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ENERGY AWARE ALGORITHM FOR AD-HOC ON DEMAND DISTANCE VECTOR PROTOCOL IN MANET

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ABSTRACT: *On demand routing protocols for ad hoc networks discover and maintain routes on a reactive, "as-needed" basis. These protocols are attractive for their low routing overheads. This paper is related with a technique to make these protocols energy-aware in order to increase the operational lifetime of an ad hoc network where nodes are operating on battery power alone and batteries cannot be recharged. This technique uses a new routing cost metric which is a function of the remaining battery level in each node on a route and the number of neighbors of this node. The idea of the cost metric is to be able to route around the nodes that are running low in battery for which alternate routes are available. Simulation results using AODV protocol show that the throughput is higher for modest motilities with larger scalability with up to limited traffic loads.*

KEYWORDS: MANET, AODV, ODMRP, PAMAS, ECSRP.

I: INTRODUCTION

The MANET [1] is decentralized, where network organization and message delivery must be executed by the nodes themselves, i.e.. Nodes work as routers. A MANET may operate in a stand-alone manner, or be connected to a larger network, e.g., the fixed Internet.

Fig.1 A Mobile Ad Hoc Network

The majority of applications for the MANET technology are in areas where rapid deployment and dynamic reconfiguration are necessary and the wire line network is not available. These include military battlefields, emergency search and rescue sites, classrooms, and conventions where participants share information dynamically using their mobile devices. These applications lend themselves well to multicast operation. In addition, within a wireless medium, it is even more crucial to reduce the transmission overhead and power consumption. Multicasting can improve the efficiency of the wireless link when sending multiple copies of messages by exploiting the inherent broadcast property of wireless transmission.

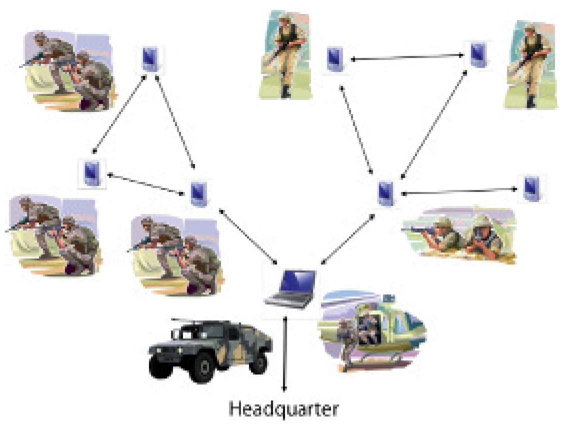

Fig.2 Application of Mobile Ad Hoc Network

Routing plays a very important role in MANET which has been done by routing protocols. Routing protocols are used to route the packets depending on the path conditions. The design of network protocols for MANETs is a complex issue. Message routing in a decentralized environment where network topology fluctuates is not a well-defined problem. While the shortest path (based on a given cost function) from a source to a destination in a static network is usually the optimal route, this idea is not easily extended to MANETs. Factors such as power expended, variable wireless link quality, propagation path loss, fading, multi-user interference, and topological changes, become relevant issues. The network should be able to adaptively alter routing paths to alleviate any of these effects.

II: Structure of An Ad-hoc Network

Why Ad Hoc Networks?

- Ease of deployment
- Speed of deployment
- Decreased dependence on infrastructure
- Basically, these three facilities of Ad Hoc Networks makes us improve and use them efficiently.

As we said any electronic device that has the wireless transmission capability with proper processing hardware can be a part of a MANET. But since the wireless transmission ranges according to transmission type of the antenna (Omni directional, bidirectional), and the variations between transceivers at different nodes effect the network structure of the MANETs.

However, members of the MANETs can be fixed without any constraint, they consist of mobile nodes. So, their processing capability is limited. Also, power consumption of the mobile nodes is a very great factor on the structure of the MANETs. So, to make MANETs applicable and get maximum performance from them, we have to consider these two factors, and design any algorithms appropriately.

MANETs are autonomous and decentralized networks. Two nodes that want to communicate with each other can send and receive messages directly, if they are both in their transmission range. Otherwise, every node is also capable to be a router, and the messages between nodes are relayed by the intermediate nodes, from the originator of the message to the destination. Since the nodes are mobile and the members of the network changes without any notice, the network structure is very dynamic. So, the route the messages are sent by, are dynamic also.

III: CHALENGES

Although MANETs have some simplifications in design, we have some issues that affect the feasibility and performance of MANETs. Most important ones are, namely:

- Limited and variable wireless transmission range.
- Broadcast nature of the wireless medium.
- Packet losses due to transmission errors.
- No centralized administration or standard support services.
- Route changes because of the dynamic structure of MANETs (mobility) which may cause to loss of packets
- Nodes with limited power
- Potential network partitions due to mobility and structure of wireless medium
- Security issues

IV: ENERGY EFFICIENT ROUTING PROTOCOL IN MANETS.

The network lifetime [2] is a key design factor of mobile adhoc networks (MANETs). To prolong the lifetime of MANETs, one is forced to attain the tradeoff of minimizing the energy consumption and load balancing. In MANETs, energy waste resulting from retransmission due to high frame error rate (FER) of wireless channel is significant. In [3] a novel protocol termed error-aware candidate set routing protocol (ECSRP) is proposed. ECSRP chooses a route in a candidate subset in the route cache in which all the nodes have enough residual battery power. This approach avoids overusing certain routes. If multiple routes exist in the candidate set, ECSRP employs a metric achieving the tradeoff between energy-efficiency and load balancing to select the optimal route. It also takes channel condition into consideration by incorporating packet loss probability in the computation of energy consumption. This helps to reduce the number of retransmissions and save energy.

V: ODMRP OVERVIEW

ODMRP [3] is a mesh based scheme and uses a forwarding group concept (only a subset of nodes forwards the multicast packets via scoped flooding). In ODMRP, group membership and multicast routes are established by the source on demand when a multicast source has packets to send, but no route to the multicast group, it broadcasts Join-Query control packets to the entire network. This control packet is periodically broadcast to refresh the membership information and updates routes as shown in the fig. When the Join-Query packet reaches a multicast receiver, it creates and broadcasts Join-Reply to its neighbors.

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Fig.3 Multicast Routing

When it has been received by the node, it checks if the next hop node id of one of the entries in Join-Reply table matches its own id. If it is does, the node realizes that it is on the path to the source and becomes the part of the forwarding group by setting the FG_FLAG (Forwarding Group flag). When receiving a multicast data packet, a node forwards it only when it is not a duplicate, hence minimizing traffic overhead. ODMRP uses location and movement information to predict the duration of time that routes will remain valid. With the predicted time of route disconnection, a “join data” packet is flooded when route breaks of ongoing data sessions are imminent. It reveals that ODMRP is better suited for ad hoc networks in terms of bandwidth utilization.

VI: PROBLEM STATEMENT

Current research efforts in mobile ad hoc networks are mainly converging towards inclusion of dissimilar communication technologies like IEEE 802.11 and IEEE 802.15.4 to a single mobile ad hoc network. Integrations of different networks like Wide Area Networks WANs (1G, 2G, 2.5G, 3G) and Metropolitan Area Networks MANs (IEEE 802.16) are also extending towards multi hop communication environment using the new and revolutionary paradigm of a mobile adhoc networks (MANETs), in which nodes constituting MANET serve as routers.

Comprehensive research efforts have been done to address the issues related to infrastructure-less multihop communications. However, an investigation needs to be made in order to analyze and address the issues arising from such integrations. Such problems relate to both end user's convenience (For example, remembering each destination with its IP address is a cumbersome job specially when every destination may carry multiple IP addresses and any communication interface may optionally be connected or disconnected) as well as network's performance; for example, routing to the best possible interface when there are multiple interfaces installed at destination. Likewise, optimized neighborhood sensing and position based routing can help to improve heterogeneous ad hoc network's performance and scalability.

VII: RELATED WORK

The problem of trying to conserve battery usage within a mobile ad hoc network is not new. Previous other work has gone in different energy conserving strategies spanning different network layers. In [4] a power-aware multiple access protocol (PAMAS) was proposed. Here, a node turns off its radio interface for a specific duration of time, when it knows that it will not be able to send and receive packets during that time because of the possibility of multiple access interference. The sleep time is of the order of packet duration, which could be very small in modern wireless LANs like 802.11b (nominal bit rate 11 Mb/sec). This means that the radios must be capable of very fast transition between on and off periods (within a millisecond in 802.11b, e.g.). The state-of-the-art in commercial radios is far from this goal. For example, experimental studies in [6] indicate that it takes about 100ms for COTS radios like Wave LAN to come out of sleep state and be ready to transmit/receive the first packet. However, PAMAS approach would be quite viable for low-bandwidth wireless networks, in radios where small packets can be combined to form large packets, or in radios with fast settling periods. Our protocol does not have any dependency on the property of the electronics and would be able to gain further from PAMAS-like support in the MAC layer.

In [5], several energy-aware metrics were discussed that will result in energy-efficient routes. The metrics included maximizing the time to network partition and reducing variance in node power levels. It is hard to use these metrics directly in a network without any central control. However, Technique in this paper uses power balancing by rerouting around nodes with low energy reserves. This indirectly achieves the above goals. In [5] performance evaluations using small (20 nodes) random graph model showed improved per packet energy cost with a energy-aware cost model (cost of route is the sum of costs of each node on the route) compared to shorest-path routing. Our cost model is similar though we use a piece-wise model dependent on the energy reserve of a node. Some of our observations are also in line with [5], such as the savings are greater in larger and denser networks, and also in moderate traffic situations as opposed to low or high traffic situations.

In a more recent work [2], the network longevity was the overall goal in reducing the battery consumption. Unlike the conventional approach of minimizing the cost of the route from a source to a given destination, the strategy here was geared towards balancing the battery usage among the nodes in the network in proportion to their energy reserves. The algorithms were centralized; no deployable distributed solution was provided.

In [7], a power saving technique was proposed with AODV routing protocol. Here the nodes are made to sleep during the idle periods. Choice of sleep periods is somewhat different from ours. Mobile networks have not been considered and no routing cost model has been used. In general, powering radios off during periods a node is known not to take part in any critical communication is a popular technique for energy saving. PAMAS [4] does it in MAC layer; [7] does it in the routing layer; some application-layer ideas can be found in [6].

There has been a growing interest in transmit power control in the ad hoc networking community for reasons of power savings and to increase spatial reuse. Minimum transmit power necessary to successfully transmit a packet to a neighboring node follows a power law relation with the physical distance. Thus there can be interesting trade-offs between total energy needed to send a packet between a source-destination pair, delay (transmitting with lower power will increase number of hops and hence delay) and degree of network connectivity. We have not used transmit power control in our work.

VIII: SIMULATION OUTPUT

The Simulation Outputs are taken from an Applet viewer in Java. Outputs are taken for various numbers of nodes starting from 10 nodes to 90 nodes. And they are also taken for different sizes of Data Packets starting from 200 packets to 1000 packets. As shown in fig. packets are sent from three different sources towards a fixed Destination. And for these various nodes and various Data Sizes Throughput and Delay is measured for proposed energy aware routing protocol.

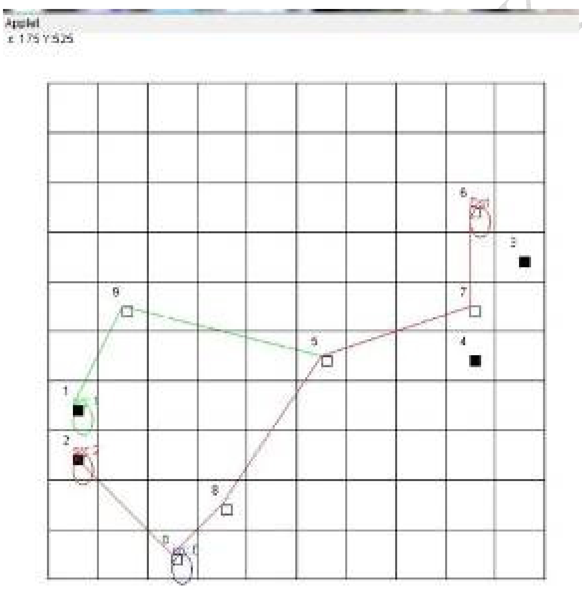

Fig.4 10 mobile nodes with 200 packets

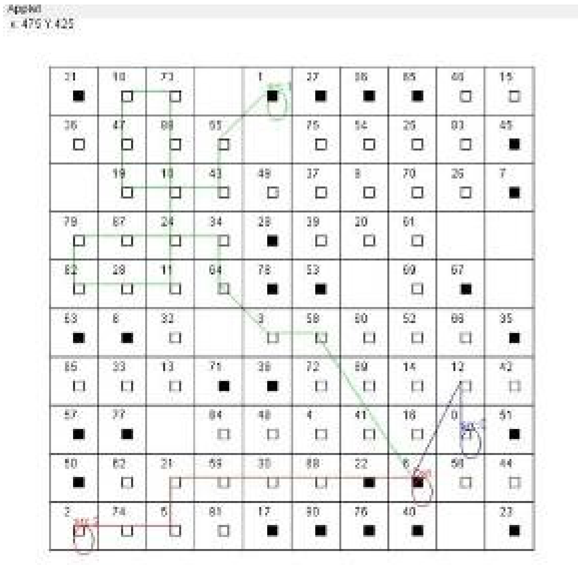

Fig.5 90 mobile nodes with 200 packets

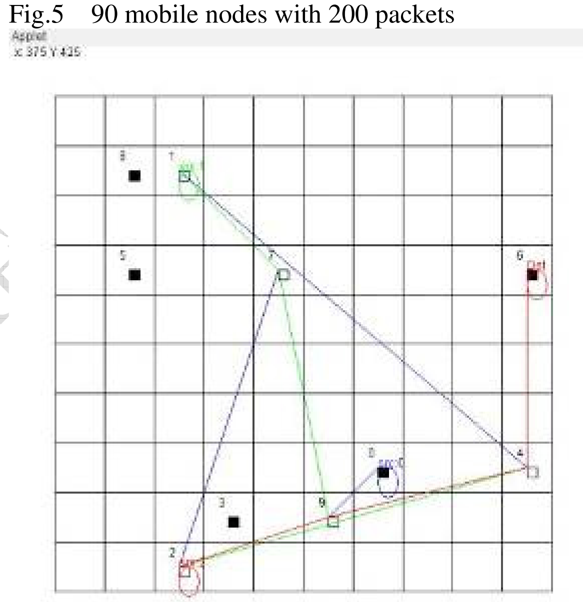

Fig.6 10 mobile nodes with 1000 packets

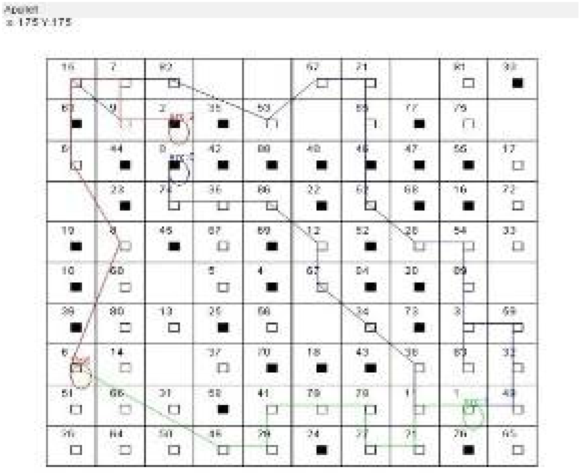

Fig.7 90 mobile nodes with 1000 packets

IX. SIMULATION RESULT

The Simulation Results show overall throughput and delay for proposed energy aware routing protocol. Simulation Results are measured for 10 nodes with 200 packets and 1000 packets, 90 nodes with 200 and 1000 packets. Also Throughput for intermediate various sizes of mobile nodes with 200 and 1000 packets are measured and Graph is plotted for these results for better analysis.

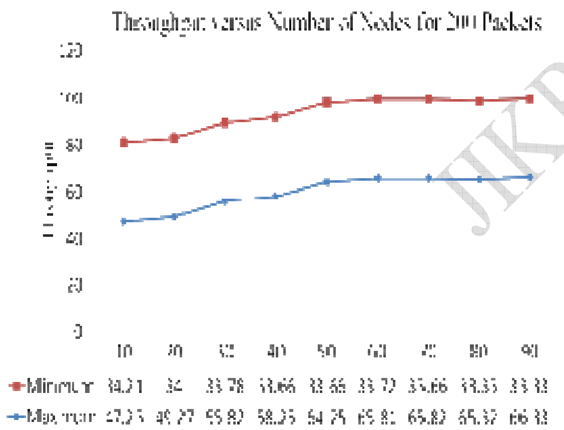

Fig.8 Throughput versus various nodes for 200 pkts

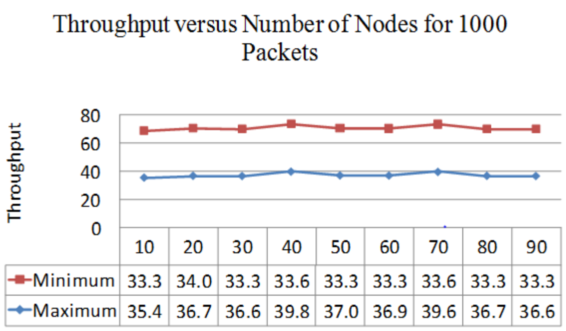

Fig.9 Throughput versus various nodes for 1000 packets

VIII: CONCLUSION

The results obtained from the packet-level simulation are sensitive to the various parameters of the system. These parameters include the initial level of energy, the categorization of different energy zones, the cost associated with the various energy zones, the timings for the sleep and the idle periods and the extent to which active neighborhood effects the cost of routing the data packets. A detailed analysis of the effect of each of these parameters individually and the together with the rest of them on the results is necessary. From the analysis we can conclude that throughput is improved by minimizing the frame error rate by considering battery level of intermediate nodes. Thus, from simulation results throughput is higher for limited traffic overhead though even number of nodes is increasing.

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