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Reliability and Delay Analysis of CSMA-CA in Multicast Wireless Sensor Networks

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***Abstract*— In a wireless network, sensor nodes employs carrier sense based MAC algorithms such as CSMA/CA for efficient sharing of communication channel. In order to reduce delay occurs in CSMA/CA state while packet transmission is a major challenge in WSN. In this proposed system the problem of delay in the RTS/CTS mechanism addressed by using the novel algorithm. Collision is avoided by reducing Contention Window values dynamically is also analysed to yield reliable effective throughput by an new-fangled algorithm.**

***Index Terms*— CSMA/CA, RTS, CTS, CW, Distributed Inter-Frame Space (DIFS) Time.**

I. Introduction

Carrier sense multiple access with collision avoidance (CSMA/CA) in computer networking, is a network multiple access method in which carrier sensing is used, but nodes attempt to avoid collisions by transmitting only when the channel is sensed to be "idle". When they do transmit, nodes transmit their packet data in its entirety.

Phil Karn proposed the Request-to-send and Clear-to-Send (RTS/CTS) handshaking scheme leading to solve delay problem [1]. When a node wants to end data to another node, it first transmits a short Request to Send (RTS) packet to the receiver. If the receiver is ready for this communication, it responds with a Clear to Send (CTS) packet. On the successful reception of CTS packet, the sender advances to transmit the actual data packet.

In RTS/CTS protocol scheme, RTS/CTS packets set the timer for the neighbouring nodes that these nodes do not interfere in communication of the intended nodes .However, if the communication between the intended nodes occurs within a time period that is less than that of the CTS timer, the neighbouring nodes have to wait even when the communication is over. So a kind of delay has been developed. Hence there is a need of advancement in the previous technique to reduce the delay time between a RTS and CTS sequence resulting in higher throughput and network efficiency.

The protocol starts by listening on the channel (this is called *carrier sense*), and if it is found to be idle, it sends the first packet in the transmit queue. If it is busy (either another node transmission or interference), the node waits the end of the current transmission and then starts the **contention** (wait a random amount of time). When its contention timer expires, if the channel is still idle, the node sends the packet. The node

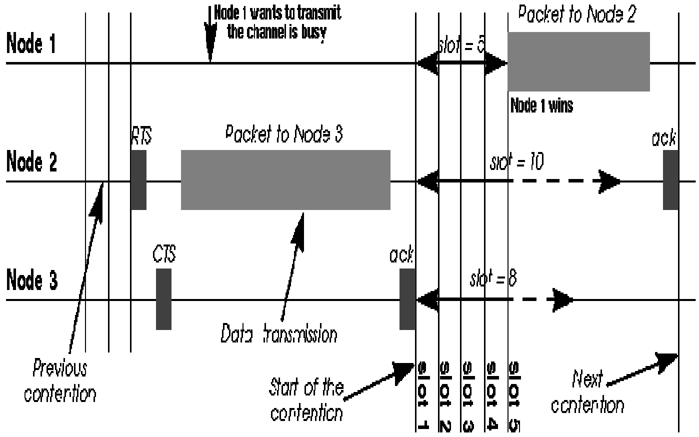

Fig 1 . Basic CSMA/CA Operations

having chosen the shortest contention delay wins and transmits its packet. The other nodes just wait for the next contention (at the end of this packet). Because the contention is a random number and done for every packets, each node is given an equal chance to access the channel (on average - it is statistic).

II. System Model

In the local area network, the set of stations are randomly distributed. A transmitted packet may be lost due to the collision or the transmission error and dropped after the maximum retransmission limit is reached. In deriving the optimal throughput, we consider that the network works in the saturation condition and each station always has packets to transmit [3].

In DCF, the channel status is monitored during the idle period, and a station can transmit if the channel is sensed free with duration of distributed inter-frame space (DIFS) time. If the channel is sensed busy, a station will back off and not immediately compete for the channel access again and the back off duration is set as a random period within a back off window [3].

RTS collision increases its CW by multiplying it by the factor mc. Any node overhearing a collision with the help of the above-mentioned technique increases its CW by lc units (slots). When a successful RTS transmission takes place, all nodes (including the sender, the receiver, and all overhearing neighbours) decrease their CWs by ls units [2].The values of mc and lc control how fast nodes increase their CWs in the case of packet collisions. Similarly, the value of ls allows nodes to lower their CWs when a successful channel access takes place. The Request-To-Send/Clear-To-Send

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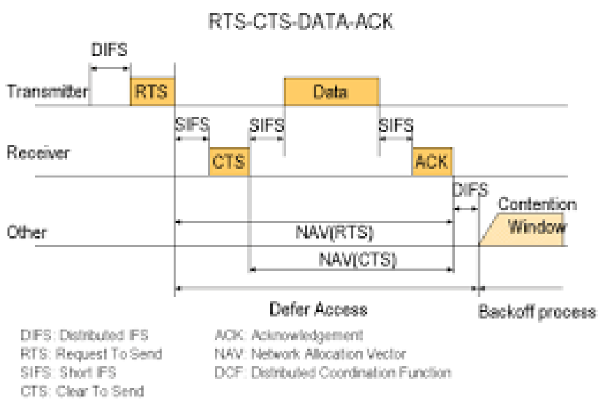
(RTS/CTS) mechanism is an optional four-way handshaking mechanism used to combat the effects of packet collisions in IEEE 802.11wireless networks. RTS threshold (RT) value is an important element to study as it decides that when RTS/CTS mechanism should be used and the value is RTR [1].

Algorithm 1: Get successor node: to determine the successor that receives the message

Find ideal angle,cluster_ area,node_ranklist
RTR=0
if no neighbours within the cluster_area then
return nil
if no neighbours within the node_ranklist then
Successor <= the node closest to ideal angle
RTR = empty list
else
Successor<= a probability node in the node_ranklist to the probability of angle deviation from the node
Increase RTR by one
return Successor,RTR
if RTR= one then
Successor is ready to receive packets
return true
else
return false

Fig 2. IEEE 802.11 RTS-CTS Exchanges



The receiving node sends Ready to Receive (RTR) packets to all the neighbouring nodes to notify them that now it is free to communicate, so by doing this, the neighbouring nodes do not wait till the timer expires. So they can communicate without any delay in network [1].

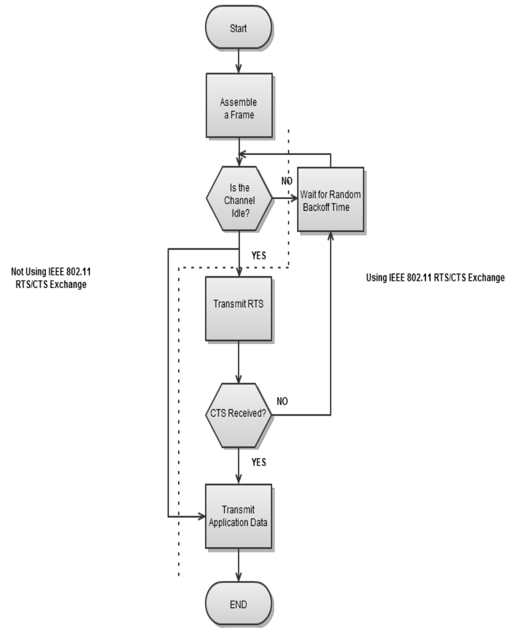


Fig 3.Flow of the CSMA/CA packet transmission

III. Mathematical Model

In this proposed a modified back off algorithm that changes its contention window dynamically around the optimal value. After a successful transmission, the window w is set to Max (w/2, CWmin), and set to Min (2w, CWmax) after collision.

Algorithm 2: To change the CW value dynamically for collision avoidance

for all *i* from 1 to N – 1 do
Get RTR,NP[i]
if RTR = true and NP[i] >= i then
CW ← Max(w/2, CWmin)
not col and successesful send
else if RTR = false and NP[i] > i then
CW ← Min(2w, CWmax)
NP[i] ← $NP[i] + 1$
a collision occurs,retry or drop the package
end for

N specifies the number of nodes in a cluster. After analysing that Successor is ready to receive a packet then RTR have a true value indicates that the Successor node is in idle state. Now we consider Contention Window is reduced for achieve the collision avoidance mechanisms. NP[i] indicates the node_ranklist (priority value to the successor node) to provide highly reliable effective throughput.

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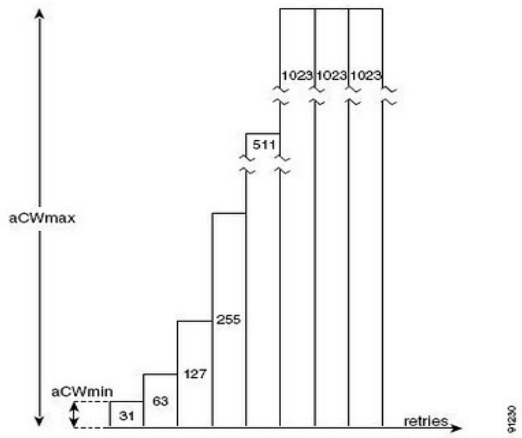
IV. ANALYTICAL RESULTS

A. *Contention Window Scaling*

Contention window scaling between CWmin and CWmax is easier to understand when illustrated. For the first transmission attempt, the random back off timer is set to a value between 0 – CWmin. Only when a retransmission is required due to the lack of a returned frame acknowledgement will the possible range grow. For the first and each subsequent retransmission attempt, the contention window will double by a power of 2. This is called binary exponential back off. Once the window grows to CWmax, it will grow no further.

Figure 2-5 Growth in Random Backoff Range with Retries



Collision occurs where two stations transmit at the same time, no acknowledgment of the frame will be received and the station will increment its retry counter and increase its contention window according to the above back off algorithm, up to a maximum contention window size of CWmax. The stations must then wait the appropriate DIFS time, select a new random back off timer using the new contention window range, and proceed as before.

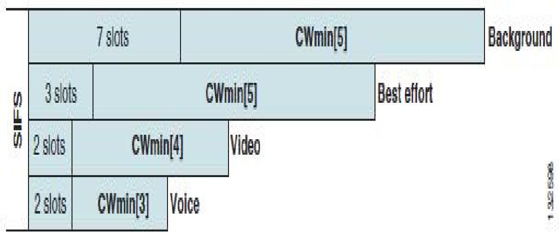
The maximum contention window range for voice and video are still relatively small compared to the other queues. On a heavily utilized network, as retransmission attempts increase, the statistical advantage for voice and video frames gets even better. The minimum contention window values are 0 and the maximum value is 32,767. However, in practice the typical maximum value is never set above 1,023.

The default EDCA contention window values for the 802.11b PHY in a QoS BSS are defined as:

TABLE I
CONTENTION WINDOW

Voice Queue	CWmin = 7	CWmax = 15
Video Queue	CWmin = 15	CWmax = 31
Best Effort Queue	CWmin = 31	CWmax = 1023
Background Queue	CWmin = 31	CWmax = 1023

Figure 2-8 Access Category (AC) Timing



B. *Reliability Analysis:*

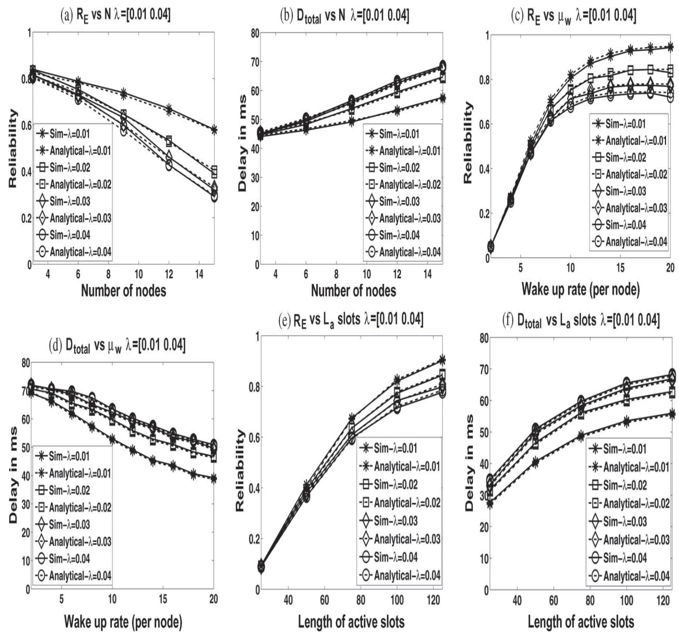


Fig 7. A sample line graph of reliability and delay performance

In this letter, a slotted any cast model for clustered multi-hop networks with the state-wise behaviour injected into 3D Markov chain is developed and analyzed [4]. Reliability and delay performance metrics are analyzed with variation in parameters such as CSMA/CA retries, number of nodes, wake up rate and active time for different packet arrival values, and are validated.

The probability of a node to reside in CSMA/CA state (P_{CSMA}) at a randomly given time slot is the sum of backoff, Clear Channel Assessment CCA, success and failure state probabilities respectively.Reliability or fault tolerance, i.e., ability to sustain sensor network functionality without any interruption by,

$$R_k(t) = e^{(-\lambda_k t)}$$

i.e., by Poisson distribution, to capture the probability of not having a failure within the time interval (0, t) with l_k is the failure rate of the sensor node k and t is the time period.

Reliability (Fault Tolerance) of a broadcast range with N sensor nodes is calculated from

$$R(t) = 1 - \prod_{k=1}^{N} [1 - R_k(t)]$$

V. CONCLUSIONS

The proposed algorithm that changes its contention window dynamically around the optimal value before a successful transmission for achieve the collision avoidance mechanisms. The delay time between a RTS and CTS sequence reduced which resulting in higher throughput and network efficiency. To determine the successor that receives the message is performed by algorithm1.The reliability of a successor node can also be determined by deriving the failure probabilities using 3D Markov chain and both analytical and emulation results with less than 0.45% error.

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REFERENCES

[1] Ramandeep Kaur, Reecha Sharma, An Analysis of RTS/CTS Mechanism for Data Transfer In Wireless Network:A Review, An International Journal of Engineering Sciences, Vol. 17,January 2016.

[2] Jing Deng,Pramod K. Varshney,Zygmunt J. Haas,A New Back off Algorithm for the IEEE 802.11Distributed Coordination Function,june 2009.

[3] Aytül Bozkurt,Optimal delay analysis for real-time traffics over IEEE 802.11 wireless LANs,EURASIP Journal on Wireless Communications and Networking ,2016.

[4] Raja Vara Prasad Yerra, M. P. R. S. Kiran, and Rajalakshmi Pachamuthu . Reliability and Delay Analysis of Slotted Anycast Multi-Hop Wireless Networks Targeting Dense Traffic IoT Applications, IEEE COMMUNICATIONS LETTERS, VOL. 19, NO. 5, MAY 2015.

[5] R. V. Prasad and P. Rajalakshmi, "Analytical model of adaptive CSMA-CAMAC for reliable and timely clustered wireless multi-hop communication,"in *Proc. IEEE WF-IoT Conf.*, Seoul, Korea, Mar. 6–8, 2014.

[6] P. Park, C. Fischione, A. Bonivento, K. H. Johansson, and A. Sangiovanni-Vincentelli, "Breath: An adaptive protocol for industrial control applications using wireless sensor networks," *IEEE Trans. MobileComput.*, vol. 10, no. 6, pp. 821–838, Jun. 2011.