Improving Application Responsiveness with the BFQ Disk I/O Scheduler

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BFQ

- Production-quality disk scheduler for hard disks and SSD
  - High responsiveness for interactive applications
  - Low latency for soft real-time (time-sensitive) applications, such as multimedia ones
  - High disk throughput
    - Also with virtual machines
  - Desired disk throughput fraction guaranteed to each application (even if throughput fluctuates)
- Used on PCs and smartphones

http://algogroup.unimore.it/people/paolo/disk_sched/

Contents of this presentation

- Demo of the performance of the new version of BFQ
  - Compared against CFQ
    - One of the most effective production-quality schedulers in terms of throughput boosting and latency
  - http://youtu.be/J-e7LnJblm8
- Then a few words about how BFQ guarantees a low latency to applications

The trick ...

- Newly-created and interactive applications enjoy a low latency because
  - BFQ provides them with more than their fair share of the disk throughput
  - Two extra slides if someone is interested
- This extra share is necessarily *stolen* to non-interactive, long-lived applications
  - Applications most sensitive to this problem:
    - Soft real-time applications

Latency for soft real-time

- **Key point:**
  - The heuristics fit the original accurate service provided by BFQ well enough to not degrade the granularity of the guarantees provided to soft real-time applications
  - An additional, simple heuristic provides a privileged treatment also to soft real-time applications
  - Latency of soft real-time applications is three times as low as with CFQ

Ongoing work

- Collaboration with Virtual Open Systems – Grenoble
  - Preserving responsiveness and low-latency guarantees also in virtualized environments
  - Collaborators are welcome
- High throughput and service guarantees with RAID
- (Un)related activity
  - Improvements over QFQ+
    - Efficient and accurate packet scheduler, in Linux from 3.8 ...
    - http://youtu.be/bG2ACt4na7A

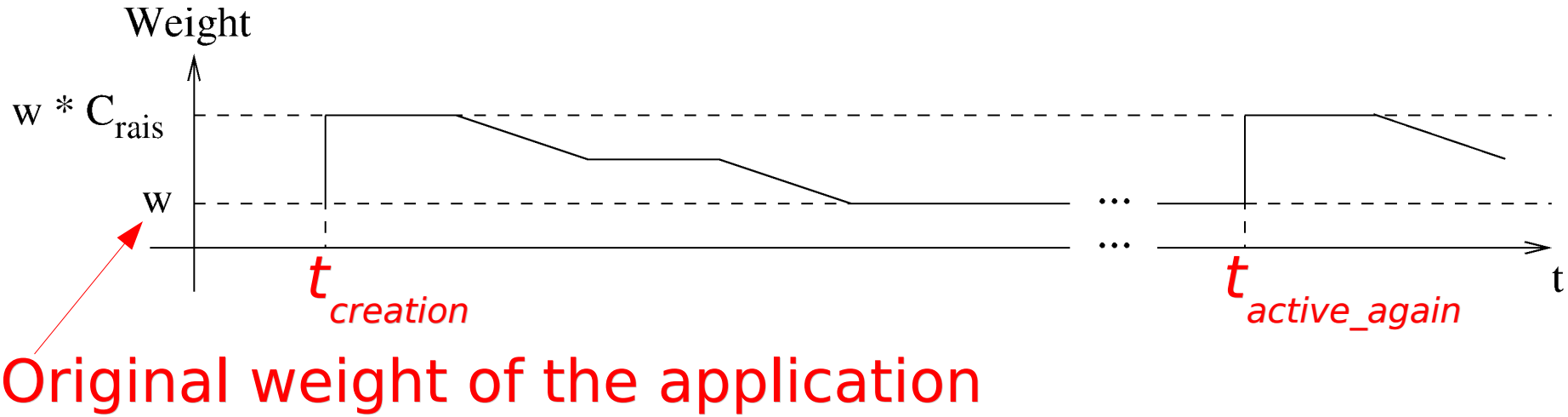
The end

Thanks for your attention

Questions?

Low-latency heuristic 1/2

- BFQ now achieves a high responsiveness thanks to the synergy of all the heuristics
- Most of the work is done by the **low-latency heuristic**, which just raises of the weight of
  - Newly-created applications
  - Applications that perform IO after being idle for a while



Low-latency heuristic 2/2

- Is it that simple?
- Just raise the weights of the applications when needed?
- Such a simple heuristic should provide low latency with any weight-based scheduler ...
- True, but an important point must be considered too
  - So far we have seen only the benefits of the low-latency heuristic, but this heuristic *may* have important drawbacks