Contention window adjustment in MAC Protocol for WSN Applications

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Abstract: Contention window adjustment is a pioneer technique to minimize energy consumption in WSN. Nodes can access the channel for data transmission by slot booking for contention window. If no data transmission during the slot, the node wins the contention and take turn to transmit its own data over the channel. Conventional MAC protocol is simulated using NS2, performance is analyzed like energy consumption, delay for overall network.

Keywords: Contention window, MAC, energy consumption, WSN.

1. INTRODUCTION

A new routing protocol named Transition State Mac Protocol reduces the energy consumption and employing the possible node in efficient manner precedent to the energy drain is proposed [1]. A protocol named SOMAC (Self Organizing Mac) achieves the best optimality and excels pure CSMA/CA, pure TDMA protocols [2]. To conserve the energy multilayer mac protocol is implemented. This conserves energy by reducing the probability of collisions and idle listening [3]. CL MAC protocol is intended to make less both energy and latency so that packet loss problem can be controlled. Nodes are selected only within the routing path [4]. Triggered CCHI multichannel MAC protocol is operated. It helps in resolving hidden terminal problem, unwanted delay and resource wastage [5]. High throughput and low delay MAC protocol approach helps to reduce data access delay and improves network throughput [6]. Energy efficient dynamic scheduling hybrid protocol is employed to achieve the network coding techniques with improved security in WSN [7], [14]. Traffic aware dynamic is employed to achieve ultralow energy consumption from ideal listening, collision and overhearing [8]. MAC protocol reduce the WuR (Wake up radio) cross layer protocols are better than single layer protocol to attain ultimate solution for IOT networks [9]. TAISC, a novel frame work hardware MAC Protocol provides high level ratio commands. It achieves about maximum throughput at an overhead of 20 micro seconds [10].

Vehicular Ad-Hoc networks (VANET'S) suggest the novel adaptive TDMA - MAC protocol supply safety message transmission with an efficient broadcast service, VAT-MAC optimizes each frame length by number of vehicles in the coverage of a roadside unit and increases system stability and throughput [11],[13]. MAC plays major role in ultra-wide band networks to obtain efficient communication, this technology is used in E-Health application. The dynamic channel coding protocol can be modified by considering node energy consumption for switching the power level between nodes. This also minimizes energy consumption of network, its life time [12].

2. RELATED WORK

This stimulation is implemented with NS2 software by adding 802.11 MAC protocol includes constant bit rate and dynamic source routing. 20MHz is the bandwidth used for 20 nodes with 125m communication range for packet transmission at 0.1 packets / second [1]. The SOMAC is implemented in a SDR testbed. SOMAC hires Q learning and gives solution for real world wireless network. SOMAC, CSMA and TDMA are the inputs used here and their evaluation is based on optimality, network performance and regret [2]. The proposed work is stimulated using MATLAB. The methods are chosen to be in poison distribution, time divided into frames (frame is poised of listen and sleep periods) and there is going to be three modes of operation [3]. The tools used here are OMNET++ and Castalia network stimulator. In this stimulation to control packet loss by adding two variables to the CL MAC algorithm which is given by Nb_tranmission and waiting delay [4]. NS2 version 2.34 tool is used. Network performance are

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evaluated using some measures-PDR, delay, throughput, packet loss ratio [5].

A new mechanism in HL MAC is implemented with OPNET Modeler tool which updates time slot request number and combining time slot mechanism. The number of nodes is made high by updating time slot and the number of packets in buffer [6]. NS2 stimulator is engaged to stimulate EDS-MAC, IH-MAC protocol. A network is created with 100 mobile nodes and with area of 1500m X 300m. Variable step size fire fly algorithm is used for analyzing the performance of EDS-MAC by comparing its throughput, delay, energy efficiency in IH-MAC [7].

Table1. Literature survey on various MAC protocols

Paper id	Algorithm /application	Approaches/ techniques	Achieved	Software used
1	Energy based neighbor selection and MAC-based Post relaying Process	Transition state MAC protocol(TSMP) is used.	Energy consumption is reduced and employs possible node in an efficient manner.	NS2
2	MAC selection algorithm	Self organizing MAC (SOMAC) is employed .	It achieves the best MAC protocol with great optimality and excels pure CSMA and TDMA protocols.	SDR testbed
3	Reservation and contention based algorithm	Multi layer MAC (ML-MAC) Protocol is used.	It is used to conserve the energy with low duty cycle to reduce their traffic activities	MATLAB
4	Nb_ transmission and weighting_delay algorithm	Cross layer (CL-MAC) protocol is employed.	It achieves liveness,boundedness,reversibility properties with the help of inserting the time net analyzer.	OMNET++ and castalia network simulator

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5	Algorithm of TCM-MAC and virtual TDMA beaconing process	Triggered CCHI multichannel MAC protocol is operated.	It helps in resolving hidden terminal problem,unwanted delay and resource wastage.	NS2 version 2.34
6	New super frame structure, updating time slot request number algorithm	High throughput low delay MAC protocol is used.	It reduces data access delay and improves network throughput.	OPNET Modeler 14.5
7	Variable step size firefly algorithm	Energy efficient dynamic scheduling hybrid protocol(EDS-MAC)is employed.	It achieves the network coding techniques with improved security in WSN	NS2 simulator
8	Adaptive wake up interval algorithm	Traffic aware dynamic (TAD-MAC) is employed.	it achieves Ultra low energy consumption from ideal listening ,collision and overhearing.	NS2 simulator

Using adaptive wake up interval for fixed and variable traffic which reduces the ideal listening, collision, over hearing and unnecessary wake up, beacon transmission. TSR length can be adjusted in optimization framework and testing the energy for the protocol [8]. WuR utilize energy harvesting methods to enlarge energy efficiency of nodes. After enlarging the nodes all the protocols modify bidirectional transmission models to protect multi-hop transmissions [9], [15]. MAC describes the MAC logic by predefined commands. TAISC compiler helps for efficient binary byte code, this byte code wirelessly further transmits to target hardware platform. Finally, TAISC kernel executes the byte code. This is the overall TAISC work flow to developed the MAC protocol [10].

Using NS2, provides a segment of 5-way uni-direction paths, with RSU located at middle point. The transmission limit of radio is set to 300 m. Nakagami RF induces is NS2 and it is used. To achieve the interval of 0.95 with half width of smaller than 5% mean, tested with different random seed, averaged the results among 100 stimulations [11]. The sensor nodes are considered in which four nodes are placed on patient body in order to monitor the patient health by measuring ECG, body temperature, blood pressure, oxygen saturation. NS2 modulator is used in order to examine protocol performance in the network with the help of dynamic traffic. This case represents an IOT application [12].

3. Proposed Contention window adjustment for MAC Protocol:

Adaptive listening in MAC protocol can save energy of the network. Frame in MAC protocol states combinely one listen and one sleep periods. Sleep period can make use of timer setting to put itself in off condition. Listen period make use of synchronization and listening mechanisms. Neighboring nodes need to access the medium based on contention. They select slot for transmission, if no data during that slot then the particular node chosen slot can take turn to transmit data and this is called winning the contention. Hence collision can be taken care by this method.

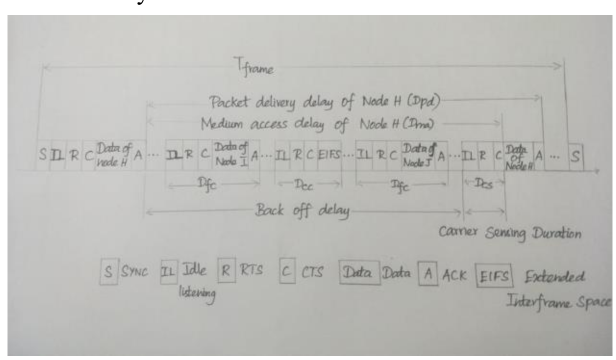

Fig1. Contention window adjustment in MAC Protocol

Fig1 show the contention window followed in our work. Frame components in adaptive listening are RTS, CTS which are request to send and clear to send. SYNC stands for synchronization packet, IL stands for idle

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listening and ACK is acknowledgement, DATA is the data to be transmitted by the particular node who has win the contention window.

4. Results:

Contention window adjustments are carried out for better MAC performance using NS2. Conventional MAC performance is shown in Fig2 to fig4. The energy consumed and the average energy in different scenarios are plotted. Table2. Show performance metrics in 3 different trials with 10 nodes, 20 nodes and 30 nodes. Table3 show simulation setup used for NS2. Fig3 show total energy for the network increases as the number of nodes increase from 10 nodes to 30 nodes. Fig4. Show average energy consumption decreases as the traffic is shared by nodes as their number increases from 10 to 30.

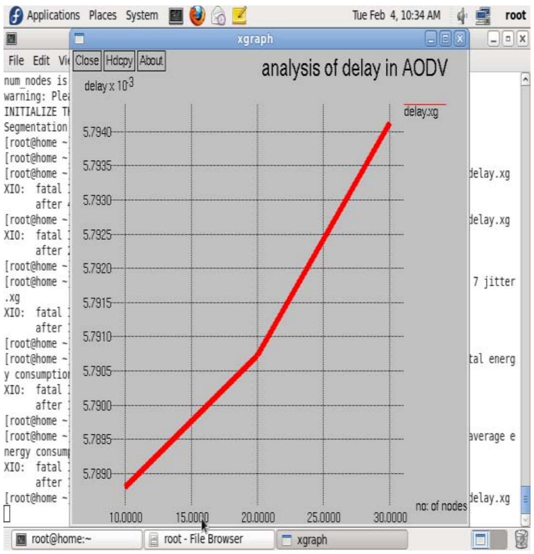

Fig2. Delay Versus number of nodes

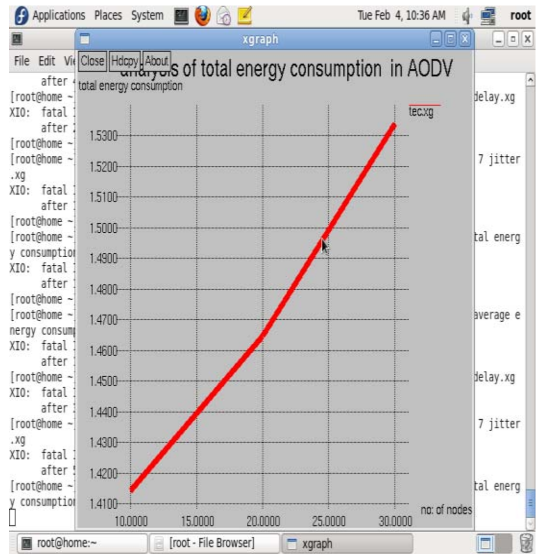

Fig3. Total energy consumption Versus number of nodes

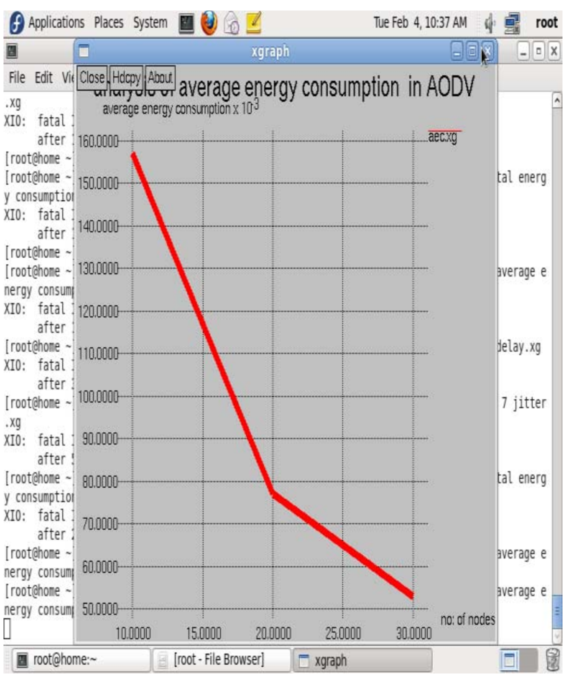

Fig4. Avg energy consumption Versus number of nodes

Table2. Performance of Conv.Mac in ADOV

PROTOCOLS	AODV, Conv. MAC		
Nodes	10	20	30
No of packets send	400	400	400
No of packets received	400	400	400
Packet delivery ratio	100	100	100
Control overhead	10	20	30
Delay	0.0057888	0.00579073	0.00579413
Throughput	42666.7	42666.7	42666.7
Jitter	0.0999671	0.0999661	0.0999673
No. of Packets Dropped	0	0	0
Total Energy Consump.	1.41421	1.4647	1.53392
Average Energy Consumption	0.157134	0.0770895	0.0528938
Overall residual energy	88.5839	188.505	288.405
Averg residual energy	9.84265	9.92132	9.94499

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Table3. Network - Simulation Setup

Network interface type	Wirelessphy
Radio-Propagation model	Two Ray Ground
No of mobile Nodes	10,20,30
Mac Type	Conv.Mac
Routing protocol	AODV
Antenna	Omni Antenna
X, Y	800,800
Channel type	Wireless channel
Interface queue type	Drop tail/priqueue

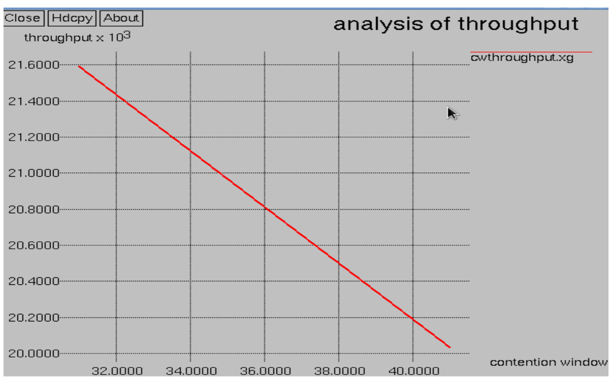

Fig5. Throughput Versus Contention Window (CW) Size

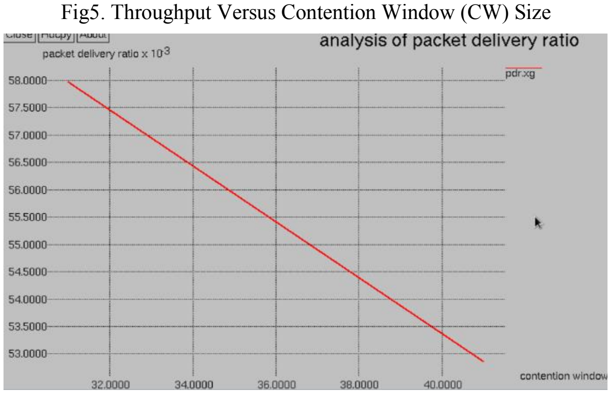

Fig6. PDR Versus Contention Window (CW) Size

Fig5. to Fig11 show the effect of contention window on MAC performance. In Fig5, as the contention window size is varied from 31 to 41, throughput decreases from 21592 to 20030. In fig6, as the contention window size is varied from 31 to 41, PDR decreases from 0.0579 to 0.0528. In fig7, as the contention window size is varied from 31 to 41, Sent packets increases from 34199 to 39731 packets. In fig8, as the contention window size is varied from 31 to 41, delay increases from 1.102ms to 1.510ms.

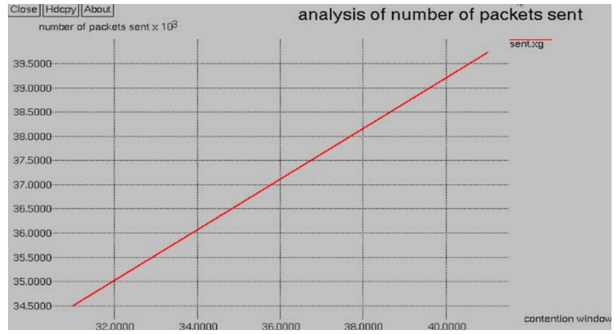

Fig7. Number of packets sent Versus Contention Window (CW) Size

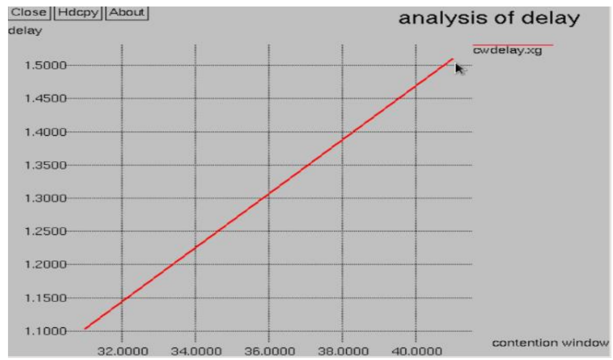

Fig8. Delay Versus Contention Window (CW) Size

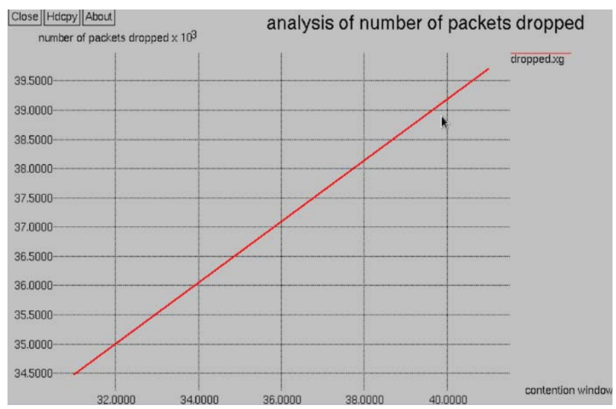

Fig9. Number of packets dropped Vs Contention Window (CW) Size

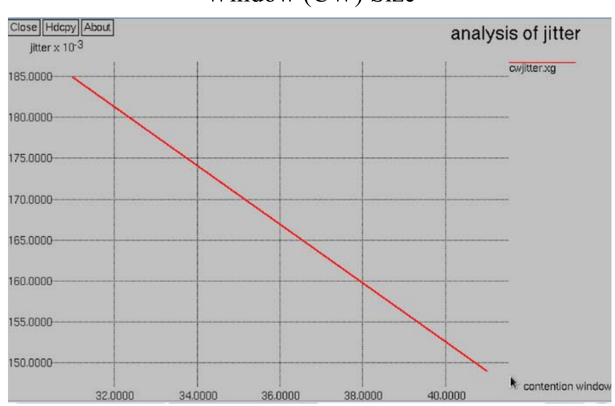

Fig10. Jitter Versus Contention Window (CW) Size

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In fig9, as the contention window size is varied from 31 to 41, dropped packets increases from 34479 to 39710 packets. In fig10, as the contention window size is varied from 31 to 41, jitter increases from 0.184 to 0.148. In fig11, as the contention window size is varied from 31 to 41, received packets increases from 20 to 21 packets.

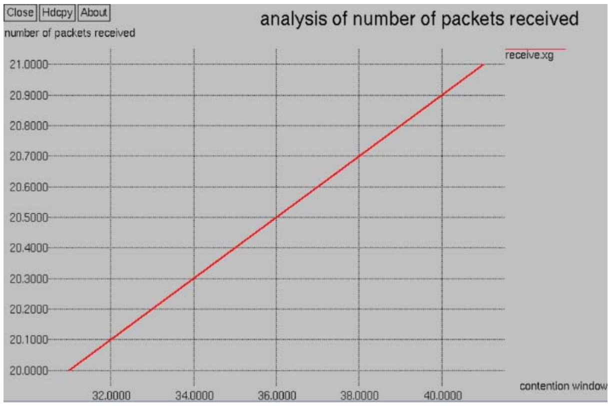

Fig11. Number of packets received Vs Contention Window (CW) Size

5. Conclusion:

Energy consumption play major role in WSN. Contention window adjustment can help in reducing the enrgy consumption in the network. The frame components like delay-oriented MAC protocol leads to minimum energy by trade off of collision probability and idle listening in the network. Uniform random selection, contention priority, self-adaptive contention window adjustments are the various methods to help in energy reduction in the network.

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