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Improving the Network Performance of MANET through Distributed Energy Adaptive Location Based Cooperative Mac Protocol and Multicast Routing

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Abstract— Cooperative communication enables single antenna mobiles in a multi-user environment to share their antennas and generate a virtual multiple-antenna transmitter that allows them to achieve transmit diversity. The mobile devices are battery driven and the communication may tend to break up due to the energy exhaustion of nodes. Thus a novel idea of user cooperation in wireless networks is to improve the performance of the Mobile Ad hoc Network in terms of network lifetime. The new MAC protocol called as Distributed Energy adaptive Location based-Cooperative Medium Access Control comprises relay involved handshaking process, optimal power allocation scheme, best relay selection strategy for lifetime improvement of MANET. In MANET during real time traffic multicasting, there is increased energy consumption and delay. In order to overcome this issue, node connectivity, energy and bandwidth aware Clustering Routing Algorithm will be used in this project. Here the cluster head is selected based on the parameters residual energy, bandwidth and node Connectivity. Using analysis and simulation, there is increase in the total network throughput, reduction in delay and energy consumption if such cooperative transmissions and Multicast routings are utilized.

Index Terms— Cooperative Communication, MANET, Virtual Multiple Antenna Transmitter, Routing, Multicast.

I. INTRODUCTION

MANET is one of the most emerging fields in research and development of wireless network. As the popularity of mobile device and wireless networks increased significantly over the past years, it has now become one of the most vibrant and active field of communication in wireless technology. MANET is a self configuring and infrastructure- less network. Each device or node is free to move independently, and will therefore change its links with other devices frequently in any direction. The primary challenge in creating a MANET environment is to continuously maintain the information required to route the traffic properly. Such networks can operate by themselves or by connecting itself to the larger Internet. They may contain one or more transceivers. This results in a highly dynamic and autonomous topology

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MANET has routable networking environment to process the exchange of information or packet from one node to other node. Different protocols are simulated for measuring the packet drop rate, the overhead introduced by the routing protocol, end-to-end delay of packet, network throughput, etc. This paper proposes an implementation of Adaptive Hello messaging scheme and Dynamic on-Demand routing protocol to establish a link and efficiently utilize the energy to enhance the life of network. The rest of this paper explains the advantages of MANET, various routing protocols is MANET, overview of previous proposals, including proposed work, finally the last section contains the performance evaluation of proposed system.

Ad hoc networks are suited for the situations where an infrastructure is unavailable, and it is simple and fast, not cost effective to deploy too. The following are some of the important application related to MANET,

- Business application
- Military application
- Emergency operations
- Home, office, and educational applications
- VANET
- Wireless sensor networks
- Mesh networks

A. Routing Protocol in Manet

MANET Routing Protocols are typically subdivided into two main categories: Proactive Routing Protocols and Reactive Routing Protocols.

B. Proactive Routing Protocol

Proactive routing protocol is the one in which each node maintains its route to all other network nodes. The route creation and maintenance are performed by both periodic and event-driven messages. The various proactive protocols are Destination Sequenced Distance Vector (DSDV) [1], Optimized Link State Routing (OLSR) [2].

C. Reactive Routing Protocol

In Reactive routing protocol, the route between two node is discovered only when it is demanded which is considered as the important advantage since message overhead is reduced i.e., total number of control packet transmission is reduced.

There are different types of reactive routing protocols such as Ad hoc On-Demand Distance Vector (AODV) [3], Dynamic Source Routing (DSR) [4], and Dynamic MANET On-Demand (DYMO) [5].

D.Hybrid Routing Protocol

An example of a hybrid routing protocol that combines both proactive and reactive approach, which brings the advantage of both the approaches together is Zone-Based Hierarchical Link-State Routing Protocol (ZRP) [6]. ZRP defines each node a zone around itself containing all neighbor nodes with certain „k hop (k=1,2 or 3). If the destination node's position is within the zone of source then it uses proactive routing else it uses reactive routing protocol. International Journal of Science, Technology

E. Working of Routing Protocol

Working of the Routing Protocol consists of 2 phases: Route discovery, Route maintenance.

F. Route Discovery

When a node desires to send packets to a destination node, it first establishes a path to it for communication. The node begins the route discovery by broadcasting a route request (RREQ) message containing the IP address of the destination. When an intermediate node receives the RREQ, it records the reverse route toward the source and checks whether it has a route to the destination. If a route to the destination is not known, the intermediate node rebroadcasts the RREQ or if it has recent information about a route to the destination, route reply (RREP) message is generated. This RREP is unicast back to the source using the reverse route that is been recorded. When a RREP reaches the source, it begins to send data packets to the destination along the discovered path. If more than one RREP is received by the source, the route with the lowest hop count to reach the destination is selected.

G.Route Maintenance

This is the phase where the maintenance of link is preserved when broadcasting the packets. When a link breaks along an active path, the node upstream of the break detects the break and creates a route error (RERR) message. This message lists all destinations that are now unreachable, due to the link breakage and this information is sent to the source. Each intermediate hop deletes any broken routes and forwards the RERR packet towards the source. When the source receives this, it determines whether the packet still needs to be forwarded. If so, it begins the route discovery process for forwarding

H.Energy Conservation in Manets

Battery energy is said to be a rare resource, and it often affects the communication activities between nodes in network. Communication takes place through direct links or through multi hop links. Due to the limited battery energy of mobile nodes, the lifetime of node becomes the key challenge. Controlling the transmission power significantly reduces the energy consumption for sending data packets and also increase lifetime of network. Nodes adjust the transmission power so as to achieve the minimum energy consumption according to the local information. The idea of distributed power control can be used to improve energy efficiency of routing algorithm in MANET. There are some control messages such as RREP in On-Demand Routing Protocol which provide a strong indication that messages should trigger a node to switch to active node from sleep. Since the communication with a neighbor is only possible if the neighbor is in active mode, it is necessary for nodes to track energy modes of neighbors i.e., active, sleep or idle. The neighbors' power mode can be discovered in two ways: the first way is through explicit local HELLO message exchanges with piggybacked information about the energy management mode of a node, and the second way is via passive inference. Energy efficiency is measured by the duration of the time over which a network can maintain a certain performance level, which is usually called as the network lifetime. Using the power consumption is not only a single criterion for conserving energy efficiency. Hence, routing to maximize the lifetime of the network is different from minimum energy routing. Minimum energy routing sometimes attract more flows since the nodes in these route exhaust their energy very soon. Hence, the whole network cannot perform many tasks due to the failure of these nodes. Routing with maximum lifetime balances all the routes and nodes globally so that it can maintain certain performance level for a longer time. Hence saving energy at the time of broadcasting in order to recover from the node failure and during re-routing around failed node is essential.

I. Energy Efficient Routing Protocol

Energy is said to be a limiting factor in case of ad hoc networks routing in ad hoc network has some unique characteristics: Energy of node is crucial and it depends upon battery which has limited power supply.¬ Nodes can move in an uncontrolled manner, so frequent route failures are possible.¬ Wireless channels have lower and more variable bandwidth compared to wired network.¬ Energy efficient routing protocols are the only solution to above situation. Most of the work of making protocols energy efficient has been done by reactive routing rather than proactive routing protocols. Energy efficiency can also be achieved by sensible flooding at the route discovery process in reactive protocols. And it can also be achieved by using efficient metric for route selection such as cost function, node energy, battery level etc. Here the efficiency not only refers to the successful delivery of packets with less consumption of power, but also refers to the increase in duration of maintaining the link between the nodes to ensure increase in performance. This can be achieved by using AODV & DYMO routing protocol.

II. DEL-CMAC PROTOCOL

The proposed DEL-CMAC protocol aims at increasing the network lifetime and the energy efficiency for multi-hop MANETs. To deal with the relaying and dynamic transmitting

power, besides the conventional control frames RTS, CTS and ACK, additional control frames are required. DELCMAC introduces two new control frames to facilitate the cooperation, i.e., Eager-To-Help or willing- to- help (ETH/WTH) and Interference- Indicator (II). The ETH frame is used for selecting the best relay in a distributed and lightweight manner, which is sent by the winning relay to inform the source, destination and lost relays.

The best relay is defined as the relay that has the maximum residual energy and requires the minimum transmitting power among the capable relay candidates. In order to enhance the spatial reuse an Interference indicator frame is utilized which reconfirms that the interference range of allocated transmitting power is only at the winning relay.

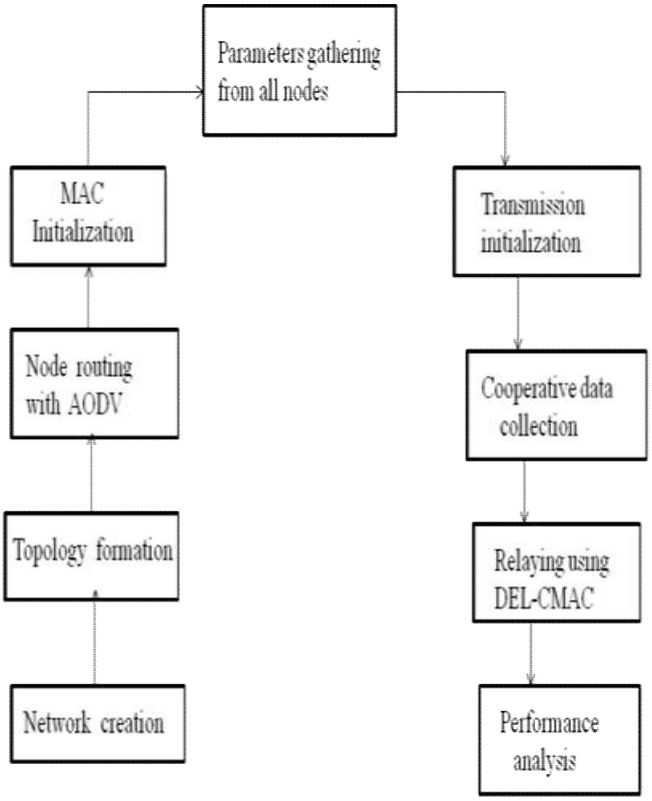
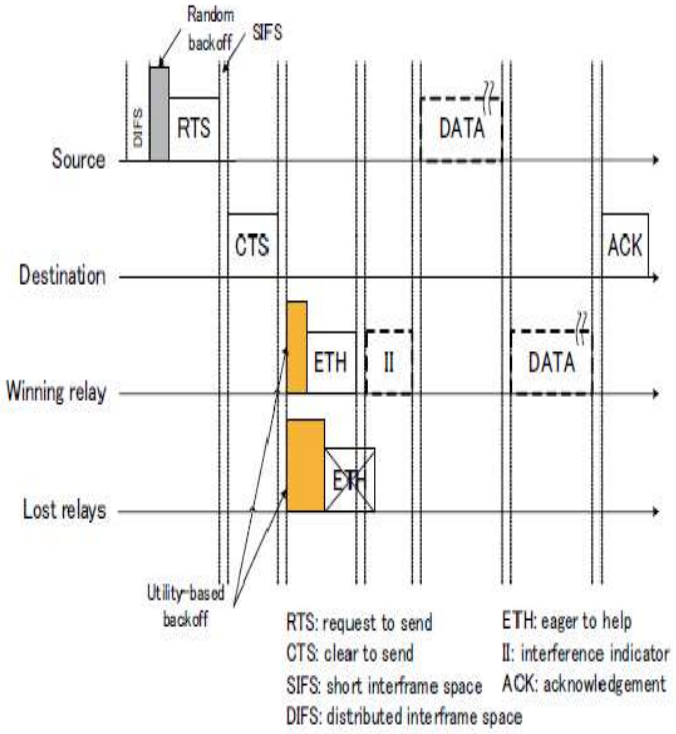


Fig.1 Block Diagram

- When a source wants to initiate the data transmission with payload length L bytes, it first senses the channel, whether it is idle or not. If the channel is idle for DIFS, the source chooses a random back off timer between 0and CW. When the back off counter reaches zero, the source sends out a RTS to reserve the channel.
- If the source does not receive CTS within TRTS+ TCTS+ SIFS, a retransmission process will be performed. Otherwise, in the case that FLAG _P of CTS is set to 0 and the DEL-CMAC is reduced to DCF protocol.
- If both CTS and ETH are received, after waiting for TII+S IFS, the source initiates a cooperative transmission with data rate 2R using the optimal transmitting power PsC which is piggybacked in the ETH.
- If the acknowledgement is not received the source handles the next packet for transmission



III. RESULTS AND DISCUSSIONS

The below Fig shows the node creation. Network is created by providing the parameters such as channel, radio-propagation model, network interface, MAC, queue type, link layer, antenna, topography, Max packet, routing protocol used, number of mobile nodes used, and simulation time. Topology is created by define the area (in terms of size) under which the simulation occurs. Configure the node using the above parameters specified will complete the node creation process.

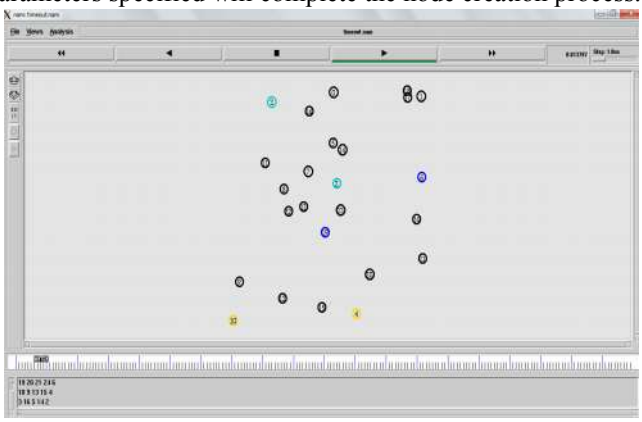


Fig.2 Node Creation

The below Fig shows the communication through relay nodes. Like a node, a link is a compound object and users can create its sub objects and connect them and the nodes. To define the traffic flow, designate the nodes as source or destination and decide the type of application/traffic. The first step is to define the source agent. Then designate which node

assumes the agent we defined. Define the traffic/application type and attach it to source agent. Now define the destination agent and attach it. Finally, connect the agents. It is necessary to tell the simulator when to start and stop the traffic flow. To do schedule events that controls the agent's activities.

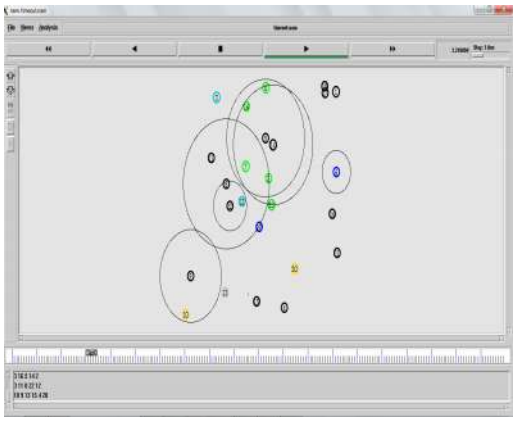


Fig.3 Communication through Relay Nodes

The below Fig shows the Energy consumption of DCF and DEL-CMAC vs Distance. The energy consumption of DCF is dramatically increased as the distance rises. While the energy consumption by DEL-CMAC remains in the same level even for farther distances. The energy consumption of DEL-CMAC is significantly below DCF for medium to long distances, considering the circuit energy consumption at both sender and receiver.

Fig.4 Energy consumption of DCF and DEL-CMAC vs Distance.

The Fig shows the End to End delay of DEL-CMAC and DCF.Delay is the difference between the time at which the sender generated the packet and the time at which the receiver received the packet. Delay is calculated using awk script which processes the trace file and produces the result. Delay is more in DCF than DEL-CMAC.

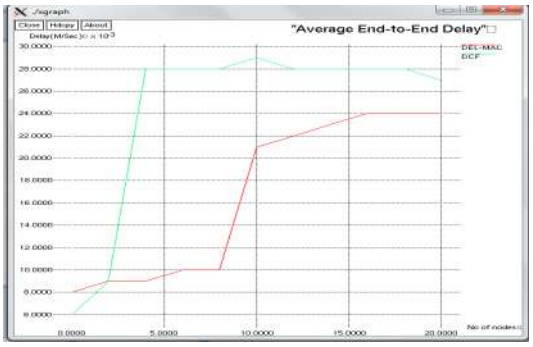


Fig.5 End to End delay of DEL-CMAC and DCF.Delay

The Fig shows the throughput of DEL-CMAC and DCF vs node density. To display the throughput Calculate the number of bits received by multiplying the value of packets variable with 8 and Divide the value by the corresponding time got from the 2nd column in the trace file. Multiply the result with 1000000 give the value in Mbps units. Throughput of DEL-CMAC is low compared with DCF

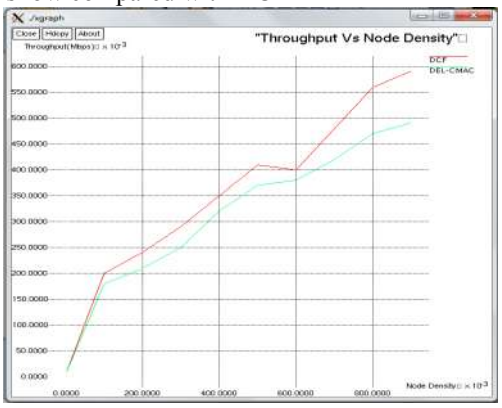


Fig.6 Throughput of DEL-CMAC and DCF vs. node density.

The Fig shows the network lifetime comparison of DEL-CMAC and DCF.Network lifetime is the time at which the first network node runs out of energy to send a packet, because to lose a node could mean that the network could lose some functionality. Lifetime of DEL-CMAC is high compared with DCF.

Fig.7 The network lifetime comparison of DEL-CMAC and DCF.Network lifetime

IV. CONCLUSION

A single routing protocol is hard to satisfy all requirements. i.e., one routing protocol cannot be a solution for all energy efficient protocol that designed to provide the maximum possible requirements, according to certain required scenarios. In future, Ant Routing Protocol can be used to find the optimal path; also Efficient Energy Aware Routing Protocol (EEARP) can be proposed to increase the network lifetime of MANET. Also using a mini-max formulation, EEARP selects the path that has the largest packet capacity at the smallest residual packet transmission capacity. The proposed scheme may reduce the energy consumption to some extent and decreases the mean delay, while achieving a good packet delivery ratio.

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