A New Transmission Scheme Using Minipackets in Wireless Packet Communications

Yeong-Hyeon Kwon, Mi-Kyung Oh, and Dong-Jo Park

Abstract—**A segmented packet retransmission scheme is proposed to reduce the length of retransmission packets, which gives throughput enhancement and short packet delivery latency. In our scheme, the only erroneous segments will be retransmitted, which are detected by the cyclic redundancy check (CRC). The optimization method for the proposed scheme is discussed by considering the wireless channels. Moreover, for the real implementation, we also proposed an adaptive search method for the optimal number of minipackets. Employing the proposed scheme, the simulations for the coded/uncoded transmission shows the benefits of the proposed scheme.**

I. Introduction

In the harsh wireless communications, the packet retransmission is often required for the link level reliability (LLR), which results in throughput degradation. The throughput degradation comes from mainly the packet overheads, e.g., preamble for synchronization, packet header, packet guard time, and so on [6]. However, these factors are physical parameters, which are fixed at the protocol design time and not controllable during the real wireless transmission. The candidates for the controllable parameters are the length of payload, the channel coding rate in Hybrid ARQ (HARQ), adaptive modulation scheme and so on [1], [2], [3], [4], [7]. The optimizations of them are well reported in literatures and will not be considered here [].

On the other hand, we can find another degradation factor, the redundant retransmission of the correctly received information (RRCI), which is not considered in literatures. This phenomenon always happens when a data packet is retransmitted, because a received packet contains both the correctly received part and erroneous part. We note that if only the erroneous part can be retransmitted, the throughput will be very good. In this letter, we propose a transmission scheme which can reduce the RRCI.

The proposed scheme loads several small packets on a payload, where the small packets have their own cyclic redundancy checks (CRCs). We term this small packet as '*minipacket*' because several minipackets reside in a transmission packet. Due to the CRC, each minipacket can be identified if it is correct or not, which results in the retransmission of only the erroneous minipackets. In the following sections, we describe the construction of the transmission packets, the protocol of the minipacket transmission, and the optimization method.

II. Minipacket Transmission Scheme

The proposed minipacket transmission scheme is shown in Fig. 1. As we can see in Fig. 1, the payload of the proposed scheme has N_m minipackets, while the conventional

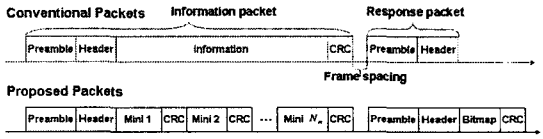

Fig. 1. Minipacket based transmission scheme compared with the single payload segment

packet transmission employs only one payload segment. For the construction of the proposed transmission packets, we first fragment the information packet into smaller segments and attach the CRC to each small segment, which results in minipacket. Assuming the maximum length of the payload to be L_p and the length of CRC N_{CRC}, then the lengths of minipackets L_m's are determined as following:

$$\begin{aligned} L_p^h &= L_p/2, \quad L_Q = \lfloor L_p^h/N_m \rfloor, \\ L_R &= L_p^h - L_Q N_m, \\ L_m(i) &= \begin{cases} 2(L_Q+1), & i = 1,\ldots,L_R \\ 2L_Q, & i = L_R+1,\ldots,N_m \end{cases}, \end{aligned} \tag{1}$$

where $\lfloor x \rfloor$ is the maximum integer less than x and the information length of each minipacket is given by $L_m(i) - N_{CRC}$.

Then, the minipackets are grouped into the payload of a transmission packet as many as possible. The reason for the grouping is that any information transmission accompanies the transmission overhead and if the space of payload is not fully utilized by the transmission protocol, the throughput will be severely degraded due to the overhead. Because the information packets have N_m minipackets in the payload, the response from the receiver should include all the information for these minipackets. These response can be easily constructed as bitmap in the response payload, where 0 indicates failure of the corresponding minipacket and 1 success. At the reception of the response, the transmitter make a new transmission packet with the retransmission minipackets and new minipackets according to the bitmap information. Note that when the kth minipacket is successfully delivered, then the length of the new minipacket should be $L_m(k)$.

III. Protocol Description

When a packet is transmitted through wireless channel, the packet frequently becomes unrecognizable, due to collision or severe channel state, and partially corrupted, due to random noise or channel jamming interference. Including these situations, the transmission sequence of the proposed minipacket scheme is shown in Fig. 2 when $N_m = 4$.