Energy Efficient Routing in Mobile Ad-Hoc Network Based on AODV Protocol

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***Abstract*— A Mobile Ad-hoc Network is a collection of autonomous mobile nodes which are characterized by random and multihop communication without any centralized administration. These networks are highly unstable due to dynamic topology and are infrastructureless. Due to dynamic topology, the network is highly prone to link break. The mobile nodes in Mobile Ad-hoc Network are battery operated i.e. energy constraint. It is a key challenge to Mobile Ad-hoc networks. In this survey paper, a range of energy efficient algorithms based on AODV routing protocol will be reviewed. The conventional approach involves only to find the shortest path and do not take energy to its consideration. These algorithms can be viewed as a modification of conventional AODV routing protocol. Reducing energy consumption and efficient battery life in an Ad-hoc network requires an integrated power control and routing strategy.**

I. INTRODUCTION

The DARPA in early 1970's served as the base for Ad-hoc networks and enables wireless networking where there is no fixed infrastructure. A Mobile Ad-hoc network [1] represents a network which is a collection of autonomous mobile nodes. Here a mobile node acts as a router as well as host as there is no centralized administration and infrastructure. These types of networks possess dynamic topology due to which nodes can move in arbitrarily in any direction. Communication between the nodes is characterized by multihop transmission. The nodes which are in transmission range of each other can communicate directly otherwise the communication is done through neighbor or intermediate node i.e. hop by hop. In this dynamic environment, the routing protocols play an important and significant role. The routing protocol should have the capabilities to support dynamic topology in an efficient way.

Routing protocols are generally the set of rules which determines how a message would reach from source to destination. In Ad-hoc network, the routing protocols determine and search the route between different nodes. However, these routing protocols are difficult to design in those systems where topology varies significantly. So, these protocols need to perform in dynamic environment in an efficient way with limited resources.

In Ad-hoc network, the operations are highly distributive. It means there in no centralization of control and workload is distributed equally among all nodes. One point to be remembered is that nodes in Ad-hoc network are battery operated and hence operations are energy constraint. Thus, limited resources must be used efficiently in terms of network bandwidth, limited memory and battery power of individual nodes. Performance of the network depends upon routing protocols and energy consumption. Other parameters that affect the network performance are throughput, jitter, bandwidth delay etc.

In the following sections, we will discuss the routing protocols and the main concentration of this will be AODV routing protocol and few energy efficient algorithms based on AODV routing protocol.

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II. ROUTING PROTOCOLS

Due to dynamic nature of Mobile Ad-hoc networks, routing techniques are the most challenging issue. There are different techniques proposed for providing efficient routing. Routing protocols defines a set of rules which governs the journey of message from source to destination. The classification of the routing protocols can be done in two ways i.e. (i) on the basis of network structure and (ii) on the basis of route discovery. Network structure based routing protocol are further classified as Flat based, hierarchical based and location based. In Flat based, each node plays the same role as other nodes do. In hierarchical based, clusters are formed and cluster head are chosen among the nodes inside that cluster. In location based protocols, the node uses their local location information for communication. On the basis of route discovery, the classification is illustrated future. The classification of routing protocols in MANET [2] [3] is described in figure 1.

A. Proactive routing protocol

These protocols are also called table-driven protocols and also comes under topology based routing protocol. In this, every node maintain routing table which contains information about the network topology. These protocols utilize information about links in the network to forward the packets. It follows the conventional routing scheme. Each node maintains one or more routing tables and for each new entry, routing table is updated periodically. They create the route before demand. So, there is no delay when a node wants to communicate to other node in the network. These protocols are not applicable for large networks. The major drawback of these routing protocols are more overhead and more bandwidth consumption as each node contain information about network topology even without requiring it. So, it incurs significant power consumption. Some of the proactive routing protocols

are Destination sequenced distance vector (DSDV), Optimized link state routing (OLSR).

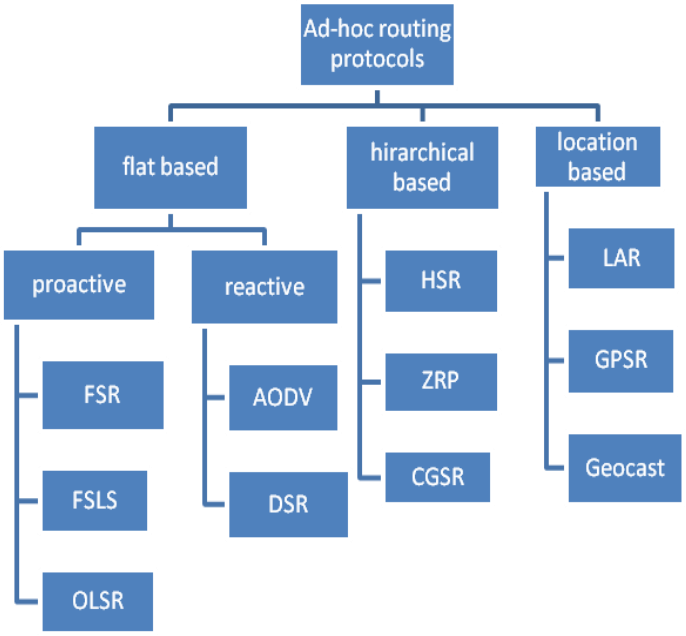

Figure 1. Classification of routing protocols

B. *Reactive routing protocol*

Reactive routing protocols are also called on-demand routing protocols which comes under topology based routing protocol. These protocols take a lazy approach to routing. Every node maintains information only about active routes to the destination. These protocols will act on demand only. Discovery process is initiated whenever a node wants to communicate with other node. They were designed to overcome the disadvantage of proactive routing protocol to reduce the routing overhead by maintaining information only about active routes. It consists of two steps: route discovery and route maintenance. Route discovery is used to find out the path to the destination and route maintenance is used in case of any link breakage. Acknowledgment mechanism is used for notifying about any link breakage for route maintenance. Some examples of reactive routing protocols are Ad-hoc on demand distance vector (AODV), Dynamic source routing (DSR).

C. *Hybrid routing protocol*

The trade-off between proactive routing protocols and reactive routing protocols lead to the development of another class of protocols called the hybrid routing protocols. These protocols are the combination of both proactive and reactive routing protocols. Proactive protocols produce large routing overhead but with less latency whereas reactive protocols produce less overhead but with more latency. So, hybrid protocols presented the overcome of trade-off of both the protocols. In these protocols, network is divided into several zones. Inside the zone, proactive routing protocol is performed and outside the zone, reactive routing protocol is performed. Some examples of hybrid protocols are Zone routing protocol (ZRP) and SHRP.

III. RELATED WORK

The main concentration of this paper is Ad-hoc on demand distance vector routing (AODV) [4] and modifications of conventional AODV routing protocol in terms of energy efficiency and lifetime of the network.

A. *AODV routing protocol*

Ad-hoc on demand distance vector routing is a reactive protocol which is described in RFC 3561. It works in two steps:

1) Route discovery: Whenever a node wants to communicate to with another node ,then it first check for a valid route to the destination.If it finds a valid route to the destination in its routing table,it forwards the packets on that route. If it does not find any valid route,it starts the route discovery process. In route discovery process, the node create a route request packet (RREQ) and send it to allits intermediate nodes. The RREQ message format consists of the varoius fields such as Type, hop count, destination IP address, destination sequence number, originator IP address, originator sequence number and reserved fields. the intermediate node on receiving that RREQ packet have the valid route to destination send a reply to the source othewise forwards RREQ to other intermediate nodes and so on. When the request reaches the destination, it replies with RREP packet to the destination containing type,hop count, dstination IP addess, destination sequence number,originator IP address and lifetime. Then source will start sending packets to the destination.

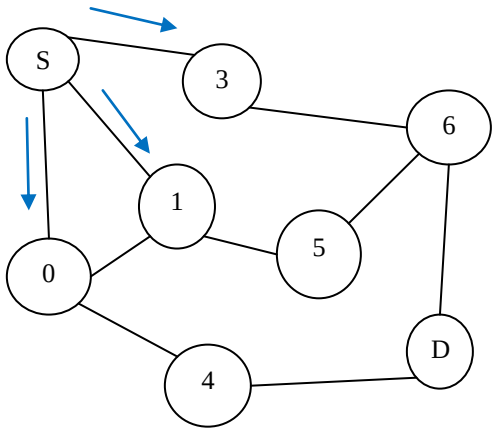

Figure 2. RREQ broadcast.

1) Route maintenance: The route maintenance process is initiated whenever there is a route failure in the network. When there is a route failure in the network, RRER message is send to the source so that the source will invalidate that route from its routing table and initiate a new route discovery process. The link failure can occur due to mobility or energy exhaustion of nodes. To check the connectivity of a route, HELLO messages are used periodically.

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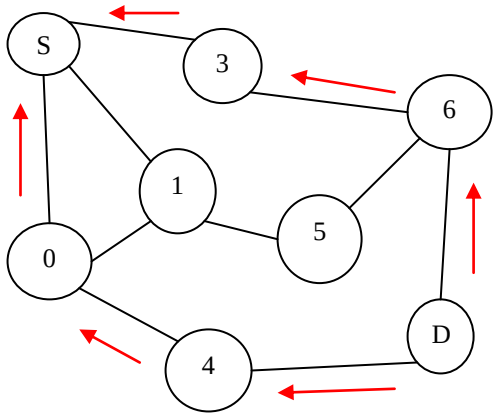

Figure 3. RREP propagation

B. *LEAR-AODV*

It stands for local energy aware routing [5] based on AODV routing protocol. It aims at balancing the energy consumption among participating nodes along a route The basic objective of LEAR-AODV protocol is to evenly distribute energy depletion among nodes.. This protocol serves the basis for using local information of mobile nodes in the network. In this approach, each node uses its local information about remaining battery level to decide whether to participate in the selection process or not. This approach uses a selection criterion as a threshold value for broadcasting the RREQ. When establishing a route between source to destination, source node broadcasts RREQ message to its intermediate nodes. On receiving the RREQ message, the intermediate node checks its battery level. If it is greater than threshold value, node will accept and forwards RREQ otherwise will drop it. The drawback of LEAR-AODV protocol is that it does not ensure least energy cost path.

C. *EEAODR:*

It stands for energy efficient Ad-hoc on demand routing based on AODV routing protocol [6]. It works on the principle that it does not leave nodes exhausted while selecting a better energy path from source to destination. It tries to balance the energy among the nodes. Each node that is involved in transmission and reception loses some amount of energy every time. The value of these loses depends on packet size, their nature and distance between the nodes. In this algorithm, an optimization function is used to consider such factors and then it will decide and select a path for transmission. Previously, the path selection criterion was only to find the shortest path i.e. repetitively using a particular node. It exhausted the energy of that node. To avoid this scenario, node individual battery level is considered to find a path which helps in saving energy of the network.

The optimization function does not choose the path with low energy level and the cost of each path can be calculated as:

Cost = [σ * Time + μ* (1/minimum battery power of node in route) + τ *(1/number of hops)]

The path that has minimum of the communication cost among all the possible paths between a source and destination node pair is chosen as the best path. In this case, every time we uses different path for sending packet which is not possible in the case of AODV which uses same path every time.

D. *LPR-AODV*

It stands for Lifetime prediction routing [5] based on AODV routing protocol. This protocol favors the route with maximum lifetime i.e. route does not contain node with a weak predicted lifetime. It finds the route at route discovery process sing a cost function. It keeps track of each node activity its past history and also about residual energy value. This information is stored in the node. This approach is a dynamic distributed load balancing approach that avoids power congested nodes and chooses paths that are lightly loaded.

E. *PAR-AODV*

It stands for Power aware routing [5] based on AODV which solves the problem of finding a route π, at route discovery time t, such that the following cost function is minimized.

$$C(\pi, t) = \Sigma C_i(t)$$

In this protocol, a node willing to begin communication floods the network with RREQ and each node will calculate link cost C_i and will add it to the RREQ packet header. When an intermediate node receives an RREQ message, it keeps the cost in the header of the packet as min-cost. On receiving the RREQ by the destination node, it replies with RREP message.

The route maintenance is initiated whenever any intermediate node has a lower value than threshold as same as in LEAR-AODV protocol.

F. *OAODV*[7]

In the conventional AODV routing protocol, source node forwards Route Request packet (RREQ) to find out path to the destination node. The intermediate node having less lifetime or energy also has to forward RREQ. As the node battery level goes down, it could not forward RREP (Route Reply) on reverse path. Hence, source node has to start RREQ rebroadcast to communicate with destination, which results in unnecessary RREQ rebroadcast, less Packet Delivery Ratio as well as throughput and more end to end delay. So, by making small changes to route request mechanism, the node does not forward RREQ unless there is sufficient energy (battery power), and until the node density in its surrounding exceeds a particular threshold. There are two types of threshold values used in this protocol. First, a threshold value which decides the rebroadcast of RREQ messages based on node battery level i.e. ThB. Second, a threshold value to determine node density of the environment i.e. ThN. This helps in maintaining the network lifetime and maximizes the throughput also.

When an intermediate node receives a RREQ message from sender node, it will check its battery level. If it is greater than threshold value and it will have a route to destination, it will accept and forward the RREQ message to the destination. If the battery level is than threshold, node will drop it.

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IV. CONCLUSION AND FUTURE WORK

From the above discussion, it is concluded that making a minor change in the route discovery process of AODV routing protocol can efficiently balance the energy consumption of the network. By considering energy as a major network metric, the lifetime of the network can be increased.

In the future work, EEAODR can be improved by introducing the concept of clustering and using directional antennas to enhance its performance.

REFERENCES

[1] Mobile Ad hoc Networking (MANET) Routing Protocol Performance Issues and Evaluation Considerations"RFC 2501, January 1999.

[2] Robinpreet,Kaur,Mritunjay kumar Rai "A Novel Review on Routing Protocols in MANETs"Academic Research Journal (UARJ), Volume-1, Issue-1, 2012.

[3] Alex Hinds, Michael Ngulube, Shaoying Zhu, and Hussain Al-Aqrabi" A Review of Routing Protocols for Mobile Ad-Hoc NETworks (MANET).

[4] C. Perkins, E. B-Royer and S. Das, "Ad hoc on-demand distance vector (AODV) routing", RFC 3561, July, 2003.

[5] Ravneet Kaur"Energy Efficient Routing Protocols in Mobile Ad hoc Network based on AODV Protocol" International Journal of Application or Innovation in Engineering, January 2013.

[6] Sanjay Kumar Dhurandher1, Sudip Misra, Mohammad S. Obaidat, Vikrant Bansal, Prithvi Raj Singh and Vikas Punia "EEAODR: An energy-efficient ad hoc on-demand routing protocol for mobile ad hoc networks", 2008 IEEE.

[7] Suvarna P. Bhatsangave ,V. R. Chirchi" OAODV Routing Algorithm for Improving Energy Efficiency in MANET", International Journal of Computer Applications (0975 – 8887) Volume 51– No.21, August 2012.

[8] Dinesh Kumar Dwivedi, Akhilesh Kosta, Akhilesh Yadav," Implementation and Performance Evaluation of an Energy Constraint AODV Routing", International Journal of Science and Modern Engineering (IJISME) ISSN: 2319-6386, Volume-1, Issue-3, February 2013.

[9] Raja ram, A. Dr. and Sugesh, J. (2011),"Power Aware Routing for MANET Using Ondemand Multipath Routing Protocol". IJCSI International Journal of Computer Science,Vol. 8 Issue 2, pp. 517-522.

[10] C. Jinshong Hwang,Ashwani Kush, Sunil Taneja" Making MANET Energy Efficient", 2011 IEEE.

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