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Transmission Times in Buffered Full–Crossbar Communication Networks with Cyclic Arbitration

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Abstract In this paper we consider the distribution of message transmission times in full crossbar interconnection networks with cyclic arbitration. The transmitting devices generate messages which are placed in independent FIFO buffers. The arbitration then works by servicing the buffers in a cyclic, or "round robin" fashion. The system is modelled as an open queueing network in which the queues appear at the network outputs. These queues are no longer FCFS queues since the scheduling discipline must take into account the cyclic nature of the arbitration mechanism: arriving messages sometimes jump the queue. We derive a recurrence equation for the Laplace transform of the density function of the transmission time through the system, conditional on the number of entries ahead of an arriving message, after that message has been placed in the queue. From this we obtain

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a generating function which yields the unconditional Laplace transform in a steady–state system, using the marginal equilibrium queue length probabilities. The density function is then enumerated by numerical inversion and compared with similar results from a simulation model. This analysis (which assumes exponential service times) is then extended to general service times by modeling each output as a LCFS queue with a suitably reduced arrival rate. In the special case of exponential service times, this model is less flexible than the previous one since it only works in the case where the jump probability is fixed. In this case, however, it is shown to produce the same result as the original model.