Copa: Practical Delay-Based Congestion Control for the Internet

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ABSTRACT

Congestion control schemes that are commonly deployed today are loss-based and were developed in the 2000s. The internet has changed dramatically since then, and these schemes are no longer suitable. This has prompted new research interest in this area, ranging from complex machine learning and optimization techniques [1, 2, 3, 4] to exploring usage of hitherto under-explored ack-arrival rate as signals [5, 6, 7]. It has long been recognized that delay-based congestion control overcomes many challenges that loss-based schemes face [8, 9]. However they have challenges of their own that have precluded their deployment. In this work, we identify and solve some of these challenges to create Copa, a practical delay-based congestion control algorithm for the Internet.

Copa solves three challenges. (1) It periodically empties the queue to accurately measure the minimum (base) RTT, (2) it proposes a simple estimator for queuing delay that is robust to noise in RTT measurements, (3) it introduces "TCP-mode switching": normally Copa maintains low delays, but typically delay-sensitive schemes get low throughput when a buffer-filling flow shares the bottleneck. To solve this problem, when Copa detects a non-Copa flow, such as a buffer-filling TCP, it switches to a TCP-competitive mode to get its fair share of the bandwidth.

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CCS CONCEPTS

• **Networks** → **Transport protocols**;

KEYWORDS

Congestion Control; Transport.