
CERN

Optimizing Ceph for High Throughput

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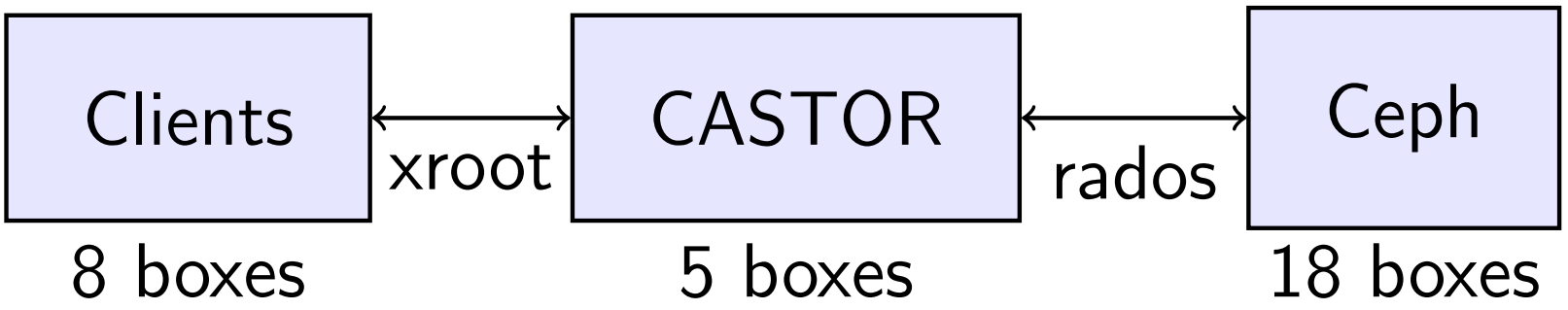
The setup



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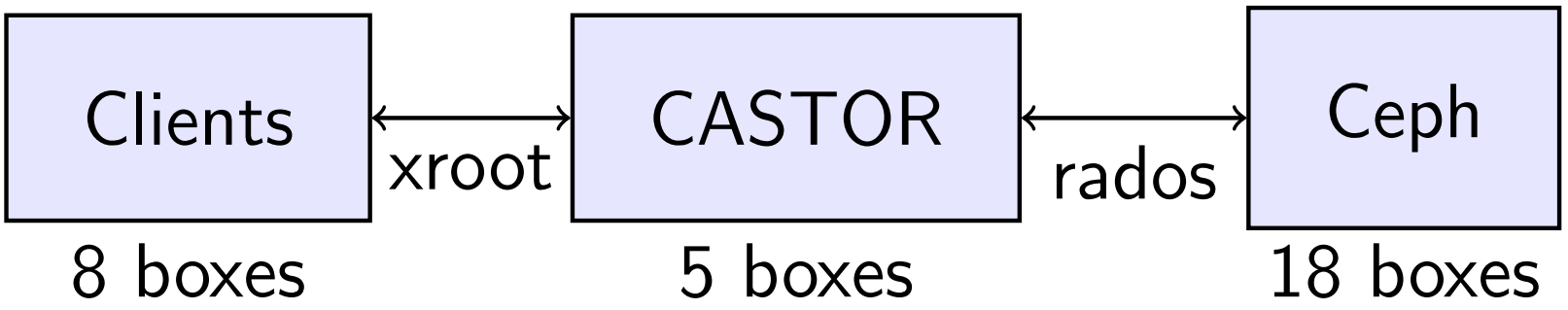
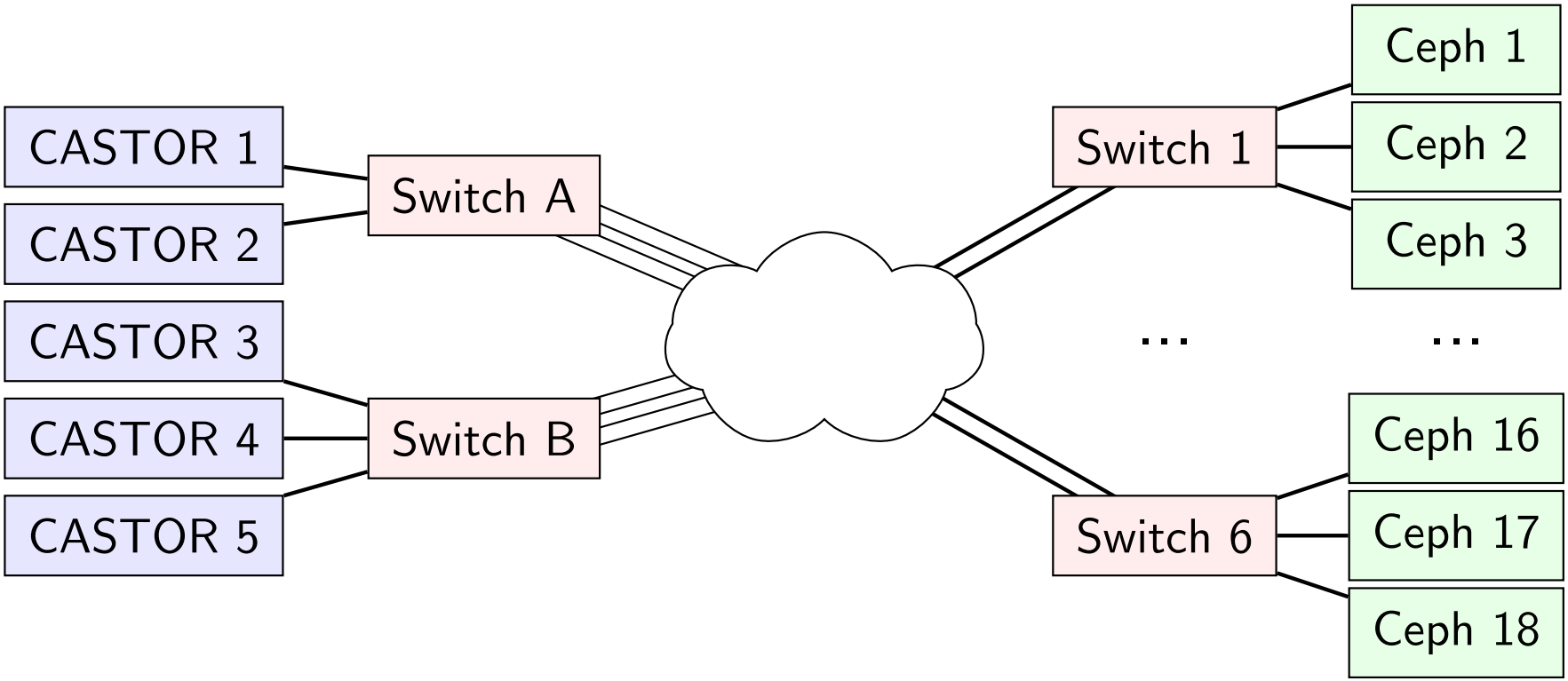


Some details

- client and CASTOR machines are batch nodes
- all machines have 10 Gb/s connection
- ceph machines have 540 disks in total
- ceph cluster has 2 PB of effective space

CASTOR - Ceph Network layout



Default test conditions

Client setup

- pure writing, 300MB files
- 10 concurrent threads per node, 8 nodes

CASTOR setup

- using xrootd protocol, with 64MB buffers
- 16 slots per disk server

Ceph setup

- erasure coded pool (8+3)
- striping into 8MB rados objects

Lesson 1 : the buffer size in transfers

Situation up to xrootd 4.2

- maximum size of xrootd buffers is 2MB
- relation between buffer size and transfer speed
  - single stream, single box
  - with recompiled version of xrootd

Buffer size (MB)	2	32	64
Speed (MB/s)X	65	300	>500

Lesson 1 : the buffer size in transfers

Situation from xrootd 4.3 on

- big buffers have been added
- activate with

  `xrd.buffers maxbsz <bsz>`
- now max buffer size is 1 GB

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  `xrd.buffers maxbsz <bsz>`
- now max buffer size is 1 GB
- but async reading from ceph is broken in 4.3...

Lesson 2 : the level of parallelization

Ceph has latency

- so async transfers are fundamental
- but they need to be sufficiently numerous

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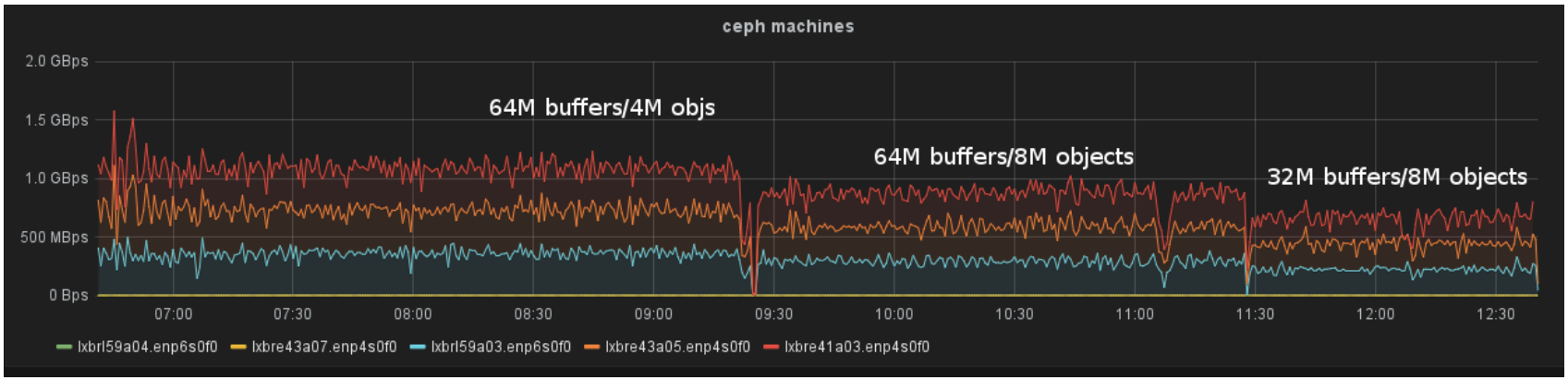
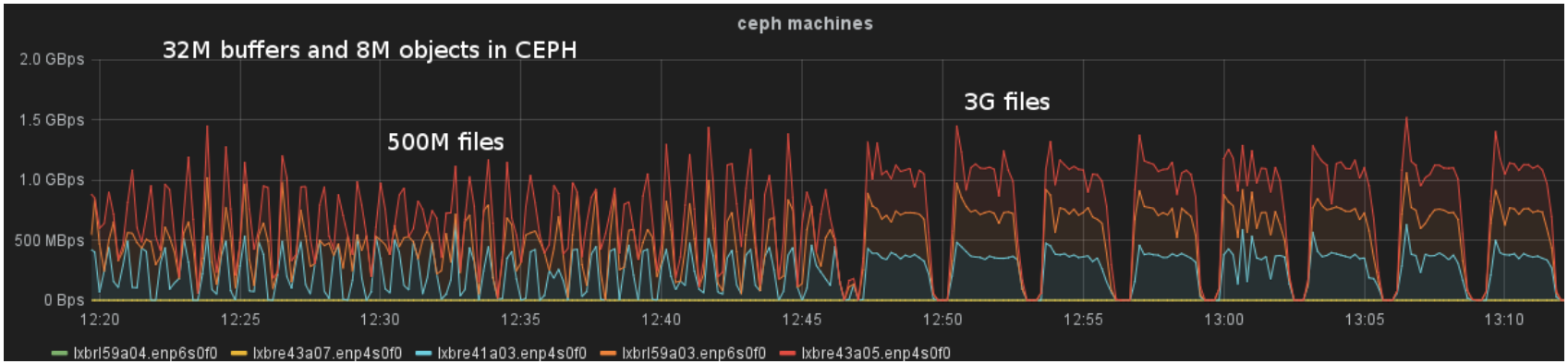
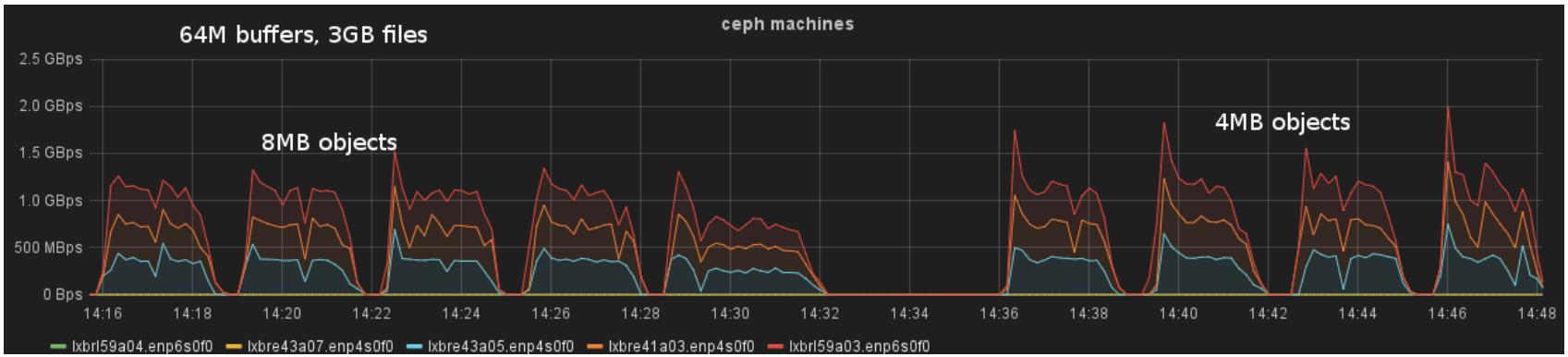


Lesson 3 : be asynchronous

We got weird patterns





Lesson 3 : be asynchronous

Ceph seemed slow to ack async writes

- Ack coming up to 20s after end of write
- ack tend to be delayed until end of activity
- file writing synchonize and files all end together
- at that moment, we wait

Lesson 3 : be asynchronous

libradosstriper code was not 100% async

- striper locks the striped object during write
- on write completion, it calls unlock
- no async unlock in rados library
- these sync calls were serializing the end of writes
- and limiting writes/s throughput

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Fix and effect

- added async unlock in rados and striper

Lesson 4 : be parallel when async

Steps of an async call to ceph

- Client threads
  - build completion object containing callback
  - call of an async method of the rados(striper) API
  - calling thread can go on with something else
- Objecter thread
  - receives a callback from Messenger
  - uses the completion object to issue client callback

Lesson 4 : be parallel when async

Limitation

- you can have many client threads
- you get a single callback thread per Objecter
  - that is by IOCtx or Striper object
- this single thread serializes all client callbacks

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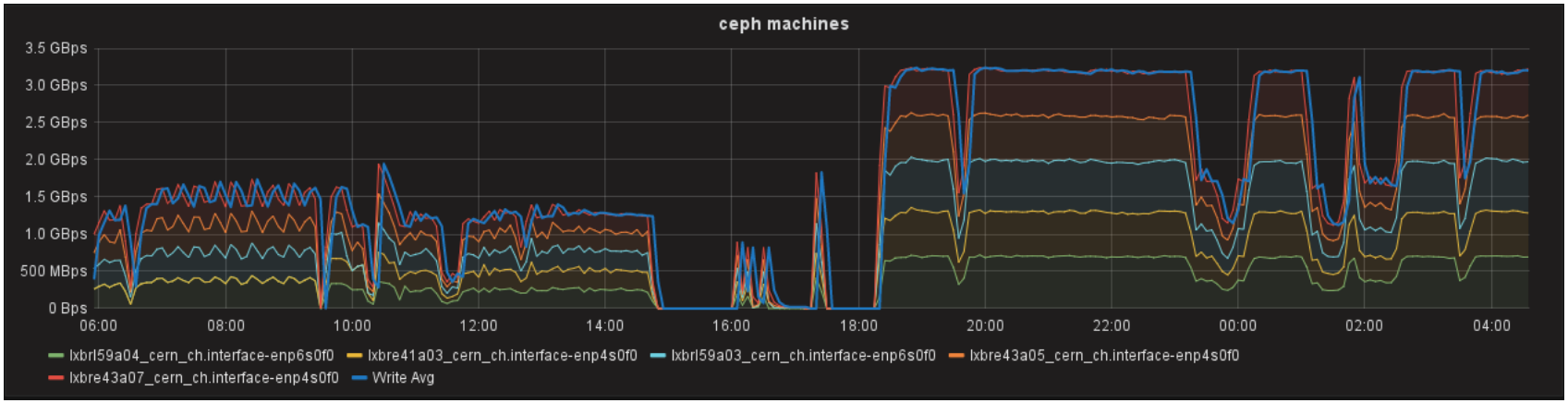
Solution

- multithreaded clients need to use a pool of IOCtx or Striper objects

Lesson 4 : be parallel when async

Impact of using the IOCtx pool



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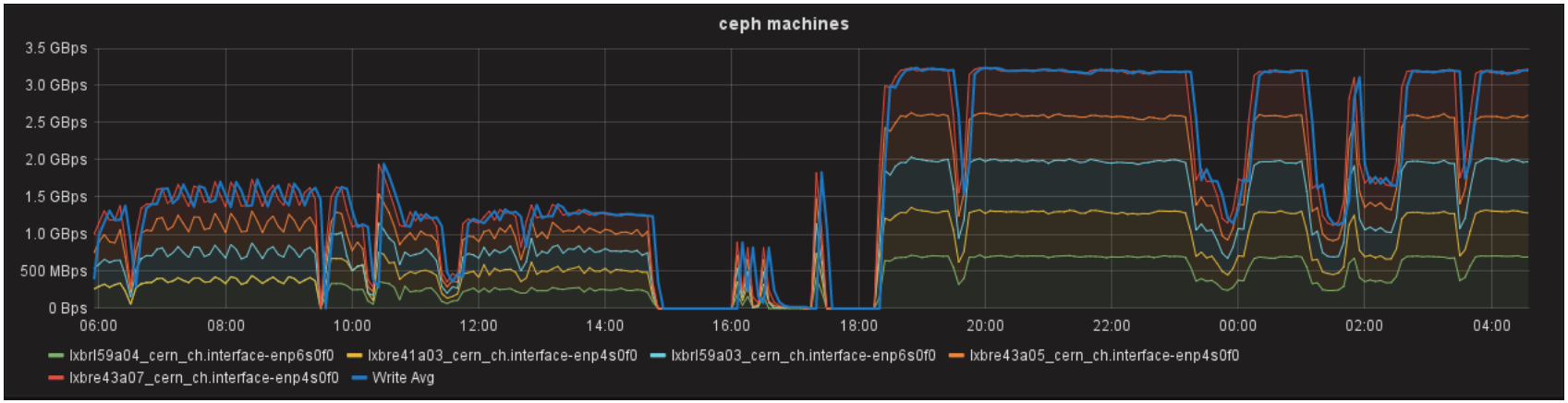
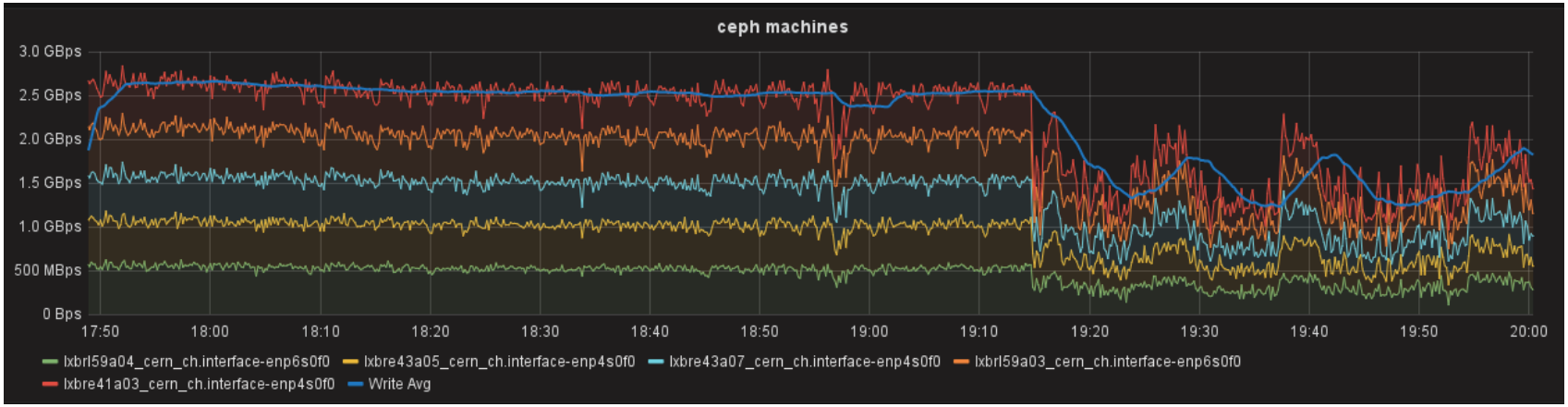


Is it something to integrate into rados library ?

Lesson 4 aftermath...



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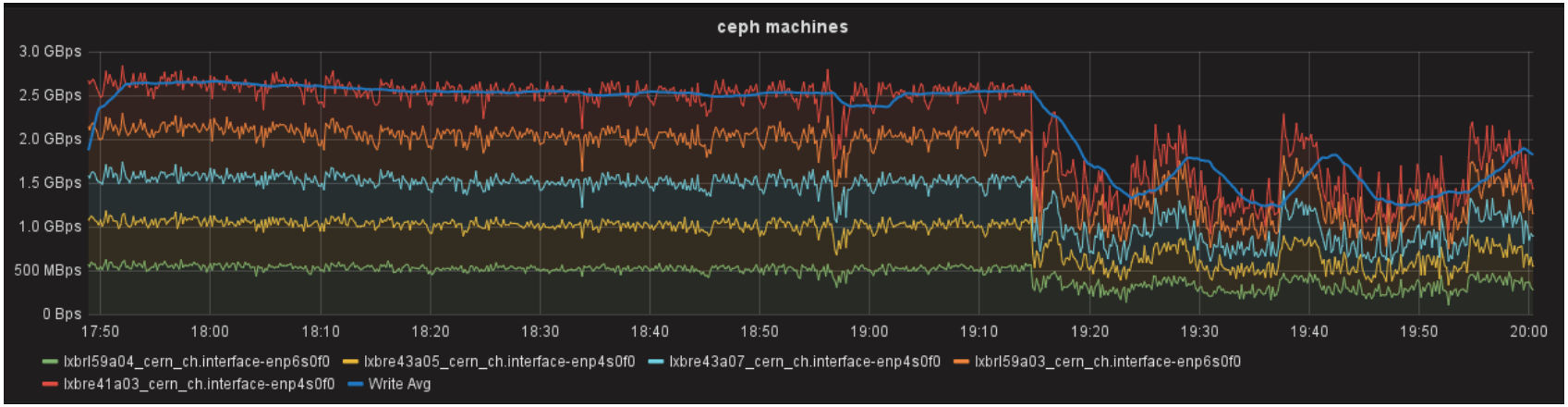

Found out to be due to full disks

And garbage collection being too slow

Lesson 5 : back to lesson 3 (be async)

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1. no async remove in the striper library
2. no async stat in the radosstriper library
   - called from garbage collector
3. no async stat / getxattr in the rados library
   - called within striper stat

Lesson 6 : back to lesson 4

- GC also needs a IoCtx pool...

Conclusions

Ceph can deliver high throughput

- after a bit of learning
- and a couple of fixes
- one major lesson : BE ASYNCHONOUS

Next steps

- bigger setup (15 proxies, 10GB/s)
- concurrent tape streams
- production for the Alice experiment

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