Jordi Dalmau Royo
Go Hasegawa (Eds.)

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Management of Multimedia Networks and Services

8th International Conference on Management of Multimedia Networks and Services, MMNS 2005
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Preface

We are delighted to present the proceedings of the *8th IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS 2005).*

The MMNS 2005 conference was held in Barcelona, Spain on October 24–26, 2005. As in previous years, the conference brought together an international audience of researchers and scientists from industry and academia who are researching and developing state-of-the-art management systems, while creating a public venue for results dissemination and intellectual collaboration.

This year marked a challenging chapter in the advancement of management systems for the wider management research community, with the growing complexities of the "so-called" multimedia over Internet, the proliferation of alternative wireless networks (WLL, WiFi and WiMAX) and 3G mobile services, intelligent and high-speed networks , scalable multimedia services , and the convergence of computing and communications for data, voice and video delivery. Contributions from the research community met this challenge with 65 paper submissions; 33 high-quality papers were subsequently selected to form the MMNS 2005 technical program. The diverse topics in this year's program included wireless networking technologies, wireless network applications, quality of services, multimedia, Web applications, overlay network management, and bandwidth management.

The conference chairs would first like to thank all those authors who contributed to an outstanding MMNS 2005 technical program, second the Program Committee and Organizing Committee chairs for their support throughout the development of the program and conference, third the worldwide experts who assisted in a rigorous review process, and fourth the sponsors, Universitat Politecnica de Catalunya, IFIP and IEEE, without whose support we would not have had such a professional conference. Last and certainly not least, we express sincere thanks to the company sponsors who were instrumental in helping to ensure a top-quality MMNS 2005.

We truly feel that this year's proceedings mark another significant point in the development of MMNS as a primary venue for the advancement of network and service management, and also novel architectures and designs in technology and network services, to enable multimedia proliferation.

October 2005 Jordi Dalmau and Go Hasegawa

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A New Performance Parameter for IEEE 802.11 DCF*

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Abstract. In this paper, we define a new performance parameter, named *PPT*, for 802.11 DCF, which binds successful transmission probability and saturation throughput together. An expression of optimal minimum contention windows (CW_{min}) is obtained analytically for maximizing PPT. For simplicity, we give a name DCF-PPT to the 802.11 DCF that sets its CW_{min} according this expression. The simulation results indicate that, compared to 802.11 DCF, DCF-PPT can significantly increase the PPT and successful transmission probability (about 0.95) in condition that the saturation throughput is not decreased.

1 Introduction

Much research has been conducted on the performance of IEEE802.11 DCF[1]. In [2] and [3], the author gave a Markov chain model for the backoff procedure of 802.11 DCF and studied its saturation throughout. Haitao Wu *et al.* [4] considered the maximum retransmit count and improved the model given in [3]. In [5], the authors evaluated the performance of 802.11 DCF in terms of the spatial reuse. Wang C. et al. [6] proposed a new efficient collision resolution mechanism to reduce the collision probability. In [7], an enhancement for DCF is proposed to augment the saturation throughput by adaptively adjusting the contention window.

Although saturation throughput is an important performance parameter for 802.11 DCF because enhancing saturation throughput can utilizes the channel more efficiently, increasing the successful transmission probability is also important for 802.11 DCF. In this paper, we define a novel performance parameter, named Product of successful transmission Probability and saturation Throughput (PPT), for 802.11 DCF. The analysis is given to maximize PPT.

The rest of this paper is organized as follows: In section 2, we define PPT, and analyze how to maximize PPT. In section 3, the performance of DCF-PPT is simulated with different stations on terms of saturation throughput, successful transmission probability and PPT. We conclude this paper in section 4.

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2 PPT: Defining and Maximizing

Before defining PPT, we give the same definition of saturation throughput as in [3] as follows:

Definition 1: The saturation throughput of 802.11 DCF, *S*, is the limit throughput reached by the system as the offered load increase, which represent the maximum throughput in system's stable condition.

Definition 2: The system's stable condition is the condition on which the transmission queue of each station is nonempty.

We define the successful transmission probability as follows:

Definition 3: The successful transmission probability *P* is the probability that a given transmission occurring on a slot is successful.

Based on Definition 1 and Definition 3, we define PPT as follows:

Definition 4: The PPT is the product of successful transmission probability and saturation throughput, that is

$$PPT = S \times P \tag{1}$$

The definition of PPT binds saturation throughput and successful transmission probability together. Maximizing PPT can increases the saturation throughput while keeping high successful transmission probability, which is illustrated in the following.

In [3], the author gave a two-dimensional Markov chain $\{b(t),s(t)\}$ to analyze the performance of 802.11 DCF, and obtained the saturation throughput *S* as follows:

$$S = \frac{P_s \cdot P_{tr} \cdot E[P]}{(1-P_{tr})\cdot \sigma + P_{tr} \cdot P_s \cdot T_s + P_{tr}(1-P_s)\cdot T_c} \tag{2}$$

where, $E[P]$ is the average packet payload size, T_s is the average time the channel is sensed busy because of a successful transmission, T_c is the average time the channel is sensed busy during a collision, σ is the duration of an empty slot time, P_{tr} is the probability that there is at least one transmission in the considered slot time, P_s is the probability that a transmission occurring on the channel is successful, and

$$P_{tr} = 1-(1-\tau)^n \tag{3}$$

$$P_s = \frac{n\tau \cdot (1-\tau)^{n-1}}{1-(1-\tau)^n} \tag{4}$$

where, τ is the probability that a station transmits in a randomly chosen slot, which can be expressed as follows[3]:

$$\tau = \frac{2\cdot(1-2p)}{(1-2p)\cdot(w+1)+p\cdot w\cdot\left(1-(2p)^m\right)} \tag{5}$$

where, w is the contention windows, m is the maximum backoff stage, p is the probability that a transmitted packet encounters a collision, which is expressed as

$$p = 1 - (1 - \tau)^{n-1} \tag{6}$$

Note that in definition 3, P is the probability that a given transmission occurring on a slot is successful, and a given transmission occurring on a slot is successful if and only if the *n-1* remaining stations don't transmit in the same slot, so it is easy to obtain that

$$P = (1 - \tau)^{n-1} \tag{7}$$

Plugging expression (2) and (7) into (1), we obtain

$$PPT = \frac{P_s \cdot P_{tr} \cdot E[P]}{(1 - P_{tr}) \cdot \sigma + P_{tr} \cdot P_s \cdot T_s + P_{tr}(1 - P_s) \cdot T_c} \cdot (1 - \tau)^{n-1} \tag{8}$$

Given the expression of (3) and (4), (8) can be rewritten as:

$$PPT = \frac{n\tau \cdot (1-\tau)^{n-1} \cdot E[P]}{(1-\tau)^n \cdot \sigma + n\tau \cdot (1-\tau)^{n-1} \cdot T_s + \left[1 - (1 - \tau + n\tau) \cdot (1-\tau)^{n-1}\right] \cdot T_c} \cdot (1-\tau)^{n-1} \tag{9}$$

Expressions (2) and (7) denote that S and P are the function of τ, but the curves of S vs. τ and P vs. τ, which are shown in Fig. 1, are very different. Maximizing S does not means maximizing P simultaneously. However, maximizing *PPT* can obtain high S and P simultaneously because PPT is their product.

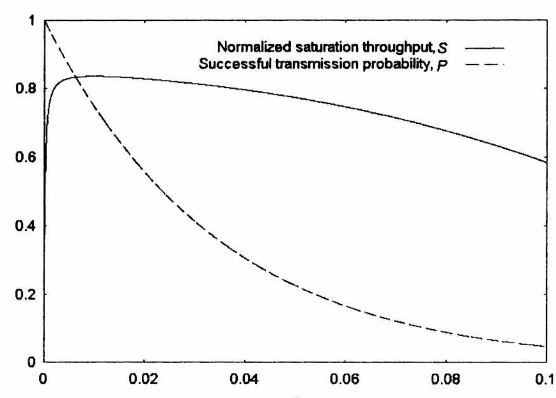

Fig. 1. S vs. τ, P vs. τ, $0 \le \tau \le 0.1$, n=30

Fig.2 indicates that *PPT* has a maximum value. We will deduce the optimal τ in the following.

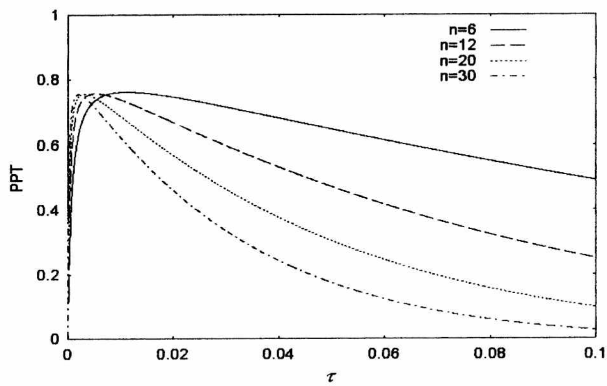

Fig. 2. *PPT* vs. τ, $0 \le \tau \le 0.1$

Taking the derivative of (1) with respect to τ, and imposing it equal to 0, we obtain the following equation:

$$\frac{d(PPT)}{d\tau} = \frac{d(S \cdot P)}{d\tau} = \frac{dS}{d\tau} \cdot P + \frac{dP}{d\tau} \cdot S = 0 \tag{10}$$

Note that

$$S = \frac{n\tau \cdot (1-\tau)^{n-1} \cdot E[P]}{(1-\tau)^n \cdot \sigma + n\tau \cdot (1-\tau)^{n-1} \cdot T_s + \left[1-(1-\tau+n\tau)\cdot(1-\tau)^{n-1}\right] \cdot T_c} \tag{11}$$

Taking the derivative of S with respect to τ, and making some simplification, we obtain

$$\frac{dS}{d\tau} = \frac{\left[n \cdot (1-\tau)^{n-1} - n\tau(n-1)\cdot(1-\tau)^{n-2}\right] \cdot f(\tau) - n\tau \cdot n \cdot (1-\tau)^{n-1} \cdot f'(\tau)}{f^2(\tau)} \cdot E[P] \tag{12}$$

where,

$$f(\tau) = (1-\tau)^n \cdot \sigma + n\tau \cdot (1-\tau)^{n-1} \cdot T_s + \left[1-(1-\tau+n\tau)\cdot(1-\tau)^{n-1}\right] \cdot T_c \tag{13}$$

$$f'(\tau) = -n(1-\tau)^{n-1}\sigma + (n-n^2\tau)\cdot(1-\tau)^{n-2} T_s + n\tau \cdot (n-1)\cdot(1-\tau)^{n-2} T_c \tag{14}$$

Taking the derivative of P with respect to τ, we obtain

$$\frac{dP}{d\tau} = -(n-1)\cdot(1-\tau)^{n-2} \tag{15}$$

Plugging expression (12) and (15) into (10), and making some simplification, we obtain

$$(1+\tau-2n\tau)\cdot f(\tau) - \tau \cdot (1-\tau) \cdot f'(\tau) = 0 \tag{16}$$