Performance Analysis of a Modified SDP in the Unsaturated Condition in the P-persistent IEEE 802.11 Network

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ABSTRACT

In the unsaturated situation that each node does not always have frames to be transmitted, we estimate the efficiency of the protocol which is called the Simple Dynamic IEEE 802.11 Protocol, shortly say SDP and show that it does not operate well contrary to the saturated siatuation that all nodes always have frames. In addition, according to loads and smoothing factors that maintain the current situation, its performances are changed i.e. the SDP with a smaller smoothing factor uses the channel more efficiently in the underload situation, but in the overload situation the result is reversed. To solve the problem we propose a method that is suitable for practice and improves to use the channel more efficiently regardless of the network configuration and load. Our results show that the proposed protocol uses the channel more efficiently than the SDP and its efficiency in the use of a channel is close to or is lower slightly than the most efficiency in the use of a channel.

INTRODUCTION

In WLANs the design of the medium access control (MAC) protocol is one of main issues because it determines the efficiency in sharing a limited wireless channel. Although the standard IEEE 802.11 protocol [7] gives a good method to use a limited channel efficiently, it does not always operate efficiently for various network and load configurations. There have been many research efforts, e.g., [1], [2], [3], [4] and [6] in the MAC protocol to improve the efficiency in the use of a wireless channel.

However, since the research works that are introduced previously to improve the capacity has been carried on the only saturation situation, we are not sure whether the proposed protocol operate well or not. In this study, we show that the protocol suggested in [1] does not operate well in an unsaturated situation in contrast with a saturated situation. In addition, studying the performance and features in the unsaturated situation, we propose improved method that is similar to [1] ,but is more suitable in practice. Our results show that the proposed protocol uses the channel more efficiently than the SDP and its efficiency in the use of a channel is close to or is lower slightly than the most efficiency in the use of a channel.

SIMULATION RESULTS

For the unsaturated situation, we assume that each node has just one buffer and each node can generate a frame with probability r if it has no frame at the end of each slot. Furthermore, if a

node transmits a frame successfully, then the node generates a frame at the end of DIFS with probability r. As a performance measure, we use the channel utilization in our unsaturated situation, which is defined by the fraction of the channel bandwidth used by successfully transmitted frames.

On the above unsaturated situation, we experiment the efficiency of the SDP and the modified SDP which we propose. The SDP does not operate well in the unsaturated condition. Moreover, we show that the channel utilization is in tradeoff with the different smoothing-factor α and the offered load. While the protocol with smaller smoothing-factor $\alpha = 0.5$ operates well in the underload condition than the others, the other with lager $\alpha = 0.9$ or 0.99 operates better in the overload condition. We also show that the performance of the modified SDP is close to or is higher than those of the SDPs with $\alpha = 0.5$, 0.9 and 0.99, and also is close to or is lower slightly than the maximum performance of p-persistent 802.11 protocol.

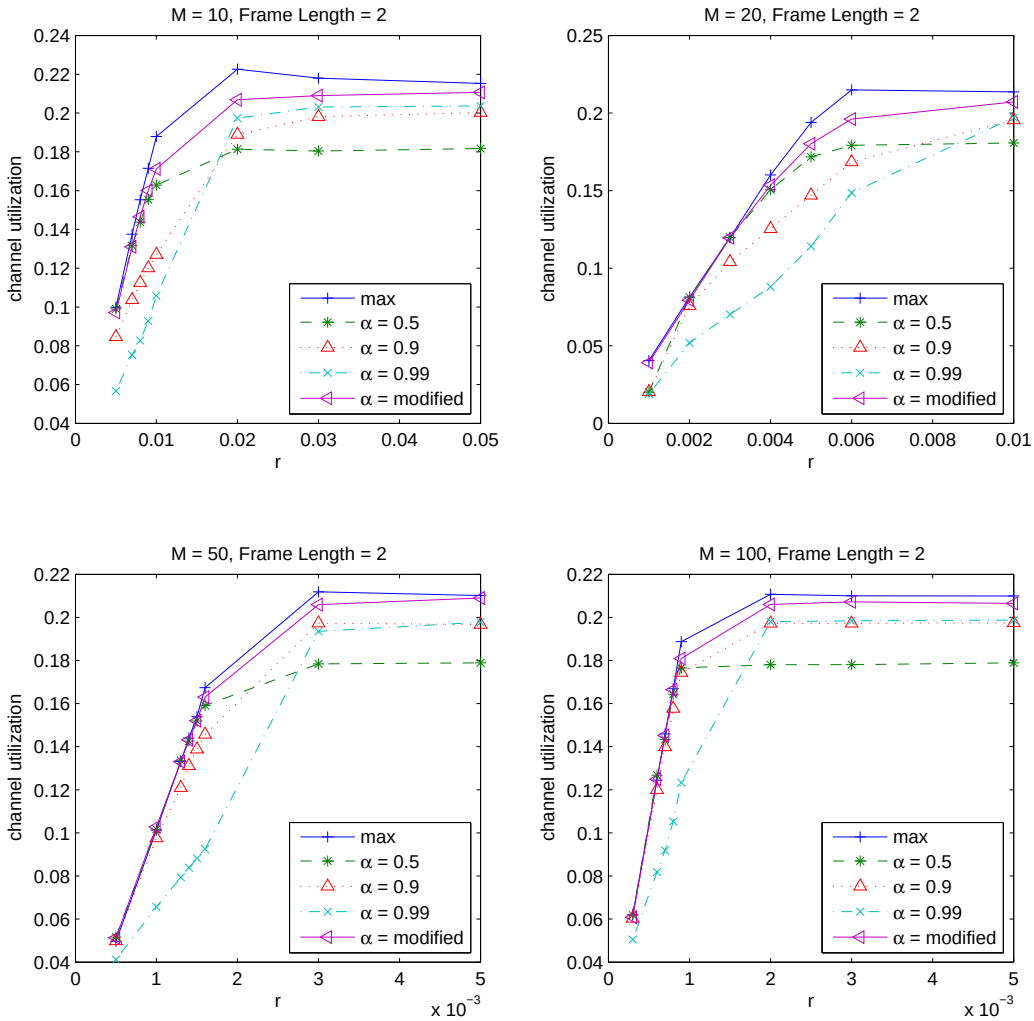

Figure 1. Channel utilization for various α when frame length = 2

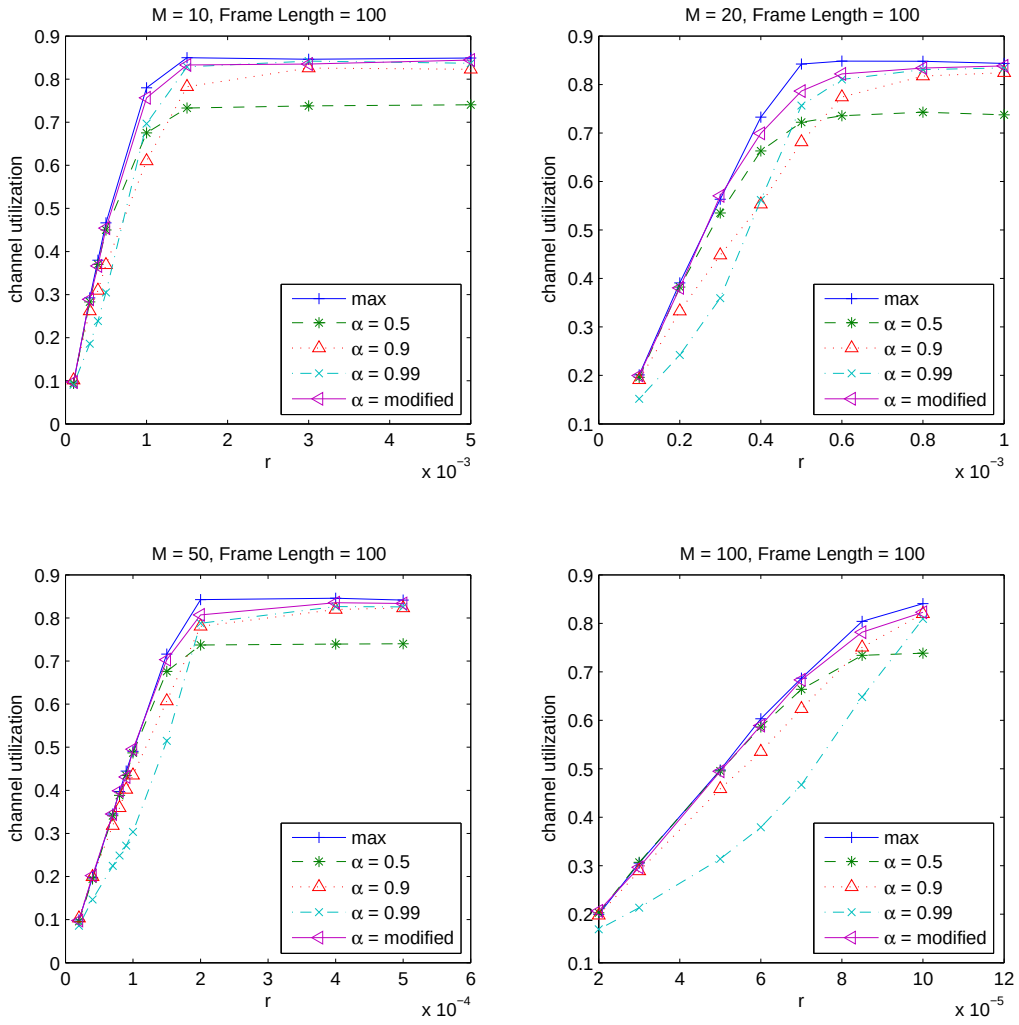

Figure 2. Channel utilization for various α when frame length = 100

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