Computer Networking and Performance Evaluation
T. Hasegawa, H. Takagi, Y. Takahashi (editors)
Elsevier Science Publishers B.V. (North-Holland)

Multiqueue Systems with Finite Capacity and Nonexhaustive Cyclic Service

Phuoc TRAN-GIA
Thomas RAITH

Institute of Communications Switching and Data Technics
University of Stuttgart
Federal Republic of Germany

The class of multiqueue systems with cyclic service has a broad spectrum of applications, e.g. in modelling approaches for switching systems, token ring local area networks, etc.. This paper presents an approximate analysis method for this class of models, whereby the realistic assumption of finite queue capacity is taken into account. The analysis is based on an imbedded Markov chain approach in conjunction with a two-moment approximation for the cycle time. The validation of the approximation is done by means of computer simulations. A number of numerical results are shown in order to illustrate the accuracy of the calculation method, over a wide range of system parameters.

1. INTRODUCTION

In performance investigations of communications systems, especially switching systems with distributed control structure or token-ring local area networks, the class of multiqueue systems with cyclic service is often employed, belonging to which diverse polling mechanisms are considered. Most of these modelling approaches consider queues with infinite capacities, where several approximation techniques for the system analysis are proposed.

In the literature, multiqueue systems served by a single server have been the subject of numerous investigations [1-14]. Various polling mechanisms like cyclic or priority order and several service disciplines, e.g. exhaustive, nonexhaustive or gating are considered. Some of these studies take into account the switchover time, i.e. the time spent by the server to switch over from one queue to the succeeding one. In most of the investigations the queues are assumed as of infinite capacity and the model is analysed by means of the imbedded Markov chain technique [1,2,3,4,5,8].

An approximative solution for symmetrically loaded systems with cyclic polling, constant switchover time and gating service was presented by Leibowitz [7]. Cooper and Murray [1,2] have considered a cyclic polling system with gating or exhaustive service and zero switchover time using an imbedded Markov chain. The case of two queues with general switchover time was treated by Eisenberg [3]. Results of Cooper and Murray are generalized by Eisenberg [4] and Hashida [5] to non-zero switchover time. An approximation technique for cyclic queues with nonexhaustive service and general switchover time has been developed by Kuehn [8]. This method has been extended in [9] for performance investigations of hierarchical polling systems with feedback. In most of investigations for a larger number of queues computational difficulties arise in the numerical evaluation of the mean delay. A simple approximation approach for the mean delay in cyclic queuing systems with exhaustive service was presented by Bux and Truong [11]. Further investigations of some specific cyclic queueing systems was performed by Manfield [12] for systems with two-way traffic and priority cyclic service and by Morris and Wang [15] for multiqueue systems with multiple cyclic servers. An exact solu-