

HISTORY BASED CONTENTION WINDOW CONTROL (HWCBC) BY IEEE 802.11 MAC PROTOCOL TO MINIMIZE THE HIDDEN NODE PROBLEM IN WIRELESS NETWORK

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Abstract: The use of wireless network has been increased the popularity of mobile devices such as mobile etc. In such system, there are many type of problem created like hidden node problem which can be reduced to increase the efficiency of the network. Hidden terminals are intermediate sources which reduces the throughput of a wireless network if it applies MAC protocol. The RTS/CTS mechanism is a popular solution of this problem. RTS/CTS (Request to Send/Clear to Send) mechanism is a reservation scheme used in the wireless networks. It is used to reduce the frame collisions created due to the hidden node problem.

Problem Statement: The IEEE 802.11 MAC

Introduction

Over the past few decades, the use of wireless network has tremendously increased. The wireless networking protocol is specified by the Media Access Protocol that has a very important role in wireless communication. It provides variety of functions that support the operations of wireless LANs. In infrastructure based network, centralized node is present that determine the allocation of channel. In ad-hoc network, channel allocation is of distributive nature. In wireless networking, the hidden terminal problem arises for a visible node from a wireless access point, rather than from other nodes whose communications are with the access point. This creates the problems in (MAC) media access control.

The hidden node problem can be explained by a simple manner as user A transmits the message to the user B, which is not known by

protocol is the most implemented protocol for the wireless network. The IEEE 802.11 controls the access and share wireless medium within competing stations. The IEEE 802.11 DCF mode doubles the contention window size in lieu to improve the network performance but there are some collisions due to sudden change in CW rest to CW_{min} in channel.

Approach: The research to date has been done only for the current number of active stations that have complex computations. A novel back-off algorithm is used for optimization of the contention window size. It uses the history based concept with packet lost.

Key words: IEEE 802.11, MAC Protocol, Back-off Algorithm, Contention window and Error prone channel.

the user C. But the user C also wants to send the message to user B. The user B does not understand that the message has been sent either user A or B. This problem is known as a hidden node problem. Due to this problem the packet collisions, dropping of packet as well as decreases network performance and the network gets busy for more than the desired time.

A simple solution for this problem is the RTS/CTS mechanism. The RTS/CTS frames play the important role to avoid the hidden node problem created by mobile node in the ad-hoc-based mobile LAN [12]. It is handshaking mechanism to remove hidden node problem at the specific duration when actual data is transferred. This mechanism generally works in the infrastructure mode. Figure 1 shows the use of RTS and CTS with

the Network Allocation Vector (NAV) value set.

Ad-hoc networks and Point Coordination Function (PCF) mode that is useful for infrastructure-based networks. DCF supports best effort delivery of packets at the link layer and is best described as the Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) protocol. While DCF works

RTS/CTS Mechanism

RTS/CTS are the three way handshaking system as RTS frame, CTS frame and acknowledgement. If any node want to send the packet to any work station then it request with RTS packet. Nodes that hear the RTS request will defer the transmission for a long period of time to allow to transmitter to receive the CTS packet. If the channel is free then receiver replies with CTS packet. Nodes hear the CTS packet with back off time that is sufficiently long to allow the receiver to receive the entire data packet [47]. After the sender receives the CTS packet successfully, it starts the transmission of actual data between the stations. According to the DCF mode, each station which has the data packet for the transmission that send RTS packet to receiver. After receiving the correct packet, it waits for the SIFS (Short Inter Frame Spacing) interval and transmitted the CTS packet when the channel is idle state. Moreover, when RTS and CTS frames involve about transmission time which is utilized in the updating Network Allocation Vector (NAV) that shows the time in which the channel will remain busy. In DCF mode, when station has packet to transmission then it will check first status of the channel if it is idle state then it is distributed Inter Frame Space (DIFS) period then a Slotted Binary Exponential Back-off (BEB) procedure chooses a random back-off interval value uniformly in $[0, CW-1]$. The 802.11 DCF sets $CW = CW_{min}$ and it is double with transmission failure up to a predefined maximum (CW_{max}). If the channel is sensed idle, back-off timer keeps running but when the channel is sensed busy back-off algorithm pauses the timer. (When other station initiates the data transmission) the back-off resumed

reasonably well in infra-structured wireless LAN environment, this is not necessarily true in a mobile ad hoc network (MANET) environment. In Mobile Ad Hoc Network (MANET) is a very popular field in these years. This technology is useful in following areas as hospitals, offices, airports, factories, campuses and other various places.

when the channel is sensed idle again for more than DIFS. After receiving the correct data packet, the receiver waits for the SIFS (Short Inter Frame Spacing) time then it is transmitted the positive acknowledgement to the sender. If the sender receives the ACK packet correctly then it resets the value of CW size that is $CW = CW_{min}$ and drops the data packet.

Otherwise, the sender increases the CW size and attempts to retransmission until CW_{max} is reached. Before transmission, each competing station defers its attempt to access the channel a random time to avoid collisions. Specifically, it sets up a back-off timer according to a random back-off time chosen uniformly between 0 and the current Contention Window (CW) size, which is controlled by the Binary Exponential Back-off (BEB) algorithm in the DCF [60]. In the literature, numerous papers have been conducted on improving the performance of IEEE 802.11 DCF by modifying the CW value groups. One group modifies the CW size with static scale and the other group changes the CW dynamically based on the current network condition.

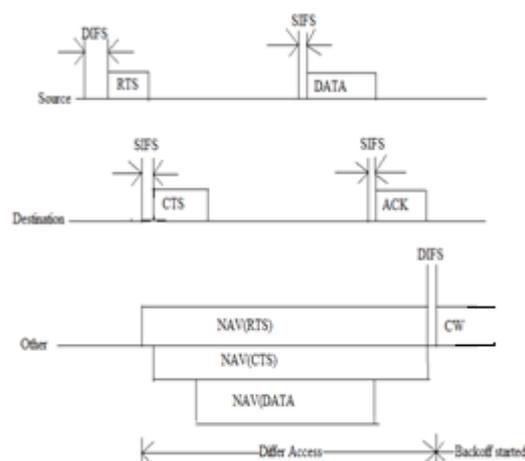


Fig. 1: Data transmission with RTS/CTS

Related Work

Wireless networks use the contention slots in standard IEEE 802.11 MAC protocol. The contention slots contain the RTS/CTS frame that is known as handshaking mechanism. Before the real data transfer, these contention slots reserve the channel for specific duration. The network is affected by the Denial of Service attacks that are many times applied on RTS/CTS mechanism. Utpal Paul, Anand Kashyap, Ritesh Maheshwari, and Samir R. Das [1] to estimate the interference between links and nodes in a live wireless network using the passive monitoring of wireless traffic. This tool does not require any type of controlled mechanism, injection of probe traffic in the network.

Sanjay Shakkottai and Theodore S. Rappaport, The University of Texas at Austin Peter C. Karlsson, Telia Sonera Sweden[2] proposed the cellular system and PCS that collides with wireless LANs and internet based data packet, new networking concept will support the integration of voice and data on the composite infrastructure of cellular base stations and Ethernet-based wireless access points.

Luciano Bononi, Marco Conti, and Enrico Gregori [3] explained a distributed mechanism for contention control in IEEE 802.11 Wireless LANs. This mechanism is called the Asymptotically Optimal Back-off (AOB), dynamically adapts the back-off window size to the current network contention level and guarantees that IEEE 802.11 WLAN asymptotically achieves the optimization for channel utilization.

Lin Dai, Member, IEEE, and Xinghua Sun [4] explained a unified analytical framework that is used to study the throughput, stability and

Fig. 2: Data transmission without RTS/CTS

delay performance, in homogeneous buffered Distributed Coordination Function (DCF).

Paal E. Engelstad [5] explained the analyses presented apply to the priority schemes of the Enhanced Distributed Channel Access (EDCA) mechanism of the IEEE 802.11e.

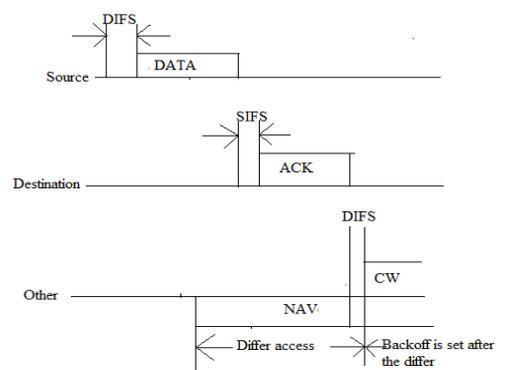
Hwangnam Kim [6] explained that envelop a model-based frame scheduling scheme, which is known as MFS, to increase the capacity of IEEE 802.11 standard, operated in wireless local area networks (WLANs) for both transmission control protocol (TCP) and user datagram protocol (UDP) traffic

Alberto Lopez Toledo [7] explained robust nonparametric detection mechanism for the CSMA/CA media access control layer denial-of-service attacks that does not require any modification to the existing protocols.

Abderrahim Benslimane [8] explained an analytical model to study the effect of jamming on WLANs. Hence, he implements a physical layer jamming to show the effect at the MAC layer level (i.e. cross-layer jamming).

Guobin Liu, Jiaqing Luo, Qingjun Xiao, Bin Xiao[9]

explained the existence of a unique Nash Equilibrium point that is based on Based an equilibrium analysis, they discuss the



condition under which a defense strategy will increase the utility of the network and a dynamic retransmission mechanism defense strategy is proposed accordingly

Rohit Negi, Arjunan Rajeswaran [10] explained Reservation based Medium Access Control (MAC) protocols such as the 802.11 Distributed Coordination Function (DCF), are designed to maximize efficiency, throughput by using small control packets.

Konstantinos Pelechrinis, Marios Iliofotou and Srikanth V. Krishnamurthy [11] explained a detailed up-to-date discussion on the jamming attacks recorded in the literature. They also explain various techniques proposed for detecting the presence of jammers.

Aravind Venkatarama, Cherita Corbettcherita, Raheem Beyah [12] presents an abstract methodology for detecting DCF parameter

manipulation as a whole. Further, we illustrate a new technique for cheating by disabling rate adaptation and detect this form of misbehavior as well.

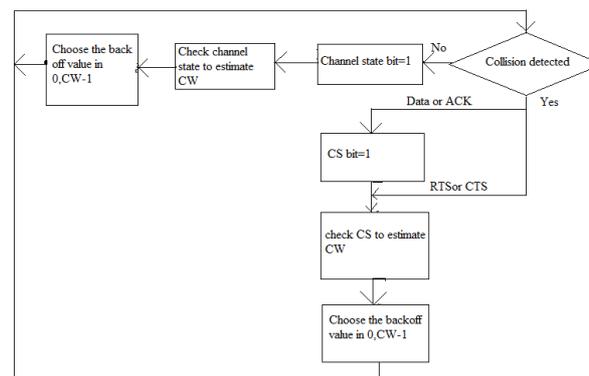
Byung Joon Oh and Chang Wen Chen [13] explained a cross-layer design for a reliable video transmission over wireless ad hoc networks based on multichannel MAC protocol with Time Division Multiple Access (TDMA) scheme. They studied of multichannel Medium Access Control Protocol (MAC) by Markov chain model. In this study there are two novel cross-layers are adopted for the design of multichannel MAC protocol.

Methodology

In this methodology, we have used contention window control phenomenon due to this call is not blocked permanently. Here we have eight states are used. We propose a novel back-off algorithm in which the loss of packet history take into account for optimization of contention window. The packet lost involves collision and channel error. The mechanism checks the last three states of transmission, and optimizes the CW size based on the following Table 1 (0 indicates a collision and 1 indicates a successful transmission without collision).

We utilize two parameters y and z , which use to update contention window size. We analyze the channel and if the packet lost rate increases because of channel error or collision, to remove this problem increases the contention window size due to which decreases the packet loss and if the packet lost rate of the channel is decreases we decrease the CW size slowly for increasing the throughput. The CS (Channel State) is three elements array that is updated every trial of transmission and every time station transmits the packet successfully and receive

Table 1: CW algorithm is used in HBC for estimation.



the acknowledgement (ACK for data and CTS for RTS packets) or when the packet becomes collide because of channel error or collision, store the new channel state, the oldest channel state in the CS array is removed and the remaining stored states are shifted to the left.

In the Table 1, we can see the contention window range according to the channel state. We find the contention window range minimum when we get the last transmission of the packet successful.

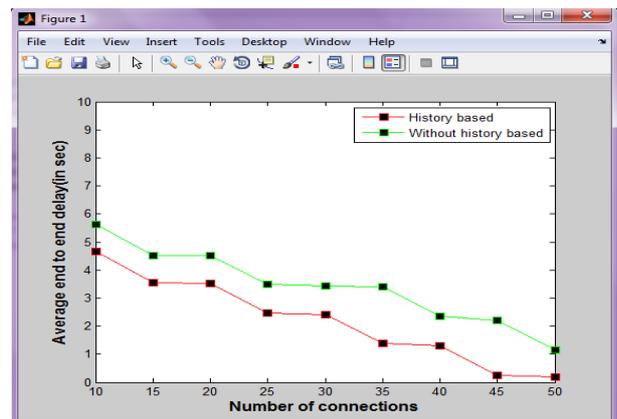
In the figure 3, there are showed the flow chart of HBCWC (History Based Contention Window Control) that has following operation .If the collision is detected then the Data or acknowledgement goes to Channel state bit and set to '0', in the next box we check the channel state for estimate the contention window and then choose the back-off value for contention window these process will be continuous until we do not get successful transmission. If there is no collision detected then again channel state bit =1, according to the bit of channel state we estimate the contention window size and then choose the back-off value in contention window. The HBCWC has the extra memory space for the channel state array that is used for saving the new variable and extra computational operation for select the window size. The station transmits a packet and if the packet lost occurs in data or ACK packet because of channel error or collision then the channel state (CS) bit will be set to '0' and the CS array is checked and new back-off value is chosen. Otherwise, if the packet lost occurs in RTS and CTS packet, only the CS array is checked and new back-off value is chosen. History Based Contention Window Control

Channel State (CS)	Contention Window (CW) range
000	$CW=CW*(y*z)$
001	$CW=CW_{min}$
010	$CW=CW*(y*z)$
011	$CW=CW_{min}$
100	$CW=CW*(y*z)$
101	$CW=CW_{min}$
110	$CW=CW*(y*z)$
111	$CW=CW_{min}$

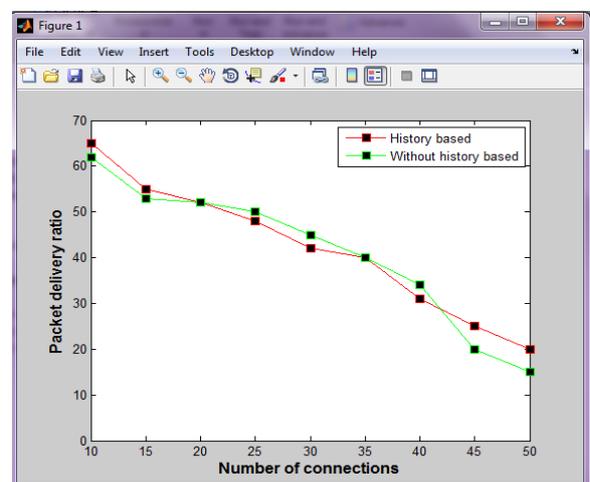
Simulation/Result

We implement proposed model at the MAT lab software version 8.1 and analyses the efficiency, Packet delivery ratio and mobility at different motion scale and compared with without taken the history concept. In this project we run the program minimum ten times for best result and taking average at different work stations for example as (10, 15, 20, 25, 30, 35, 40, 45, 50) and we get knowledge about the successful transmission, total transmission, total acknowledgement, total collisions, unreachable

methodology that is based upon the history



concept of node or we can say that we analyze the transmission of packet that is successful or not here we have used three channel state bits



and then the total combination of eight that is showed in the Table:1 .In this mechanism we have four variable as Contention Window, y, z and channel state.

Fig. 3: Operation of HBCWC

packets, unreachable acknowledgement, efficiency, estimate time.

There are following evaluating performance of our scheme as follows:

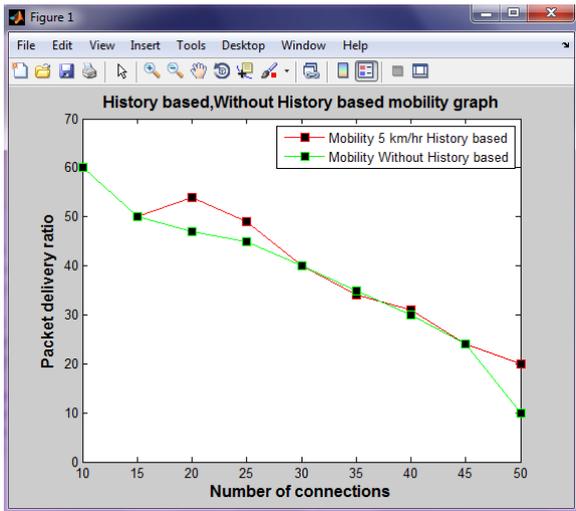
We set the value of following parameter:

Simulation time = 0.2sec.

Motion of random scale = 0 km/hr, 5 km/hr, 10 km/hr

Frame size=8184

Packet Delivery Ratio (PDR): The packet delivery ratio (PDR) which represents the ratio between the number of packets originated by



completely blocked after unsuccessful transmission.

Fig.4: Average end to end delay

the application layer source and packet received by the final destination.

Fig.5: Packet delivery ratio

Average end to end delay to receive the

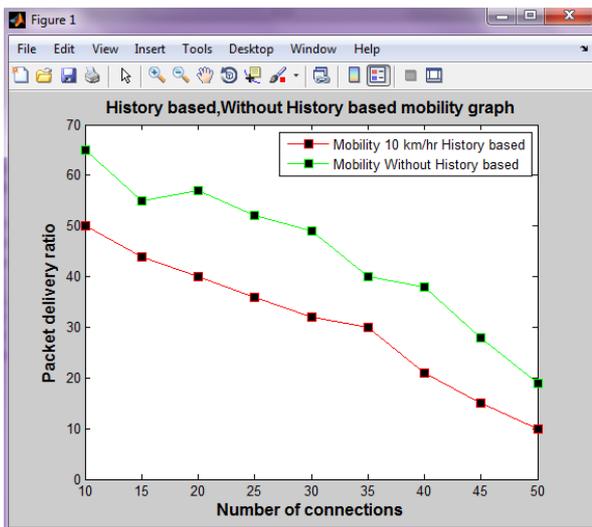


Fig.6 History without history based mobility graph at static node.

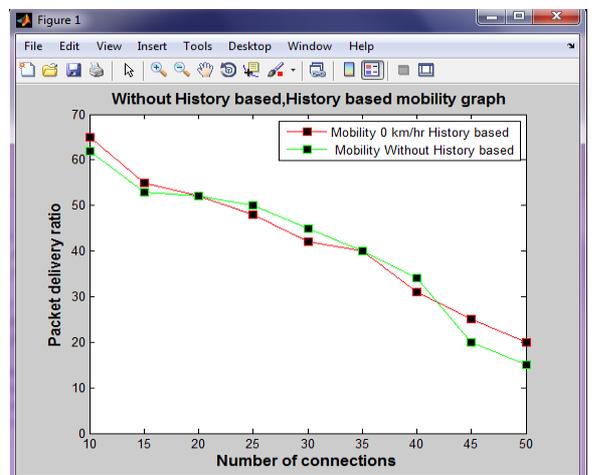
packet: The average end to end delay which calculates the average time required time to receive the packet.

Fig.7 History/without history based Graph 5 km/hr

Mobility at different motion scale: Here we have analyzed the mobility at different motion scale as static motion or we can say static node, 5km/hour and 10km/hour and compared the packet delivery ratio, average end to end delay with history concept and without history concept.

Fig.8 History/without history based Graph 10 km/hr

There are following result shown in the graph these propose the best result of packet delivery ratio, Average and to end delay, and mobility at different motion scale than the without history based concept because in this mechanism the call or transmission is



Conclusion

In this study, we proposed the novel back-off

algorithm to enhance the performance over error prone channel in ad-hoc network based upon IEEE 802.11 architecture. The basic idea that is used here that is History concept here we see the previous history of node or we can say how many times that node has successful or unsuccessful transmission. The basic concept that is used here history of node to and optimize the CW size based on that for combating channel error and obtaining better performances. Simulation results show that the HBCWC significantly improves the performances and reliability of the system compared with the IEEE 802.11 in terms of PDR, average end to end delay and throughput over error prone network.

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