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Full Usage of Remaining Payload for Short Packets in the Wireless Packet Networks

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Abstract

We propose a novel transmission scheme suitable for short packet transmission over wireless channels. The proposed scheme is characterized by two schemes: 1) multicopy transmission per transmission payload and 2) multiple fragmented packet (referred to as minipacket) transmission. The multicopy transmission is to mitigate the transmission inefficiency of short packets and improve the decoding probability at the receiver. On the other hand, the minipacket transmission is to avoid the retransmission of correctly received symbols. By implementing the proposed scheme into the traditional IEEE 802.11b WLAN system, simulation results show the improved system throughput and reduced packet transmission time.

I. Introduction

Many wireless applications, such as short message service (SMS), instant messaging (IM) and so on, which are running on the wireless platforms, generate very short packets [2], [3]. The transmission of the short packets yields two critical problems: 1) any transmission accompanies a large transmission overhead and 2) due to the high error rate of wireless channels, the packet retransmission amplifies the transmission overhead and increases redundant transmission of correctly received symbols, which is termed as 'redundant retransmission.' Hence the transmission of such short packets reduces the total system throughput and in turn increases the overall packet delay [1], [5], [6].

In the commonly used wireless systems, such as, WLAN, WPAN or mobile internet, packet-based transmission scheme is used [7]–[9]. In these systems, the packet length can be very short so that the occupied part of a payload is very small, where the short packet transmission is accompanied with a large transmission overhead. In addition to the large overhead, any retransmission seriously degrades the system performance.

A few research results to optimize the short packet transmission can be found. In [5], [6], the multicopy transmission scheme was adopted to be used over noisy wireless channels so that the retransmission overhead can be reduced. As the combined packet of multicopy packets shows the improved SNR, the multicopy scheme reduces the retransmission count of a packet and round trip time (RTT). For the wired communication, copied transmission over a redundant path was proposed in [4]. On the other hand, the effects of packet length were inspected in [1], [6], where the retransmission count was also reduced.

In this paper, we deal with the problems of short packet transmission in the wireless packet-based systems, specially focusing on the reduction of the overheads. To reduce the transmission overhead, we use multicopy transmission of the short packet within the remained space of a payload so that the payload can be fully utilized, which in turn alleviates the transmission inefficiency. Another merit of the proposed multicopy transmission is that the expectant retransmission is transmitted with the original packet in advance, while the conventional retransmission scheme is still active. Another proposed scheme is to divide the short packet and construct many short packets (minipackets), which are included simultaneously-and-multiply into a single payload. Then, only the erroneous minipackets are requested to be retransmitted at the receiver so that the retransmission of correctly received symbols can be effectively avoided.

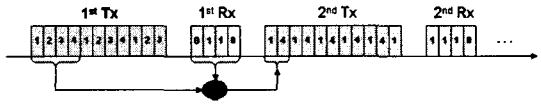

Fig. 1. Packet transmission procedure: Only payload part of the packets are described. Multicopy of the multiple minipackets are transmitted in a single payload and ACK/NACKs are received in the response bitmap. The next transmission packet consists of only the NACKed minipackets.

This paper is organized as follows. The proposed transmission scheme of short packets is described in Section II. Then we design the transmission parameters of the proposed scheme for the AWGN channel in Section III. Section IV shows the performance of the proposed scheme and conclusion remarks are followed in Section V.

II. System Description

Let us consider a new transmission scheme to avoid both the overhead and retransmission as shown in Fig. 1.

We assume that the transmission packets are very short compared with the payload length so that multiple copies of it can be accommodated in the payload. And the short packets are fragmented into smaller minipackets as described in Fig. 2, where the length of each minipacket is the same. The