ABSTRACT

Mobile Ad hoc Network (MANET) is a collection of wireless mobile hosts forming a temporary network without the aid of any established infrastructure or centralized administration. In MANET, a mobile host can act both as a host and a router forwarding packets to other mobile nodes in the network. In order to facilitate communication within the network, a routing protocol is used to discover routes between nodes. The primary goal of such an ad hoc network routing protocol is efficient route establishment between a pair of nodes so that messages may be delivered in time.

In MANET, intermediate nodes are required to route packets between source and destination if the source and destination are not directly within the radio coverage of each other. If the network has a flat topology (all nodes are treated equally), the size of the routing table is proportional to the number of nodes in the entire network. The increase in network size tends to consume a larger portion of the bandwidth. As the rate of the network topology change increases, the exchange of routing tables between neighboring nodes must be more frequent to keep the routing information up to date. Several studies have shown the difficulty for a single routing protocol to scale with respect to mobility, traffic load and network size. There are many open issues in ad hoc networks like providing scalability, energy efficient routing, Quality of Service (QoS) and security.
This research work is aimed at improving energy efficiency and scalability of existing network routing protocols.

Clustering strategies tend mainly to support the network scalability. Clustering is a technique that partitions a network into different groups or clusters, creating a logical hierarchy in the network. There are several clustering schemes such as Mob D Hop, Max Min, Lowest ID [LID], Highest connectivity clustering (HCC) etc. In this research work, network scalability is improved by constructing two level hierarchical network using LID clustering algorithm. A heterogeneous routing protocol developed for a two level hierarchical network uses a proactive protocol that is AODV protocol in the backbone network and a reactive protocol that is DSDV protocol in the local subnets (AODV – DSDV). Secondly, the routing protocol AODV is modified to utilize the physical hierarchy which is referred as Hierarchical AODV (H-AODV). In H-AODV, basically both backbone nodes and nodes in the subnet run the same AODV routing protocol. Simulations are run with AODV – DSDV and HAODV in the identical environment. Thirdly as a comparison, the AODV routing protocol in a corresponding “flat” ad hoc network is run without the higher-level backbone links where no backbone election is needed.

Further, the research is extended by modifying Dynamic Source Routing (DSR) protocol to be suitable for two level hierarchical networks and named as Hierarchical Dynamic Source Routing (HDSR) protocol. It is proved using network simulator that the control overhead and end-to-end delay are reduced in a hierarchical network compared with a flat network.
HDSR achieves a reduction of control overhead equivalent to 78.57%. The end to end delay of HDSR architecture compared to DSR architecture is less by 44.44% for a mobility of 7 m/s, the throughput of HDSR protocol is 66.67% greater than that of flat DSR protocol. The average energy saving in HDSR is up to 40%, hence the nodes have longer lives.

Efficient energy conservation plays an important role in the performance of MANET routing because mobile nodes in such networks are battery-operated. Many theoretical studies show that energy consumption in MANET can be significantly reduced using energy aware routing protocols compared to fixed power minimum-hop routing protocols. Two approaches are broadly suggested for energy aware routing protocols –load sharing approach and transmission power control approach.

The load distribution approach protocols focus on balancing energy usage among the nodes by avoiding over utilized nodes while selecting a routing path. This approach is applied to HDSR protocol and is referred as Energy Efficient HDSR (EEHDSR). In EEHDSR, the nodes which has a 'tendency' to 'die out' very soon are avoided during the route discovery phase of this protocol. The 'tendency' of the node to 'die out’ is expressed quantitatively as the ratio of the remaining battery energy and the current transmit power of the node which is called as ‘expected life’ of the node.

The simulation results show that the proposed EEHDSR can save energy up to 40% per packet and it can send 20 % more packets to destinations by spending the same battery power compared to DSR.
The transmission power control approach determines the optimal transmission power required between adjacent nodes in the routing path that minimizes total power required to deliver data packets from source to destination. This approach is applied to Zone Routing Protocol (ZRP) and is referred as Location Based Power Efficient ZRP.

In this thesis, the modified ZRP creates zones with respect to two power levels such that nodes lying in the intermediate range are transmitted with less power while border nodes are transmitted with maximum power. Before any node sends packets to its other node it calculates the distance between both. The average energy saving in power efficient ZRP is up to 23% when compared to traditional ZRP, thus enabling the nodes and the network to have a longer life time.