In this work, the achievable rate of three-node relay systems with selection relaying under statistical delay constraints, imposed on the limitations of the maximum end-to-end delay violation probabilities, is investigated. It is assumed that there are queues of infinite size at both the source and relay node, and the source can select the relay or destination for data reception. Given selection relaying policy, the effective bandwidth of the arrival processes of the queue at the relay is derived. Then, the maximum constant arrival rate can be identified as the maximum effective capacity as a function of the statistical end-to-end queueing delay constraints, signal-to-noise ratios (SNR) at the source and relay, the fading distributions of the links, and the relay policy. Subsequently, a relay policy that incorporates the statistical delay constraints is proposed. It is shown that the proposed relay policy can achieve better performance than existing protocols. Moreover, it is demonstrated that buffering relay model can still help improve the throughput of relay systems in the presence of statistical delay constraints and source-destination link.