

### **1. mClock: Handling Throughput Variability for Hypervisor IO Scheduling**

(1) mClock is proportional-share fairness I/O allocation algorithm for several VMs. Storage I/O allocation is difficult because storage workload characteristics are variable and must adjust allocation dynamically. mClock can allocate storage I/O using these three key ideas; Real-time tags, separate tags for reservation, shares & limit, and dynamic tag selection and synchronization. Eventually, mClock supports reservation, limit and shares in one place and handles variable I/O performance seen by hypervisor. Also, mClock can be used for other resources such as CPU, memory and network I/O allocation as well.

(2)

(+): mClock is good at proportional I/O scheduling for several VMs.

### **2. FlashFQ: A Fair Queueing I/O Scheduler for Flash-Based SSDs**

(1) Flash-based SSD achieve fast I/O performance without any mechanical components, such as disk platters. But fairness is still important in cloud systems. In existing fair I/O schedulers are mostly using timeslice. But, timeslice scheduling focuses on the equal allocation of device time. So, timeslice scheduling may not provide fair shares of time-varying resource. In contrast, the fair queueing scheduling targets equal progress of completed work and therefore it can achieve fairness even for resources with time-varying capacities. FlashFQ is builded on classic fair queueing with parallelism and throttled dispatch to address restricted parallelism on flash.

(2)

(+): FlashFQ attains fairness in several workloads.

(-): FlashFQ is no big differences about slowdown ratio compare to Quanta and FIOS.