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Survey Of Energy Efficient Strategies In Wireless Ad Hoc Network

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Abstract:
wireless links. Nodes in a MANET have limited transmission range; communication is achieved by making use of nodes to forward packets to other nodes, which thereby have to operate as routers. Finding a path between two communication end points in an Ad Hoc network is important. It presents a survey on AODV (Ad Hoc on Demand Distance Vector) is a reactive protocol, it using the Sequence number for loop prevention. The DSDV (Destination Sequenced Distance Vector) routing protocol, each node periodically transmits updates includes its own sequences number, routing table updates and nodes also send for important link changes. Battery power is crucial parameter in the algorithm design to increase lifetime of nodes in the network. In addition to maximizing the lifetime, it is preferable to distribute the bandwidth in all the nodes.

Key words*: Mobile Ad Hoc network, Ad Hoc on Demand Distance Vector Routing, Destination Sequenced Distance Vector Routing, Expanding Ring Search, Time To Live.*

1.Introduction

Mobile Ad Hoc Networks (MANETS) consists of a collection of mobile nodes without having a central coordination. In MANET, node mobility and dynamic topology play an important role in the performance. MANET provides a solution for network connection at anywhere and at any time. The major features of MANETs are quick set up, self organization and self maintenance. Routing is a major challenge in MANET due to its dynamic topology and high mobility. Several routing algorithms have been developed for routing. The bandwidth is recognized as the important factor reducing the performance of the network.

The nodes are highly portable in MANET and the placement of node is depend on the application and is random. The nodes and routing are not controlled by any central node or router. Every node is acting as router or source and the control is distributed among nodes[1]. In spite of this rising interest MANET imposes serious challenges in routing due to unlimited mobility of nodes and dynamic topology. Due to the limited bandwidth path failures are very frequent in nature. This degrades the performance and throughput of the network significantly. Wireless medium is shared by many users so number of collisions, contentions and chances of errors are more in MAMET. Routing is a major issue in MANET due to the lack of central coordination. The routing protocols for MANETs are like proactive, reactive and hybrid have been proposed from a variety of perspectives [7].

The protocols try to satisfy various properties, like: distributed implementation, efficient utilization of bandwidth and battery capacity, optimization of metrics, fast route convergence and freedom from loops.

2. Overview Of Routing Protocols

The main approaches in the routing are proactive, reactive, and hybrid.

2.1.Proactive Protocols

Proactive protocols continuously learn the topology of the network by exchanging topological information among the network nodes. Thus, when there is a need for a route to a destination, such route information is available immediately. If the network topology changes too frequently, the cost of maintaining the network might be very high. If the network activity is low, the information about actual topology might even not be used.

Proactive protocols continuously evaluate the routes within the network so that when the client required forwarding the packet route is already known and immediately ready for use. So there is no any time delay (time spend in route discovery process) takes place. So a shortest path can be find without any time delay however these protocols are not suitable for very dense Ad Hoc networks because in that condition problem of high traffic may arise. Several modifications of proactive protocols have been proposed for removing its shortcomings and use in Ad Hoc networks.

2.2.Reactive Routing Protocols

The Reactive routing protocol is also known as on demand routing protocol[4]. In this protocol route is discovered whenever it is needed Nodes initiate route discovery on demand basis. Source node sees its route cache for the available route from source to destination if the route is not available then it initiates route discovery process. The on-demand routing protocols have two major components,

2.2.1.Route Discovery

In this phase source node initiates route discovery on demand basis. Source nodes consult its route cache for the available route from source to destination. Otherwise, if the route is not present, it initiates route discovery[3]. The source node, in the packet, includes the destination address of source node as well as address of the intermediate nodes to that destination.

2.2.2.Route Maintenance

Due to dynamic topology of the network cases of the route failure between the nodes arises due to link breakage, so route maintenance is done. Reactive protocols have an acknowledgement mechanism due to which route maintenance is possible[5]. Reactive protocols add latency to the network due to the route discovery mechanism. Each intermediate node involved in the route discovery process adds latency.

2.3.Power Aware Routing

The power aware routing is to choose appropriate transmission range and routes to save energy for multihop packet delivery. Assuming the lifetime for each node is inversely proportional to the information going through that node,use the optimal lifetime as the key metric, trying to maximize the minimum lifetime for individual nodes under the constraints of information flows at each nodes. In order to solve this problem, to proposed distributed algorithms using bisection search. One is the heuristic flow redirection algorithm, whose basic idea is to start from a feasible routing strategy, then redirect the flows from nodes with low lifetimes to nodes with higher lifetimes. Another algorithm in [9] uses bisection search for successive feasible routing strategies.

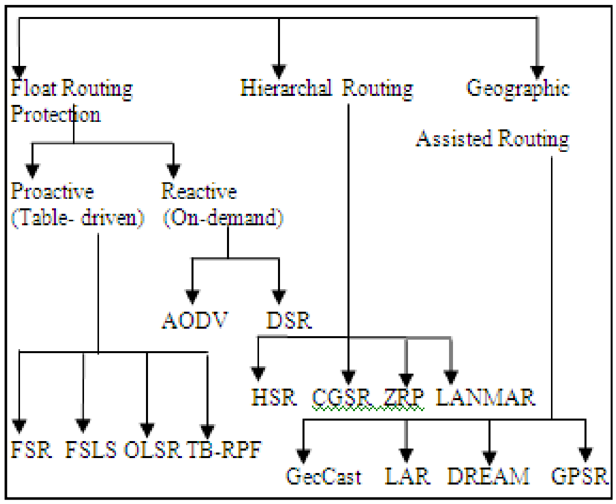

Figure 1: Classification of Routing Protocols in Mobile Ad Hoc Networks

3. Ad Hoc On Demand Distance Vector (AODV) Routing

AODV is a routing protocol for Mobile Ad- hoc networks (MANETs) and other wireless Ad Hoc networks. It is a reactive routing protocol, meaning that it establishes a route to a destination only on demand. In contrast, the most common routing protocols of the Internet are proactive, meaning they find routing paths independently of the usage of the paths [7]. AODV avoids the counting-to-infinity problem of other distance-vector protocols by using sequence numbers on route updates; AODV is capable of both unicast and multicast routing. In AODV, the network is silent until a connection is needed. The network node that needs a connection, broadcasts a request for connection. Other AODV nodes forward this message, and record the node that they heard it from, creating the temporary routes back to the requesting node. When a node receives such a message and already has a route to the desired node, it sends a message backwards through a temporary route to the requesting node. The requesting node then begins using the route that has the least number of hops through other nodes. Unused entries in the routing tables are recycled after a time. When a link fails, a routing error is passed back to a transmitting node, and the process repeats. Much of the complexity of the protocol is to lower the number of messages to conserve the capacity of the network; each request for a route has a sequence number. Nodes use this sequence number so that they do not repeat route requests that they have already passed on. Another such feature is that the route requests have a "time to live" number that limits how many times they can be retransmitted. Another such feature is that if a route request fails, another route request may not be sent until twice as much time has passed as the timeout of the previous route request.

The AODV Routing protocol uses an on-demand approach for finding routes, that is, a route is established only when it is required by a source node for transmitting data packets. It employs destination sequence numbers to identify the most recent path. In AODV, the source node and the intermediate nodes store the next-hop information corresponding to each flow for data packet transmission. In an on-demand routing protocol, the source node floods the Route Request packet in the network when a route is not available for the desired destination. It may obtain multiple routes to different destinations from a single Route Request.

The major difference between AODV and other on-demand routing protocols is that it uses a destination sequence number (DestSeqNum) to determine an up-to-date path to the destination. A node updates its path information only if the DestSeqNum of the current packet received is greater or equal than the last DestSeqNum stored at the node with smaller hopcount [6].A RouteRequest carries the source identifier (SrcID), the destination identifier (DestID), the source sequence number (SrcSeqNum), the destination sequence number (DestSeqNum), the broadcast identifier (BcastID), and the time to live (TTL) field. DestSeqNum indicates the freshness of the route that is accepted by the source. When an intermediate node receives a RouteRequest, it either forwards it or prepares a RouteReply if it has a valid route to the destination. The validity of a route at the intermediate node is determined by comparing the sequence number at the intermediate node with the destination sequence number in the RouteRequest packet. If a RouteRequest is received multiple times, which is indicated by the BcastID-SrcID pair, the duplicate copies are discarded[8]. All intermediate nodes having valid routes to the destination, or the destination node itself, are allowed to send RouteReply packets to the source. Every intermediate node, while forwarding a RouteRequest, enters the previous node address and it's BcastID. A timer is used to delete this entry in case a RouteReply is not received before the timer expires. This is used for storing an active path at the intermediate node as AODV does not employ source routing of data packets. When a node receives a RouteReply packet, information about the previous node from which the packet was received is also stored in order to forward the data packet to this next node as the next hop toward the destination[10]. The main advantage of this protocol is having routes established on demand and that destination sequence numbers are applied for find the latest route to the destination. The connection setup delay is lower. It creates no extra traffic for communication along existing links.

Whenever an AODV router receives a request to send a message, it checks its routing table to see if a route exists. Each routing table entry consists of the following fields:

- Destination address
- Next hop address
- Destination sequence number
- Hop count

If a route exists, the router simply forwards the message to the next hop. Otherwise, it saves the message in a message queue and then in initiates the route request to determine the route.Upon receipt of the rputing information it updates its routing table and then sends the queued messages.

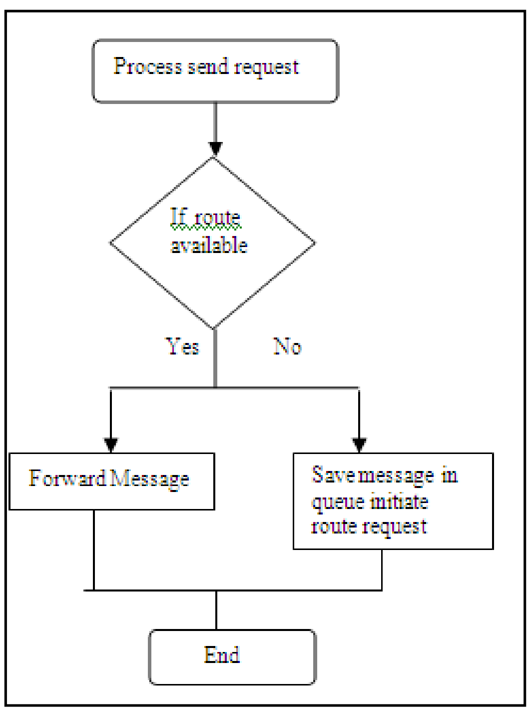

Figure 2: Route Request Process

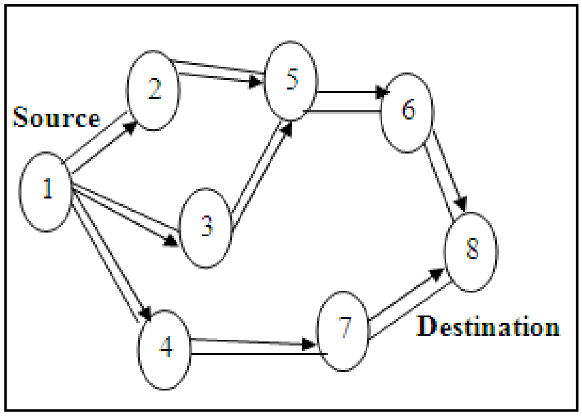

Figure 3: Propagation of Route Request (PREQ) Packet

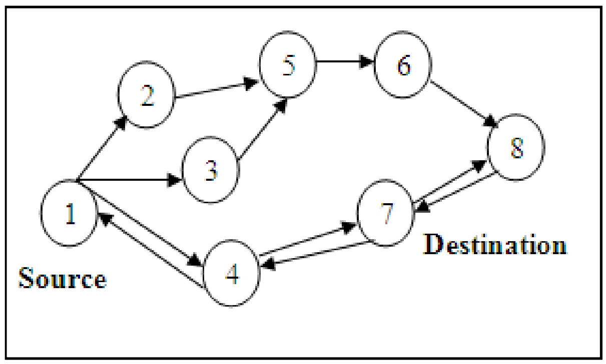

Figure 4: Propagation of Route Reply (PREP) Packet

4. DESTINATION SEQUENCED DISTANCE VECTOR ROUTING PROTOCOL

The destination sequenced distance vector (DSDV) routing protocol is a proactive routing protocol which is a modification of conventional Bellman-Ford routing algorithm. This protocol adds a new attribute, sequence number, to each route table entry at each node. Routing table is maintained at each node and with this table; node transmits the packets to other nodes in the network. This protocol was motivated for the use of data exchange along changing and arbitrary paths of interconnection which may not be close to any base station.

DSDV is based on the Bellman-Ford routing algorithm; it is a proactive protocol and belongs to the table-driven family. Routes between the nodes in the network are always being maintained and updated[11]. Each node in the network maintains a routing table which contains information about how old the route is, the shortest distance as well as the first node on the shortest path to every other node in the WSNs. In order to prevent loops and counter the count to infinity problem, a sequence number which is originated by the destination node tags each entry in the network. The sequence number for each node is chosen randomly and it is usually an even number.

Each node has to update its sequence number periodically and in the normal update, the sequence number is increased by two. If node discovers an expired path and wants to send an update about it to its neighbours, only then does it increase the sequence number for a disconnected node. There are two classified categories for routing updates: full dump update and incremental update[12]. In the former, the complete routing table is transmitted by the node. In order to reduce the potential traffic, this type of update should be used only in the situation where complete or huge amounts of topology are changed. Whereas, in the case of incremental updates, the node sends only the entries that have been changed since the last update. In a fast changing network, incremental messages could grow and get bigger which affect the performance of the network, so full dumps are preferred in a fast changing network. Each node in the network maintains routing table for the transmission of the packets and also for the connectivity to different stations in the network[13]. These stations list for all the available destinations, and the number of hops required to reach each destination in the routing table. The routing entry is tagged with a sequence number which is originated by the destination station. In order to maintain the consistency, each station transmits and updates its routing table periodically. The packets being broadcasted between stations that indicate stations are accessible and how many hops are required to reach that particular station[14]. Routing information is advertised by broadcasting or multicasting the packets which are transmitted periodically as when the nodes move within the network .

The DSDV protocol requires that each station in the network must constantly; advertise to each of its neighbors, its own routing table. Since, the entries in the table may change very quickly; the advertisement should be made frequently to ensure that every node can locate its neighbors in the network[16]. This agreement is placed, to ensure the shortest number of hops for a route to a destination; in this way the node can exchange its data even if there is no direct communication link. The data is broadcasted by each node and it contains its new sequence number and the following information for each new route:

- The destination address
- The number of hops required to reach the destination and
- The new sequence number, originally stamped by the destination

The transmitted routing tables will also contain the hardware address, network address of the host transmitting them. The routing tables will contain the sequence number created by the transmitter and hence the most new destination sequence number is preferred as the basis for making forwarding decisions[17]. This new Sequence number is also updated to all the hosts in the network which may decide on how to maintain the routing entry for that originating host. After receiving the route information, receiving node increments the metric and transmits information by Broadcasting. Incrementing metric is done before transmission because, incoming packet will have to travel one more hop to reach its destination.Time between broadcasting the routing information packets is the other important factor to be considered. When the new information is received by the mobile host it will be retransmitted soon effecting the most rapid possible dissemination of routing information among all the cooperating mobile hosts. The mobile host cause broken links as they move from place to place within the network[18]. The broken link may be detected by the protocol, which may be described as infinity. When the route is broken in a network, then immediately that metric is assigned an infinity metric there by determining that there is no hop and the sequence number is updated. Sequence numbers originating from the mobile hosts are defined to be even number and the sequence numbers generated to indicate infinity metrics are odd numbers.

The main purpose of DSDV is to address the looping problem of the conventional distance vector routing protocol and to make the distance vector routing more suitable for Ad Hoc networks routing. However, DSDV arises route fluctuation because of its criteria of route updates. At the same time, DSDV does not solve the common problem of all distance vector routing protocols, the unidirectional links problem.

4.1.Damping Fluctuation

Fluctuation is a general problem arising in DSDV by the following criteria of route updates:

Routes are always preferred if the sequence numbers are newer, routes with older sequence numbers are discarded. A route with a sequence number equal to that of an existing route is preferred if it has a better metric, and the existing route is discarded or stored as less preferable. The broadcasts of routing information by mobile nodes are asynchronous events, though some regularity is expected. In the case of many mobile nodes independently transmitting update messages and having different transmission intervals, it may turn out that a particular mobile node receives new update packets in a way that causes this mobile node to consistently change route back and forth between different next hops, even though no network topology change has taken place. This variation happens because of the above two route selection criteria.

A mobile node can always receive two routes with equal sequence numbers or with a newer sequence number one after the other via different neighbors to the same destination, but the mobile node always gets the route with the worse metric first. This situation leads to the fluctuation with a continuing burst of new update packets. This can happen when there aremany mobile nodes, all transmitting their updates irregularly. Alternatively, if the mobile nodes are acting independently and with and with markedly differently transmission intervals, the situation can occur with fewer mobile nodes.

4.2.Unidirectional Links

DSDV assumes that all wireless links in an Ad Hoc network are bi-directional. However, this is not true in reality. Wireless media is different from wired media due to its asymmetric connection. Unidirectional links are common in wireless networks.

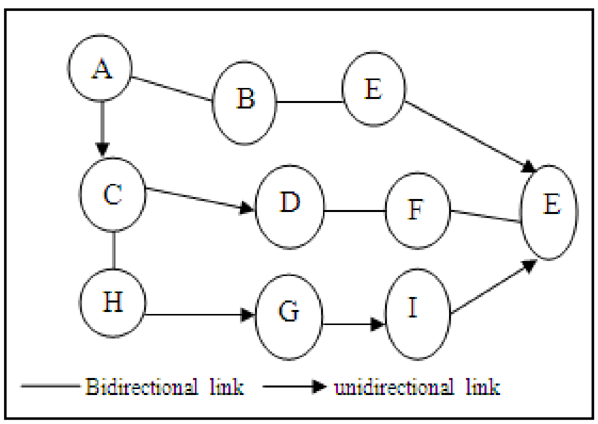

Figure 5: An Ad Hoc network with unidirectional and bi-directional links

5. Experimental Result

In order to evaluate the performance of AODV and DSDV routing protocol , consider the following metrics.

5.1.Packet Delivery Fraction

Packet delivery fraction is the percentage of the number of packets received by the destinations to the number of packets originated by the application layer.

5.2.Average End To End Delay

Average end to end delay includes all the possible delay occur due to buffering during route discovery latency, queuing at the interface queue, retransmission delay at the MAC and propagation and transfer time of data packets.

5.3.Node Throughput

Node throughput is the ratio of the total amount of data that reaches a receiver from a sender to the time it takes for the receiver to get the last packet.

5.4.Routing Overhead

Routing overhead is the number of control packets produced per mobile node. Control packets include route request, replies and error messages. Routing overhead measured the internal effectiveness of routing protocol.

6.Conclusion

Mobile Ad Hoc networks are not new to computer science, but the concept of a well organized routing simulator that can demonstrate routing protocols used in Ad Hoc networks a reality. DSDV compared with AODV, DSDV routing protocol consumes more bandwidth, because of the frequent broadcasting of routing updates. While the AODV is better than DSDV as it does not maintain any routing tables at nodes which results in less overhead and more bandwidth. AODV perform better under high mobility simulations than DSDV. High mobility results in frequent link failures and the overhead involved in updating all the nodes with the new routing information as in DSDV is much more than that involved AODV, where the routes are created as and when required. AODV protocol uses a on -demand route discovery, but with different routing mechanisms.

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