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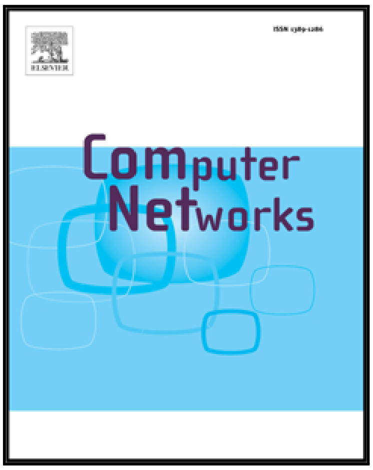

Efficient Interference-Aware Power Control for Wireless Networks

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Efficient Interference-Aware Power Control for Wireless Networks

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***Abstract*—Interference management through power control in wireless networks has both the hidden terminal problem which induces transmission collisions, and the exposed terminal problem which blocks concurrent transmissions. Both problems are caused by the varied interference range of different links. Through observing that the nodes adopt the power control mechanism induce collisions in one scenario and miss concurrent transmission opportunities in two scenarios, this paper presents IAPC (Interference-Aware Power Control), a novel protocol to improve the network throughput from the three aspects. IAPC makes the interference range of each link covered by its CTS (Clear-To-Send) transmission through utilizing a signature detection process, so as to avoid interference. Meanwhile, it makes the CTS frame carry the transmission and reception power information of this link, according to which the neighboring node can determine a limited transmission power, trying to make itself outside the interference range of the ongoing link, so as to exploit concurrent transmissions. The signature detection range has been investigated through both experiment results and theoretical analysis, and the performance improvement of IAPC comparing with the other protocols has been shown through simulation results based on ns2.**

***Index Terms*—Keywords: Power control; Interference; Wireless Networks**

I. Introduction

With the increased density of wireless nodes and the explosive growth of data traffic, throughput improvement becomes a key issue in wireless networks and has attracted much research interest. Power control is a well-known green method to improve the network throughput through adjusting the transmission power to an optimal value to decrease the interference range, so as to reduce transmission collisions and increase concurrent transmissions, and meanwhile decrease the energy consumption. The current power control mechanism is based on the four-way handshake mechanism in the 802.11 standard [1], which uses the exchange of the RTS (Request-To-Send) and CTS (Clear-To-Send) frames to reserve medium for the data packet transmission, and uses the ACK (ACKnowledgement) frame to indicate a successful reception of the data packet. The RTS and CTS frames have a NAV field which defines the duration of the data packet transmission, all the neighboring nodes which receive the RTS or CTS should keep silent in this NAV duration to avoid interference. The basic power control mechanism [2] lets RTS and CTS transmitted at the maximum power P_{tMAX}, while data and ACK transmitted at a required minimum data transmission power P_{tDATA}, which just makes the received data packet's SINR (Signal to Interference plus Noise Ratio) above a threshold β_{SINR}. This mechanism suffers from serious hidden terminal and exposed terminal problems, which degrade the network throughput dramatically.

Many works have been proposed to improve the network throughput under the power control mechanism [3]–[9]. Some researchers propose to optimize the power control mechanism through reducing interferences, such as periodically increasing the transmission power within one data packet transmission to avoid interference [3], increasing the transmission power in the retransmission state to guarantee the data reception [4], predicting collisions and preventing them [5], increasing the transmission power of CTS to make its transmission range larger than d_{IR} [6], increasing the data transmission power to shorten the interference range and avoid interference [7]. All these schemes cannot exploit concurrent transmissions to improve the network throughput. Some other researchers propose to optimize power control to increase concurrent transmissions, such as utilizing the information exchange in the ATIM window of PSM (Power Saving Mode) to find non-interfering links [8], optimizing the transmission power to both avoid interference and enable concurrencies [9]. However, these schemes still block some effective data transmissions.

In this paper, we observe that the basic power control mechanism induces transmission collisions in one scenario and misses concurrent transmissions in two scenarios, due to the varied interference range caused by the adjustment of the transmission power. We then propose IAPC (Interference-Aware Power Control), a novel protocol to improve the network throughput from these aspects. IAPC makes the interference range of each link covered by its CTS transmission through utilizing a signature detection process in the physical layer, so as to enlarge the CTS transmission range to avoid interference. It also makes the CTS frame carry the transmission and reception power information of this link, according to which the neigh-

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