DEMAND BASED ENERGY EFFICIENT TOPOLOGY IN MANETS USING AOMDV ROUTING PROTOCOL

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ABSTRACT

Energy efficient topology in Ad-hoc networks can be achieved mainly in two different ways. In the first method, network maintains a small number of nodes to form a route and the remaining nodes sleep to conserve energy. This method is effective for low traffic networks. Energy efficiency in the second method is achieved by power control technique. This technique is effective in high traffic conditions. The first method is not effective in high traffic conditions. Similarly, the second method is not effective in low traffic networks. So, in this paper we propose a Demand Based Energy efficient Topology (DBET) to reduce the energy consumption for mobile ad hoc network, by dynamically adjusting the topology for various network traffic conditions. We have simulated our proposed protocol DBET by using AOMDV as routing protocol in network simulator and compared with AODV. The simulation studies revealed that the proposed scheme perform better in terms of energy, delay, and delivery ratio.

Keywords: Energy efficient topology, Routing, MANET, AOMDV.

INTRODUCTION

Mobile Ad-hoc Networks (MANETs) are self-organizing, self-configuring and infrastructure-less multi-hop wireless networks, where each node communicates with other nodes directly or indirectly through intermediate nodes without any infrastructure. Such temporary networks can be used in battlefields, disaster areas, military applications, mining operations and robot data acquisition. Besides these characteristics they present challenges like limited energy, dynamic topology, low bandwidth and security. The description of the arrangement of the MANETs, called topology, is usually temporary or dynamically changed with time. Energy conserving is one of the challenges because of limited battery resource. The techniques which are used to reduce the initial topology of network to save the energy and increase the lifetime of network, with the preservence of network connectivity, called topology control techniques. Various techniques, in network layer, are proposed in the literature to conserve energy.
These techniques can be classified mainly into two categories: by controlling the number of nodes with the smaller link cost. In the first method a small number of nodes awake to maintain

the network connectivity and remaining nodes go into sleep state to conserve energy. This method is effective in low traffic conditions, because the power consumption to keep nodes awake dominates the power consumption in data transfer. In the second method, topology is controlled by keeping lesser cost links in the network. This method is effective in high data traffic because power consumption in data transfer dominates the power required to keep nodes awake. We combine the advantages of these two techniques to dynamically adjust network topology for various network traffic conditions.

In this paper, we present a demand based energy efficient topology (DBET) that dynamically adjust network topology for various network traffic conditions. We have simulated our proposed protocol DBET by using AOMDV as routing protocol using network simulator and compared with AODV. The simulation studies revealed that the proposed scheme perform better in terms of energy, delay, and delivery ratio. In general network topology is controlled by keeping small number of nodes awake as in the first technique. The proposed DBET keeps more number of nodes along the bulk data transfer path to conserve energy by keeping low link cost as in the second technique.

Wireless Mesh Networks (WMNs) are being developed actively and deployed widely for a variety of applications, such as public safety, environment monitoring, and citywide wireless Internet services. They have also been evolving in various forms to meet the increasing capacity demands by the above-mentioned and other emerging applications. Some parts of networks might not be able to meet increasing bandwidth demands from new mobile users and applications. Many solutions for WMNs to recover from wireless link failures have been proposed with different algorithms, but they have some limitations.

- Resource-allocation algorithms
- Greedy channel-assignment algorithm
- Fault-tolerant routing protocols

Resource-allocation algorithms can provide guidelines for initial network resource planning. Next, a *greedy* channel-assignment algorithm can reduce the requirement of network changes by changing settings of only the faulty link(s). Fault-tolerant routing protocols, such as local rerouting or multipath routing , can be adopted to use network-level path diversity for avoiding the faulty links. To overcome those limitations, we propose an *autonomous network reconfiguration system* (ARS) that allows a multiradio WMN to autonomously reconfigure its local network settings

FORMATION OF SYSTEM

Demand based energy efficient topology (DBET) for mobile ad hoc network, which dynamically changes the topology according to the network traffic requirements. Initially we compute a small set of nodes, which form a connected backbone, while the other nodes are put off to conserve energy. These connected backbones are used for routing the packets under low network load. When there is a bulk data transfer between a pair of nodes, the topology dynamically changes along the path between these nodes by power control and route optimize technique to minimize the power consumption. The proposed DBET can be divided into four cases.

Independent set formation: The first one selects a minimal set of nodes that constitute a minimal independent set of a connected backbone of the network. This selection is done in a distributed and localized manner using neighbor information available with the network layer. The following terms plays major role in these case.

Stability factor (*S*): Nodes that are relatively more stable as compared to the others in the localities are given more preference. The node's stability is measured as the ratio of number of link failures and new connection established per unit time to the total number of nodes surrounding that node.

Utility factor (U): Nodes that have higher number of neighbors without an active neighbor are given more preference.

Energy factor (E): Nodes that have higher amounts of percentage remaining power are given more preference over others to be elected as active nodes. This introduces fairness in the protocol by ensuring proper rotation in the selection of active nodes.

$C = S + U + E$

Only nodes that do not have an active node in their neighborhood are allowed to participate in the election. Announcement contention occurs when multiple nodes discover the lack of an active node, and all decide to become active nodes. We resolve the contention by delaying the announcement with randomized back off delay, which is proportional to the extent to which the node satisfies the heuristics. The selected nodes forms an independent set of a connecting backbone of the network. Selected active nodes go back to sleep after they have used up a fixed percentage of their power to ensure fairness and allow other nodes to become active.

Connecting the Independent Set: Nodes selected in the first case are not connected. This is because there is only one active node in a given locality. In this phase more nodes are elected to ensure that the selected nodes form a connected network. All nodes that have two or more active nodes as neighbors, which are not connected directly or through one or two active nodes, are eligible to become active in this case. Preference is given to the nodes satisfying the following criteria:

- Nodes having higher amount of remaining energy.
- Nodes having higher stability. This can be measured similar to the one used in the first case.
- Nodes having more number of active nodes in the 1-hop neighborhood.

The stability and energy factors of this case is very much similar with first c*ase*. But the utility factor is depends upon the first c*ase*'s black active nodes.

Coordinator Withdraw: Every active node periodically checks if it should goto sleep state or not. The need for a node to be an active may also cease to exist due to the dynamics of the system. More explicitly, this may happen due to one of the following reasons.

- If first case active nodes may move into a region that already has another first case active node so that the region now has more than one first case active nodes. These active nodes recognize this situation and one of them withdraws.
- If the withdrawal of a first case active node may mean that the second case active nodes in the locality no longer serve their purpose and hence withdraw.

However, when an active node withdraws by virtue of completion of its quota of time it needs to be awake until another node is elected in the locality. The proposed DBET uses only 1-hop neighbor information to create an energy efficient connected backbone network, but the AOMDV use 2-hop neighbor information.

Local route customization with Power control technique: The energy consumption per data packet form source to destination is high when each node uses full transmission power. This can be reduced by chooses a lower energy cost path. The minimum transmission power is required to send data to a node at a distance *d*, The receiving power by surface reflection model.

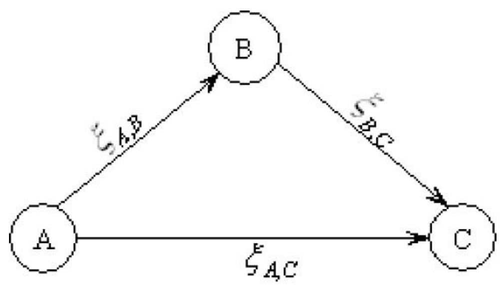

Fig. A. Minimizing the transmission power.

The minimum required energy for the data transmission can be calculated as follow: each node in the network has fixed default full transmission power *Pt*, when a node *I* receives control message from node *J* with power *Pr* it calculates the distance between nodes *I* and *J* then node *I* can find minimum energy *Pt*(*d*) required for transmitting the data to node *J*. Let consider the nodes *B* and node *C* which are in the transmission range of a node *A* If $\xi A,B + \xi B,C < \xi A,C$ then sending data packet from node *A* to the node *C* via intermediate node *B* consume less energy. Our proposed DBET uses this power optimization technique locally along the routing path to minimize the energy consumption during the transmission. Whenever a new node satisfies the above criteria it remains awake to participate in the high traffic flow path. Please note that a new node can come either a sleeping node wakes up near high traffic flow path or awake node moves closer to high traffic flow path.

The proposed DBET can be integrated with any routing protocol. In this section, we discusses the process of integration with AOMDV. In our approach all control packets and data packets are transmit on low traffic path with full transmission power and data packets on high traffic path with minimum required energy.

Route discovery: Route discovery uses route cost in place of hop count as route metric. Let we use the notation $\delta I,J$ denotes the cost of least cost path from the node *I* to the node *J*. When a source node wants to find a route to a destination, it broadcasts the route request packet (RREQ) to its neighbors. The route request packet contains the least route cost from source node, which is initially zero. An intermediate node *J* receiving the route request packet from another intermediate node *I*, it calculates the cost of the path from source(s) node to nodes *J* as $\delta S,I + \xi I,J$. The node *J* update its routing table if the calculated cost is less than the cost in its routing table and forward the route request packet to its neighbors with updated cost. In order to avoid another cost update, node *J* waits for the time (propositional to the cost to $\delta S,J$) before forwarding. When a destination node (d) receives first route request packet (RREQ), it calculates the route cost and update its routing table. It waits for a fixed time interval to receive more route request packets and find the least cost route among them. The node *D* unicast a route reply packet (RREP) back to its neighbor from which it received the least cost route. The neighbor nodes unicast RREP towards the source node *S*.

Local route customization: As we discussed earlier due to the dynamic nature of the network new node may come closer to existing path, which may reduce the existing route cost, if it participates in forwarding the data. When the node *I* and the node *C* receive (RUP) messages and then update their routing tables.

SIMULATION EVALUATION

We have evaluated the performance of DBET with AOMDV as a routing protocol and compared with AOMDV and AOMDV with SPAN using the network simulator.

The simulation parameters are listed in the table.

Simulation Time	500 sec
Number of nodes	20, 40, 60, 80, and 100
Max Node Energy	3000 J
Energy Distribution Normal Distribution	(0 to 3000 J)
Low traffic load	2×512 *bytes/sec.*
High traffic load.	10×512 *bytes/sec*
Max Tx power	0.2 W
Max Rx power	0.09 W
Propagation Model	Two ray ground propagation model
Basic routing protocol	AOMDV

Energy consumption: The energy consumed by DBET is same as that of SPAN in low load traffic since both the methods keep fewer number of nodes in the backbone and remaining nodes in sleep state to conserve energy. However, in high traffic DBET will gives better performance than others. The overhead of keeping more nodes in awake state along the high traffic, flow path is less than the energy conserved using power controlled data transmission. From these graphs we can also observe that AOMDV without using any topology control consumes very high energy.

Throughput: Throughput is the ratio of the data packets received at the destination to the data packets sent out from the sources. The throughput with respect to the number of nodes and mobility rate. As the mobility rate increases, the end-to -end delay is always increases because the network topology changes more frequently. In high net work load the DBETs performance is better in AOMDV than AODV.

SIMULATION RESULTS

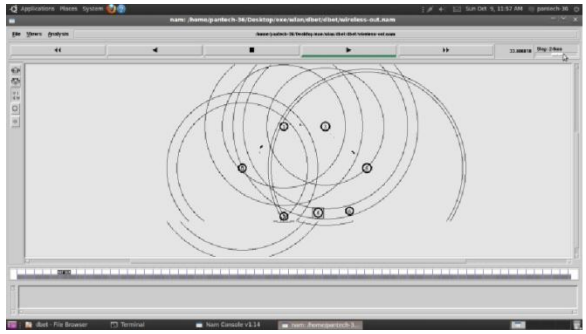

Fig 1: Network Animator

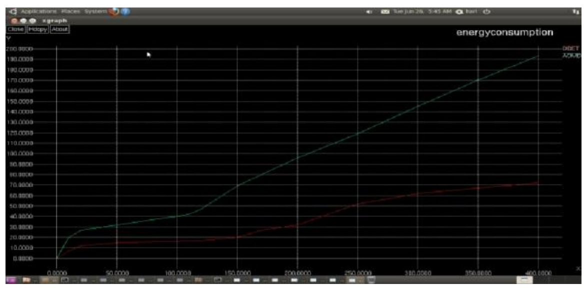

Fig 2: AODV & AOMDV Energy Consumption

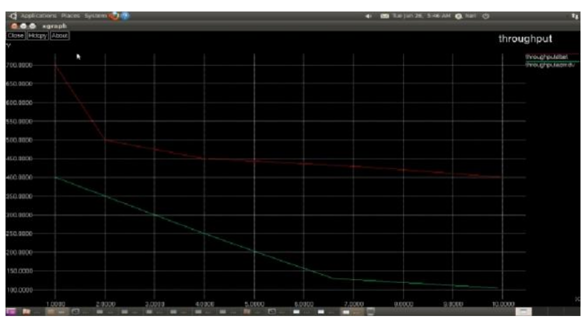

Fig 3: Through put

CONCLUSION

In this paper, we proposed a demand based energy efficient topology that dynamically adjusts its topology for various network traffic conditions. We have simulated our proposed protocol DBET and compared with AOMDV and AOMDV with SPAN. The simulation studies revealed that the proposed scheme perform better in terms of energy, delay, and delivery ratio. It would be interesting to investigate the use of directional antenna to further reduce the energy consumption.

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