Prioritized Dispersal: Improving Network Performance through Selective Exploitation of Redundancy

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Abstract

Many networks exhibit topological redundancy, and its judicious exploitation for performance enhancements is a challenging problem, particularly in the absence of full knowledge of system state. One approach, redundant traffic dispersal, entails replicating each message or partitioning it into several "data" packets and generating several "redundant" ones; all are then sent over different paths to the destination. As a result, loss or excessive delay in some of the paths can be tolerated, but the extra load caused by the redundant traffic may reduce overall performance. To address this problem, we propose to exploit the data redundancy selectively. We present and analyze novel "prioritized dispersal" schemes, whereby "redundant" packets receive lower priority than the "data" ones. Moreover, the use of non-FCFS queueing policies for the redundant packets leads to the timely arrival of at least a fraction of them even under heavy load. Queuing-theoretic analysis shows the new schemes to substantially outperform non-prioritized ones in terms of both the blocking probability and that of delay exceeding a specified limit. One possible use of prioritized dispersal, which is discussed in this paper, is to improve the quality of service for best-effort traffic in ATM networks with multiple paths between nodes. Another is in conjunction with ad hoc path trunking. Additional likely uses include parallel access to mirrored data sites and reliable multicast.