Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 3, Issue. 12, December 2014, pg.133 – 139

SURVEY ARTICLE

A SURVEY ON ENERGY EFFICIENT ROUTING PROTOCOLS IN MANET

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Abstract— Day by day technology rapidly increases, mobility capabilities have become easily available to devices, thus mobile ad hoc networks (MANETs) are being deployed to perform a number of important tasks. Power consumption is a very crucial design concern in Mobile ad hoc networks since wireless nodes are typically battery power limited. Power consumption can occur due to receiving the data packets as well as transmitting the data traffic, mobility of nodes etc. Power failure of mobile node affects networks lifetime. In this paper, we are going to describe various power aware routing protocols in mobile ad-hoc networks.

Keywords— MANETs, MTPR, DSR, EPAR, Routing protocol

I. Introduction

Wireless network is divided in to two types of networks infrastructured and infrastructureless networks. In infrastructured networks communications among nodes are established and maintained through centralized controllers. Infrastructureless network is commonly referred to as wireless adhoc network. This type of a network is organized in an adhoc manner, where nodes are capable of making connections between them and communicate with each other in a multi-hop manner. MANET is group of mobile nodes that form a network by connecting each other with wireless links, independent of any centralized administration.

Each mobile nodes act as a host and router and forward packets to other nodes. Due to the moving nature of mobile nodes in this network continously changes its network topology.

Characteristics of MANET

- Each node in MANET acts as both router and host. That is it is autonomous in behavior.
- When a source node and destination node is out of the radio range, the MANETs are capable of using multi-hop routing for sending message between them .
- The nature of operation is distributed for security, host configuration and routing. A centralized firewall is not present here.
- The nodes can connect or disconnect the network anytime, making the network topology dynamic in nature.
- Mobile nodes are characterized with less power, less memory and light weight features.
- The efficiency, stability, capacity and reliability of wireless links are often inferior when compared with wired links. This shows that the fluctuating link bandwidth of wireless links.
- Due to mobile and spontaneous behavior of nodes ,it demands minimum human interactions to configure the network.
- All nodes in MANET have identical features with similar capabilities and responsibilities and hence it forms a completely symmetric environment.
- User density is high and level of user mobility is large.
- The connectivity of nodes is intermittent.

MANET have many applications ,they are applied in Disaster management , Data Networks , Military Scenarios , Sensor Network etc All mobile nodes are battery operated. They are going through the problems of limited energy level ,so our aim is to extend the battery lifetime of mobile nodes. Some nodes in mobile ad-hoc networks get down due to power exaustion and thus there is reduction the lifetime of manet[1]. Nowadays researchers are trying to develop better and efficient energy routing protocols. Although there are different types of protocols like DSDV, DSR, AODV etc these protocols uses smallest distance routing algorithm for making routing decisions and not considering the factor power. But in an energy efficient routing protocol the main considering factor is power.

Applications of MANETs

- **Rescue Operations:** It is going to provide Disaster recovery by replesing fixed infrastructure network incase of environmental disaster.
- **Data Networks:** The mobile ad-hoc networks provides support for the exchange of data between mobile devices.
- **Device Networks:** Device Networks are used for wireless connections between various mobile nodes so that they can communicate with each other.
- **Sensor Network:** It consists of devices that have capability of sensing, computation and wireless networking.

II. Classification Of Routing Protocols

In mobile ad-hoc networks nodes are connected through wireless links, If nodes want to communicate between them ,then first of all source node finds route to the destination . MANET routing protocols can be classified into three main categories[5]: proactive , reactive and hybrid routing protocols.

1. Proactive Routing Protocols

The proactive routing protocols is nothing but table driven routing protocols. In table driven routing, mobile nodes periodically broadcast the routing information to its neighbourig nodes ,each nodes in MANETs needs to maintains the routing information of

neighbour and its reachable node in its routing table . As topology changes the routing information of nodes also get change. The proactive routing protocols are Destination Sequenced Distance Vector (DSDV) and Optimized Link State Routing (OLSR)protocols.

2. Reactive Routing Protocols

The reactive routing protocols are On-demand routing protocols .If there is no communication between the nodes ,then these protocols does not maintains the routing information so they are called as Reactive Routing protocols. Any node in MANETs wants to send data packet to other node, then the protocol finds the route on demand and establishes the connection from source to destination to transmit data packet. When node desire to transmit data packet at that time only reactive routing will starts. The examples of reactive routing protocols are Ad-hoc On Demand Distance Vector (AODV), Dynamic Source Routing (DSR) etc.

3. Hybrid Routing Protocol

The hybrid routing protocol combines pros of proactive routing and reactive routing to overcome the disadvantages of both. It includes the advantages of both protocols. Proactive routing is gathering the unfamiliar routing information and make use of reactive routing to maintain the routing information when network topology get changed . Examples of hybrid protocols are Zone Routing Protocol (ZRP) and Temporally- Ordered Routing Algorithm(TORA).

III. Related Research Work

1.Power aware model

The mobile nodes in MANET are connected to other mobile nodes. These mobile nodes are free to transmit, i.e. send or receive the data packets to or from other nodes respectively, and require power for such activities. There are 4 important power components [4]: (1) Transmission Power (2) Reception Power (3) Idle Power and (4) Overhearing Power.

Transmission power: Whenever a node sends data packet to other nodes in the network, some amount of energy is required for transmission and such energy is called Transmission Energy (T_x) of that node and this energy is dependent on size of the data packet. On sending the data packet, some amount of power is consumed.

The Formulation of transmission energy is as:

$$T_x = (330 * P_{length})/2*10\text{^}6$$

And

$$P_t = T_x / T_t$$

Where T_x is transmission energy, P_T is Transmission Power, T_t is the time taken to transmit a data packet and P_{length} is the length of data packet in bits.

Reception power: Whenever a node receives data packet from other nodes then some amount of energy is taken by the node to receive data packet, which is called Reception Energy(R_x). On receiving the data packet, some amount of power is consumed. Reception Energy is formulated as:

$R_x = (230 * P_{length})/ 2*10\text{^}6$ and $P_R = R_x / T_r$,

Where R_x is the Reception Energy, P_R is the Reception

Power, The time taken to receive data packet is T_r , and P_{length} is the length of data packet in bits.

Idle power: In this situation, node neither transmits nor receives any data packets. Power is consumed because it needs to listen to the wireless medium continuously in order to detect a packet that it should receive, so that the node can then switch into receiving mode from idle mode. Idle power is a wasted power that should be eliminated or reduced to a minimum. Thus, Idle Power is:

$$P_I = P_R ,$$

Where P_I is Idle Power and P_R is Reception Power.

Overhearing power: In this case the data packets that are destined to other nodes are picks up by node and this is called overhearing and it may consume power. This power is called overhearing power. Receiving unnecessarily such data packets will cause power consumption. Then power consumed in overhearing is:

$$P_{over} = P_R ,$$

Where P_{over} is Overhearing Power and P_R is Reception Power.

2. DSR (Dynamic Source Routing Protocol):

DSR is on demand routing protocol. This protocol is initiated by source and it is designed for communication between nodes in mobile Ad-hoc network. In [2] DSR protocol consists of two processes Route Discovery and Route Maintenance .In Route discovery phase when a node wants to send packet to some node ,it first checks its entry in the cache ,If it is present there then it uses that path, If it is not there in the cache, the source node broadcasts a route request (RREQ) packet to all its neighbours asking for the path to destination and waits till route is discovered. If an intermediate node has routing information to the destination in its route cache , it will reply with a route reply (RREP) packet to source node. When the route request (RREQ) is forworded to a node , the node adds its address information into the route record in the RREQ packet .When destination receives the route request message ,it can know the address of each intermediate node among the route. Then destination node sends route reply (RREP) message to the source along with whole routing information of route.
When source get Route Reply from various nodes then it selects the route that has minimum number of hopes in between the source to destination.

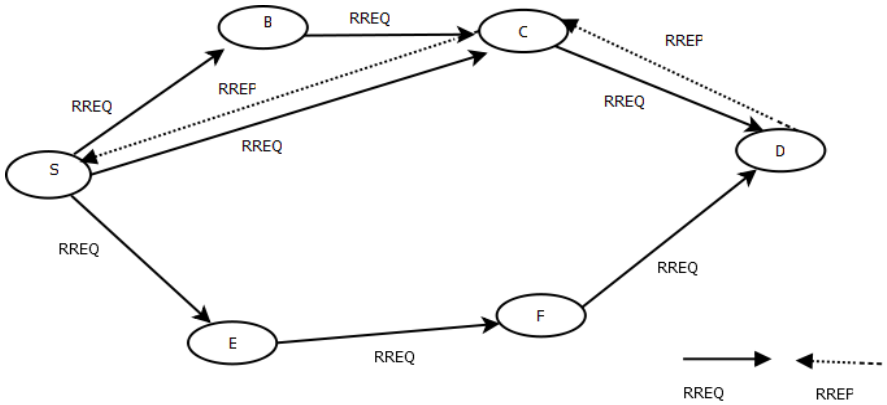

Figure 1. Route discovery and maintenance process in DSR

In the above figure DSR selects the S-C-D path for communication between source S to destination D.

Advantages of DSR
One of the main advantage of DSR protocol is that there is no need to keep routing table so as to route a given data packet as the entire route is contained in the packet header.

Limitations of DSR

The limitations of DSR protocol is that DSR does not support multicasting. The data packet header in DSR consists of all the intermediate route address along with source and destination, therefor it decreasing the throughput.

3.MTPR (Minimum Total Transmission Power Routing)

In [3] MTPR tries to select a path that has minimum total transmission power. A node that requires a path to a distant node broadcast RREQ to all its Neighbours This process continues at each and every intermediate nodes till the packet reaches to a destination node. The destination node receives RREQs from various nodes but selects The path with minim um total transmission power.
The above protocol can made clearer with the help of an example network as shown in Figure 2. The distances between various pairs of nodes are shown in path matrix (see table-1)
Let us suppose 1 as the source and 7 as the destination. The paths selected from source node 1 to destination node 7 may be as follows:

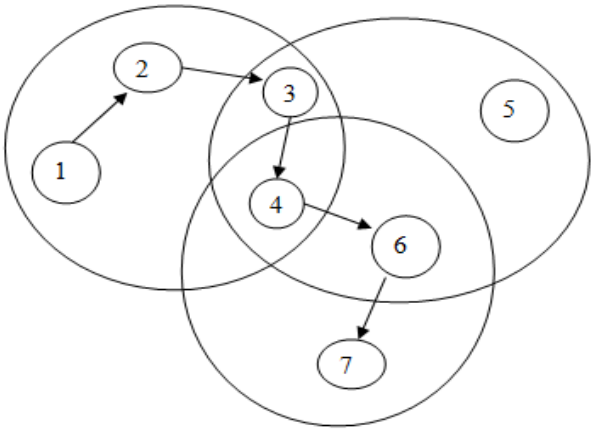

Figure .2 Packet move from source node 1 to destination node 7 using MTPR

•The path (1-2-3-4-6-7) has total transmission loss =k(15*15+10*10+10*10+5*5+10*10)=550k units (Here total transmission loss is taken as kd2)
•The paths (1-3-4-6-7)has total transmission loss =k(20*20+10*10+5*5+10*10)=625k.
•Similarly we see the total transmission power loss in path (1-4-6-7)=k(25*25+5*5+10*10)=750k
The path (1-2-3-4-6-7) has minimum to total transmission power loss.

Node →	1	2	3	4	5	6	7
	Distance between Nodes						
1	0	15	20	25	----	----	----
2	15	0	10	20	----	----	----
3	----	----	----	10	----	----	----
4	----	----	----	----	----	----	----
5	----	----	----	----	----	----	----
6	----	----	----	----	----	----	10
7	----	----	----	----	----	----	----

Table 1: Path Matrix

4. EPAR Protocol

EPAR identifies the capacity of a node by considering its residual battery power as well as the expected energy spent in reliably forwarding data packets over a specific link. EPAR selects the path using a mini-max formulation, that path has the largest packet capacity at the smallest residual packet transmission capacity [1].

Route discovery and route Maintenance in EPAR

For EPAR [1], however, the path is chosen based on energy. First, we calculate the battery power for each path, that is, the lowest hop energy of the path. The path is then selected by choosing the path with the maximum lowest hop energy.

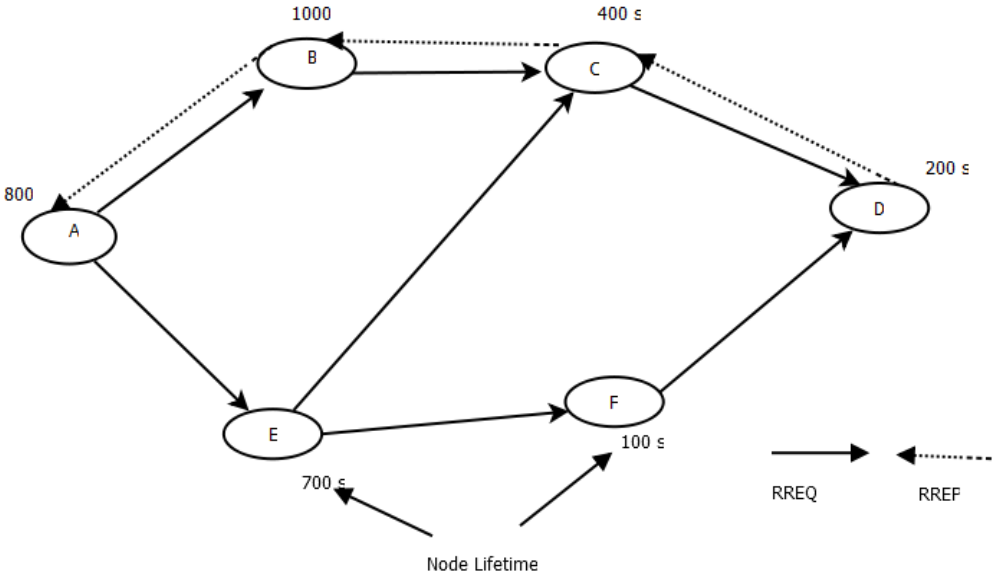

Figure 3: Route discovery and maintenance process in EPAR

Using a mini-max formulation EPAR selects the routing path . Here in figure 3 there are three applying EPAR protocol we first select the minimum hope energy for each path. For the path ABCD the minimum hope energy is min(800,1000,400,200)= 200. For the path AECD the minimum hope energy is min(800,700,400,200)=200. For the path AEFD the minimum hope energy is min(800,700,100,200)=100. Then taking the maximum of the minimum hope energy ,we will take max(200,200,100)=200. Thus our method is dynamic distributed load balancing method that chooses the lightly loaded paths and avoids the power congested nodes. This will help the EPAR protocol to minimize the variance in energy levels of various nodes in the network and helps to increase network lifetime .

IV. Conclusion

This survey paper mainly deals with the problem of maximizing the network lifetime of a MANET In this Paper we have discussed about various routing protocols like DSR,MTPR and EPAR ,in these protocols EPAR is better than other two because it overcomes the problems of DSR and MTPR, so the performance of EPAR in terms of throughput will be good.

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