

QUEUEING NETWORKS WITH “TRANSPARENT” CALLS

V.V. RYKOV (E-mail: vladimir_rykov@mail.ru)
Russian State University of Oil & Gas,
Institute for Information Transmission Problems RAS

01. 04. 2007

In some applications of queueing networks the situations arise when all calls of the same type can be served simultaneously as only one of them. One of the main applications of these types models is the queueing networks with the multipoint connection protocols [1], which are used in TV-broadcasting, video-on-demand, some types of teleconferencing etc.

Analogous service principles are probably realized in neuron networks, where an impulse caused by some irritant is delivered to all executive for it organs simultaneously, being each kind of irritant during the whole neuron fibre occupies some specific for it resource without duplicate for each executive organ.

Traditional approach to analysis of a complex telecommunication networks is based on their modelling with the help of stochastic networks (SN) and reversible Markov processes (see for example [2]—[4]), which permit to obtain the steady state probabilities in product form.

The reversibility approach is not applicable directly for stochastic network with general service time distributions because of absence of the theory of reversible processes with general state space. In this case the product form for the steady state distribution is usually obtained by the phase method approach (together with above mentioned see also [5], [6] and the reference therein). This approach consists in approximation of any distribution by the mixture of convolutions of the exponential ones and the fact that these mixtures are dense in the class of all probability distributions on $[0, \infty)$. But the weak convergence arguments, necessary for strong argumentation of these statements, are proved only for the case of finite state space [7].

An alternative approach to proving of product form for stochastic networks with general service time distributions was proposed in [8] – [13]. This approach is based on direct investigation of Markov process with additional variables, which is described the stochastic network under consideration.

In [14], [15] the model of networks with transparent calls was proposed under assumption, which allows to consider it as a reversible Markov process. In the paper [16] this model was generalized for the case of general service times with the help of approach, proposed in [12], [13]. It is shown that the product form also takes place in this case. The formulas for different types of blocking probabilities was presented. In the talk this model is considered jointly with algorithms for some performance characteristics calculation.

References

- [1] C. Diot et al. Multipoint communication: a survey of protocols, functions and mechanisms. IEEE Journal on Selected Areas of Communications, 1997, NO. 15 (3), pp. 227-290.
- [2] F.P. Kelly. *Reversibility and stochastic network*. Wiley, Chichester, 1979.
- [3] K.W. Ross. *Multyservice loss models for broadband telecommunication networks*. Springer-Verlag, Lnd, 1995
- [4] R. Serfozo. *Introduction to stochastic networks*. Springer-Verlag, N.-Y., 1999
- [5] R. Shassberger. Insensitivity of steady state distributions of generalized semi-Markov processes with speeds. *Adv. in appl. prob.* 10 (1978), No. 4, pp. 836-851.
- [6] R. Shassberger. The insensitivity of stationary probabilities in networks of queues. *Adv. in appl. prob.* 10 (1978), No. 4, pp. 906-912.
- [7] A. Hordijk, R. Shassberger. Weak convergence theorems for generalised semi-Markov processes. *Technical Report*. Dept of Math. and Stat. Univ. of Calgary. 1977
- [8] A.L. Tolmachev. Queueing networks with regenerative trajectories of jobs. *Problems of information transmission*, 22 (1986), No. 2, pp. 59-68.
- [9] V.V Rykov On decomposition of hierarchical computer communication networks. In: *Distributed Computer Communication Networks. Theory and Applications*. Proceedings of the International Conference, November, 4 – 8, 1996, Tel-Aviv (Israel). IITP RAS, Moscow, 1996, pp. 77 - 85.
- [10] V.V. Rykov. Two approach to decomposition of complex hierarhical systems. Continuously interacting systems. *Autom. and Remote Control*, 1997, No. 10, pp. 91-104.
- [11] V.V. Rykov. Two approach to decomposition of complex hierarhical systems. Agregative systems. *Autom. and Remote Control*, 1997, No. 12, pp. 140-149.
- [12] A.V. Pechinkin, V.V. Rykov. Product form for open queueing networks with dependent service times. In: *Proceedings of the International Conference “Distributed Computer Communication Networks. Theory and Applications (DCCN-97)”*. Institute for Information Transmision Problems RAS, Moscow. 1997, pp. 171-178.
- [13] A.V. Pechinkin, V.V. Rykov. On decomposition of closed networks with dependent service mechanizm. *Autom. and Remote Control*, 1999, no. 11, pp. 58–68.
- [14] V.V. Rykov, K.E. Samouylov. Product form solution for stochastic model of dynamic multicast connectiions. In: *Proceedings of The Internzional conference on Distributed Computer Communication Networks (DCCN-99)*, November 9-13, 1999, Tel-Aviv (Israel), IITP RAS, Moscow, 1999, pp. 152-160.
- [15] V.V. Rykov, K.E. Samouylov. On blocking probabilities for networks with dynamic multipoint connections. *Elektrosvyaz'*, No. 10 (2000).
- [16] V.V. Rykov. Queueing networks for ”transparent” calls. *Autom. and Remote Control*. V. 62 (2001), No. 5, pp. 809-819. (In Russian)
- [17] G.P. Klimov. *Stochastic service systems*. Nauka, Moscow, 1966,243p. (In Russian)