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A Hybrid Mechanism For Dominating Set Based Power Aware Routing In MANET

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ABSTRACT
Many researches are going on to improve the routing, control the topology, reduce the energy consumption, improve quality of service and to establish a secured routing. Among these energy conservation is one of the vital factor deciding up the life time of the network. There are many existing works carried out for power-aware routing. Each of them is concentrating on individual factors like controlling transmission range, reducing power distribution among nodes, using directional antennas and controlling mobility topology. But no work is done that covers all the above factors. The proposed work is based on the idea of combining the important factors of energy aware routing like controlling topology, reducing power distribution and adapting variable transmission range. So it is a hybrid approach for saving power in the mobile ad hoc networks. The proposed model of MANET first insists on identifying the dominating set of nodes and based on the controlled topology, power aware routing is carried on. In this case the node mobility is completely neglected. Then a dynamic topology is considered and the dominating set is identified for the same. Then the power distribution is taken into account to carry on the routing. Finally a variable transmission range of the nodes is considered to implement the power-aware routing. In each of the cases the network parameters like throughput, bandwidth, number of hops, distance-hop energy are evaluated and analyzed.

***Keywords* – Ad hoc network, MANET, Nodes, router, topology.**

I. INTRODUCTION
Ad hoc networks are multi-hop wireless networks where all nodes cooperatively maintain network connectivity. These types of networks are useful in any situation where temporary connectivity is needed, such as in disaster relief. Building such ad hoc network poses a significant technical challenge because of the many constraints imposed by the environment. A Mobile Ad hoc NETwork (MANET) as shown in Fig.1.1, is a kind of wireless ad hoc network, and is a self-configuring network of mobile routers (and associated hosts) connected by wireless links – the union of which form an arbitrary topology. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger Internet. Recently the introduction of new technologies such as the Bluetooth, IEEE 802.11 and HIPERLAN are helping enable eventual commercial MANET deployments outside the military domain. These recent evolutions have been generating a renewed and growing interest in the research and development of MANET. Applications include emergency management, security, helping vulnerable people to live independently, traffic control, warehouse management, and environmental monitoring.

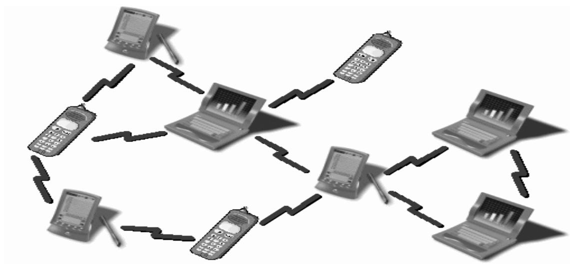


Figure 1.1 Mobile Ad hoc NETwork (MANET)

II. ENERGY CONSERVATION
Energy use is a crucial design concern in wireless ad hoc networks since wireless terminals are typically battery operated. The devices used in the MANET must be light weight. Furthermore, since they are battery operated, they need to be energy conserving so that battery life is maximized. Energy management strategies need to consider the node and its local applications. Nodes are interdependent and must cooperate to provide routing and other services, to maximize the network lifetime. When Greedy strategies are taken over by the nodes, it results in frequent network failure, since each node seeks only to minimize its own energy consumption.

III. POWER-AWARE ROUTING
Recent studies have stressed the need for designing protocols to ensure longer battery life. The design objectives of energy-aware routing are two folds: selecting energy-efficient paths and minimizing the protocol overhead incurred for acquiring such paths. Examining the existing MAC protocols and network protocols, indicates a clear need for improvement: in all of the current protocols, nodes are powered on most of the time even when they are doing no useful work. Intuitively, it is best to route packets through nodes that have sufficient remaining power. Similarly, routing packets through lightly loaded nodes is also energy-conserving because the energy expended in contention is minimized.

Two classes of power-saving protocols:

- Network layer
- Medium Access Control layer

3.1 Network layer

Network layer protocols make up the largest class of power-save protocols. Scheduling of the interface is driven by network layer traffic which is buffered at the MAC layer for sleeping neighbors or routed so as to take advantage of non sleeping ones. The power-save protocols are based upon three basic strategies outlined below:

First approach:

- Simplest synchronized power-save mechanism
- Nodes periodically wake up to listen to announcement of pending traffic, till the work is over.
- Phase synchronization problem in a dynamic network is present.
- Restricted windows for announcing and forwarding traffic can result in high latencies.

Second approach:

- Based on the network topology.
- Covering set of network that provides connection equivalent to that of the full network.
- Other nodes remain in sleep state with minimal impact on network performance.
- Protocols may be either synchronous or asynchronous.

Third approach:

- Fully asynchronous operation.
- Nodes maintain independent and dissimilar sleep-wake schedule.
- Scheduling rules are defined.
- Retransmission rules are defined.

3.2 Medium Access Control layer

MAC layer power-save protocols use information derived from the media-access control process to find intervals during which the network interface does not need to be awake. While a packet is being transmitted, nearby nodes whose transmissions might interfere with the ongoing transmission must remain silent. These nodes can sleep with little or no impact on throughput.

IV. RELATED WORKS

4.1 FEED BACK POWER CONTROL

Distributed power control schemes are extensively employed in the cellular networks and are capable of improving the capacity of the network. However the power control schemes from the cellular networks suffer from performance degradation due to self and direct-interference and hidden-terminal problems when directly employed in ad hoc networks. Most of the existing channel reservation-based power control protocols for ad hoc networks employ incremental power allocation rather than global allocation of the power to the incoming links; thus they may not effectively utilize the spatial frequency reuse in the network. So a distributed channel access protocol that couples the channel reservation and the iterative/global transmission power control schemes in ad hoc networks is proposed. The designed protocol considers the convergence problem of the global power control in ad hoc networks. The designed access criteria employ the local transmission control based on the sufficient criteria for admissibility and global power control for balancing the SIR (signal to interference ratio) of the links.

4.2 CORRELATIVE POWER CONTROL

The correlations that exist between the required transmission power of RTS (Request To Send), CTS (Clear To Send), DATA and ACK frames to guarantee a successful 4-way handshake in wireless ad hoc networks based on the IEEE 802.11 distributed coordination function (DCF) are examined. From these correlations, and starting from a set of different initial conditions, a class of power controlled media access control (MAC) algorithms for single channel ad hoc networks based on the existing IEEE 802.11 DCF is derived. From substantial simulations of the different algorithms and comparison to prominent alternatives, a conclusion that contradicts the intuitively sound, commonly held belief which states that sending control frames at maximum power-to reduce interference on the long data frames-then, the ensuing long data frames at a lower, yet sufficient power level decreases power consumption per carried bit was arrived.

4.3 VARIABLE-RANGE TRANSMISSION POWER CONTROL

Effective transmission power control is a critical issue the design and performance of wireless ad hoc networks. Today, the design of packet radios and protocols for wireless ad hoc networks is primarily based on common range transmission control. Power control affects the performance of the physical layer in two ways. First, power control impacts the traffic carrying capacity of the network. On the one hand, choosing too high a transmission power reduces the number of forwarding nodes needed to reach the intended destination, but as mentioned above, this creates excessive interference in a medium that is commonly shared. In contrast, choosing a lower transmission power reduces the interference seen by potential transmitters, but packets require more forwarding nodes to reach their intended destination. The impact of variable-range transmission power control on the physical and network connectivity, on network capacity, and on power savings in wireless multihop networks are taken into account. The average range is half the range obtained when common-range transmission control is used. An expression for the average traffic carrying capacity of variable-range-based multihop networks is derived. A model that approximates the signaling overhead of a routing protocol as a function of the transmission range and node mobility for both route discovery and route maintenance is derived. There is an optimum setting for the transmission range, not necessarily the minimum, which maximizes the capacity available to nodes in the presence of node mobility.

4.4 FAIR COALITIONS FOR POWER-AWARE ROUTING

Several power-aware routing schemes have been developed for wireless networks under the assumption that the nodes are willing to sacrifice their power reserves in the interest of the network as a whole. But, in several applications of practical utility, nodes are organized in groups, and as a result, a node is willing to sacrifice in the interest of other nodes in its group but not necessarily for nodes outside its group. Such groups arise naturally as sets of nodes associated with a single owner or task. Here, considering the premise that groups will share resources with other groups only if each group experiences a reduction in power consumption. Then, the groups may form a coalition in which they route each other's packets. The sharing between groups has different properties from sharing between individuals and investigates fair, mutually beneficial sharing between groups. A pareto-efficient condition for group sharing based on max-min fairness called fair coalition routing is given. The fair coalition routing allows different groups to mutually beneficially share their resources.

4.5 ENERGY-AWARE ADAPTIVE ROUTING

An energy-aware traffic-adaptive routing strategy for large-scale mobile ad hoc network is done. Energy-Aware GEolocation-aided Routing (EAGER) protocol optimally blends proactive and reactive strategies for energy efficiency. In proactive routing, the network topological information is maintained at every node. Such a strategy avoids the need for establishing routes for each message and is especially efficient when the network topology is relatively static and traffic is relatively heavy. Reactive routing, on the other hand, does not maintain global topological information. When a message arrives, the source floods a request packet over the network, searching for the destination. Such strategy avoids the need for frequent topological updates and, therefore, substantially reduces energy consumption when the traffic is light or the topological variation is high. EAGER partitions the network into cells and performs intracell proactive routing and intercell reactive routing. The cell size and the transmission range are optimized analytically. By adjoining cells around hot spots and hot routes in the network, EAGER is capable of handling time varying and spatially heterogeneous traffic conditions.

4.6 SELFISH NODE BEHAVIOUR

The problem of topology control is to assign per-node transmission power such that the resulting topology is energy efficient and satisfies certain global properties such as connectivity. The conventional approach to achieve these objectives is based on the fundamental assumption that nodes are socially responsible. Here, considering nodes to behave in a selfish manner and its impact on the overall connectivity and energy consumption in the resulting topologies is examined. The above problem is established as a non-cooperative game and game-theoretic analysis is used to address it. It shows that even when the nodes have complete information about the network, the steady-state topologies are suboptimal. An algorithm based on a better response dynamic is derived and this algorithm is guaranteed to converge to energy-efficient and connected topologies. Moreover, the nodes transmit power levels are more evenly distributed, and the network performance is comparable to that obtained from centralized algorithms.

V. PROPOSED HYBRID APPROACH

The proposed system contributes a solution for the energy efficient routing in the mobile ad hoc networks. The topology of the network, power distribution among the nodes and the transmission range of the nodes are combined to get a well-organized model for the MANET.

5.1 DOMINATING SET

The first module of the proposed system is based on the topology of the networks. The dominating set of nodes can be identified and the topology of the network can be decided based upon it. A dominating set of a network is a subset of nodes such that each node is either in the dominating set (the minimum number of nodes that are sufficient to establish energy efficient routing) or is a neighbor of a node in the dominating set. In a connected dominating set as shown in Fig.5.1, the dominating nodes form a connected sub graph of the network.

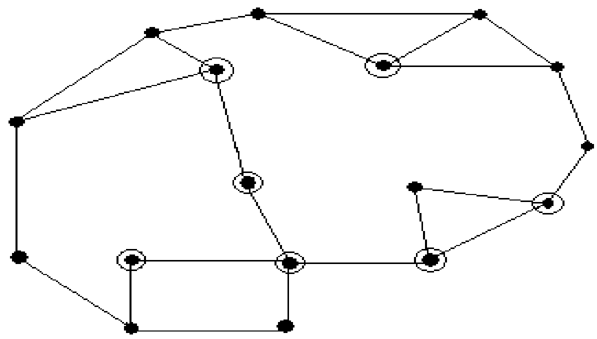


Figure 5.1 Connected dominating sets

5.1.1 ALTERED PRORITY BASED SELECTION ALGORITHM

Step 1: Send neighbor list to all neighbors
Step 2: Receive neighbor list from all neighbors
Step 3: Determine status:

If the node's status is INT CANDIDATE:

- Change status to DOMINATEE if at least one neighbor has DOMINATOR status
- Change status to DOMINATOR if

* the node has the highest priority among its 1-hop INT CANDIDATE neighbors and the neighbors of these INT CANDIDATE nodes, which are two hop away from the original node.

* the node has a leaf INT CANDIDATE neighbor, i.e., an INT CANDIDATE neighbor node with degree 1.

* a DOMINATOR neighbor reported fully connected status.

- If the node's status is DOMINATEE or EXT CANDIDATE:

- Change status to DOMINATOR if

* the node has the highest priority among its 1-hop INT CANDIDATE neighbors and their two hop neighbors.

* the node has a leaf INT CANDIDATE neighbor.

* at least one DOMINATOR neighbor reported fully connected status.

- If the node's status is DOMINATOR:
- Change status back to DOMINATEE if there is another DOMINATOR node with lower node ID covering the same set of DOMINATEE nodes.

With the dominating sets identified the energy efficient routing in the network is carried on.

5.2 TOPOLOGICAL CONTROL METHOD

The second module of the proposed system is based upon the effects caused by the dynamic topological changes of the above model of the mobile ad hoc networks. The topological control methods are applied to find out the energy efficient routing in this case. The transmit power of the nodes is controlled to have power over the mobility of the nodes.

5.2.1 COMMON POWER LEVEL

Network nodes executing COMPOW operate on the smallest power level to reach maximum network connectivity. COMPOW maintains a routing table at different power levels. Each routing table exchanges link state updates at different powers to generate the route information. The optimum power of a node is the smallest power level whose routing table has the same number of entries as that of a routing table at the maximum power level. COMPOW reduces the transmission power redundancy and interference by selecting the maximum operational power settings to reach the furthest neighbour node. In the worst case scenario the algorithm will incur a cost of O(PN), where P are the number of power levels and N are the number of network nodes. In this module by controlling the transmission controlling the transmission stabilizes power the node mobility and power aware routing is implemented for the mobile ad hoc networks.

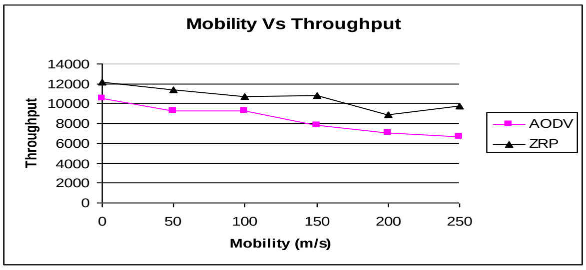
5.3 VARIABLE RANGE TRANSMISSION TECHNIQUE

The third module of the proposed system concentrates on the transmission range of the mobile nodes in the network. A variable transmission range is taken up for the nodes leaving of the common transmission range, since the former increases the network connectivity. Routing protocols can take advantage of fully connected networks to provide multiple routes for a given source-destination pair in cases where some nodes or links fail. However, it results in reducing network capacity and energy-savings (Javier Gomez 2007). To improve the power minimum energy routing is implemented along with the variable transmission range technique. The minimum energy routing minimizes the total energy consumed in forwarding a packet from source to destination. In each of the modules after finding the energy efficient routing, the network parameters like distance per hop, overall hop count, per-node energy consumption, residual energy, distance-hop energy and throughput are evaluated and compared with the earlier results as specified in the reference papers.

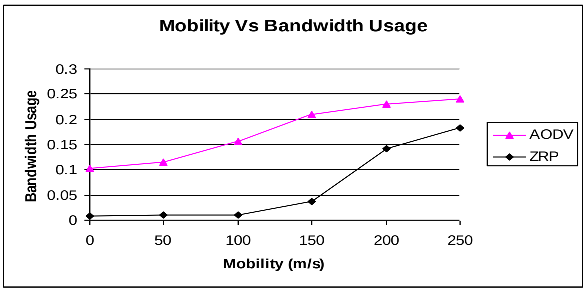
CONCLUSION

Minimum energy routing is combined with the variable range transmission technique and the network parameters like distance per hop, overall hop count, per-node energy consumption, residual energy, distance-hop energy and throughput are evaluated in both AODV and ZRP routing techniques. The results and analysis shows this energy efficient routing setup, works efficiently with ZRP rather than AODV.The minimum energy routing minimizes the total energy consumed in forwarding a packet from source to destination.

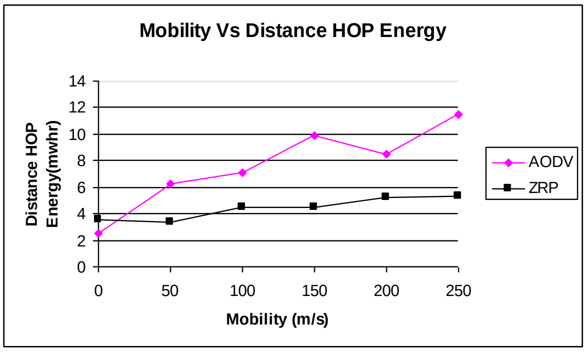
RESULTS



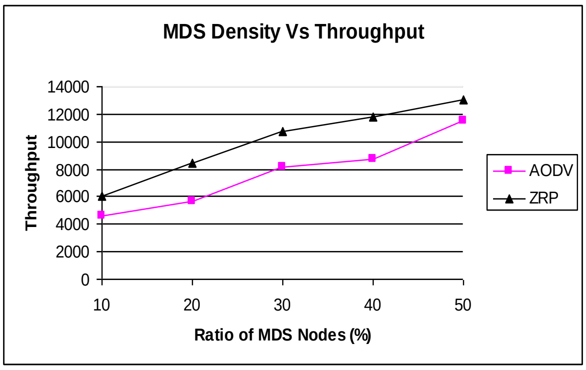
Performance Analysis chart for Mobility Vs Throughput



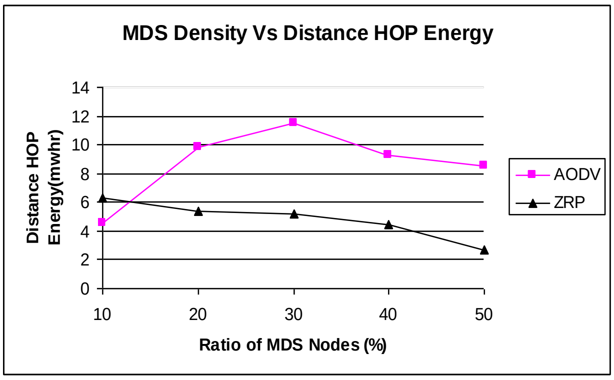
Performance Analysis chart for Mobility Vs Bandwidth Usage



Performance Analysis chart for Mobility Vs Distance Hop Energy



Performance Analysis chart for MDS Density Vs Throughput



Performance Analysis chart for MDS Density Vs Distance Hop Energy

ACKNOWLEDGEMENTS

An acknowledgement section may be presented after the conclusion, if desired.

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