Block-based Bitrate Control for Wireless Networks*

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ABSTRACT

In this poster, we present BlockRate, a wireless bitrate adaptation algorithm designed for *blocks*, or large contiguous units of transmitted data, as opposed to small packets. In contrast to state-of-the-art algorithms that can either have the amortization benefits of blocks or high responsiveness to underlying channel conditions of packets, BlockRate has both. Our evaluation shows that BlockRate achieves up to 1.4× and 2.8× improvement in goodput under indoor and outdoor mobility respectively.

1. MOTIVATION

Our work is motivated by the growing disparity between state-of-the-art bitrate control algorithms that are optimized to react on a per-packet basis and technology trends that suggest significant performance benefits to amortizing overhead across blocks. For example, Li et al [1] demonstrate significant gains in reliable goodput using blocks by reducing the overhead of acknowledgments, timeouts and backoffs compared to per-packet TCP. Widely deployed commodity 802.11n cards already enable large opportunities of uninterrupted transmission consisting of many packets. However, state-of-the-art bitrate control algorithms continue to be designed with per-packet adaptation in mind. If used as-is with blocks, these algorithms are prone to be unresponsive to underlying channel changes as large blocks imply a commensurately large delay in obtaining feedback about channel quality. This disparity raises the following question that forms the focus of our work. Can we design a bitrate control algorithm that leverages the performance benefits of blocks without compromising on the responsiveness of bitrate control?

2. BlockRate DESIGN

Our main contribution, the design and implementation of BlockRate, a block-based bitrate control algorithm, answers the question in the affirmative. The key insight in BlockRate is to use multiple bitrates across packets within a block that are predictive of future channel conditions. BlockRate uses a history-trained SNR-to-bitrate mapping in conjunction with its predictive models for predicting the future SNR to pick (possibly different) bitrates for packets in the next block.

BlockRate uses two simple predictive models to predict the SNR experienced by packets in the near future. The first is a *linear regression model* invoked in slow-changing environments such as in static or pedestrian mobility scenarios. It uses the historic time series of SNR values to predict the future SNR. The second is a *path loss model* invoked in fast-changing scenarios such as under vehicular mobility. It uses the historic SNR values in conjunction with its knowledge of the distance to the receiver to predict the future SNR.

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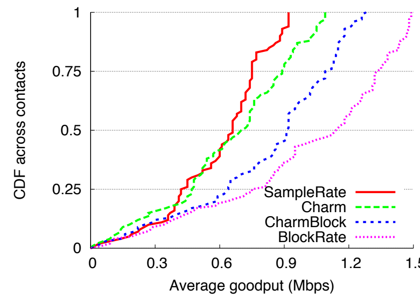

Figure 1: CDF of goodput in the vehicle tesbed.

3. RESULTS

We implemented a prototype of BlockRate in the MadWiFi driver and deployed it on an indoor mesh testbed and an outdoor vehicular testbed. Figure 1 shows the CDF of the goodput across all vehicular-to-vehicular contacts in the vehicular testbed for four algorithms, SampleRate, Charm, CharmBlock and BlockRate. SampleRate and Charm are packet-based bitrate algorithms. CharmBlock is a straightforward adaptation of Charm to blocks and it assumes that all packets in a block have the same predicted SNR and thus are transmitted at the same bitrate. We observe that BlockRate achieves a median goodput improvement of 1.25× over CharmBlock and 1.62× over SampleRate and Charm. The result shows that BlockRate has the amortization benefits of blocks (as compared to SampleRate and Charm) while still being responsive to channel changes (as compared to CharmBlock). A thorough evaluation of BlockRate is in [3].

4. CURRENT WORK

BlockRate's current block size is three times larger than TCP's default window size. Hence our current effort is focused on adapting BlockRate to make it work under the packet-based transport layer TCP. Recent works [4, 2] have shown the benefits of using PHY layer information to adapt the bitrate. We are also planing to evaluate the added benefit of using this information in BlockRate.

5. REFERENCES

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