A SURVEY ON ENERGY EFFICIENT ROUTING PROTOCOLS FOR MANET

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ABSTRACT

With the popularization of Internet and formation of wireless technologies provide significant impact on Internet and Communication Technologies. These technologies have support of one of famous technique known as Adhoc Network.Adhoc Networks are assortment of mobile nodes connected by wireless links and also receiving attention in the scientific community. Energy Efficient is one of the key issues in MANETs because of highly dynamic and distributed nature of nodes. Especially energy efficient is most important because all the nodes are battery powered. Failure of one node may affect the entire network. If a node runs out of energy the probability of network partitioning will be increased. Since every mobile node has limited power supply, energy depletion has become one of the main threats to the lifetime of the mobile ad-hoc network. This article surveys and classifies the energy aware routing protocols proposed for MANETs. They minimize active communication energy required to transmit or receive packets and the inactive energy consumed when a mobile node stays idle even though it listens to the wireless medium for any possible communication requests from other nodes. Transmission power control approach and load distribution approach belong to the active communication energy, and sleep/power-down mode approach belongs to the inactive energy. While it is not clear that any particular algorithm or a class of algorithms is the best for all scenarios, each protocol has definite advantages/disadvantages and is well-suited for certain situations. The purpose of this paper is to facilitate the research efforts in combining the existing solutions to offer a more energy efficient routing mechanism.

KEYWORDS: *Mobile ad hoc network, energy efficient routing, GNDA, AODV, Congestion Control*

I. INTRODUCTION

Mobile devices coupled with wireless network interfaces will become an essential part of future computing environment consisting of infra-structured and infrastructure-less mobile networks [1]. Wireless local area network based on IEEE 802.11 technology is the most prevalent infra-structured mobile network, where a mobile node communicates with a fixed base station, and thus a wireless link is limited to one hop between the node and the base station. Mobile ad hoc network (MANET) is an infrastructure-less multihop network where each node communicates with other nodes directly or indirectly through intermediate nodes. Thus, all nodes in a MANET basically function as mobile routers participating in some routing protocol required for deciding and maintaining the routes. Since MANETs are infrastructure-less, self-organizing, rapidly deployable wireless networks, they are highly suitable for applications involving special outdoor events, communications in regions with no wireless infrastructure, emergencies and natural disasters, and military operations [2,3]

Routing is one of the key issues in MANETs due to their highly dynamic and distributed nature. In particular, energy efficient routing may be the most important design criteria for MANETs since mobile nodes will be powered by batteries with limited capacity. Power failure of a mobile node not only affect the node itself but also its ability to forward packets on behalf of others and thus the overall network lifetime. For this reason, many research efforts have been devoted to developing energy aware routing protocols.

Based on the aforementioned discussions, this paper surveys and classifies numerous energy efficient routing mechanisms proposed for MANETs [4, 10]. They can be broadly categorized based on when the energy optimization is performed. A mobile node consumes its battery energy not only when it actively sends or receives packets but also when it stays idle listening to the wireless medium for any possible communication requests from other nodes. Thus, energy efficient routing protocols minimize either the active communication energy required to transmit and receive data packets or the energy during inactive periods. The active communication energy can be reduced by adjusting each node's radio power just enough to reach the receiving node but not more than that. This transmission power control approach can be extended to determine the optimal routing path that minimizes the total transmission energy required to deliver data packets to the destination.

The GNDA protocol (GNDA) used for identifying good neighbor nodes in the network. Besides, this approach is extended by adding extra parameters i.e. signal strength, flow capacity and relative position of a node into the account by optimizes the routing issues by using AODV.

To design energy efficient and reliable congestion control (EERCCP) protocol for multicasting. An admission control scheme is used in which a multicast flow is admitted or rejected depending upon on the output queue size, which adjusts the multicast traffic rate at each bottleneck of a multicast tree. For protocols that belong to inactive communication each node can save the inactivity energy by switching its mode of operation into sleep/power-down mode or simply turns it off when there is no data to transmit or receive.

This leads to considerable energy savings, especially when the network environment is characterized with low duty cycle of communication activities. However, it requires well-designed routing protocol to guarantee data delivery even if most of the nodes sleep and do not forward packets for other nodes. Another important approach to optimizing active communication energy is load distribution approach. While the primary focus of the above two approaches is to minimize energy consumption of individual nodes, the main goal of the load distribution method is to balance the energy usage among the nodes and to maximize the network lifetime by avoiding over-utilized nodes when selecting a routing path.

While it is not clear that any particular algorithm or a class of algorithms is the best for all scenarios, each protocol has definite advantages/disadvantages and is well-suited for certain situations.

The remainder of the paper is organized as follows. Section 2 presents a general discussion on ad hoc routing protocols where the goal is to find the shortest paths as well as detecting good neighbour nodes and delay. Section 3 first presents taxonomy of energy efficient routing protocols based on the various goals are used to determine an energy efficient routing path. Then, the rest of the section surveys the phases and approaches to energy efficient routing protocols. Finally, Section 4 provides a conclusion.

II. ROUTING PROTOCOL FOR MOBILE ADHOC NETWORK

The routing protocols proposed for MANETs are generally categorized as table-driven and on-demand driven based on the timing of when the routes are updated. With table-driven routing protocols, each node attempts to maintain consistent, up-to-date routing information to every other node in the network. This is done in response to changes in the network by having each node update its routing table and propagate the updates to its neighbouring nodes. Thus, it is proactive in the sense that when a packet needs to be forwarded the route is already known and can be immediately used.

As is the case for wired networks, the routing table is constructed using either link-state or distance vector algorithms containing a list of all the destinations, the next hop, and the number of hops to each destination. Many routing protocols including Destination-Sequenced Distance Vector (DSDV) [11] and Fisheye State Routing (FSR) protocol [12] belong to this category, and they differ in the number of routing tables manipulated and the methods used to exchange and maintain routing tables.

With on-demand driven routing, routes are discovered only when a source node desires them. Route discovery and route maintenance are two main procedures: The route discovery process involves sending route-request packets from a source to its neighbor nodes, which then forward the request to their neighbours, and so on. Once the route-request reaches the destination node, it responds by unicasting a route-reply packet back to the source node via the neighbor from which it first received the route-request. When the route-request reaches an intermediate node that has a sufficiently up-to-date route, it stops forwarding and sends a route-reply message back to the source. Once the route is established, some form of route maintenance process maintains it in each node's internal data structure called a route-cache until the destination becomes inaccessible along the route. Note that each node learns the routing paths as time passes not only as a source or an intermediate node but also as an overhearing neighbour node. In contrast to table-driven routing protocols, not all up-to-date routes are maintained at every node. Dynamic Source Routing (DSR) [13] and Ad-Hoc On-Demand Distance Vector (AODV) [14] are examples of on-demand driven protocols.

2.1 Energy Efficient Manet Routing

In contrast to simply establishing correct and efficient routes between pair of nodes, one important goal of a routing protocol is to keep the network functioning as long as possible. As discussed in the Introduction, this goal can be accomplished by minimizing mobile nodes' energy not only during active communication but also when they are inactive. Transmission power control and load distribution are two approaches to minimize the active communication energy, and sleep/power-down mode is used to minimize energy during inactivity. Table 1 shows taxonomy of the energy efficient routing protocols.

Table 1 shows taxonomy of the energy efficient routing protocols

Approach		Protocols/Algorithms	Goal
Minimize Active Communication Energy	Transmission Power Control	GNDA: Good neighbour nodes – Identified[19] EERCC: To detect Congestion & adjust receiving rates[18] Smallest Common Power (COMPOW)[17]	Improves performance of routing protocol in terms of good communication and stable route. It has very limited control traffic overhead & delay Minimize the total transmission energy while considering retransmission overhead or bi-directional requirements.
	Load Distribution	Localized Energy Aware Routing (LEAR)[16]	Distribute load to energy rich nodes.
Minimize Inactive Communication Energy	Sleep/ Power Down mode	Prototype Embedded Network (PEN)[15]	Minimize energy Consumption During inactivity

However, since future network lifetime is practically difficult to estimate, the next three metrics have been proposed to achieve the goal indirectly. Variance of residual battery energies of mobile nodes is a simple indication of energy balance and can be used to extend network lifetime. Cost-per-packet metric is similar to the energy-per-packet metric but it includes each node's residual battery life in addition to the transmission energy. The corresponding energy-aware routing protocol prefers the wireless link requiring low transmission energy, but at the same time avoids the node with low residual energy whose node cost is considered high. With the last metric, each path candidate is annotated with the maximum node cost among the intermediate nodes (equivalently, the minimal residual battery life), and the path with the minimum path cost, min-max path, is selected. This is also referred to as max-min path in some protocols because they use nodes' residual battery life rather than their node cost.

III. MINIMIZE ACTIVE COMMUNICATION ENERGY

3.1 Transmission Power Control Approach

A routing algorithm essentially involves finding an optimal route on a given network graph where a vertex represents a mobile node and an edge represents a wireless link between two end nodes that are within each other's radio transmission range. When a node's radio transmission power is controllable, its direct communication range as well as the number of its immediate neighbors is also adjustable. While stronger transmission power increases the transmission range and reduces the hop count to the destination, weaker transmission power makes the topology sparse which may result in network partitioning and high end-to-end delay due to a larger hop count.

3.1.1 GNDA: Good neighbour nodes

In this approach, initially all nodes maintain their own transmission range. Transmission range (NTr) of each node present in the network with the total transmission of network (TTrN) of the node is compared. Determination of transmission power is required to send a message between node n and its neighbor n1. It can be measured by calculating the received power of hello message. When node n receives hello messages from a neighbor node n1, it can estimate the minimum power level needed to reach n1 by comparing the received power of hello message with maximum transmit power.
This approach is enhanced by adding parameters in the neighbor table such as flow capacity, signal strength. Reaching time of hello messages between node and its neighbor is calculated. Address of node is stored into the neighbor table based on their transmission range. If (NTr >TTrN), then adjust energy of this node accordingly, otherwise calculate signal strength by using equation (1). If threshold value is maximum then evaluate position of node and also set timer for the same. Further work is preceded by calculating the flow capacity of a node as mentioned in equation (2). If flow capacity of a node is good then store address of a node otherwise remove address of the node from routing table (refer figure 1)
Suggested algorithm is an optimal solution for finding good nodes. Categorization of nodes is based on performance metrics such as transmission range and power of node, signal strength, capacity of node for high packet forwarding and relative position of node. Neighbor routing table maintains address of node for maintaining record of the entire nodes. These stored nodes are used for data transmission and forwarding. This approach minimizes energy consumption of node and increases its battery life.

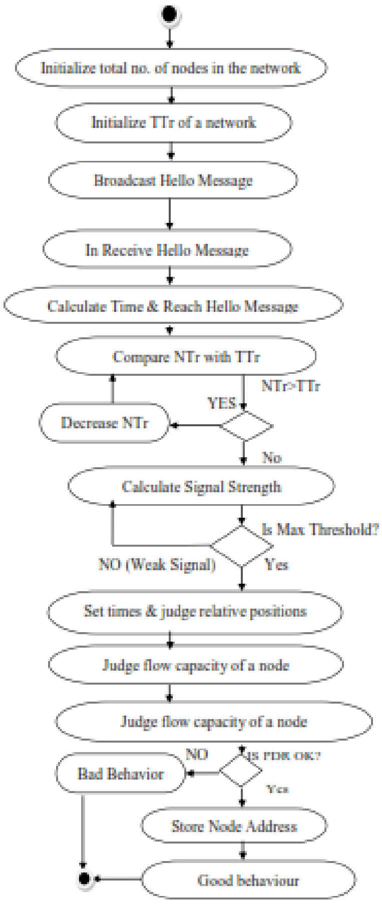


Fig1: GNDA Algorithm Proposing Approach

Definition1: Signal Strength of a node is computed by using well known formula which is as follows:

Transmitter $_{\text{signal strength}}$= $\{S_H-\{S_H-S_{threshold}*T/e\}$ if farther (T>e) ------------ (1a)

S_H closer (T<e) ------------ (1b)

S_{thresh} otherwise ------------- (1c)

Where SH signal strength of hello message and T is is the time period between two successive hello packets and e is the link connectivity between i and j.

Definition2: Assume a graph G (V, E) [13]. The capacity of directed edge is denoted as Cij source s and destination d.

F is assumed as a flow in G where E belongs to edge (i, j).

If for all (i, j) Є E; 0<= Fij <= Cij; s.t.

$$\sum_{j:(s,j)\epsilon E} F_{sj} - \sum_{i:(i,s)\epsilon E} F_{is} \quad \text{------------------------} \ (2)$$

Let Fis and Fsj be the counter of amount of bytes that flowed on the link (i, j) upto time t in packets.

Thus, If signal strength range is negligible then discard this node and delete entry of this node from the neighbour table. Otherwise calculate flow capacity of a node by considering equation (2). Based on flow capacity and packet delivery ratio, good neighbors are identified.

Complexity Computation between AODV and GNDA: By adding new parameters into the routing table, suggested approach increases size of routing table. Thus storage complexity of suggested approach is same as AODV i.e. O (N), where N is the total number of nodes present in the network. It slightly increases overhead by using hello messages but it provides good communication between source and destination as compared to AODV (RFC (3561)). Thus communication complexity of suggested algorithm in O (N).

Cao Minh Trang et. al [14] has suggested an effective approach for an intrusion detection system in AODV routing protocol. But this approach was not suitable against impersonation attack and also its accuracy decreases in case of high mobility. Our approach is not limited to specific attacks. Performance of each node is evaluated and analysed individually. And evaluation is done by increasing number of nodes and network size in the networks. But suggested approach has some limitation. By increasing size of network or number of nodes, this approach may increase costing factor.

3.1.2. Energy Efficient Reliable Routing Congestion Control:

Energy Efficient Tree Construction

In our energy efficient and reliable congestion control protocol we build a multicast tree routed at the source towards the receivers. The distance i.e. the geographical location of the nodes is assumed. Their residual energy is measured. The nodes are sorted based on its location from the source and arranged in a sequence order. A threshold value Q is set and the nodes which are less than Q (n<Q) are unicast from the source and the nodes which are greater than Q (n>Q) are multicast. In case of multicasting the node which has the minimum energy per corresponding receiver is set as the relay node. The relay node then forwards the packets from the source to the corresponding receivers.

Calculating Residual Energy of a Node

Consider a network with multicast groups G1, G2……………Gx. Each group {Gi} consists of N nodes. Every node in the MANET calculates its remaining energy periodically. The nodes may operate in either transmission or reception mode. Let $\{E_1, E_2 \dots\dots\dots E_n\}$ are the residual energies of the nodes measured by the following method.

The power consumed for transmitting a packet is given by the Eq (3)

Consumed energy = TP* t --------------------- (3)

Where TP is the transmitting power and t is transmission time. The power consumed for receiving a packet is given by Eq (4)

Consumed energy = RP * t ------------------------- (4)

Where RP is the reception power and t is the reception time. The value t can be calculated as

T=Ds/Dr-------------------- (5)
Ds is Data size and Dr is data rate

Hence, the residual energy (E) of each node can be calculated using Eq (1) or Eq (2) and Eq (3)
E = Current energy – Consumed energy

Algorithm

- Consider a group Gj = $\{N_1, N_2\ldots\ldots\ldots N_n\}$
- Measure the distance d of each node from source d (S, Ni) where i=1,2……….n
- Sort the nodes N_i in ascending order of d.
- Create the partitions X1 and X2 of the nodes Ni such that X1= $\{N_1\ldots\ldots\ldots N_Q\}$
- X2= $\{N_{Q+1}\ldots\ldots\ldots N_n\}$
- Where Q is the distance threshold.
- Source unicast the packets to X1
- In X2 find a relay node N_r which has max (E_i)
- Then S unicast the packets to N_r which in turn multicast the packets to the rest of the nodes in X2.

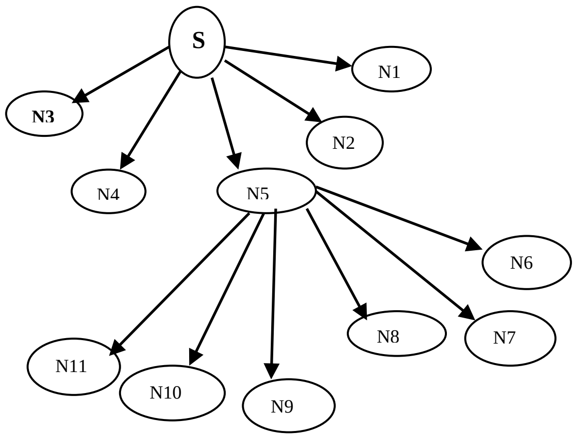


Fig 2: Energy Efficient Tree Structure

Source S unicast the packets to nodes $N_{1,}$ $N_{2,}$ N_3 N_4 and N_5. N_5 is the relay node. N_5 multicast the packets to the rest of the nodes N_6…….. $N_{11.}$

Multicast Admission Control

Most of the existing schemes depend on individual receivers to detect congestion and adjust their receiving rates which are much disadvantageous. We propose a scheme which adjusts the multicast traffic rate at each bottleneck of a multicast tree. Each node estimates its current traffic load and arrival rate. Based on its traffic load, it estimates the receiving rate. If the receiving rate is less than the arrival rate, it adaptively adjusts its receiving rate.

In order to adjust the total number of multicast flows which traverse a bottleneck, the following procedure is used. In our proposed scheme, based on the link's output queue state, multicast flows at a bottleneck can be blocked or released. Let the number of packets in the queue is N. Let QT1 and QT2 (QT1 < QT2) are two thresholds for the queue size. Then the flow is released or blocked based on the following conditions.

If N<= QT1, then the multicast flow is released. If N > QT2, then the multicast flow is blocked.

In most of the existing schemes, in order to detect congestion and for adjusting the receiving rate they depend on the individual receivers. In our proposed scheme multicast traffic rate is adjusted at each bottleneck of a multicast tree. Whenever congestion happens or about to, then the multicast sessions which traverse the branch are blocked.

Thus the packets are stopped from entering the branch. The blocked flows are released to traverse the branch when the branch is lightly utilized.

Multicast Traffic Rate Adjustment

When the available bandwidth is less than the required bandwidth or the queue size is less than a minimum threshold value, it indicates the possibility of congestion or packet loss. The behaviour of the multicast session is expressed as

$$R(t+1) = \begin{cases} R(t) - g & R(t) > B \\ R(t) + g & R(t) <= B \\ R(t) & \text{otherwise} \end{cases}$$

Here R (t) denotes the instantaneous rate of the multicast session at time t.
B is the bottleneck bandwidth.
When R (t) > B then the network is congested and the multicast session decreases its rate by a step g.
If R (t) <=B then the network is not congested and the multicast session increases its rate by a step g.
The proposed scheme overcomes most of the disadvantages of existing schemes:

1) Link errors cannot cause the proposed scheme to wrongly block a layer, because instead of the loss information at receivers, the queue state at a bottleneck is used as the metric to adjust the multicast traffic rate at the bottleneck.
2) Link access delay caused by competition in MANETs cannot hinder the rate adjustment in this scheme, because, it blocks multicast layers right at each bottleneck of a multicast tree instead of depending on receivers to request pruning to drop layers.
3) Because of the on-the-spot information collection and rate control this scheme has very limited control traffic overhead. Moreover, the proposed scheme does not impose any significant changes on the queuing, scheduling or forwarding policies of existing network

3.1.3 Power Optimization with Other Practical Requirements

However, when applying the technique in routing protocols, some link layer issues need to be considered. This subsection will address these issues.

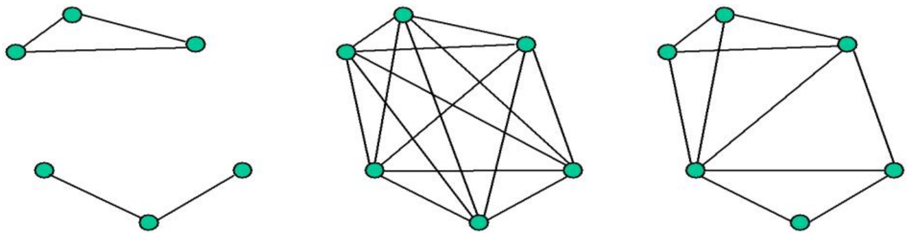
Bidirectionality Requirement

To deliver packets with minimum energy, the transmission power control approach adjusts each node’s radio power and allows different transmission power levels at different nodes. However, in order for the link-level connectivity of a MANET to work correctly, any pair of communicating nodes must share a bidirectional link [10]. For example, at the link level, control packet handshaking is usually employed to enhance the link-level reliability in error-prone wireless environment; i.e., when a node receives a packet, it immediately replies back to the sender with the ACK. If no ACK is returned to the sender, it automatically retransmits the packet. In addition, RTS (request to send) and CTS (clear to send) packets are exchanged to deal with the hidden terminal problem [20]. Therefore, when two nodes have different power levels, data communication along one direction (from the node with stronger transmission power to the other node with weaker transmission power) is possible but not in the reverse direction.

Smallest Common Power (COMPOW) protocol [10] presents one simple solution to maintain bi-directionality between any pair of communicating nodes in a MANET. This is achieved by having all the nodes in the MANET maintain a common transmission power level (P_i). If P_i is too low, a node can reach only a fraction of the nodes in the MANET as in Figure 3(a). If P_i is very high, a node can directly reach all other nodes as in Figure 3(b) but results in high energy consumption. In fact, a node can directly or indirectly reach the entire MANET with a smaller P_i as shown in Figure 3(c). Therefore, the optimum power level (P_i) is the smallest power level at which the entire network is connected.

In COMPOW, it is assumed that the transmission power levels cannot be arbitrarily adjusted but instead it must be selected among a small number of discrete power levels (P_1, P_2, ..., P_{max}) [10]. Different power levels result in different node connectivity since they cover different radio transmission ranges. Each node maintains a routing table as in table-driven routing mechanism (see Section 2), but one for each power level (RT_{P1}, RT_{P2}, … , RT_{Pmax}).

The number of entries in RT_{Pi}, denoted as $|RT_{Pi}|$, means the number of reachable nodes at P_i. This includes directly connected nodes as well as indirectly connected nodes via intermediate nodes. By exchanging these routing tables, nodes find the minimal P_i that satisfies $|RT_{Pi}|=n$ for all nodes, where n is the total number of nodes in the MANET. Extended solutions are also discussed in [10] for the case where there are many discrete power levels and where the latency involved with switching power levels is not negligible.



(a) P_i is too low (b) P_i is too high (c) P_i is optimal

Figure 3: Proper selection of the common transmission power level in COMPOW.

3.2 Load Distribution Approach

The specific goal of the load distribution approach is to balance the energy usage of all mobile nodes by selecting a route with underutilized nodes rather than the shortest route. This may result in longer routes but packets are routed only through energy-rich intermediate nodes. Protocols based on this approach do not necessarily provide the lowest energy route, but prevent certain nodes from being overloaded, and thus, ensures longer network lifetime.

3.2.1 Localized Energy Aware Routing (LEAR) Protocol [11]

The LEAR routing protocol is based on DSR but modifies the route discovery procedure for balanced energy consumption. In DSR, when a node receives a route-request message, it appends its identity in the message's header and forwards it toward the destination. Thus, an intermediate node always relay messages if the corresponding route is selected. However, in LEAR, a node determines whether to forward the route-request message or not depending on its residual battery power (E_r). When E_r is higher than a threshold value (Th_r), the node forwards the route-request message; otherwise, it drops the message and refuses to participate in relaying packets. Therefore, the destination node will receive a route-request message only when all intermediate nodes along a route have good battery levels, and nodes with low battery levels can conserve their battery power.

LEAR is a distributed algorithm where each node makes its routing decision based only on local information, such as E_r and Th_r. As E_r decreases as time passes, the value of Th_r must also be decreased adaptively in order to identify energy-rich and energy-hungry nodes in a relative sense. For example, if the source node does not receive any reply for a route-request message, the source re-sends the same route-request message. If an intermediate node receives the duplicate request message, it adjusts (i.e., lowers) its Th_r to allow forwarding to continue. A sequence number is used to distinguish between the original and the re-sent route-request message.

A complication can arise when route-cache replies are directly sent to the source without evaluating the residual battery levels of all following intermediate nodes. To prevent this from occurring, a new control message, route-cache, is used as shown in Figure 4. In the original DSR, when an intermediate node (node B) finds a route in its route cache, it stops broadcast forwarding and sends a route-reply back to the source. However, in LEAR, the intermediate node (node B) stops broadcast forwarding the route-request message but continues to forward the route-cache message ($B \rightarrow C_1 \rightarrow C_2 \rightarrow D$ in this example). This does not add any significant traffic to the network because the route-cache message can be delivered in unicast mode.

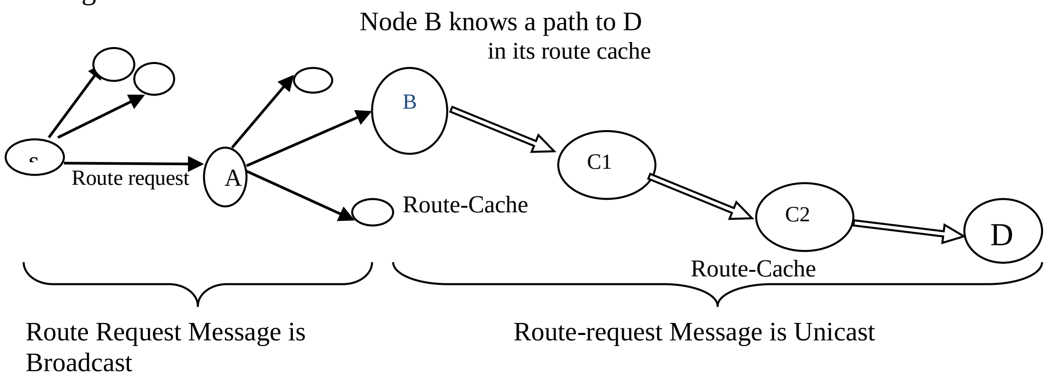


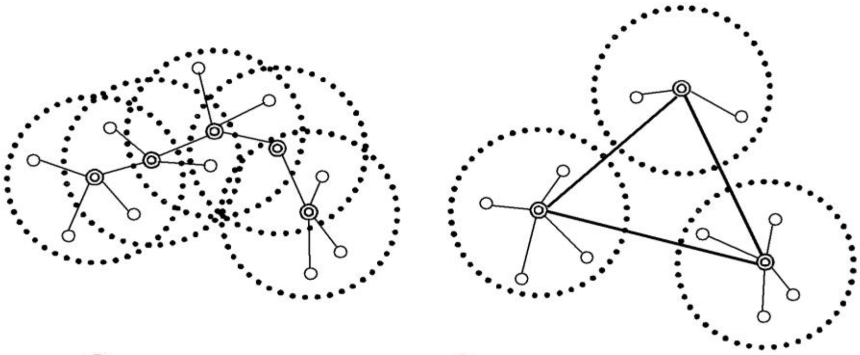
Fig4: Route cache Message in LEAR ALGORITHM

3.3 Sleep/Power-Down Mode Approach

Unlike the previous two subsections, the sleep/power-down mode approach focuses on inactive time of communication. Since most radio hardware supports a number of low power states, it is desirable to put the radio subsystem into the sleep state or simply turn it off to save energy.

However, when all the nodes in a MANET sleep and do not listen, packets cannot be delivered to a destination node. One possible solution is to elect a special node, called a *master*, and let it coordinate the communication on behalf of its neighboring slave nodes. Now, slave nodes can safely sleep most of time saving battery energy. Each slave node periodically wakes up and communicates with the master node to find out if it has data to receive or not but it sleeps again if it is not addressed.In a multi hop MANET, more than one master node would be required because a single master cannot cover the entire MANET. Figure 5 shows the master-slave network architecture, where mobile nodes except master nodes can save energy by putting their radio hardware into low power state. The master-slave architecture in Figure 5(a) is based on symmetric power model, where master nodes have the same radio power and thus the same transmission range as slave nodes. On the other hand, Figure 5(b) shows the asymmetric power model, where master nodes have longer transmission range.

While this type of hierarchical network architecture has been actively studied for different reasons, such as interference reduction and ease of location management [3], the problem of selecting master nodes and maintaining the master-slave architecture under dynamic node configurations is still a challenging issue.



◎ Master ○Slave

a) Symmetric power model (b) Asymmetric power model

Figure 5: Master-slave MANET architecture

3.3.1 Prototype Embedded Network (PEN) Protocol [15]

As in SPAN and GAF, the PEN protocol exploits the low duty cycle of communication activities and powers down the radio device when it is idle. However, unlike SPAN and GAF, nodes interact "asynchronously" without master nodes and thus, costly master selection procedure as well as the master overloading problem can be avoided. But in order for nodes to communicate without a central coordinator, each node has to periodically wake up, advertises its presence by broadcasting beacons, and listens briefly for any communication request before powering down again.

A transmitting source node waits until it hears a beacon signal from the intended receiver or server node. Then, it informs its intention of communication during the listening period of the server and starts the communication.

Route discovery and route maintenance procedures are similar to those in AODV, i.e., on-demand route search and routing table exchange between neighbor nodes. Due to its asynchronous operation, the PEN protocol minimizes the amount of active time and thus saves substantial energy. However, the PEN protocol is effective only when the rate of interaction is fairly low. It is thus more suited for applications involving simple command traffic rather than large data traffic.

IV. CONCLUSION

A mobile ad hoc network (MANET) consists of autonomous, self-organizing and self-operating nodes, each of which communicates directly with the nodes within its wireless range or indirectly with other nodes via a dynamically computed, multi-hop route. Due to its many advantages and different application areas, the field of MANETs is rapidly growing and changing. While there are still many challenges that need to be met, it is likely that MANETs will see wide-spread use within the next few years.In order to facilitate communication within a MANET, an efficient routing protocol is required to discover routes between mobile nodes.The common objective is to provide better Efficient Energy aware routing schemes.We have highlighted the several algorithms that can be well-suited for certain situations. Therefore, more research is needed to combine and integrate some of the protocols presented in this paper to keep MANETs functioning for a longer duration. Developing efficient routing protocols for MANET appears to be a promising direction of future research.

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