LOW-PRIORITY QUEUE FLUCTUATIONS IN TANDEM OF QUEUING SYSTEMS UNDER CYCLIC CONTROL WITH PROLONGATIONS

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Abstract

A tandem of queuing systems is considered. Each system has a high-priority input flow and a low-priority input flow which are conflicting. In the first system, the customers are serviced in the class of cyclic algorithms. The serviced high-priority customers are transferred from the first system to the second one with random delays and become the high-priority input flow of the second system. In the second system, customers are serviced in the class of cyclic algorithms with prolongations. Low-priority customers are serviced when their number exceeds a threshold. A mathematical model is constructed in form of a multidimensional denumerable discrete-time Markov chain. The recurrent relations for partial probability generating functions for the low-priority queue in the second system are found.

Keywords: tandem of controlling queuing systems, cyclic algorithm with prolongations, conflict flows, multidimensional denumerable discrete-time Markov chain

1. Introduction

Conflict traffic flows control at a crossroad is one of the classical problem of queuing theory. The problem has been solved for different classes of algorithms: the class of algorithms with a cyclic fixed rhythm, with renewals (”with a loop”) with dynamic priorities, etc. However, several (two in our case) consecutive crossroads are of great interest, because in a real life after car passed one highway intersection it finds itself at another one. In other words, output flow of the first intersection forms input flow of the second intersection. Hence, the second input flow no longer has simple probabilistic structure known a priori (for example, non-ordinary Poison process) and knowledge about service algorithm should be taken into account to deduce formation properties of the flows.

1.1. Subsection heading here. Subsection text here. Maximum level of depth allowed for defining sections is 2.

2. Submitted paper

The full source text using $\TeX$ as well as all auxiliary materials, namely,

- .tex file,
- pictures in .pdf (or .eps) format (if available),
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have to be submitted as a zip-archive.

The name of the archive should be **Surname1_Surname2_Surname3.zip**.

3. Font

Type the text of the paper in 10 points, regular. Each paragraph is to be indented 5 mm, and their intervals must be 0 points before and after.

4. Mathematical formulae and references

To make references to mathematical expressions, it is recommended to use LaTeX mechanism. For example, the formula given below

$$P(n,t) = \frac{\partial^n B(t)}{\partial t^n} \tag{1}$$

can be referred as (1).

5. Theorems and proofs

Theorems are defined like follows

Theorem 1. *Text of the theorem.*

Proof. Proof of Theorem 1. If using such reference, you need to recompile your paper with LaTeX twice. ■

6. Figures and tables

Figures should be provided in PDF or EPS format. Raster pictures have to be made with maximal resolution (minimal 300 dots per inch).

Parameter	T	E	Δ, %	Parameter	T	E	Δ, %
$\rho_1^{(1)}$	0,187	0,194	3,7	$\rho_1^{(2)}$	0,127	0,120	5,6
$\rho_2^{(1)}$	0,073	0,072	1,4	$\rho_2^{(2)}$	0,052	0,053	1,9
$\rho_3^{(1)}$	0,148	0,147	0,7	$\rho_3^{(2)}$	0,103	0,103	0,0
$\rho_4^{(1)}$	0,036	0,036	0,0	$\rho_4^{(2)}$	0,026	0,027	3,7
$C^{(1)}$	0,479	0,476	0,6	$C^{(2)}$	0,656	0,640	2,5
C_1^*	0,341	0,339	0,6	C_3^*	0,323	0,329	1,8
C_2^*	0,296	0,298	0,7	C_4^*	0,286	0,286	0,0

Table 1: Comparison of system parameters.

The figures and tables must be numbered, have a self-contained caption and referred in the main text. Figure and table captions are placed below the object and

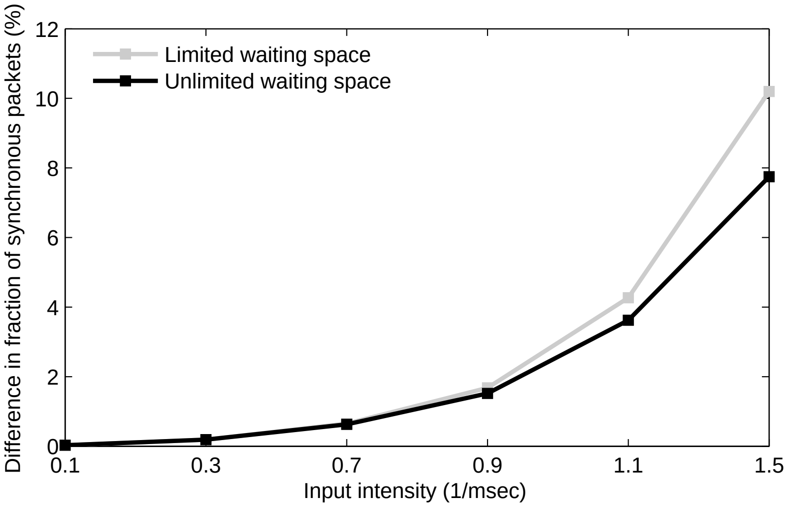

Figure 1: Difference in fractions of synchronous packets for $W = 16$.

centered. Also, avoid placing figures and tables before their first mention in the text. Use the abbreviation "Fig." even at the beginning of a sentence.

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7. Conclusion

Place a full list of references [1, 2, 3, 4, 5] at the end of the paper. List the references according to the order of their appearance in the text.

REFERENCES

1. Bianchi G. Performance Analysis of the IEEE 802.11 Distributed Coordination Function // IEEE Journal on Selected Areas in Communications. 2000. V. 18. P. 535-547.
2. Vishnevsky V. M., Lyakhov A. I. IEEE 802.11 Wireless LAN: Saturation Throughput Analysis with Seizing Effect Consideration // Cluster Computing. 2002. V. 5. P. 133-144.
3. Neuts M. F. Structured Stochastic Matrices of M/G/1 Type and Their Applications. Marcel Dekker, New York, 1989.
4. Schriber T. J. Simulation using GPSS. John Wiley & Sons, 1974.

5. National Center for Biotechnology Information, http://www.ncbi.nlm.nih.gov