Reactive Power Monitor Algorithm To Enhance The Network Capacity

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Abstract— **Wireless ad hoc network is an infrastructure less wireless network with self organization and self configuration properties. Due to its characteristics, MANETs are well suited for sensitive real time applications like military, law enforcement and disaster recovery. Heterogeneous mobile nodes present in network are communicates one another by wireless communication channel, directly if they are present within a radio communication channel of rely on intermediate nodes for communication. Existing work discussed about reactive link interference monitoring method for multi hop mobile ad hoc networks. The prime objective of this method is to achieve effective communication in MANETs. Algorithm provides effective results, as the data transmitted via wireless link based on its monitored status. The data packets only forwarded through those links, which are capable of handling them and congestion in the link is very less. This algorithm enhances the network capacity by the help of link optimization method. However this objective is not enough to effectively enhance the network capacity. Thus in this paper we propose a per node power monitor method to decrease the power interference. This method is based on multiple access power to every communicating node. Performance results shows that our work is enhance the network performance by Power optimization.**

Keywords— **Manets; Capacity; Interference; Power; Network Traffic;**

I. INTRODUCTION

Uplink of MANETs [9, 10] communication system, problem of far near is fight through the composition of open & close loop power control to assure the nodes to generate identical signal for communication. The communicating nodes monitor the obtained signal power from its neighbouring nodes and inform the far nodes to enhance their signal power strength & close nodes to decrease their power signals. However, it creates an overhead in MANETs. Let us assume the situation shown in figure 1, the distance between nodes A and B is d_{AB}. Let assume A want to communicate with node B with specific code, at the same time node C want to communicate with node D with different code. All the nodes placed in equal distance, such a way that $d_{AB} = d_{CD}$, $d_{CB} = d_{DB}$ and $d_{AD} = d_{CD}$. Then, communication is not possible due to multiple access interference (MAI), as Node C restrict the communication between node A and B similarly node A restrict the communication between node C and D, irrespective codes and power level. (e.g., if A increases its power to combat the MAI [2] at B, then this increased power will destroy the reception at D).

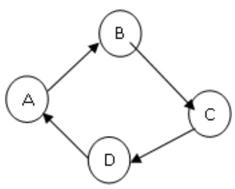

Figure 1: A power control scheme to combat near-far problem

From above discussion, there exist two concern issues; firstly, two simultaneous transmissions is not possible in network with different power levels, which belong to MAC issue. Secondly, simultaneous transmission is possible only when the nodes power level should be adjust such a way that, one node transmission power should not be destroy the reception of packets at other neighbour nodes, which belongs to power management issue. In order to solve the far-near problem in MANETs, by managing Power control and MAC layer settings.

Monitoring algorithm responsibility is to minimize the interference/ eliminate collision, to achieve the good network performance by effectively utilizing intended bandwidth. Monitoring node should not allow the nodes to participate in communication even if they are present in a communication range, and allow only if mutual access interference is manageable. The proposed method is described as follows with below objectives.

- proposed method should be asynchronous, distributed and scalable
- Must be suitable for real time applications with minimal overhead
- Receiving node receiver circuitry should not be overly complex in the sense that it should not be required to monitor the whole code set.
- It must recognize the changes in medium and mobility

Proposed protocol work on higher layer, so it must be minimize the interference, irrespective of assigned code. This is important because it is usually difficult to guarantee correct power assignment at all times when network topology is continuously changing

II. PROPOSED WORK

The proposed method is designed for contention depended routing mechanisms with the help of changed CTS reservation method. The CTS control messages are sent over the control channel at predefined maximum power P_{max}. This message is received by all the interfering nodes, as discussed in IEEE 802.11 mechanism [3][4]. but IEEE 802.11 mechanism may allows the interfering nodes to send simultaneously, based on some standards. In order to guarantee the packet to communicate successfully, both sender and receiver should agree two parameters i.e., source code and transmitting power. Code selection about data is depends on code allocation mechanisms. The selection of power level is major considerable factor and it trade-off among the quality of link and multiple access interference. For consideration, increasing sender transmission power will decrease the bit error rate at receiver and also improve the link quality, but multiple access interference will added to other simultaneous reception and causes the quality at these receivers degrades. By considering these two factors, this chapter provides a method to incorporate the interference limit in power computation.

Interference limit in power computation permit nodes at particular interference distance from intended receiving nodes to initiate new transmission in future. This development uses two frequency channels one for data and other for control. All the devises in network uses the identical spreading code via control channel, while data channels used for different terminal specific codes. Any signal (code) via control channel is orthogonal to any signals over data channel due to frequency separation. Dividing the present bandwidth into two parts allow the nodes to communicate simultaneously via control and data channel, regardless of signal power

In MANETs, broadcast packets processed immediately, irrespective of channel. Under respective monitoring method, conventional mechanisms are assured to free from primary collision. However, because of nonzero cross correlation among the various data sent, creates the interference with multiple data, which results in secondary collision at receiver nodes (MAI). In our approach we consider this interference is occurred due to near-far problem, and it causes the degradation of network performance with respect to throughput. In order to improve network performance, we designed a protocol which can dynamically adjust the transmission power; each receiver nod is not strong enough to trigger a secondary collision. This assignment enhances the network throughput by minimum energy consumption. Proposed method saves the energy in comparison with existing 802.11 MAC protocol.

III. INTERFERENCE LIMIT

Threshold Interference is required at every neighbouring node to receive the packets from different transmitters in future. This threshold value is calculated as follow;. Let an receiver node ′i′ and μ^* is the Eb/No ratio and is used to get the expected bit error rate at receiver node by

$$\frac{P_0^{(i)}}{P_{thrmal} + P_{MAI}^{(i)}} \geq \mu^* \text{------------------}1$$

where Pthrmal denotes the thermal noise power & P(i)MAI is the total MAI at receiving node ′i′, so the minimum required received power is

[P(i))min = μ*(Pthrmal + P(i)*MAI]

Threshold interference is majorly depends on the network load, which itself can be conveyed in terms of the so-called noise rise (ξ(i)), calculated by below equation:

$$\xi^{(i)} \stackrel{\text{def}}{=} \frac{(\frac{E_b}{N_o})_{unloaded}}{(\frac{E_b}{N_o})_{loaded}} = \frac{P_{thrmal} + P_{MAI}^{(i)}}{P_{thrmal}} \text{------------------}2$$

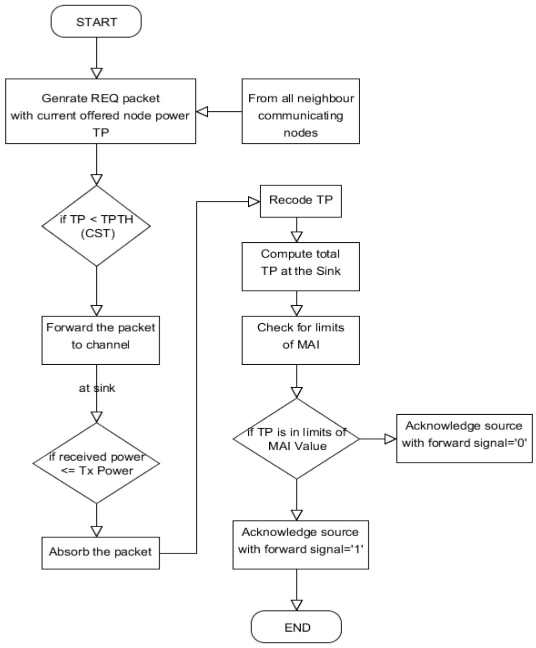

Figure..2 Flowchart of power monitoring system

(P(i))min = ξ(i)μ*Pthrmal is also dependent on the noise rise. While more capacity can be achieved by increasing the noise rise (i.e., allowing larger P(i) MAI), the maximum allowable noise rise is constrained by two factors. Firstly, the regulations limit the power to a fixed value i.e., 1 Watt for 802.11 devices. Provided this maximum power will enhance the noise rise, tends to increase in received power (P(i))min (as μ* and Pthrmal are constants) and due to this coverage/range of reliable communication decreases. Secondly, enhancing the noise rise will enhances the power utilization to send packets, and in turn increases the consumption of energy. Energy is a constrained resource in AD hoc network environment, so it is unsuitable for trade off energy for network throughput. We place the interference threshold by transmitting node to enhance the planned noise rise (ξmax), which is achieved by considering the above discussed factors on ξ(i).

The method of admission permits only transmissions that cause neither primary collision nor secondary collision to process simultaneously. The control message fields CTS used for three functions. Packet format for requesting is similar to IEEE 802.11 [3][4], excluding for extra field for entry P(j)value with two bytes. Requesting packet format of proposed approach is shown in figure 3.

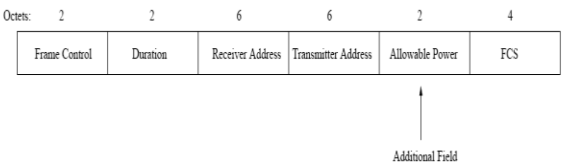

Figure 3: Format of a requesting packet.

Firstly, these packets are used to calculate the estimated channel gain among the sender-receiver pairs. Secondly, a receiver nodes uses the CTS packets for notifying their neighbouring nodes about the additional noise power (denoted by P(i) noise) that each of the neighbours can add to node i without impacting i's current reception. These neighbours constitute the set of potentially interfering terminals. Lastly, every node keeps listening to the control channel regardless of the signal destination in order to keep track of the average number of active nodes in their neighbourhoods.

IV. COMMUNICATION OPERATION

The progress of packets communicate over the network is described as follows. If node 'A' want to transmit a packet, it initiates the request packet over control channel at P_{max} , and includes the maximum limit of power level, which could not disturb any ongoing reception in A 's neighbourhood. By receiving the packet, receiver node let 'B' used the predefined value of P_{max} and received power value P (ji) to calculate the channel gain Gji = P(ji) received/Pmax between communicating entities at that time. Node 'A' be able to decode the data accurately, if transmitted power P(ji) min given by in small interval of time:

$$P_{min}^{(ji)} = \frac{\mu^*(P_{thrmal}+P_{MAI-current}^{(i)})}{G_{ji}} \text{------------------}3$$

Where $P_{MAI-current}^{(i)}$ is the efficient present MAI from current all ongoing transmissions. The value of Gji is constraint during transmission, as we assumed the channel gain for small duration of time interval. Node 'A' must use P(ji) min for data transmission to correctly decode the data packets at receiving node 'B' at current level of interference. Moreover, node A's Min power P(ji) not allow any interference tolerance, thus the neighbours of Node 'A' has to defer their transmission during terminal A's current reception (i.e., no cunccerent transmissions could take place in the neighbourhood of A). Power allowed at node B use to send to node B is calculated by

$$P_{allowed}^{(ij)} = \frac{\xi_{max}\mu^* P_{thrmal}}{G_{ji}} \text{-----------}4$$

If P(ji)allowed < P(ji)min, then the MAI in the vicinity of terminal i is greater than the one allowed by the link budget. In this case, i responds with a negative CTS, informing j that it cannot proceed with its transmission. This is to prevent transmissions from taking place over links that provides high MAI. This consequently increases the number of active links in the network (subject to the available power constraints). On the other hand, if P(ji)allowed > P(ji)min, then it is possible for terminal i to receive j's signal but only if P(ji) allowed is less than P(j) (included in the requesting). This last condition is necessary so that transmitter j does not disturb any of the ongoing transmissions in its vicinity. In this case, terminal I calculates the interference power tolerance P(i) MAI-future that it can endure from future unintended transmitters. This power is given by,

$$P_{MAI-future}^{(i)} = \frac{3W\,G_{ji}}{2\mu^*}\left(P_{allowed}^{(ji)} - P_{min}^{(ji)}\right)\text{--------------}5$$

The factor 3W/2 comes from the spreading gain. The next step is to equitably distribute this power tolerance among future potentially interfering users in the vicinity of i. The objective behind this distribution is to prevent one neighbour from consuming the entire P(i)MAI-future.

The distribution of this power tolerance is given as;

If terminal i keeps track of the number of simultaneous transmissions in its neighbourhood, donated by K(i)inst. Monitored by the requesting/CTS exchanges over the control channel. In addition, i keeps an average K(i),(avg of K(i)inst)over a specified window. The, K(i) is calculated as:

$$K^{(i)} = \begin{cases} \beta(K_{avg}^{(i)} - K_{inst}^{(i)}), & \text{if } K_{avg}^{(i)} > K_{inst}^{(i)} \\ \beta, & \text{otherwise} \end{cases} \quad --6$$

where β > 1 is a safety limit.

While communication it is observed that when the within interference [5-8] is more than the neighbour interference the level of effect observed is high to reduce this interference effect the neighbour interference is to be reduced. On the calculation if the average interference level per node the CTS packets are generated with the available interference limit with the required power transmission request to the neighbouring node as shown in figure 4.

This demanded power Derived from the CTS packet is then compared with the available power limit and transmitted back for acceptance over the control channel to forward the packet. In case the requested power is more than the limiting power the request is denied.

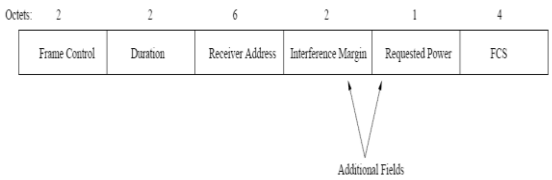

Figure 4: Format of the CTS packet in the proposed algorithm.

A summarized format of the proposed communication algorithm is as presented below;

To monitor the per node power interference, the Power Monitoring algorithm is developed with an updated requesting packet, An additional field of current node power is added to the conventional request frame to exchange the current power reference of the source node.

For a distributed network,

Generate a request packet with current offered node power Tp, due to all its neighbour communicating nodes.

Forward the request packet to the channel if Lp < Lpth At sink,

If the received packet is in transmitted power value, absorb the information.

Decode the transmitted power field Tp from the request field,

Compute the local Tp at the sink due to each neighbour links.

If current node Tp is in limit to MAI acknowledge the source with forward signal ='1' else '0'.

If forward signal is observed high source forwards data packet.

This proposal contributes in reducing MAI at node due to simultaneous transmission.

As in conventional approaches irrespective of per node offered power each individual node observes the offered load as its own load.

Whereas from sink side the offered link power is sum of all successive (Lp)

During communication as the forwarding of packet is controlled by the CTS packet of the receiver unit offered power load at the sink is controlled.

The sink node based on its current offered power load allows or reject the packet reception and also generation, hence resulting in reducing MAI and network overhead in the network.

Additional to the stated two approach the quality factor of the transmission and reception is also considered. As in wireless node power are constraint running of heavily computing estimating algorithms may not be suitable. As these algorithm leads to early drain of battery power, a simple but efficient approach of data transfer is developed.

V. PERFORMANCE ANALYSIS

Performance analysis of proposed work is carried out by network simulator 2 by necessary extensions and compared it with work [9]. Simulation parameters are shown in table 1. Performance analysis metrics are as follows

Table1. Simulation parameters for analysis

Simulation Time	10000 s
Number of Nodes	20-100
Link Layer	Logical Link
MAC	802.11
Mobility	Random way
Routing	AODV
Radio	Two-Ray Ground
Queuing	Drop-Tail priority
Energy	15j
Traffic	FTP,CBR
Area of Network	1000m *1 000m

i. Packet delivery fraction: The ratio of number of data packets successfully received by CBR (constant bit rate) destination to the number of packets generated by the CBR sources multiple by hundred.

ii. Energy consumption: The energy consumed by the nodes while transmitting and receiving data and control packets.

iii. Reliability of routes: The maximum the number of data packets successfully received by the destination, the high is the reliability of routes.

VI. RESULTS

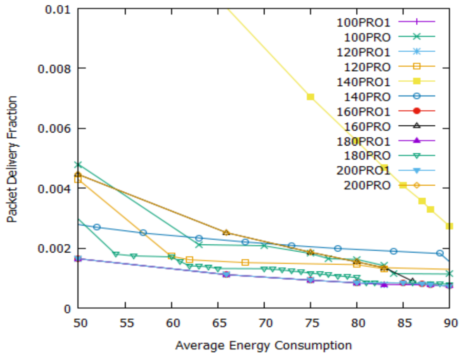

Figure 5(i). Comparison of Average energy consumption of nodes with respect to packet delivery fraction

We have compared our work with existing reactive link interference monitoring algorithm [1]. Scenarios of our work is as follows. Scenario 1:- We analyses the average energy consumption of nodes in a network with respect to packet delivery fraction, range of nodes is from 100 to 200.Scenario 2:- We analyses the average energy consumption of nodes in a network with respect to reliability of links, range of nodes is from 100 to 200. Figure 4 and 5 shows the better performance of proposed algorithm with respect to packet delivery fraction as well as in link reliability, thus using our proposed approach, MANETs scalability will increase with maximum throughput

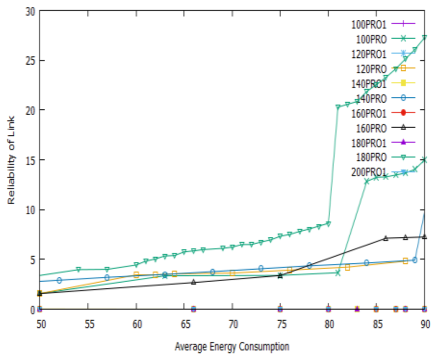

Figure 5(ii). Comparison of Average energy consumption of nodes with respect to reliability of routes

VII. CONCLUSION

Thus in this paper we propose a per node power monitor method to decrease the power interference. This method is based on multiple access power to every communicating node. Performance results shows that our work is enhance the network performance by Power optimization. Results shows that proposed algorithm enhance the network capacity by per node power monitoring. However, our approach provides the power optimization to enhance the capacity of network.

VIII. REFERENCES

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