International Journal of Future Innovative Science and Engineering Research (IJFISER)
Volume - 2, Issue - I ISSN (Online): 2454- 1966

Research Manuscript Title

An Energy Efficient Routing Algorithms for Mobile Ad Hoc Network

Dr. T. Ramaprabha[1], M.karthika[2]

Asst. Professor, Department of Computer Science & Applications[1]

M.Phil Full Time Research Scholar, Department of Computer Science[2]

Vivekanandha College of Arts and Sciences for Women (Autonomous),

Namakkal, TamilNadu, India.

E-mail id: jpkarthika3@gmail.com, ramaradha1971@gmail.com

March – 2016

www.istpublications.com

An Energy Efficient Routing Algorithms for Mobile Ad Hoc Network

Dr. T. Ramaprabha[1], M.karthika[2]

Asst. Professor, Department of Computer Science & Applications[1]
M.Phil Full Time Research Scholar, Department of Computer Science[2]
Vivekanandha College of Arts and Sciences for Women (Autonomous),
Namakkal, TamilNadu, India.

E-mail id: jpkarthika3@gmail.com, ramaradha1971@gmail.com

ABSTRACT

The Ad hoc networks are non-infrastructure networks consisting of mobile nodes. Battery power being limited, extending the lifetime of batteries is an important issue, especially for Mobile Ad Hoc Networks (MANETs). To reduce the energy consumption in mobile devices, there have been efforts in physical and data link layers as well as in the network layer related to the routing protocol. Mobile ad hoc network (MANET) is an autonomous system of mobile nodes connected by wireless links. Each node operates not only as an end system, but also as a router to forward packets. The nodes are free to move about and organize themselves into a network. In computer networking, an ad hoc network refers to a network connection established for a single session and does not require a router or a wireless base station. In this paper, the three routing protocols are studied i.e. AODV, DSR, DSDV.

Keywords: Energy Efficiency, AODV, DSR, DSDV, mobile ad hoc networks (MANET).

I. INTRODUCTION

An ad-hoc network is a collection of wireless mobile hosts forming a temporary network without the aid of any stand-alone infrastructure or centralized administration. Mobile Ad-hoc networks are self-organizing and self-configuring multi-hop wireless networks where, the structure of the network changes dynamically. This is mainly due to the mobility of the nodes. Nodes in these networks utilize the same random access wireless channel, cooperating in a friendly manner to engaging themselves in multihop forwarding. The node in the network not only acts as hosts but also as routers that route data to/from other nodes in network [1]. The main limitation of ad-hoc systems is the Availability of power. In addition to running the onboard electronics, power consumption is governed by the number of processes and overheads required to maintain connectivity [2]. The disadvantage of ad hoc network is that the nodes should be in range of a base, so that these nodes can receive the information and transmit it for further devices. If these nodes are not available, the whole network would fail [1].

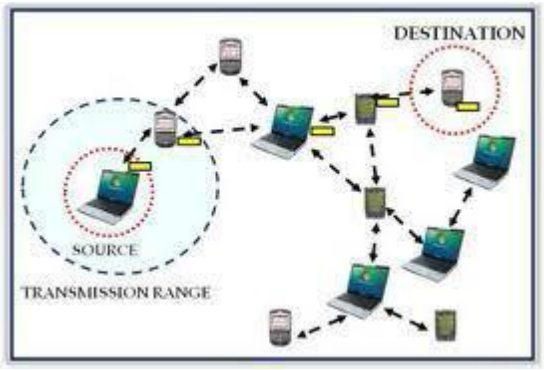

Fig 1: Mobile Ad hoc Network

These nodes generate traffic to be forwarded to some other nodes or a group of nodes. Due to a dynamic nature of ad hoc networks, traditional fixed network routing protocols are not viable. Based on that reason several proposals for routing protocols have been presented. Ad hoc radio networks have various implementation areas. Some areas to be mentioned are military, emergency, conferencing and sensor applications. Each of these application areas has their specific requirements for routing protocols. For example in military applications low probability of detection and interception is a key factor such is routing efficiency during fading and disturbed radio channel conditions. At sensor applications low or minimum energy consumption is a precondition for an autonomous operation. In conference applications a guaranteed quality of service for multimedia services is a needed feature. All application areas have some features and requirements for protocols in common.

The routing protocol overhead traffic is not allowed to drive the network to congestion nor is a local change in link not allowed to cause a massive control traffic storm throughout the network [3]. There are number of routing protocols for ad hoc networks, they are categorized into two: Proactive Routing and Reactive routing.

II. ROUTING PROTOCOLS FOR MANET

Routing protocols are the set of rules or standards which controls the nodes in which way to route the packets between the nodes in the network. Routing protocols for MANET can be classified into three main groups: Proactive Routing Protocols, Reactive Routing Protocols and Hybrid Routing Protocols based on the timing policy to update the routs.

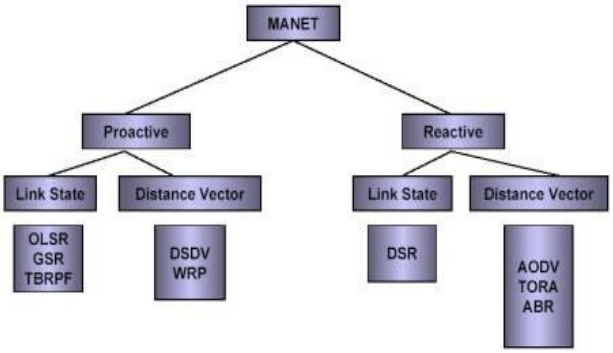

Fig 2: Routing Protocol for MANET

Proactive Routing Protocols

These protocols are based on table driven routing, in which each node maintains routing tables that contains the latest information of the routes to its neighbor node in the network. The table updating can be done either as a periodic update or triggered update. In periodic updates, nodes periodically broadcast its tables in network. In triggered updates, table broadcasted whenever a node finds a change in its neighbors [4], [5]. Frequent routing table updating is required in which it consumes large amount of memory, bandwidth and power that cause these algorithms to become inefficient [6]. This group contains so many protocols such as, "Destination Sequenced Distance Vector" (DSDV), "Cluster head Getaways Switch Routing" (CGSR), "Link State Routing" (LSR), Wireless Routing Protocol (WRP), and Optimized Link State Routing (OLSR).

Reactive Routing Protocols

Reactive protocols are also called as "On Demand Routing Protocols". In reactive protocols node initiates a route discovery process only when a route to destination is required. The established route is maintained by a route maintenance procedure until the route is no longer described. Reactive protocols discover and maintain routes only if and when necessary. Two main procedures are done in this group I) route discovery II) route maintenance. When a source node wants to send a message to some destination node and this source node does not have any route to that destination node then it uses a path discovery process. The source node discovers the route by sending a Route Request (RREQ) packet into the network and the destination replies with a Route Reply (RREP) packets. As a result the source finds route to the destination. The route to the destination is stored in the route-cache and maintained until the route is no longer desired. These protocols are found efficient when a route discovery is done infrequently in comparison to data transfer [7]. These reactive routing protocols minimize the routing overheads. The examples of on demand routing protocols are "Dynamic Source Routing" (DSR), "Ad hoc on-demand Distance Vector" (AODV), "ad hoc on-demand Routing Protocol" (AORP)etc.

III. ENERGY EFFICIENT ROUTING ALGORITHMS FOR MANET

Energy Efficient Routing Algorithms are not just related to minimize the total energy consumption of the route but also to maximize the lifetime of each node in the network to increase the lifetime of the network. The main purpose of energy efficient algorithm is to maintain the network functioning as long as possible. In MANTEs energy consumption is done in three states of the nodes which are transmitting, receiving and sleeping state. Nodes Consume more energy while transmitting than in sleep state. Sleep state means nodes are idle, in which they neither transmit nor receive any signals. More energy can be saved by keeping more nodes in sleep state. The energy consumption of nodes should be minimized not only during the transmission but also during sleep state to accomplish the network functioning goal. In [8] authors have mentioned some energy related metrics in which the energy efficient routing can be found. The metrics are as following:

- Minimize Energy consumed per packet: the most intuitive metric, however not optimal for maximum lifetime.

- Maximize Time to Network Partition: important for mission critical applications, hard to maintain low delay and high throughput simultaneously.
- Minimize Variance in node power levels: balance the power consumption for all the nodes in the network i.e. all nodes in the network have the same importance.
- Minimize Cost per packets: try to maximize the lifetime of all the nodes. Minimize Maximum Node Cost: try to delay the node failures.

There are so many algorithms in which they prolong the lifetime of the network and give the energy efficient routing. These algorithms are classified into two categories which are i) Minimizing Total Transmission power ii) Maximizing Network lifetime. Minimizing Total Transmission power algorithms focuses on minimizing the total transmission power that is used to send packets from source to destination. These algorithms don't consider the power loss at receiver side and select the route with large number of hops. Maximizing Network lifetime algorithms use average residual battery level of entire network or individual battery power of a node. Algorithms achieve goal of maximizing network life time by distributing the forwarding load over the multiple paths, making some nodes in sleep state and by balancing the traffic load inside the MANET.

Comparison of Proactive and Reactive routing protocols

Proactive Protocols	**Reactive protocols**
Attempt to maintain consistent, up-to-date Routing information from each node to every other node in the network.	A route is built only when required.
Constant propagation of routing information periodically even when topology change does not occur.	No periodic updates. Control information is not propagated unless there is a change in the topology
First packet latency is less when compared with on-demand protocols	First-packet latency is more when compared with table-driven protocols because a route need to be built
A route to every other node in ad-hoc network is always available	Not available

IV. DESCRIPTION OF SELECTED ROUTING PROTOCOLS

Ad Hoc On Demand Distance Vector (AODV)

The Ad hoc On Demand Distance Vector (AODV) routing algorithm is a routing protocol designed for ad hoc mobile networks. 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.

The AODV protocol uses *route request* (RREQ) messages flooded through the network in order to discover the paths required by a source node. An inter-mediate node that receives a RREQ replies to it using a *route reply* message only if it has a route to the destination whose corresponding destination sequence number is greater or equal to the one contained in the RREQ. 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).

Characteristics of AODV

- Unicast, Broadcast, and Multicast communication.
- On-demand route establishment with small delay.
- Multicast trees connecting group members maintained for lifetime of multicast group.
- Link breakages in active routes efficiently repaired.
- All routes are loop-free through use of sequence numbers.
- Use of Sequence numbers to track accuracy of information.
- Only keeps track of next hop for a route instead of the entire route.
- Use of periodic HELLO messages to track neighbors .

Advantages and Disadvantages of AODV

The main advantage of AODV protocol is that routes are established on demand and destination sequence numbers are used to find the latest route to the destination. The connection setup

delay is less. The HELLO messages supporting the routes maintenance are range limited, so they do not cause unnecessary overhead in the network.

One of the disadvantages of this protocol is that intermediate nodes can lead to inconsistent routes if the source sequence number is very old and the intermediate nodes have a higher but not the latest destination sequence number, thereby having stale entries. Also multiple Route Reply packets in response to a single Route Request packet can lead to heavy control overhead. Another disadvantage of AODV is that the periodic beaconing leads to unnecessary bandwidth consumption.

Dynamic Source Routing (DSR)

Dynamic Source Routing (DSR) is a routing protocol for wireless mesh networks and is based on a method known as *source routing*. It is similar to AODV in that it forms a route on-demand when a transmitting computer requests one. Except that each intermediate node that broadcasts a route request packet adds its own address identifier to a list carried in the packet. The destination node generates a route reply message that includes the list of addresses received in the route request and transmits it back along this path to the source. Route maintenance in DSR is accomplished through the confirmations that nodes generate when they can verify that the next node successfully received a packet. These confirmations can be link-layer acknowledgements, passive acknowledgements or network-layer acknowledgements specified by the DSR protocol. However, it uses source routing instead of relying on the routing table at each intermediate device. When a node is not able to verify the successful reception of a packet it tries to retransmit it.

Advantages and Disadvantages of DSR

DSR uses a reactive approach which eliminates the need to periodically flood the network with table update messages which are required in a table-driven approach. The intermediate nodes also utilize the route cache information efficiently to reduce the control overhead.

The disadvantage of DSR is that the route maintenance mechanism does not locally repair a broken down link. The connection setup delay is higher than in table-driven protocols. Even though the protocol performs well in static and low-mobility environments, the performance degrades rapidly with increasing mobility. Also, considerable routing overhead is involved due to the source-routing mechanism employed in DSR. This routing overhead is directly proportional to the path length.

Destination-Sequenced Distance-Vector Routing (DSDV)

Destination-Sequenced Distance-Vector Routing (DSDV) is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm. It eliminates route looping, increases convergence speed, and reduces control message overhead

SNo.	AODV	DSR	DSDV
1	It is Reactive Protocol	It is Reactive Protocol	It is Proactive Protocol
2	It delivers virtually all packets at low mobility	It is very good at all mobility rates.	It performs almost as DSR, but requires transmission overheads of many packets.
3	-	It has low end to delay end	It has high for pause time 0 but it starts decreasing as time increases.
4	It performs better for larger number of nodes	It performs better for larger number of nodes	It performs better for few number of nodes
5	For real time traffic AODV is preferred.	-	-

Comparison between DSR, AODV, DSDV

V. CONCLUSION

As MANET does not have any fixed infrastructure, topology changes unpredictably because of At higher rates of node mobility it's actually more expensive than DSR. Compared the On-Demand (DSR and AODV) and Table-Driven (DSDV) routing protocols by varying the number of nodes and measured the metrics like end-end delay, dropped packets, As far as packet delay and dropped packets ratio are concerned, DSR/AODV performs better than DSDV with large number of nodes. Hence for real time traffic AODV is preferred over DSR and DSDV. For less number of nodes and less mobility

REFERENCES

[1] Anne Aaron, JieWeng, Performance Comparison of Ad-hoc Routing Protocols for Networks with Node Energy Constraints International Journal of engineering and technology, EE 360 Class Project Spring 2000-2001

[2] Kapang Lego, Pranav Kumar, Dipankar Sutradhar Comparative Study of Adhoc Routing Protocol AODV, DSR and DSDV in Mobile Ad hoc NetworkKapang Lego et. All Indian Journal of Computer Science and Engineering Vol. 1 No. 4 364-371, 2001.

[3] PetteriKuosmanen, Finnish Defence Forces, Naval Academy Classification of Ad Hoc Routing Protocols., IMECS, Vol. 1, pp. 321-323 , March 2009.

[4] C. E. Perkins, "Ad Hoc Networking," Addison Wesley, 2001.

[5] David A. Maltz "On-Demand Routing in Multihop Wireless Mobile Ad Hoc Networks" PhD. Thesis in School of Computer Science Carnegie Mellon University, 2001.

[6] S. Santhi, G. Sudha Sadasivam," Performance Analysis of Different QoS Routing Protocols to Minimize Power in Heterogeneous Network" 2011 International Conference on Process Automation, Control and Computing (PACC), IEEE, PP 1-6, 2011.

[7] M. Chaturvedi, G B Nagar "A Survey of Routing Protocols for Ad Hoc Wireless Home Networks" International Journal of Electronics and Computer Science Engineering,, Vol1 (1), 2012.

[8] S. Singh, M. Woo and C.S. Raghavendra, "Power- Aware Routing in Mobile Ad Hoc Networks", MobiCom '98 Proceedings of the 4th annual ACM/IEEE International , Conference on Mobile Computing and Networking,1998.