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T-preemptive priority queue and its application to the analysis of an opportunistic spectrum access in cognitive radio networks.

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Summary: We propose a new priority discipline called the T-preemptive priority discipline. Under this discipline, during the service of a customer, at every T time units the server periodically reviews the queue states of each class with different queue-review processing times. If the server finds any customers with higher priorities than the customer being serviced during the queue-review process, then the service of the customer being serviced is preempted and the service for customers with higher priorities is started immediately. We derive the waiting-time distributions of each class in the M/G/1 priority queue with multiple classes of customers under the proposed T-preemptive priority discipline. We also present lower and upper bounds on the offered loads and the mean waiting time of each class, which hold regardless of the arrival processes and service-time distributions of lower-class customers. To demonstrate the utility of the T-preemptive priority queueing model, we take as an example an opportunistic spectrum access in cognitive radio networks, where one primary (licensed) user and multiple (unlicensed) users with distinct priorities can share a communication channel. We analyze the queueing delays of the primary and secondary users in the proposed opportunistic spectrum access model, and present numerical results of the queueing analysis.

Keywords: priority queues; T-preemptive priority discipline; periodic queue review; opportunistic spectrum access; cognitive radio network
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