Quality of Service Guarantee for Storage Systems

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The ultimate vision of storage virtualization technology enables construction of multiple virtual disks, each with a distinct combination of capacity, latency and bandwidth requirements, to be multiplexed on a physical disk storage system with complete performance isolation. In this talk, I will present design and implementation techniques that solve the availability guarantee and fairness assurance problems involved in such storage virtualization systems.

We first show that a measurement-based admission control algorithm can reduce the effective resource requirement of a virtual disk with availability guarantee by accurately estimating its resource needs without prior knowledge of its input workload characteristics. Moreover, to accurately factor disk access overhead into real-time disk request scheduling algorithm, we propose a virtual disk switching overhead extraction and distribution algorithm that can derive the intrinsic disk access overhead associated with each virtual disk so as to achieve perfect performance isolation. Finally, we develop an adaptive server time leap-forward algorithm to effectively address the short-term unfairness problem of virtual clock-based disk scheduler, the only known proportional-share scheduler that is based on wall-clock time and thus enables disk utilization efficiency optimization while delivering disk QoS guarantees.