

ISMCC: Enhancing Goodput in WANs through In-Network Caching and Multipath Coordination

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Abstract—In modern wide-area networks (WANs), the surge of AI-driven traffic, the intensified traffic burstiness, and the difficulty of long-distance loss recovery collectively impose significant stress on data transmission. Although in-network storage and per-packet multipath transmission have become feasible solutions, existing approaches primarily optimize network-level metrics while insufficiently considering end-to-end performance. When packets of the same flow traverse multiple paths or caching nodes, they easily arrive out-of-order at the receiver and severely degrade end-to-end goodput. To address this challenge, we propose ISMCC, a network-layer per-packet congestion control method that jointly optimizes in-network caching and multipath transmission. ISMCC employs a per-interface cache system to absorb excessive traffic and handle varying levels of out-of-order packets. It effectively allocates available bandwidth among multiple next hops based on traffic states. Backpressure signal is utilized to coordinate in-network cache systems and the transport-layer hosts. Evaluation results show that ISMCC significantly reduces out-of-order packets and improves end-to-end goodput over existing network-layer multipath schemes, enabling finer-grained of network resource allocation.

Keyword—In-network caching, multipath, congestion control, out-of-order, WANs.



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