Improving Application Responsiveness with the BFQ Disk I/O Scheduler

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BFQ

- Production-quality disk scheduler for Linux
  - Each application can be reserved the desired fraction of the disk throughput
    - Guaranteed even if the overall throughput fluctuates
  - High disk throughput
  - Low latency for applications performing little and sporadic I/O, such as multimedia ones
- Used on PCs and smartphones
  [link](http://algogroup.unimore.it/people/paolo/disk_sched/)
Contributions

- A set of heuristics added to BFQ
  - The resulting new version of BFQ is labeled v1

- A benchmark suite
  http://algogroup.unimore.it/people/paolo/disk_sched/

- Experimental results on three different systems with a single rotational disk
The new heuristics

- The heuristics improve:
  - Responsiveness
    - Application start-up time
    - Time to accomplish the jobs of interactive applications
  - Throughput
  - Robustness across heterogeneous devices
Contents of this presentation

- Focus on
  - Responsiveness
  - Throughput
- Live demo of the performance of the new version of BFQ (recorded version here)
  - Compared against CFQ
    - One of the most effective production-quality schedulers in terms of throughput boosting and latency
- The demo also briefly shows the performance of BFQ in terms of latency for soft real-time applications and of disk throughput
• Newly-created and interactive applications enjoy a low latency because
  • BFQ provides them with more than their fair share of the disk throughput
• This extra share is necessarily *stolen* to non-interactive, long-lived applications
  • Applications most sensitive to this problem:
    • Soft real-time applications, such as multimedia
Latency for soft real-time

- **Key point:**
  - The heuristics fit the original accurate service provided by BFQ well enough to still guarantee to soft real-time applications a latency comparable to CFQ.
  
  - Even better, from BFQ-v2 on, a new simple heuristic guarantees to soft real-time applications a latency three times as low as CFQ.
    
    - Without breaking high-responsiveness guarantees.
Throughput

- In addition to low latency for both interactive and soft real-time applications

- **High disk throughput**
  - Up to 30% higher throughput than CFQ under most workloads in our experiments
  - The same throughput as CFQ under the other workloads

- Ongoing work
  - High throughput with virtual machines (KVM)
  - High throughput and service guarantees with SSD and RAID