Topology Control Method for Enhancement of Throughput in MANET

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Abstract - The objective of topology control in MANET is to reduce the transmission power at each node in order to sustain the network topology and energy consumption as well. Controlling the transmission radii of nodes decreases the radio interference which in turn increases the spatial reuse of channel. The location of neighbour and direction are obtained by Global Positioning System (GPS) and angle of arrival. To reduce the hardware cost, only group of nodes are equipped with GPS device while other nodes get the location information. Several protocols based on location for the topology control have been proposed. We have proposed Enhancement of Throughput by Topology Control Based on Location in MANET. Extensive simulation is carried out to compare our proposed scheme with the existing protocol LBTC. The simulation results confirm that the proposed scheme out performs in terms of throughput.

Index Terms - Topology control, Spatial Reuse, GPS, Mobile Ad hoc Networks (MANET).

I INTRODUCTION

The nodes in Mobile Adhoc Networks (MANETs) are operated with limited battery supply Routing of packets is affected if the nodes run out of battery which in turn affects the network lifetime. Nodes in MANET transmit with maximum power so that packets take less no of hops to reach destination. Thus, there is no appreciable channel utilization. Topology control is one of the approaches to conserve the energy by reducing the transmission power at node while maintaining the connectivity. In non homogenous approach, each node has different transmitting power with different transmitting range. This further grouped into location based, neighbour based and direction based methods depending upon type of topology control. In location based approach, the exact location is known to calculate the transmission range of a node. Neighbour based method is based on knowledge of relative neighbour IDs which will be used in the topology control. Direction based method assumes nodes know their relative positions and estimate neighbour's direction.

The end-to-end delay can be reduced by increasing the transmission power of certain nodes. This results in reduction in the number of hops between source and destination and hence end to end delay. However, this causes the interference in the nearby receiving nodes leading to retransmissions of packets due to contention among the sending nodes. Another factor that influences the end to end delay is mobility of nodes. A node having higher mobility quickly moves out of sender's transmission range causes link breaks. Hence, it is important to consider delay due to mobility. Most of the protocols based on location assume that a node knows its location. We propose Enhanced Location Based Topology Control (ELBTC) which combines the merits of topology control as well as energy conservation along with interference and delay constraints taking into account. The rest of the paper is organized as follows. Section II deals with review of related works, section III describes the proposed scheme while section IV and V meant for results and conclusion respectively.

II RELATED WORKS

Nodes in Mobile ad hoc network change the transmission range due to dynamic nature require topology control [8]. The topology control algorithms assume that nodes get location information. However, acquiring the location information leads to computational overhead. The extended topology control algorithm (XTC) [1] overcomes these flaws by making topology control location free. Other feature of XTC protocol is that it exhibits symmetrical property in which the link between pair of nodes is symmetric. Symmetric networks are more susceptible to hidden terminal problem. This causes collision of packets when two nodes which are in receiver's transmission range start transmitting simultaneously. Neighbour based topology control protocol is simple in its form and each node connects k-least neighbours. Asymmetric links are formed for lower value of k while higher values results in interface. Finding the optimum value is challenging task. Adaptive Neighbour based Topology Control (ANTC) [2] nodes decide transmission range based on the information provided by neighbouring nodes. Then with the help of backbone node, a network of symmetrical link is formed. Location Free Topology Control (LFTC) [3] avoids hidden station problem and interference is reduced by controlling transmission power of RTS/CTS packets which is different from transmission power of data packets. In SPAN, some of the nodes are selected as coordinators. These coordinators actively participate in routing process. Nodes are not put into sleep mode in ANTC and LFTC protocols. Several algorithms have been proposed for sleep scheduling in order to save the power. Geographic routing is most efficient routing scheme with sleep scheduling. Sleep scheduling involves subset of nodes needs to be active in a given epoch [6] while other nodes are in sleep mode so that overall energy consumption can be reduced. Geographic-distance based connected k neighbourhood (GCKN) [7] algorithm try to reduce the transmission path. In hierarchical least mean square adaptive filter mechanism (HLMS), energy saving is achieved by reducing the packet transmission between source and destination. Energy saving is major concern due to link failure as a result of node mobility.

III. PROPOSED WORK

The existing Location Based Topology Control (LBTC) [5] aims at topology control and power management approach by means of controlling the transmission power with The existing Location Based Topology Control (LBTC) [5] aims at topology control and power management approach by means of controlling the transmission power with sleep scheduling phase but fails to meet the interference and delay constraints. The proposed work, Enhanced Location Based Topology Control (ELBTC) with sleep scheduling and incorporating interference and delay constrains. The proposed scheme operates in the following phases.

A. Link determination phase:

In this phase, nodes transmit hello messages containing location information and sender ID with maximum power *Pmax.*The receiving node on receiving hello message computes the transmission power of the sender of hello message and updates its vicinity table. The vicinity table consists of 1) sender ID field 2) location information field, Loc Info 3) Common node through which current node exists from sender of hello 4) Link Type specifies heather the link is one hop or multi hop 5) Minimum cost between current node and sender of hello message.6) Direct cost is the link cost from current node and sender node of hello message.

A node after receiving all the information from neighbours, a node determines the transmission power which is maximum value in the direct cost field in the vicinity table.

B Sleep scheduling phase:

In order to minimize the energy consumption, a subset of nodes to be in active mode for a given period whiles other nodes in sleep mode. Active nodes in a given period cover the entire deployed area. Then all the active nodes assemble such that for each sleeping node there is one active node. There are many neighbours for source node. Source selects one particular node as a next hop and that node must be in active mode to receive the packets. The other nodes receive a status" zero"so that they move to sleep mode. The active node after forwarding the packet move to sleep state. This process is repeated until destination is reached.

C. Data Transmission:

Each node acquires its position through GPS receiver. Sender node includes the position of the destination in the packet header. If an intermediate node knows accurate position of the destination then it updates its packet header before forwarding. Active nodes take part in the data transmission.

D. Interference and Delay constraint:

Distributed cross layer approach is used for information exchange between physical layer, data link and network layer is needed. The transmission delay incurred at each intermediate node. Nodes contending for sharing the channel cause contention delay and queuing delay incurred at each intermediate node.

E Delay model of path:

Let the transmission delay of the link between node *u(i)* and node *u(i+1)* be *L(i)(i+1)* over the path P.Let *C(i)* and *Q(i)* denote contention and queuing delay at node(i).The total delay *Dp* [4] is the delay due to contention,queing and transmission delays is given by equation 1.

$$Dp=\sum (L\ (i)\ (i+1)\ +(C\ (i)\ +Q\ (i) \qquad (1)$$

Where i=0, 1, 2........N-1

F Delay Model of Intermediate node.

The Transmission delay between the nodes node *u (i)* and node *u(i+1)* for successful transmission in the first attempt is given by equation 2.

$$L(i)(i+1)=L/B+DIFS+Tack+SIFS \qquad (2)$$

Where L is the length of the packet and B is the data rate. DIFS means Distributed Inter Frame Spacing. SIFS stands for Short Inter Frame spacing and T*ack* is Transmission Delay Acknowledgment.

Minimizing the transmission power reduces the communication range. However, Transmission power is reduced according to SINR threshold to deliver the packet to far reaching one hop neighbours.

IV SIMULATION AND RESULTS

QuelNet 4.5 simulator is used to simulate the nodes which are randomly distributed in a terrain dimension of 1500×1500m square area. The velocity of each node is 0-10m/s with pause time of 30 sec. The simulation parameters are as shown in the table 1

Table 1: Simulation Parameters

Parameters	values
Simulation Time	120 minutes
Terrain Dimension	1500×1500 m2
Traffic Type	CBR
Mobility model	Random Waypoint
Speed	0 - 10 m/s
Pause time	30 second
Data rate	2 Mbps
Packet size	512 bytes

Battery model	Linear

The transmit power of node is set to 500mw.The energy consumption with 60 nodes and 100 nodes in transmit mode and Receive mode by varying the CBR applications are plotted as shown in the figures 1 to 7 along with end to end delay and throughput plots.. By properly adjusting the transmit power in link determination phase and in sleep scheduling phase increase in longevity of the network. This is attributed to increased throughput and decreased end to end delay.

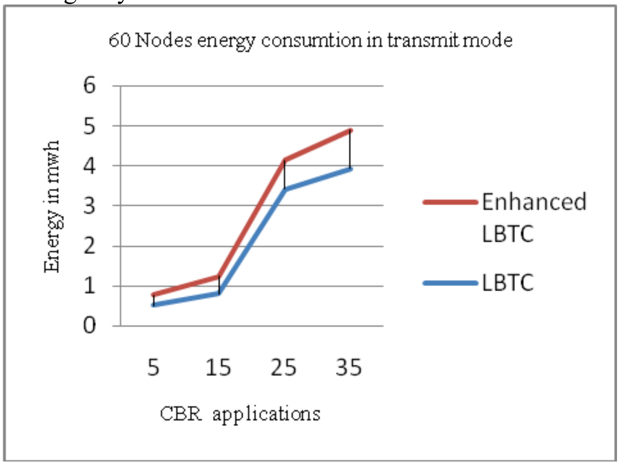

Fig 1: Energy consumption in transmit mode for 60 nodes

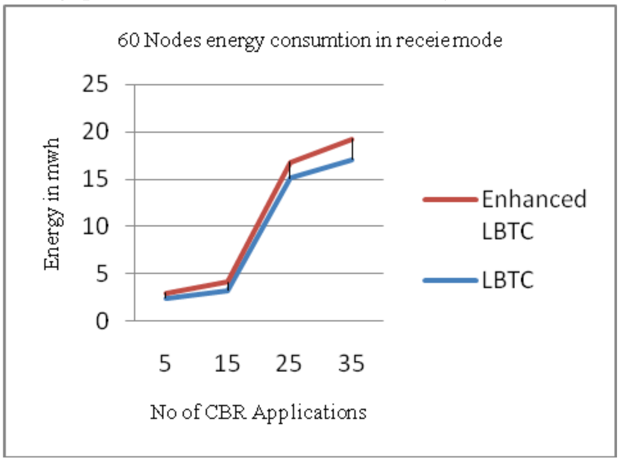

Fig 2: Energy consumption in receive mode for 60

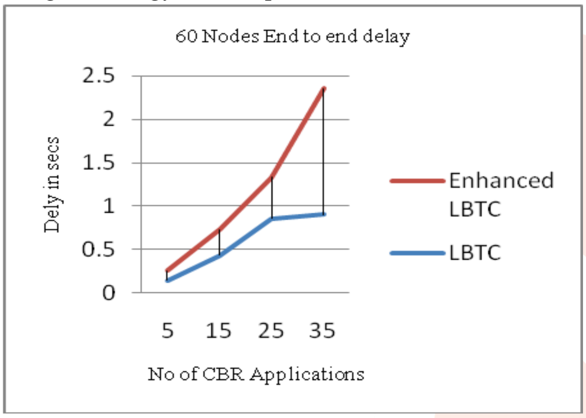

Fig 3: End to end delay with 60 nodes

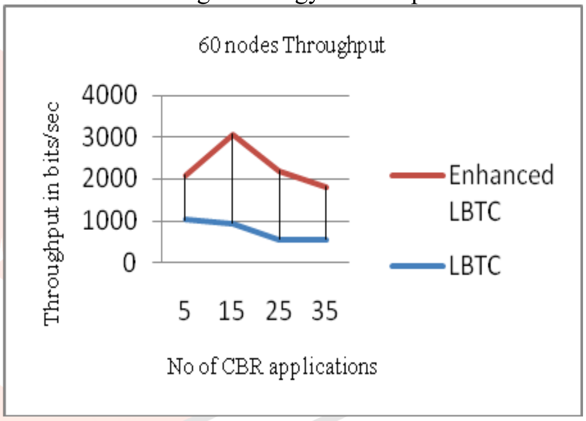

Fig 4: Throughput with 60 nodes

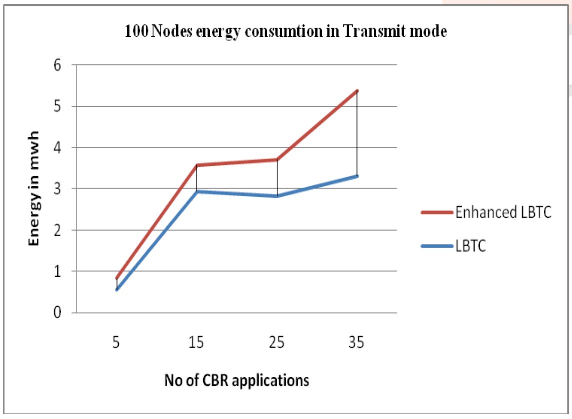

Fig 5: Energy Consumption with 100 nodes in transmit mode.

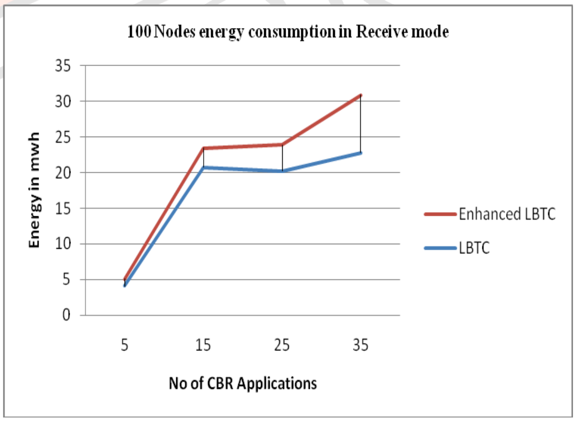

Fig 6: Energy consumption in receive mode with 100 nodes

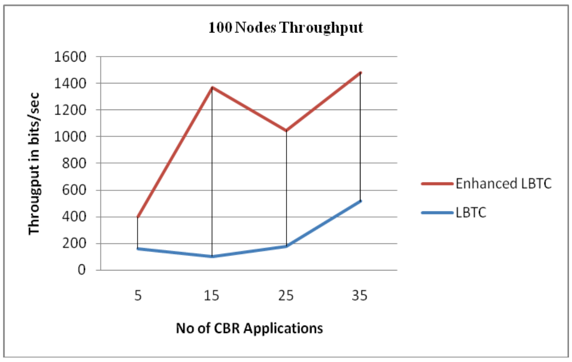

Fig 7: Throughput with 100 nodes .

V CONCLUSION

The simulation results show that energy consumption in the proposed scheme when compared with Location Based Topology control protocol has been drastically reduced as a result of proper transmit power control and sleep schedule. With the interference delay constraint, End to end delay is reduced when the no of CBR traffic is increased along with the no of nodes to 100.Thus the proposed scheme outperforms in terms of throughput.

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