On Transient and Stationary Regime for Multichannel Networks With Periodical Input

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Abstract

Queueing models are an efficient tool for analytical modelling of information networks, cellular communication networks, economic models (logistics, insurance, etc.) and in home automation that has caught the attention of the media and researchers not long ago. This is particularly important at the stage of networks design when it is necessary to obtain estimates of basic network performance measures. Models of general form are extremely difficult to study and their exact calculations usually can not be realized. It leads to the need to simplify the models and to develop different methods for their study. Many of stochastic networks can be described in terms of queueing theory with parameters depending on time. Moreover, in practice it would appear reasonable that input flow dependence on time is periodical dependence.

The main model in question is a stochastic network consisting of r service nodes. From the outside a periodic non-homogeneous Poisson flow of calls $\nu_i(t)$ with the leading function $\Lambda(t)$ arrives to the network. A call arrived to the network is directed to i-th node with probability p_{0i}, $i = 1, 2, \ldots, r$. Each of the "r" nodes operates as a multi-channel stochastic system. If a call arrives at such a system then its service immediately begins. Service time in the i-th node is exponentially distributed with parameter μ_i, $i = 1, 2, \ldots, r$. After the completion of service in the i -th node the call arrives to the j-th node with probability p_{ij} and leaves the network with probability $p_{ir+1} = 1 - \sum_{j=1}^{r} p_{ij}$. Let us denote $P = \|p_{ij}\|_1^r$ as a switching matrix of the network. An additional node numbered "$r + 1$" is interpreted as "output" from the network.

We will define the service process in the network as an r-dimensional process $Q(t) = (Q_1(t), ..., Q_r(t))'$, where $Q_i(t)$ is the number of calls in the i-th node at the moment of time t. In the work we study the transitional and stationary regime for such a network. A special form of Jackson's law is obtained.

References

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