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A Matrix Analytic Solution of a Finite Buffer Queue with PH Distributed Customers' Impatience*

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Abstract. We study a multiserver finite buffer queue in which customers have a stochastic deadline of phase-type until the beginning of their service. The following service disciplines are considered: *FCFS* (First-Come First-Served), *LCFS* (Last-Come First-Served) and *SIRO* (Service In Random Order) along with a parameterizable probabilistic push-out mechanism. The analysis of the system is performed using a matrix analytic approach and we obtain performance measures such as probabilities of blocking, expulsion and abandonment as well as the sojourn time distribution in different system conditions.
Keywords: impatient customers, service discipline, phase-type, matrix-analytic.

1 Introduction

Queuing models in which customers abandon the system if their service has not started by a given deadline have many applications in telecommunications as well as in other disciplines (some examples can be found in [1]).

While this topic has attracted the interest of queuing theorists for a few decades, the existing literature is rather limited (see [2] and references therein). To the best of our knowledge, infinite buffer size is assumed in all queuing models considering the impatience phenomenon, except [3] and [4]. Moreover, in [3] only the relatively simple case of exponentially distributed patience time is contemplated.

Intuition seems to indicate that the service order may have an influence on the number of customers that leave the system without being served. Indeed, in [5] the authors give a characterization of the optimal scheduling discipline that minimizes the number of customers that abandon the system before receiving service, and there are some instances where the optimal policy is not the conventional *FCFS*. Zhao and Alfa [6] consider a system in which impatient customers are served on an *LCFS* basis. The analysis in [6] is approximate and the patience time is assumed to be deterministic. Doshi and Heffes [7] study a model quite related to ours, where customers may "turn bad" after some time although they do not abandon the system, i.e. bad customers are served even though

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