A FUNCTIONAL CENTRAL LIMIT THEOREM FOR A MODULATED NETWORK OF INFINITE-SERVER QUEUES

H.M. Jansen, Ghent University, Belgium, h.m.jansen@telin.ugent.be
M.R.H. Mandjes, University of Amsterdam, The Netherlands, m.r.h.mandjes@uva.nl
K. De Turck, École CentraleSupélec, France, koen.deturck@supelec.fr
S. Wittevrongel, Ghent University, Belgium, sw@telin.ugent.be

We consider a network of infinite-server queues. Its distinguishing feature is the presence of a continuous-time Markov chain (called the background process) that modulates all queues in the network. This means that the arrival rate, the service requirement, and the server speed of each queue depend on the state of the background process. This process may be interpreted as an independently evolving random environment to which all parts of the network react. We are interested in the behavior of the network in this environment under a central limit-type scaling. In particular, we would like to know how the background process influences scaling limits of the network. To this end, we introduce a linear scaling of the arrival rate together with a sublinear, linear or superlinear speedup of the time-scale of the background process. Under each of these scalings, we derive a functional central limit theorem for the number of jobs in the system. We show how the background process influences the behavior of the network and we indicate how we may use the limit results to solve control problems.