

Channel-aware Link Layer Protocol for Energy-Efficient Communication

Priyadarshi Mukherjee, Swades De
Department of Electrical Engineering
Indian Institute of Technology Delhi, New Delhi, India

Abstract—In this work, we propose a dynamic window link-layer protocol. The proposed protocol is based on the temporal correlation present in channel in order to provide energy-efficient communication.

Index Terms—Fading channel, temporal correlation, energy-aware communication, dynamic window protocol

I. INTRODUCTION

Energy efficiency is a key factor in the context of wide-spread IoT technology deployment. In this context, there has been some studies [1]–[4] in channel-adaptive communication strategies. But these approaches fail to fully exploit the channel knowledge on increasing the energy efficiency in link-layer communications. Motivated by this lacuna, we investigate the usage of temporal variation of the wireless channel and propose accordingly a generalized channel-aware link layer communication strategy that just depends on the rate of temporal variation of the channel and not on its underlying fading distribution. Considering this channel state variation knowledge, we decide on the transmission and waiting windows in link-layer transmission.

II. PROTOCOL DESCRIPTION

We consider link-layer communication between a IoT wireless node pair in mobile environment. Depending on the received signal quality, the receiver (Rx) sends ACK/NAK to the transmitter (Tx). A NAK/ACK is sent if the received signal envelope X_0 is below/above a threshold X_{th} . The channel is considered to be in ‘good’ state if $X_0 \geq X_{th}$, and bad otherwise. Rx also sends the useful channel information in the NAK/ACK packet.

Based on the temporal correlation present in channel, we propose an analytical model for calculating the probability of signal strength staying above/below a given X_{th} over a given time duration. Accordingly we estimate the time over which the channel will continue to remain above/below X_{th} , given that it is currently above/below X_{th} . With these interval estimates, we propose a channel-aware dynamic window size based link-layer protocol. It may be noted that ACK/NAK feedback consumes energy. Hence the proposed protocol aims at reducing the frequency of these feedback packets, which is eventually reflected in terms of higher energy efficiency in comparison to its nearest competitor.

However, the performance gain is at the cost of some small amount of extra overhead in terms of extra bits in

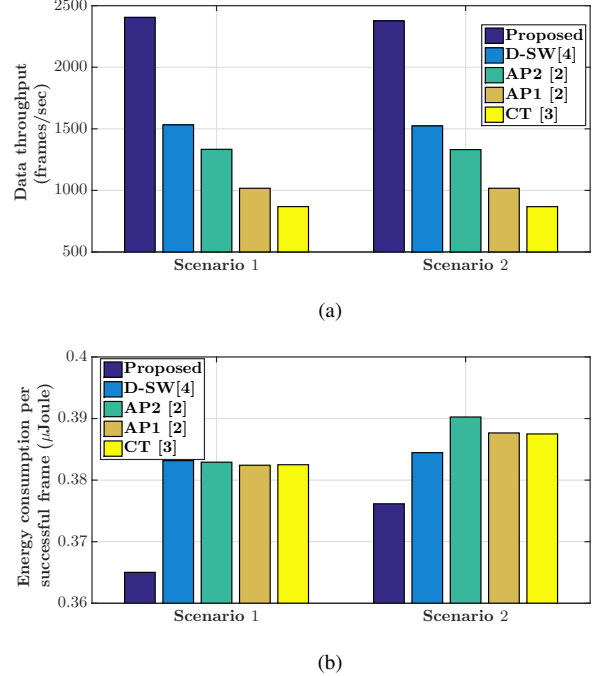


Fig. 1. Performance comparison: (a) Data throughput and (b) Energy consumption per successful frame.

the ACK/NAK packets conveying the current channel state information.

III. PERFORMANCE EVALUATION

Performance is evaluated in terms of data throughput and energy consumption per successful frame (cf. Fig. 1). Two test scenarios are considered, where we observe that the proposed protocol outperforms its nearest existing competitor by a significant margin.

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