Saturation throughput analysis for IEEE 802.11 WLANs using Fibonacci algorithms

K.NISHANTH RAO, G.KARTHIK REDDY, A. DEEPTHI

Abstract— Wireless communications is, one of the most effervescent areas in the communication field today. Wireless Local Area Network (WLAN) provides short-range wireless high-speed data connections, as users move from place to place. WLANs include IEEE 802.11a, IEEE 802.11b, IEEE 802.11g and IEEE 802.11n. IEEE 802.11b adopts an HR-DSSS modulation on the 2.4 GHz band, reaching a bit rate of 11 Mbit/s. In this paper we are discussed about IEEE802.11b, and here we have measured the saturation throughput analysis for IEEE802.11b protocol. Here we have compared the two different mechanisms i.e. one of its Basic access and RTS/CTS mechanisms and another one is Fibonacci algorithms.

Index Terms*— IEEE *802.11b, fragmentation, Fibonacci Algorithm

I. Introduction

IEEE 802.11 is the most popular standard used in Wireless Local Area Networks (WLANs). The IEEE 802.11 standard has defined two different access mechanisms in order to allow multiple users to access a common channel, the fundamental MAC technique is distributed coordination function (DCF) and a centrally controlled access mechanism called the point coordination function (PCF). CSMA/CA having binary exponential backoff (BEB) algorithm which is employed by (DCF). In this mechanism, when a station listens to the medium before beginning its own transmission and detects an existing transmission in progress, the listening station enters a suspension period determined by the binary exponential backoff algorithm. Retry Counter is appropriately incremented by DCF which is associated with the frame.

In this paper, we present a new backoff algorithm, referred to as Fibonacci Increment Backoff (FIB)" that can overcome the limitation of the existing MAC solutions in. In the FIB algorithm the difference between consecutive contention window sizes are reduced according to a Fibonacci sequence. Results from simulation experiments reveal that the proposed algorithm achieves higher throughput than the BEB when used in a mobile ad hoc environment. DCF describes two techniques to employ for packet transmission: the two-way handshaking technique called basic access mechanism and an optional four way handshaking technique, known as request-to-send/clear-to-send (RTS/CTS) mechanism. The basic access mechanism consists of two frames, a frame sent from the source to the destination and an acknowledgement from the destination that the frame was received correctly. If the source does not receive the acknowledgment, the source will attempt to transmit the frame again, according to the rules of the basic access mechanism. This happens when the destination did not send the acknowledgement due to errors in the original frame or due to the corruption of acknowledgement. This retransmission of frames by the source effectively increases the bandwidth consumption.

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II. FRAGMENTATION IN IEEE 802.11

The process of partitioning a MAC service data unit (MSDU) or a MAC management protocol data unit (MMPDU) into smaller MAC level frames, MAC protocol data units (MPDUs), is called fragmentation. Fragmentation creates MPDUs smaller than the original MSDU or reliability is increased in MMPDU length, by increasing the probability of successful transmission of the MSDU or MMPDU in cases where channel characteristics limit reception reliability for longer frames. Each immediate transmitter is accomplished by fragmentation. In defragmentation, recombining MPDUs process into a single MPDU or MMPDU. Each fragment is transmitted individually and acknowledged separately. Once a station has contended for the medium, it shall continue to send fragments with SIFS (short inter-frame space) gap between the acknowledgment (ACK) reception and the start of the subsequent fragment transmission until either all the fragments of a single MSDU have been sent, or an ACK frame is not received. If there is no acknowledgement, the failed fragment is retransmitted after a backoff procedure.

A. RTS/CTS with Fragmentation

The RTS/CTS frames define the duration of the following frame and acknowledgment. The Duration/ID field in the data and ACK frames specifies the total duration of the next fragment and acknowledgment. Each frame contains information that defines the duration of the next transmission. The duration information from RTS frames shall be used to update the Network Allocation Vector (NAV) to indicate busy until the end of ACK 0. The duration information from the CTS frame shall also be used to update the NAV to indicate busy until the end of ACK 0. The Fragment 0 and the ACK 0 shall contain duration information to update the NAV to indicate busy until the end of ACK 1. This shall be done by using the Duration/ID field in the Data and ACK frames. Last fragment is to be continued until it have a duration of one ACK time plus one SIFS time, and its ACK, which shall have its Duration/ID field set to zero. Each fragment and ACK acts as a virtual RTS and CTS; therefore no further RTS/CTS frames need to be generated after the RTS/CTS that began the frame exchange sequence even though subsequent fragments may be larger than a RTS Threshold. The node needs only to retransmit one small fragment is the major advantage of using fragmentation, so it is faster. Also the probability of error reduces if the frame is fragmented into small packets. In most applications fragmentation is used primarily to reduce the impact of interference and fading effects on performance

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B. FIBONACCI ALGORITHM

Most backoff algorithms suffer from the following shortcoming due to their inherent operations. Increasing the contention window in case of failure to transmit tends to rapidly increase large contention windows to even larger sizes. Reaching such large window sizes dangerously decrease the possibility of gaining access to the channel. Moreover, a large window size tends to contribute to increasing channel idle times, leading to a major waste the shared limited communication channel. By this above observation, we motivated to propose a new backoff algorithm to improve the performance of the backoff algorithm.

One of the most famous series in math is the Fibonacci series defined by the following rule F(n)=F(n-1)+F(n-2).F(0)=0,F(1)=1,n>=0. (1)

The Fibonacci series has a number of useful characteristics. Golden section is one specific property having a specific value closely related to the Fibonacci series. This value is obtained by taking the ratio of successive terms in the Fibonacci series.

III. THROUGHPUT ANALYSIS

The performance of the wireless Communication network can be evaluated in terms of QOS parameters like throughput, packet delay and packet delivery ratio, packet drop etc. Let S be the throughput of the normalized system, defined as the fraction of time the channel is used to successfully transmit the MAC frame.

Let n be the fixed number of contending stations and τ be the probability that a station transmits the packets. According to Bianchi, the probability τ that a station transmits in a randomly chosen slot time using fixed contention window.

The probability τ is that a station transmits a packet in a randomly chosen slot time. Since a station transmits when its back-off timer reaches the value of zero, τ can be found as

$$\tau = \frac{2.(1-2p).(1-p)}{w.\left(1-(2p)^{m+1}\right).(1-p)+(1-2p).\left(1-p^{m+1}\right)} \quad (2)$$

The probability τ isthat a station transmits a packet in a randomly chosen slot time. Then the constant contention window is

$$\tau = \frac{2}{w+1} \quad (3)$$

The transmission probability τ depends on the collision probability p. A collision of transmitted packet is encountered by probability p is the probability that at least one of the $n-1$ remaining stations transmit in the same time slot. If all station transmits with probability τ , the collision probability p is

$$p = 1-(1-\tau)^{n-1} \quad (4)$$

Equations (2) and (4) form a nonlinear system with two unknowns τ and p. This nonlinear system can be solved utilizing numerical methods and has a unique solution. Let p_{tr} be the probability that at least one station transmits a packet in the considered slot time. For contending n stations of a wireless LAN , p_{tr} is given by

$$p_{tr} = 1-(1-\tau)^{n} \quad (5)$$

The probability p_s is the successful packet transmission and it is given by the probability that exactly one station transmits and the remaining $n-1$ stations defer transmission, conditioned on the fact that at least one station transmits

$$p_s = \frac{n.\tau.(1-\tau)^{n-1}}{1-(1-\tau)^{n}} \quad (6)$$

Considering that a random slot is empty with probability$(1-p_{tr})$, contains a successful transmission with probability $p_s \cdot p_{tr}$ and a collision with probability $p_{tr}.(1-p_s)$,the saturation throughput S is given by

$$S = \frac{p_{tr} \cdot p_s .l}{(1-p_{tr})\sigma + p_{tr} \cdot p_s \cdot T_s + p_{tr} \cdot (1-p_s) T_c} \quad (7)$$

Where l is the length of the transmitted packet, σ the duration of an empty slot time, T_s and T_c is the average times that the medium is sensed busy due a successful transmission or a collision respectively. The values of T_s and T_c depend on the channel access mechanism and in the case of basic access,

$$Basic: \begin{Bmatrix} T_s^{bas} = PHY_{pre/hdr} + MAC_{hdr} + L + SIFS + ACK + DIFS \\ T_c^{bas} = PHY_{pre/hdr} + MAC_{hdr} + L + DIFS \end{Bmatrix}$$

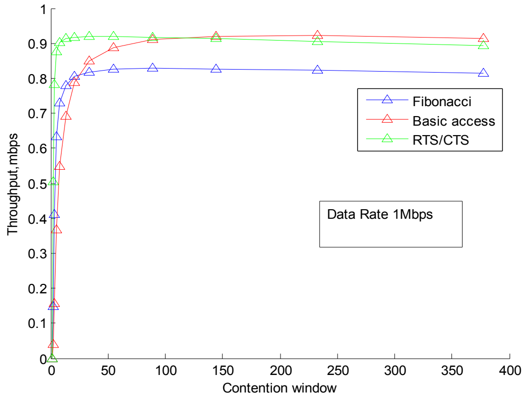
$$RTS/CTS: \begin{Bmatrix} T_s^{rts/cts} = RTS + SIFS + CTS + SIFS + PHY_{pre/hdr} + \\ MAC_{hdr} + L + SIFS + ACK + DIFS \\ T_c^{rts/cts} = RTS + DIFS \end{Bmatrix}$$

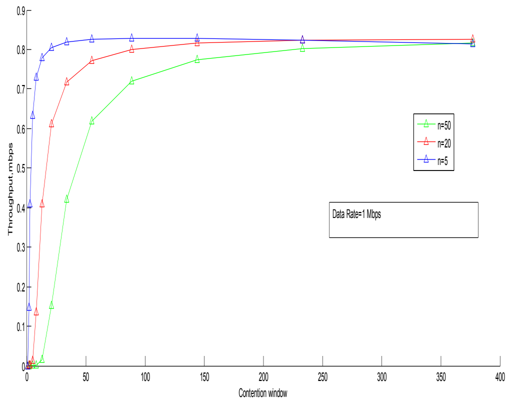
Where $H = MAC_{hdr} + PHY_{hdr}$ is the packet header

IV. SIMULATION RESULTS

As shown in the below figures, depicts that we are analyzed the saturation throughput for IEEE 802.11 WLANs for using the different mechanisms. In this paper we are using the Basic access, RTS/CTS mechanisms and Fibonacci algorithms.

The figure 1 shows the contention window vs. saturation throughput for 1Mbps data rate. In this we are analyzed the two different mechanisms for opting the better saturation throughput. And figure 2 also we are analyzed the saturation throughput but, using various number of nodes.





V. CONCLUSION

In this paper we have analyzed that for opting the better saturation throughput for the IEEE802.11WLANs for using various mechanisms. And using the same mechanisms we can also calculate the various data rates. And using similar mechanisms we can also analyzed the packet delay analysis.

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