MANY-SERVER HEAVY-TRAFFIC LIMITS FOR QUEUEING NETWORKS WITH TIME-VARYING PARAMETERS AND PROBABILISTIC ROUTING

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We establish a many-server heavy-traffic *functional weak law of large numbers* (FWLLN) and *functional central limit theorem* (FCLT) for the $(G_t/M/s_t + GI)^m/M_t$ queueing network with time-varying parameters (e.g., arrival rates and staffing functions), non-exponential distributions and Markovian routing structure. The analysis is based upon the assumption that all queues of the network alternate between underloaded and overloaded, and are never critically loaded except at isolated switching points. The extension of the FWLLN and FCLT from single-queue $G_t/M/s_t+GI$ models to network models draws heavily on careful treatments to the total arrival processes of the network model, namely, the processes consisting external arrivals and internal feedback flows. The established FCLT limits, i.e., the diffusion processes, are characterized by multi-dimensional Brownian *stochastic differential equations* (SDE's) that are analytically tractable. Useful variance formulas are developed for the purpose of engineering approximation. Besides mathematical proofs, we provide concrete computer simulation experiments as an engineering proof for correctness of these theoretical formulae.