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Energy Savings in Mobile Adhoc NETworks (MANET) Using Routing Protocols

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ABSTARCT

Reducing the energy consumption of wireless mobile adhoc network devices is paramount to a wide spread adoption of mobile applications. Energy saving is an important issue in Mobile AdHoc Networks (MANETs).To maximize the lifetime of an adhoc network it is essential to prolong each individual node(mobile) life through minimizing the total transmission energy consumption for each communication request. This paper identifies the necessary features of an on-demand minimum energy routing protocol. To fully and fairly study the performance of these different energy-related routing metrics or routing protocols, we implement all of them in the most popular network simulator (NS-2), using the same underlying ad hoc routing protocol (AODV). We conduct a complete set of simulations to evaluate these protocols.The most similar works in the literature are compared three different energy efficient routing protocols with minimum-hop routing protocol using their own simulators, In this paper, we implement a greater number of energy efficient protocols we use AODV as the base protocol; we use NS-2; The result is a thorough, informative study.

Keywords : Energy Saving, Routing Protocols, MANET

INTRODUCTION

A mobile ad hoc network (MANET) is a wireless LAN without relying on any pre-existing infrastructure. The mobile ad hoc networks have become a major component of the future network development due to their ease of deployment, self-configurability, flexibility and independence on any existing network infrastructure. But most of the research in the field of ad hoc network is limited to stand-alone isolated networks. The demand for any time anywhere connectivity has increased rapidly with the tremendous growth of the Internet in the past decade and due to the huge influx of highly portable devices such as laptops, PDAs etc. In order to facilitate the users with the huge pool of resources and the global services available from the Internet and for widening the coverage area of the MANET there is a growing need to integrate these ad hoc networks to the Internet. For this purpose we need gateways which act as bridges between these two different protocol architectures.

The gateway discovery in hybrid network is considered as a critical and challenging task and with decreasing pause time and greater number of sources it becomes even more complex. Due to the scarcity of network resources in MANET, the efficient discovery of the gateway becomes is a key issue in the design and development of future hybrid networks. In this paper the AODV reactive routing protocol is extended to support the communication between the MANET and the Internet. We have carried out a systematic simulation based performance evaluation of the different gateway discovery approaches using NS2 under different network scenarios. The performance differentials are analyzed on the basis of three metrics – packet delivery fraction, average end-to-end delay and normalized routing load.Wireless Mobile Adhoc Networks usually consist of mobile battery operated computing devices that communicate over the wireless medium. While the processing capacity and the memory space of computing devices increase at a very fast speed, the battery technique lags far behind. Therefore, it is critical to derive energy conservation schemes to increase the device and network operation time. With the advance of wireless communication technology, small size and high performance computing and communication devices like commercial laptops and personal computers are increasingly used in convention centers, conferences and electronic classrooms.

In wireless ad-hoc networks, a collection of nodes with wireless communications and networking capability communicate with each other without the aid of any centralized administrator. The nodes are powered by batteries with limited energy reservoir. It becomes difficult to recharge or replace the batteries of the nodes hence energy conservation is essential. An energy efficient routing protocol balances node energy utilization to reduce energy consumption and increase the life of nodes thus increasing the network lifetime, reducing the routing delay and increasing the reliability of the packets reaching the destination. Wireless networks do not have any fixed communication infrastructure. For an active connection the end host as well as the intermediate nodes can be mobile. Therefore routes are subject to frequent disconnection. In such an environment it is important to minimize disruptions caused by changing topology for applications using voice and video. Power Aware Routing enables the nodes to detect misbehavior like deviation from regular routing and forwarding by observing the status of the node. By exploiting non-random behaviors for the mobility patterns that mobile user exhibit, state of network topology can be predicted and perform route reconstruction proactively in a timely manner. In this paper we propose an Energy Efficient-Power Aware routing algorithm where we have integrated energy efficiency with power awareness parameters for routing of packets. Mobile Ad hoc Networks (MANETs) are a specific type of wireless network that is infrastructure-less, dynamic and self-organising. There is a growing need for MANETs to support real-time multimedia applications. Most current MANET routing protocols only support best-effort routing. By improving the QoS on MANETs, we can extend the set of multimedia services that can run on the MANET.

Formally, a MANET is described as a set V of N nodes placed in 2-D or 3-D Euclidean space. In location-based schemes, it is assumed that each node is aware of its location, expressed as Cartesian coordinates (x, y) or (x, y, z). We assume that the transmission range of all nodes is the same and equal to R. Two nodes can communicate with each other if and only if their Euclidean distance is, at most, R. The ability to communicate is represented by an edge between the corresponding nodes. The resulting graph, i.e., $G = (V, E)$, is the topology of the network. G varies over time due to the presence or absence of the links among nodes. Given G and a pair of nodes (i, j), $i, j \in V$, the problem of routing is to find a path from i to j while minimizing some objective functions

MATERIALS AND METHODS

Routing Protocols

OLSR

Energy-efficient MANET routing protocol *Optimized Link State Routing Protocol* (OLSR) is widely used for routing in ad hoc networks. Residual energy of nodes play a vital role in route discovery in MANET. To support energy-efficient routing, accurate state information about energy levels of nodes should be available. But due to bandwidth constraints, communication costs, high loss rate and the dynamic topology of MANET, collecting and maintaining up-to-date state information is a very complex task. We focus on the inaccuracy of state information, more specifically the residual energy level of nodes that is collected by the control messages of OLSR. Inaccurate information effect the efficiency of OLSR protocol. We study some parameters of OLSR that forces the inaccuracies in the energy level information of neighboring nodes and show the comparison between ideal and realistic version of OLSR. Our study concluded that tuning of OLSR does not really improve the residual energy information of nodes. And finally try to suggest some techniques to reduce inaccuracies.

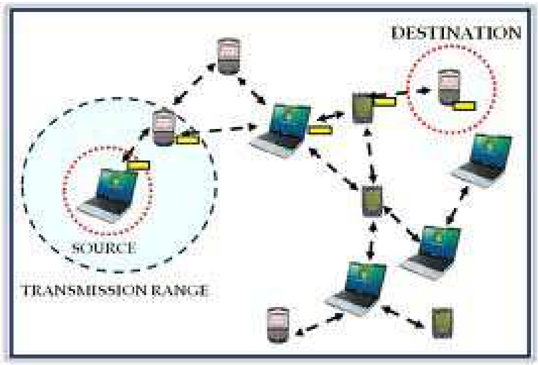

Figure 1: OLSR Overview

AODV

Adhoc **O**n Demand **D**istance **V**ector (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.

AODV builds routes using a route request / route reply query cycle. When a source node desires a route to a destination for which it does not already have a route, it broadcasts a route request (RREQ) packet across the network. Nodes receiving this packet update their information for the source node and set up backwards pointers to the source node in the route tables. In addition to the source node's IP address, current sequence number, and broadcast ID, 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 hopcount, 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 travelling 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). After receiving the RERR, if the source node still desires the route, it can reinitiate route discovery.

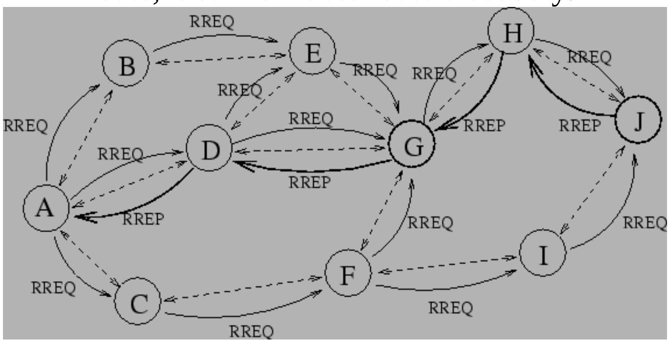

Figure 2: AODV Routing Protocol

There is a growing need for MANETs to support real-time multimedia applications. Most current MANET routing protocols only support best-effort routing. By improving the QoS on MANETs, we can extend the set of multimedia services that can run on the MANET. We propose to practically implement enhancements to the AODV routing protocol and quantify the effect of these enhancements on the QoS achieved in a wireless grid test bed. The work will then be extended by comparing relative performance with the DYMO routing protocol. First, the routing metric will be changed from hop count to measured end-to-end delay. This will allow AODV to take the requirements of delay-sensitive applications such as voice and video services into account when selecting a route. The hypothesis is that this simple enhancement will greatly improve the level of QoS achieved.

PEER Protocol

PEER is a cost-based energy efficient routing protocol.In a cost-based routing protocol, the total cost of all the links on each available path between the source node and the Target node will be calculated, and a minimum cost path (meeting certain criteria) will be selected. As link cost is very important in the cost-based energy efficient routing protocols, it is critical to derive an accurate link cost metric to obtain an optimal path. It’s the one of the Protocol for Enegy Savings in MANET.

PERFORMANCE CONSIDERATIONS

Energy Saving

Wireless networks usually consist of mobile battery operated computing devices that communicate over the wireless medium. While the processing capacity and the memory space of computing devices increase at a very fast speed, the battery technique lags far behind.

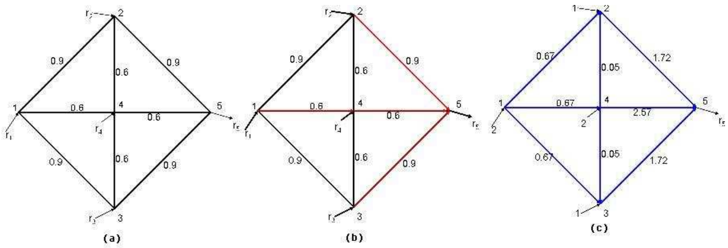

Fig 3. Maximum Lifetime and Minimum Energy Consumption

In Fig.3 (a), the energy consumption for transmitting one bit over each link is labeled right beside the link. Now we want to transmit data from nodes 1, 2, 3, and 4 with rate r1, r2, r3, and r4 respectively to node 5. To minimize the whole power consumed, the routing is shown in Fig.3 (b). However, we show in Fig.3 (c) another routing strategy, where the numbers adjacent to the link are the fractional data rates going through the route. By simple calculations, the strategy in (c) outperforms (b) because node 1 can function 33% longer time.

RESULT&DISCUSSION-

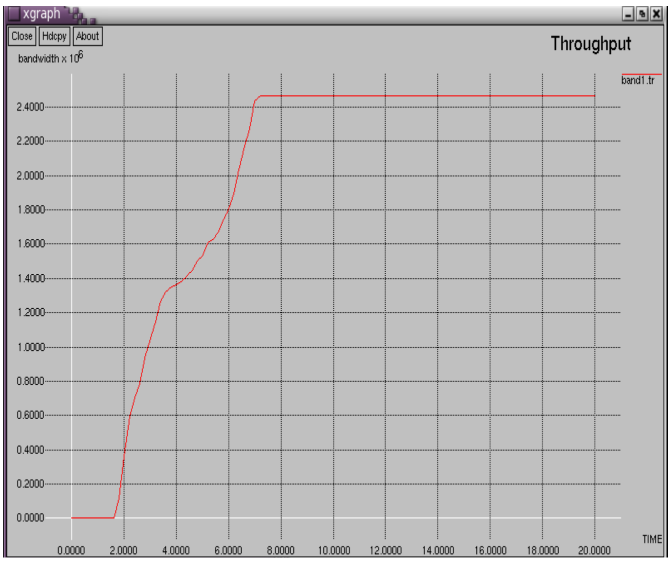

Figure 4: An AODV Throughput for Energy Saving

An ad hoc network was simulated with 25 nodes moving randomly in an area of 500 m by 500 m with OLSR routing protocol. 'Hello' message time was varied from t=2,4 and seconds and the throughput studied.

It is clear from the results that the normal on-demand routing protocol performs the best in terms of Routing Overhead,Energy Consumption for Routing Overhead followed by PEER minimum energy routing protocol. Both the routing overhead and setup time for the minimum energy routing protocol are much more than the on-demand routing protocol, and increase dramatically with the number of nodes. That is because the routing overhead for minimum energy routing protocol is $O(n^2)$.

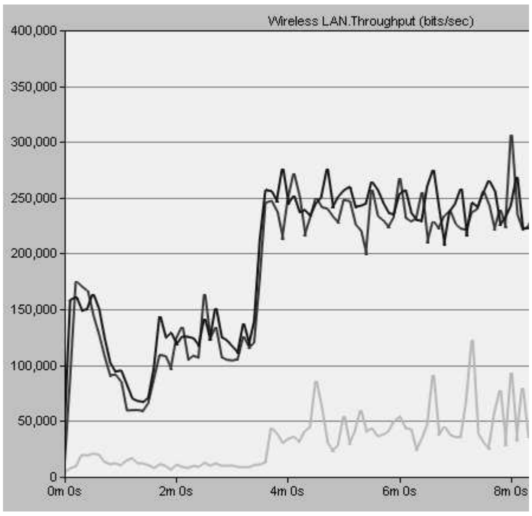

Figure 5: An OLSF Throughput for Energy Saving

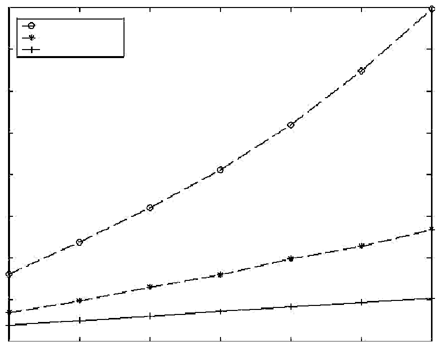

Figure 6: Energy Consumption for PEER Protocol

CONCLUSION

There has been increased interest recently from military, civil, and commercial sectors in networks capable of self-organization. In order to achieve theses we prposed a MANET, an efficient routing protocol is required to discover routes between mobile nodes. Energy efficiency is one of the main problems in a MANET, especially in designing a routing protocol. In this paper, we surveyed and classified a number of energy aware routing Protocols. In many cases, it is difficult to compare them directly since each method has a different goal with different assumptions. 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.

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