao, Pei Tingrui and Zeng Wenli propose a new mechanism of energy-aware routing named EAODV, which is based on the classical AODV protocol. Here a backup routing mechanism is adopted. In EAODV, the route which spends less energy and owns larger capacity is selected by synthetic analysis.

AODV – Ad-hoc on demand routing protocol

AODV is one of the routing protocols used in Ad- hoc network. In AODV, the network is hushed until a connection is needed. AODV has two phases to i.e. **Route request** and **Routemaintenance** At that fact the network node that requires a connection broadcasts a route request (RREQ) for connection. Route maintenance require when links breaks occurs due to the mobility and topology changes.

Route Discovery:

As stated before, route discovery in AODV is done on demand and it follows a route request / route reply discovery cycle. Whenever a route is needed between two nodes, the originator node broadcasts a route request (RREQ) across the network. Nodes that receive this RREQ will update their information for the originator node in question and set up backward pointers to the originator node in their route tables (reverse route) is set up in order to forward a RREP. Packet back to the originator from the destination or from an intermediate node having a route to the destination.



Route discovery process

RREQ contains the most recent Destination Sequence
RREQ contains the most recent Destination Sequence
Number of which the originator node is aware. A nodethat receives the RREQ message may unicast a routereply back to the originator nodeif: immediate neighbor is the destination or the other node if it has a "freshenough" route to the destination (correspondingsequence number greater than or equal to thatcontained in the RREQ). Otherwise, the node willrebroadcast the RREQ. All nodes keep track of thoseRREQs they have already seen (Originator IP Address– RREQ ID pair). If the same RREQ is received again, it is silently discardedNumber of which the originator node is aware. A nodethat receives the RREQ message may unicast a routereply back to the originator nodeif it is the destination or another if it has a "fresh enough" route to the destination (corresponding sequence number greater than or equal to that contained in the RREQ). Otherwise, the node will rebroadcast the RREQ. All nodes keep track of those RREQs they have already seen (Originator IP Address– RREQ ID pair). If the same RREQ is received again, it is silently discarded.

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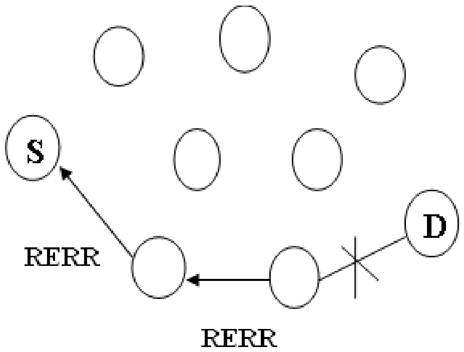
Route maintenance:
Routes are maintained as long as they remain active (as long as there is frequent enough data traffic to the destination). When traffic to a destination stops, the route will time out and eventually it will be deleted from the route table. If a link break occurs while the route is still active, a route error message to the originator node is sent by the node that is closer to originator node. RERR message includes information on the now unreachable destinations. If the originator node still needs routes to these destinations, it can reinitiate route discovery.



RERR MESSAGE

AODV problem statement:
In the conventional AODV routing protocol mechanism, RREQ messages send by the source node to its neighbours is on demand i.e. a node broadcast a RREQ message to its neighbours when it wants to communicate with a destination node. If intermediate nodes' lifetime is less, that node expires after sometime. Thus it may not be able to forward the RREP message on the reverse path. Hence the source node would have to rebroadcast the RREQ message in order to find a path for communicating to the destination node. This may cause congestion to network, decrease the packet delivery ratio, increase the end to end delay and unnecessary rebroadcasting of RREQ packets.

Optimized Ad- hoc on demand routing protocol (OAODV):
The routing algorithm which is adopted by optimized Ad-hoc distance vector protocol (OAODV) has enhanced the energy is mobile devices. Optimized AODV considers some level of energy as the minimum energy which should be available in the node to be used as an intermediary node (or hope). When the energy of a node reaches to or below that level, the node should not be considers as an intermediate node, until and unless no alternative path is available. The intermediate node doesn't forward the RREQ message immediately if there is route to destination. In fact, it will first check its lifetime and calculate the node density in its surrounding. Second parameter is taken into consideration because there should be sufficient number of nodes to forward RREQ. It must compare its remaining energy of one node with that of the other node; it finds the node that has maximum energy and it rebroadcast the request to that particular neighbor node.
As soon as the destination receives the first RREQ packet, it transmits a RREP towards the source.

The treatment of this RREP packet by the source is identical to that of AODV. But we modified this scenario by using the concept of remaining energy of nodes.

Energy calculation:
Nodes involved in the delivery process of packets losses some energy after each transmit and receive. Let TP be the transmit Power forone packet, TT be the transmit Time of onepacket, so, the amount of energy ET consumedduring transmission of one packet will be:-

$$ET = TP \times TT \quad (1)$$

Hence, Remaining Energy Enew of node will be,

$$E_{new} = E_{curr} - ET$$

Similarly, let RP be the receiving Power for onepacket, RT be the receiving Time of one packet, the amount of energy ER consumed during receiving of one packet will be:-

$$ER = RP \times RT$$

Hence, Remaining Energy Enew of node will be,

$$E_{new} = E_{curr} - ER$$

With these calculations energy of the node at any interval of time can be calculated [14].

3. RESULT AND SIMULATION

Network simulator with 2.35 versions on Ubuntu 14.04 operating system for the simulations. As stated earlier, comparative analysis of AODV and optimized AODV protocol perfomed.

Simulation parameters:
- Transmission range: 500 meter
- Carrier sensing range : 500 meter
- Simulation time : 150 sec
- Number of nodes : 30, 40, 50
- Topology area : 500 x 400 meter
- Mobility model : random way point
- Traffic time : TCP
- Maximum speed : 20 m/s
- Packet size : 512 byte for TCP
- Initial energy : 90 Joules
- Pause time : 2 sec
- Type of antenna : omnidirectional
- Channel type : wireless channel
- Maximum packet in queue : 50
- Radio propagation model : two ray ground
- Interface queue type : Drop Tail/ priQueue
- Network interface type : Wireless Phy

Evaluation Metrics:

Battery lifetime:

Battery lifetime of node is the remaining energy which is contain by the node

Remaining energy = Initial Energy- consumed energy

Energy consumption in OAODV is less compare to the AODV energy consumption because each node is aware of its energy constraints for making a communication.

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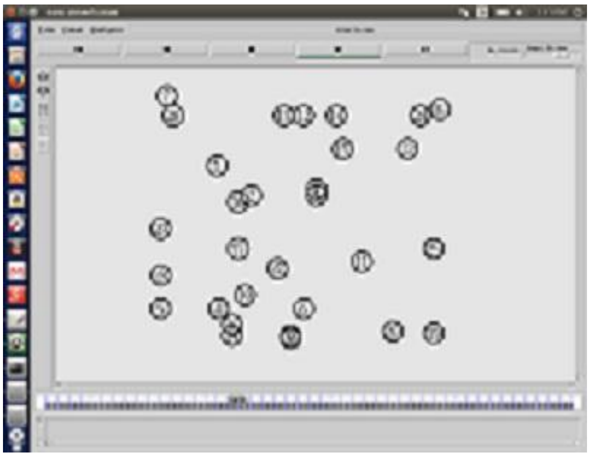
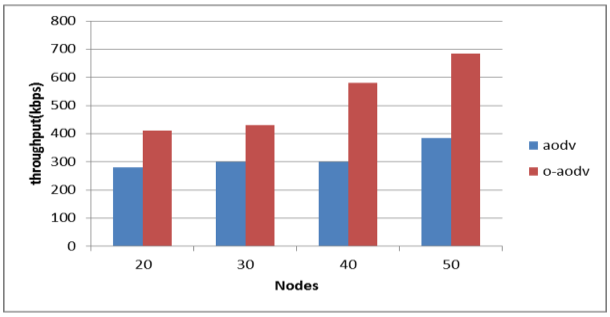


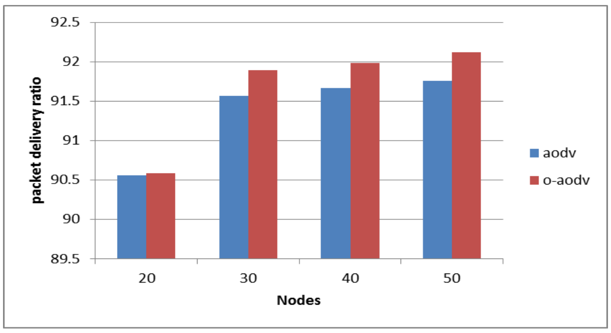
Throughput:

It is the amount of data moved successfully from one place to another in a given time period. Analysis on various scenarios based on different number of nodes is performed. Simulation result indicates that the proposed scheme provides enhanced performance. OAODV generates good throughput as compared to AODV.



Packet delivery ratio:

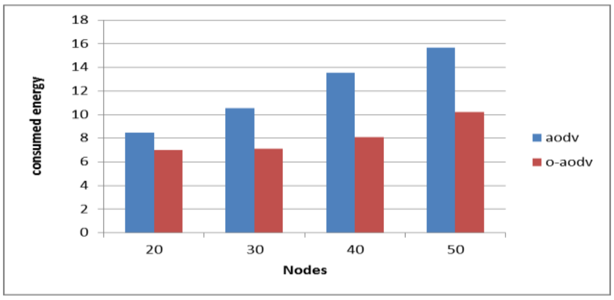
It describes that number of packets received and number of packet sent. The number of packet sent is an important parameter to determine the efficiency of the protocol. Simulation shows that packet delivery ratio is much better in OAODV as compared to the AODV.



Average consumed energy: Energy is an amount of battery life which is consumed by the node when it transfers packets in the network.

Average energy = total residual energy/ number of Node

The next result shows energy consumed by AODV as well as OAODV in which it shows that the proposed protocol performs better than AODV. The energy consumed in AODV is higher than OAODV.



4. CONCLUSION

Our simulation work illustrate the performance of AODV and OAODV routing protocols used in MANETs in different mobility case under low, medium and high scenario. We vary the number of nodes from 30 to 50 in a fixed topography of 500*400 meters. After comparing OAODV and AODV in terms of average energy consumption, packet delivery ratio, number of packet drop, throughput, it is observed that the new protocol is much better than AODV and lengthens the communication among the nodes. This paper provides an overview and discusses how energy is one of the most important constraints for these types of networks. The objective of the proposed work is to develop energy efficient AODV routing algorithm in a way which allows researchers to choose most appropriate routing algorithm.

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