Performance Analysis with ceph
雲儲存性能分析

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Agenda 議程

SES5 is base on Luminous – The Why? 為何分析性能?

Ceph performance – The How? 如何分析性能?

Ceph analysis – The What? 分析結果是怎樣?

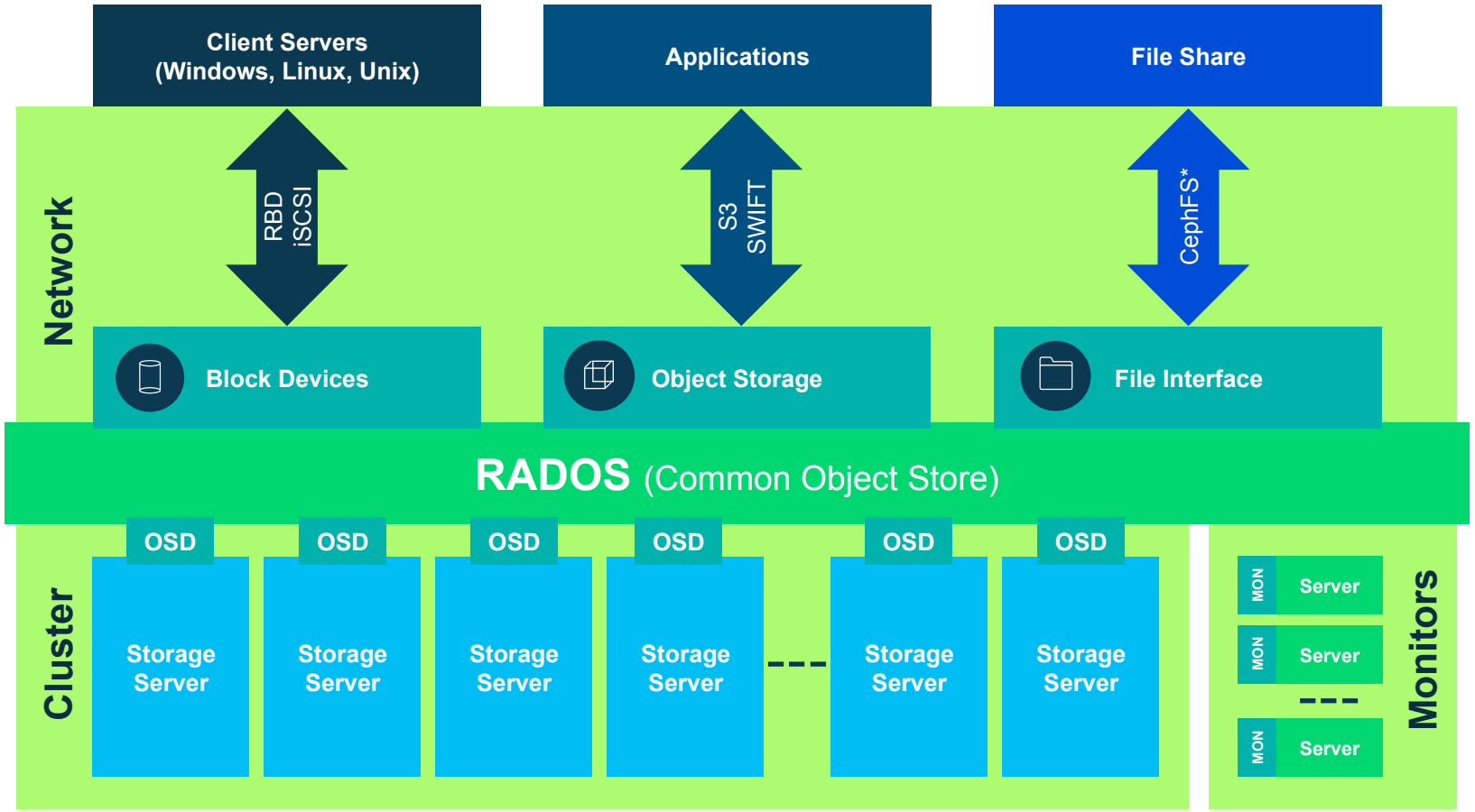
The Future? 大家有什麼展望?

SES5 is base on Luminous – The Why?
為何分析性能?

SUSE Enterprise Storage 5 base on Ceph Luminous

- Support x86-64 and AArch64
- Easy to use WebUI openATTIC 3.x
- Simple DeepSea Cluster orchestration
- BlueStore ready with data compression
- Cephfs and NFS-Ganesha ready

Ceph Info 基本資料



Code Developers
782

Core	Regular	Casual
22	53	705

Total downloads
160,015,454

Unique downloads
21,264,047

SUSE Enterprise Storage其實做了什麼?

基於Ceph

2013: SUSE 加入 Ceph 社區

2015.01 : SUSE Enterprise Storage 1.0

2015.11: SUSE Enterprise Storage 2.0

2016.01: SUSE Enterprise Storage 2.1

2016.07: SUSE Enterprise Storage 3.0

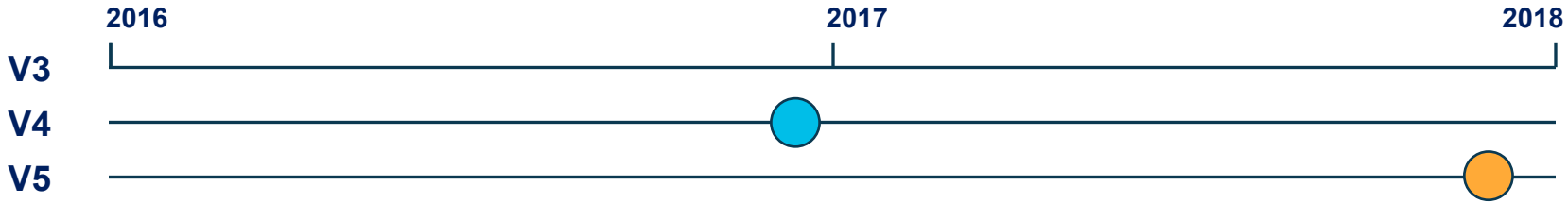
2016: SUSE 收购 IT-Novum（主要開發存儲管理工具 openATTIC）

2016.09: SUSE 合併 HPE 軟體

2016.11: SUSE Enterprise Storage 4.0

2017.09: SUSE Enterprise Storage 5.0 (Beta Now)

SUSE Enterprise Storage
Roadmap



SUSE Enterprise Storage 4

Built On
- Ceph Jewel release
- SLES 12 SP 2 (Server)

Manageability
- SES openATTIC management
- Initial Salt integration DeepSea

Interoperability
- AArch64
- CephFS (production use cases)
- NFS Ganesha (Tech Preview)
- NFS access to S3 buckets (Tech Preview)
- CIFS Samba (Tech Preview)
- RDMA/Infiniband (Tech Preview)

Availability
- Multisite object replication
- Asynchronous block mirroring

SUSE Enterprise Storage 5*

Built On
- Ceph Luminous release
- SLES 12 SP 3 (Server)

Manageability
- SES openATTIC management phase 2
- SUSE Manager integration

Interoperability
- NFS Ganesha
- NFS access to S3 buckets

Availability
- Asynchronous block mirroring
- Erasure coded block pool

Efficiency
- BlueStore back-end
- Data compression

SUSE 和 Ceph社區的關系

2013年建立Ceph開發團隊,正式加入Ceph的代碼支持

SUSE 是 Ceph理事會8大理事會員之一

一直以來代碼貢獻頭3名, 上次v12 Luminous發報第2多, 單個人第1 Ricardo

1. 10648 Ricardo Dias rdias@suse.com
2. 6422 Sage Weil sweil@redhat.com

有收到 Inktank 和 Mirantis 開發人員

加大研發投入: 2016年中收購存儲管理工具: it-novum (openATTIC)

Customer needs! 客戶的需要!

What's our cluster IOPS?

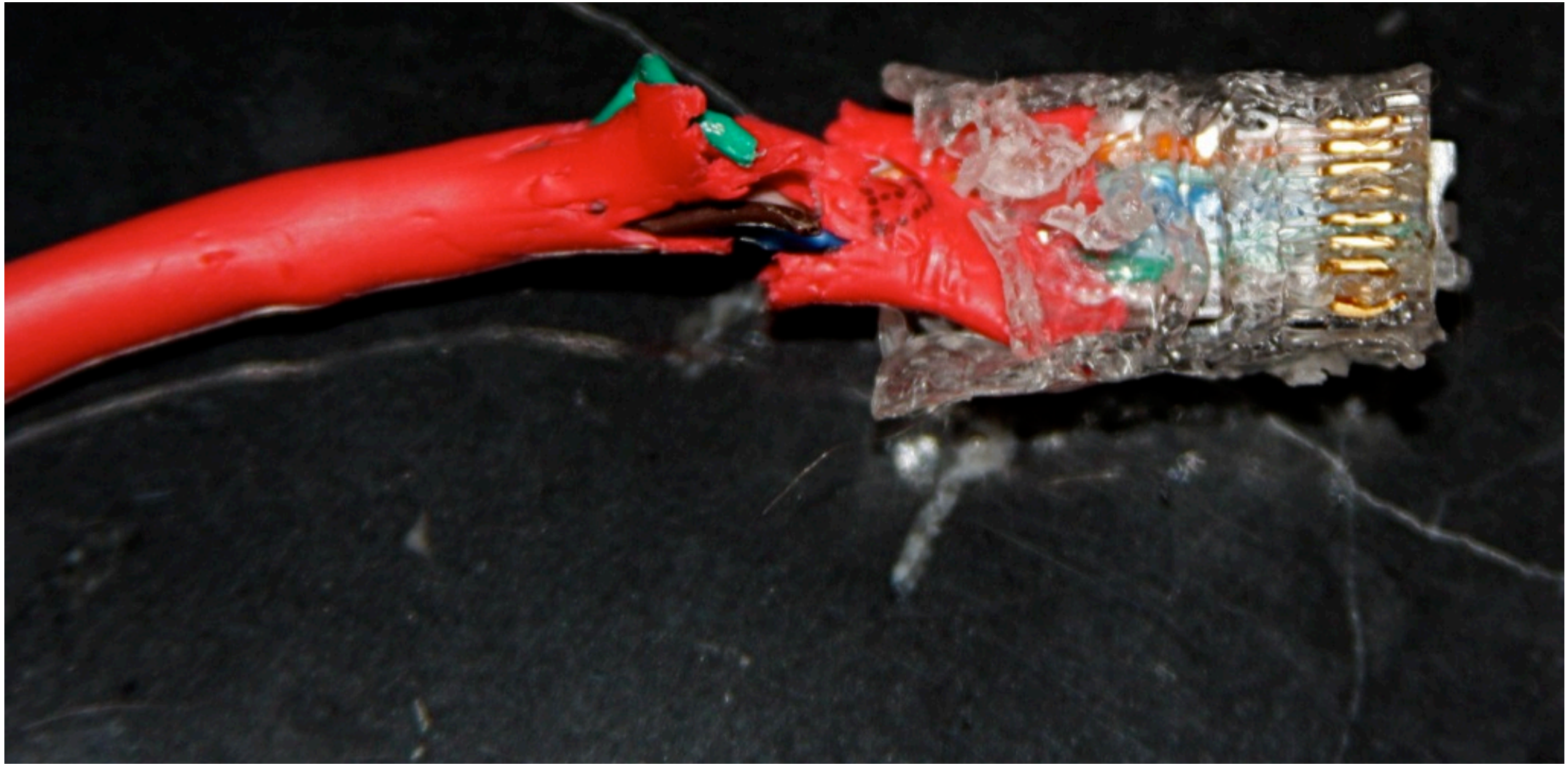
- How high do we need?
- How much do we want to pay?
- Are we counting 4K Random Write?
- Do we need Erasure Coding?
- Can we have the number on BlueStore vs FileStore?
- What about cephfs over nfs?
- ……

我們的存儲叢集能跑多少IOPS?

- 我們需要多高的IOPS?
- 我們想花多少錢?
- 我們只需要看4K隨機寫?
- 我們有糾刪碼的需要嗎?
- 我們能看看BlueStore對比FileStore嗎?
- 我們能看看cephfs上的NFS能怎樣?
- …….

System Engineer needs! 售前售後工程師的需要!

Putting them here is already show how much we care!



The DevOps Needs!開發運維的需要!

Can we have some base line number?

Can we have tools to re-do performance analysis?

BTW we need all that to our live cluster!

能否告訴正常時叢集該跑多快?

能否每天再測試報告叢集現在的性能?

不是分開測而是實際運作中的叢集性能哦!

The Developers Needs! 開發者的需要!

How much is BlueStore vs Filestore 4K, 16K, 64K, 1M, 4M write seq, random, read write performance in hdd vs ssd vs nvme pure and mixed pool, when an OSD is down, and the recovery process is started and meanwhile tracking how much memory needed when the capacity are 50% full without stopping the client keep writing to the cluster….

In short … very complicated analysis

…. 不寫了.. 很多很多要求就是.

p.s. 大家有硬體提供我們測試請找我, 會後我請你… ☺

The Community Project Need! 社區的性能有關項目!

Ceph Brag

- It require to use CBT
  - https://github.com/ceph/cbt
- Setting up the CBT environment could be complicated
- It require another set of multiple nodes setup
- It is intrusive test that can't be operate in a live cluster
- http://ceph.com/performance/

Ceph Brag

- CBT是現在測試的標準
  - https://github.com/ceph/cbt
- 設定CBT環境並不簡單
- 需要多台機器誰行測試
- 影響到內容不能向運作中的系統做測試
- 每週的性能有關會
  - http://ceph.com/performance/

The Goal

- Discover hardware, driver issue from time to time to check for degrade.
- Intrusive / Non-intrusive performance testing to do before and after the cluster being setup
- Able to perform to live and production cluster without stopping operation
- Low dependence, flexible, open source, and able to share eventually and align wth Ceph Brag
- Dynamic using different tools to do monitoring and tracing but able to orchestrated by a central admin that fit the container and cloud story

- 可以不定時發現硬體或驅動出現問題
- 在叢集設定前可以具破壞性的測試但在運作中的叢集可以用一樣的工具去做同類但不具破壞性的做法
- 測試可以在正在運作中的系統上進行而不影響一般運作
- 不用依賴太多三方面的需要, 可以靈活使用, 開源, 最終可以和Ceph Brag共享一樣的發報方法
- 可以使用不同的管理和跟蹤工具, 同時可以利用中央管理工具預備可以和容器和雲管理整合

Ceph Performance – The How?
如何分析性能?

Hardware Testing

Network:

```
ping -c1 -q -W1
```

Specific for Jumbo Frame

```
ping -Mdo -s8972 -c1 -q -W1
```

Bandwidth:

```
iperf3 -fm -A0 -t10 -c<server ip> -p<port>
```

Harddisk:

Read:

```
hdparm -t <osd_partition>
```

Write:

```
dd if=/dev/zero of=`mount <osd_data_partition>/test/
conv=fdatasync bs=4K count=10000
```

Cluster Testing

OSD Bench (1G write with 4M block default)

```
ceph tell osd.0 bench
```

RADOS Bench

```
rados -p <pool> <time> <write,seq,rand> -t <thread> --no-cleanup
```

RBD bench

```
rbd -p <pool> bench-write <image> --io-size <e.g 4096>
--io-threads <1,4,16 etc> --io-total<total size e.g.209715200>
--io-pattern <rand | seq>
```

New version has io-type

```
rbd -p <pool> bench --io-type read rbd_test --io-size 4096
--io-threads 1 --io-total 209715200 --io-pattern rand
```

Client Testing

FIO can be use against any of the following:

```
fio --ioengine=libaio --iodepth=32 --direct=1 --rw=write
--bs=4K --size=200MB --filename=/mnt/200M_data --numjobs=1
--name=cephfs_seqwrite_4K --output=cephfs_write_seq_4K.out
```

RBD Block

--ioengine can be either librbd or mount using libaio as default

ISCSI export

we can use it in windows or other OS that support iscsi

CephFS mount

```
mount.cephfs mon1,mon2,mon3:/ /mnt/
```

NFS/CIFS mount

```
mount.nfs nfs-server-ip:/ /mnt/
```

Lttng Testing

Kernel Tracing make easy!

```
lttng create -o .
lttng enable-channel --num-subbuf 16 --subbuf-size 8M  -k c0
lttng enable-event --kernel --all
lttng enable-event --syscall -a -k -c c0
lttng start
<do something>
lttng stop
lttng destroy
```

Mixing with Salt

It is already in next version of DeepSea

Network:

```
salt-run net.ping exclude=<non-cluster-ip>
salt-run net.jumbo_ping exclude=<non-cluster-ip>
```

Bandwidth:

```
salt-run net.iperf cluster=ceph output=full
salt-run net.iperf exclude=<non-cluster-ip>
```

Experiment

https://github.com/AvengerMoJo/Ceph-Saltstack

Since some of those test could be intrusive to OSD it is not in DeepSea yet.

```
salt "*" ceph_sles.disk_info
salt "*" ceph_slse.bench_disk /dev/sdb /dev/sdc /dev/sde
```

(dd write to a mount point a partition can mount to)

Lttng ust user space tracing

Client-side tracing only with librbd

compile ceph librbd with using `-finstrument-functions`

compile ceph with `-DWITH_LTTNG=ON`

```
export LD_PRELOAD=/usr/lib64/liblttng-ust-cyg-profile.so
```

Calling rbd to do something < write >

Stop tracing and collect the result for reporting

Can use Salt to do a multiple nodes tracing and collect all the report for you

Collecting Reporting with Salt

Calling salt to start lttng in every nodes of the cluster

```
salt-run lttng.run
     cmd="[fio --ioengine=libaio --iodepth=256 --direct=1
          --rw=write --bs=4K --size=20MB
          --filename=/mnt/cephfs/20M_data --numjobs=1
          -name=write_4K --output=/tmp/cephfs/write_seq_4K.out]"
     cmd_server=salt-master
```

Then collecting all the result back to the master.

Ceph Analysis – The What?
分析結是怎樣?

Example we use in the following hardware from SUSE Enterprise Storage Partners

HPE - OEM

- Apollo – Apollo 4200 * 3
  - osd with 18 hdd 2 ssd
- Proliant – DL380/DL360 * 3
  - mon

Network Ping

Regular Ping:

`ping -c1 -q -W1` **(rtt higher then 1ms maybe something wrong)**

```
--- 192.168.128.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.298/0.298/0.298/0.000 ms
```

Jumbo Frame:

`ping -Mdo -s8972 -c1 -q -W1` **(double normal ping)**

```
--- 192.168.128.5 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.649/0.649/0.649/0.000 ms
```

Network Bandwidth

Bandwidth: `iperf3 -fm -A0 -t10 -c<server ip> -p<port>`

```
Connecting to host 192.168.128.1, port 5201
[  4] local 192.168.128.77 port 41008 connected to 192.168.128.1 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   119 MBytes  1002 Mbits/sec    0    368 KBytes
[  4]   1.00-2.00   sec   118 MBytes   990 Mbits/sec    0    402 KBytes
[  4]   2.00-3.00   sec   118 MBytes   992 Mbits/sec    0    420 KBytes
[  4]   3.00-4.00   sec   118 MBytes   991 Mbits/sec    0    420 KBytes
[  4]   4.00-5.00   sec   118 MBytes   991 Mbits/sec    0    420 KBytes
[  4]   5.00-6.00   sec   118 MBytes   991 Mbits/sec    0    420 KBytes
[  4]   6.00-7.00   sec   118 MBytes   991 Mbits/sec    0    420 KBytes
[  4]   7.00-8.00   sec   118 MBytes   992 Mbits/sec    0    420 KBytes
[  4]   8.00-9.00   sec   118 MBytes   991 Mbits/sec    0    420 KBytes
[  4]   9.00-10.00  sec   118 MBytes   991 Mbits/sec    0    420 KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  1.16 GBytes   992 Mbits/sec    0             sender
[  4]   0.00-10.00  sec  1.15 GBytes   991 Mbits/sec                  receiver
```

DeepSea Network Test

```
salt-run net.ping exclude=<non-cluster-ip>
    Succeeded: 8 addresses from 7 minions average rtt 0.15 ms
salt-run net.jumbo_ping exclude=<non-cluster-ip>
    Succeeded: 8 addresses from 7 minions average rtt 0.26 ms

salt-run net.iperf exclude=192.168.128.9 cluster=ceph output=full
192.168.128.1:
    8644.0 Mbits/sec
192.168.128.2:
    10360.0 Mbits/sec
192.168.128.3:
    9336.0 Mbits/sec
192.168.128.4:
    9588.56 Mbits/sec
192.168.128.5:
    10187.0 Mbits/sec
192.168.128.6:
    10465.0 Mbits/sec
```

Disk Direct Read Write

Read: `hdparm -t`

```
HDD:    Timing buffered disk reads: 618 MB in  3.01 seconds = 205.58 MB/sec

SSD:    Timing buffered disk reads: 1510 MB in  3.00 seconds = 503.25 MB/sec
```

Write: Direct dd right zero into disk mount point

```
/usr/bin/dd if=/dev/zero of=/var/lib/ceph/osd/ceph-0/test conv=fdatasync
bs=4K count=10000
    10000+0 records in
    10000+0 records out

HDD: 40960000 bytes (41 MB, 39 MiB) copied, 0.257385 s, 159 MB/s

SSD: 40960000 bytes (41 MB, 39 MiB) copied, 0.117944 s, 347 MB/s
```

With RAID Card Cache Enable

```
HDD: 40960000 bytes (41 MB, 39 MiB) copied, 0.038911 s, 1.1 GB/s
```

OSD Bench (without external communication)

OSD Bench (1G write with 4M block default)

```
 ceph tell osd.<num> bench
SSD
{
    "bytes_written": 1073741824, (1G)
    "blocksize": 4194304, (4M)
    "bytes_per_sec": 260063627 (248M)
}
RAID 0 HDD with cache
{
    "bytes_written": 1073741824,
    "blocksize": 4194304,
    "bytes_per_sec": 464233957 (442M)
}
```

RADOS Bench: rados –p hdd3 bench 20 write -t 32 –b 4096 --no-cleanup

Maintaining 32 concurrent writes of 4096 bytes to objects of size 4096 for up to 20 seconds or 0 objects

2017-07-11 13:59:02.450884 min lat: 0.000861743 max lat: 0.193705 avg lat: 0.0033328

sec	Cur ops	started	finished	avg MB/s	cur MB/s	last lat(s)	avg lat(s)
20	9	191944	191935	37.4835	36.7539	0.00325612	0.0033328

Total time run: 20.008286

Total writes made: 191944

Write size: 4096

Object size: 4096

Bandwidth (MB/sec): 37.4735

Stddev Bandwidth: 2.88217

Max bandwidth (MB/sec): 44.332

Min bandwidth (MB/sec): 32.9258

Average IOPS: 9593

Stddev IOPS: 737

Max IOPS: 11349

Min IOPS: 8429

Average Latency(s): 0.00333329

Stddev Latency(s): 0.00611436

Max latency(s): 0.193705

Min latency(s): 0.000861743

Byte Size = 4M

Total time run: 20.186976

Total writes made: 4985

Write size: 4194304

Object size: 4194304

Bandwidth (MB/sec): 987.766

Stddev Bandwidth: 178.349

Max bandwidth (MB/sec): 1200

Min bandwidth (MB/sec): 596

Average IOPS: 246

Stddev IOPS: 44

Max IOPS: 300

Min IOPS: 149

Average Latency(s): 0.129235

Stddev Latency(s): 0.228253

Max latency(s): 6.50408

Min latency(s): 0.0230147

RBD Bench: rbd write with seq and rand

```
rbd -p ssd bench-write rbd_test --io-size 4096 --io-threads 16
--io-total 209715200 --io-pattern seq
     elapsed:     2  ops:    51200  ops/sec: 17947.54  bytes/sec: 73513129.85
rbd -p hdd bench-write rbd_test --io-size 4096 --io-threads 16
--io-total 209715200 --io-pattern seq
     elapsed:     2  ops:    51200  ops/sec: 22725.83  bytes/sec: 93085010.58
rbd -p ssd bench-write rbd_test --io-size 4096 --io-threads 16
--io-total 209715200 --io-pattern rand
     elapsed:    12  ops:    51200  ops/sec:  4010.68  bytes/sec: 16427739.46
rbd -p hdd bench-write rbd_test --io-size 4096 --io-threads 16
--io-total 209715200 --io-pattern rand
     elapsed:    13  ops:    51200  ops/sec:  3844.75  bytes/sec: 15748101.36
```

HDD with RAID card cache run faster in Sequence compare to Random

RBD Feature enable vs disable

To enable all the features in rbd: striping, object-map, fast-diff, deep-flatten, journaling

```
rbd -p ssd bench-write rbd_test --io-size 4096 --io-threads 16
--io-total 209715200 --io-pattern seq
     elapsed:     2  ops:    51200  ops/sec: 17143.89  bytes/sec: 70221393.28
rbd -p hdd bench-write rbd_test --io-size 4096 --io-threads 16
--io-total 209715200 --io-pattern seq
     elapsed:     2  ops:    51200  ops/sec: 22173.81  bytes/sec: 90823913.76
rbd -p ssd bench-write rbd_test --io-size 4096 --io-threads 16
--io-total 209715200 --io-pattern rand
     elapsed:    13  ops:    51200  ops/sec:  3711.78  bytes/sec: 15203449.44
rbd -p hdd bench-write rbd_test --io-size 4096 --io-threads 16
--io-total 209715200 --io-pattern rand
     elapsed:    33  ops:    51200  ops/sec:  1508.59  bytes/sec: 6179179.33
```

HDD with RAID cache run much worst in Random

RBD Block XFS mount hdd (cache) 4K IOPS benchmark

```
fio --ioengine=libaio --iodepth=256 --direct=1 --rw=write --bs=4K --size=200MB
   --filename=/mnt/hdd/200M_data  --numjobs=1 -name=seq_write_4K
write: io=204800KB, bw=17667KB/s, iops=4416, runt= 11592msec
fio --ioengine=libaio --iodepth=256 --direct=1 --rw=randwrite --bs=4K --size=200MB
   --filename=/mnt/hdd/200M_data --numjobs=1 --name=write_4K
write: io=204800KB, bw=104118KB/s, iops=26029, runt=  1967msec
fio --ioengine=libaio --iodepth=256 --direct=1 --rw=read --bs=4K --size=200MB
   --filename=/mnt/hdd/200M_data --numjobs=1 --name=read_4K
read : io=204800KB, bw=71235KB/s, iops=17808, runt=  2875msec
fio --ioengine=libaio --iodepth=256 --direct=1 --rw=randread --bs=4K --size=200MB
  --filename=/mnt/hdd/200M_data --numjobs=1 --name=read_4K
read : io=204800KB, bw=228317KB/s, iops=57079, runt=   897msec
```

RBD Block XFS mount ssd 4K IOPS benchmark

```
fio --ioengine=libaio --iodepth=256 --direct=1 --rw=write --bs=4K --size=200MB
   --filename=/mnt/ssd/200M_data  --numjobs=1 -name=seq_write_4K
write: io=204800KB, bw=16394KB/s, iops=4098, runt= 12492msec
fio --ioengine=libaio --iodepth=256 --direct=1 --rw=randwrite --bs=4K --size=200MB
   --filename=/mnt/ssd/200M_data --numjobs=1 --name=write_4K
write: io=204800KB, bw=104757KB/s, iops=26189, runt=  1955msec
fio --ioengine=libaio --iodepth=256 --direct=1 --rw=read --bs=4K --size=200MB
   --filename=/mnt/ssd/200M_data --numjobs=1 --name=read_4K
read : io=204800KB, bw=90619KB/s, iops=22654, runt=  2260msec
fio --ioengine=libaio --iodepth=256 --direct=1 --rw=randread --bs=4K --size=200MB
  --filename=/mnt/ssd/200M_data --numjobs=1 --name=read_4K
read : io=204800KB, bw=302959KB/s, iops=75739, runt=   676msec
```

RBD Block XFS hdd (cache) 1M ThoughtPut benchmark

```
fio --ioengine=libaio --iodepth=16 --direct=1 --rw=write -bs=1M --size=4GB
   --filename=/mnt/hdd/4G_data  --numjobs=1 -name=seq_write_1M
write: io=4096.0MB, bw=1043.6MB/s, iops=1043, runt=  3925msec
fio --ioengine=libaio -iodepth=16 --direct=1 --rw=randwrite --bs=1M --size=4GB
   --filename=/mnt/hdd/4G_data --numjobs=1 --name=write_1M
write: io=4096.0MB, bw=1146.6MB/s, iops=1146, runt=  3574msec
fio --ioengine=libaio --iodepth=16 --direct=1 --rw=read --bs=1M -size=4GB
   --filename=/mnt/hdd/4G_data --numjobs=1 --name=read_1M
read : io=4096.0MB, bw=316790KB/s, iops=309, runt= 13240msec
fio --ioengine=libaio --iodepth=16 --direct=1 --rw=randread --bs=1M -size=4GB
  --filename=/mnt/hdd/4G_data --numjobs=1 --name=read_1M
read : io=4096.0MB, bw=183647KB/s, iops=179, runt= 22839msec
```

RBD Block XFS ssd 1M ThoughtPut benchmark

```
fio --ioengine=libaio --iodepth=16 --direct=1 --rw=write --bs=1M --size=4GB
   --filename=/mnt/ssd/4G_data  --numjobs=1 -name=seq_write_4G
write: io=4096.0MB, bw=540225KB/s, iops=527, runt=  7764msec
fio --ioengine=libaio -iodepth=16 --direct=1 --rw=randwrite --bs=1M --size=4GB
   --filename=/mnt/ssd/4G_data --numjobs=1 --name=write_4G
write: io=4096.0MB, bw=554142KB/s, iops=541, runt=  7569msec
fio --ioengine=libaio --iodepth=16 --direct=1 --rw=read --bs=1M --size=4GB
   --filename=/mnt/ssd/4G_data --numjobs=1 --name=read_4G
read : io=4096.0MB, bw=96998KB/s, iops=94, runt= 43241msec
fio --ioengine=libaio --iodepth=16 --direct=1 --rw=randread --bs=1M --size=4GB
  --filename=/mnt/ssd/4G_data --numjobs=1 --name=read_4G
read : io=4096.0MB, bw=113158KB/s, iops=110, runt= 37066msec
```

Lttng tracing regular RBD, Journaling enable RBD

Default:

```
                SEC       OPS   OPS/SEC   BYTES/SEC
elapsed:     0  ops:       1  ops/sec:   23.64  bytes/sec:   94.56
```

Journaling:

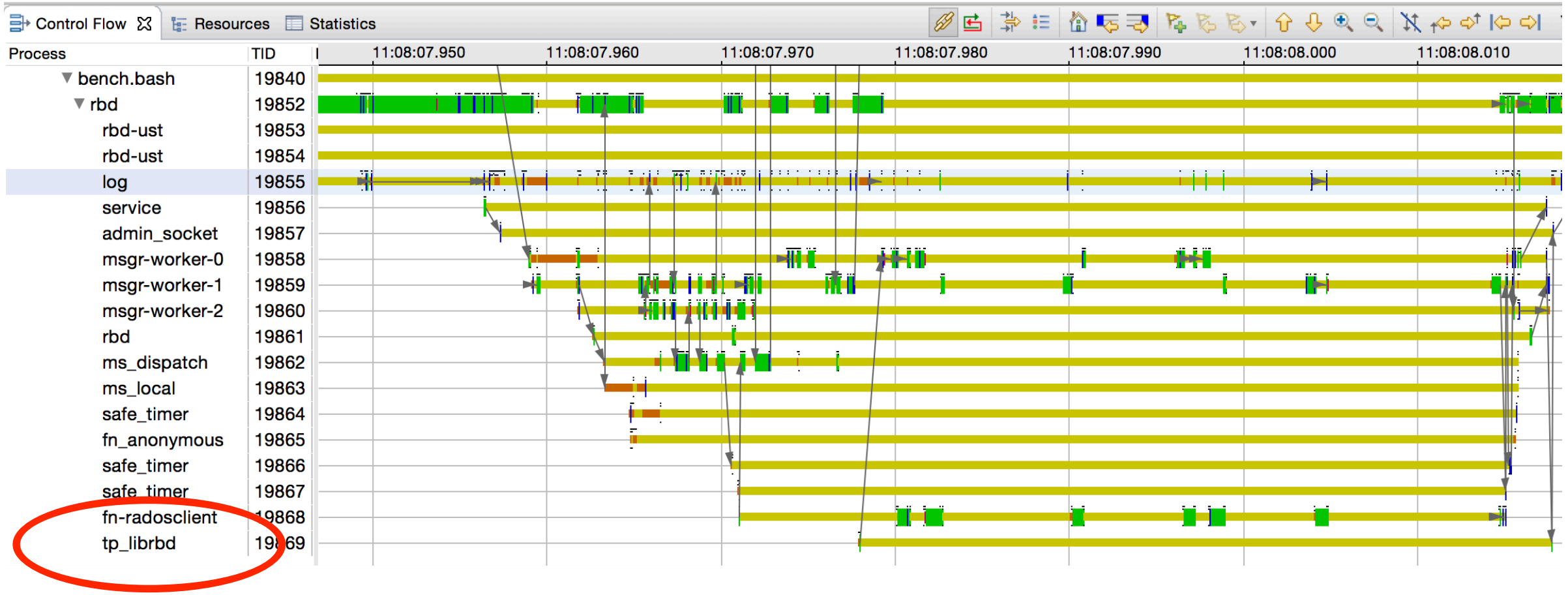
```
        bench  type write io_size 4 io_threads 1 bytes 4 pattern random
                SEC       OPS   OPS/SEC   BYTES/SEC
elapsed:     0  ops:       1  ops/sec:   9.54  bytes/sec:   38.14
```

Using Tracecompress

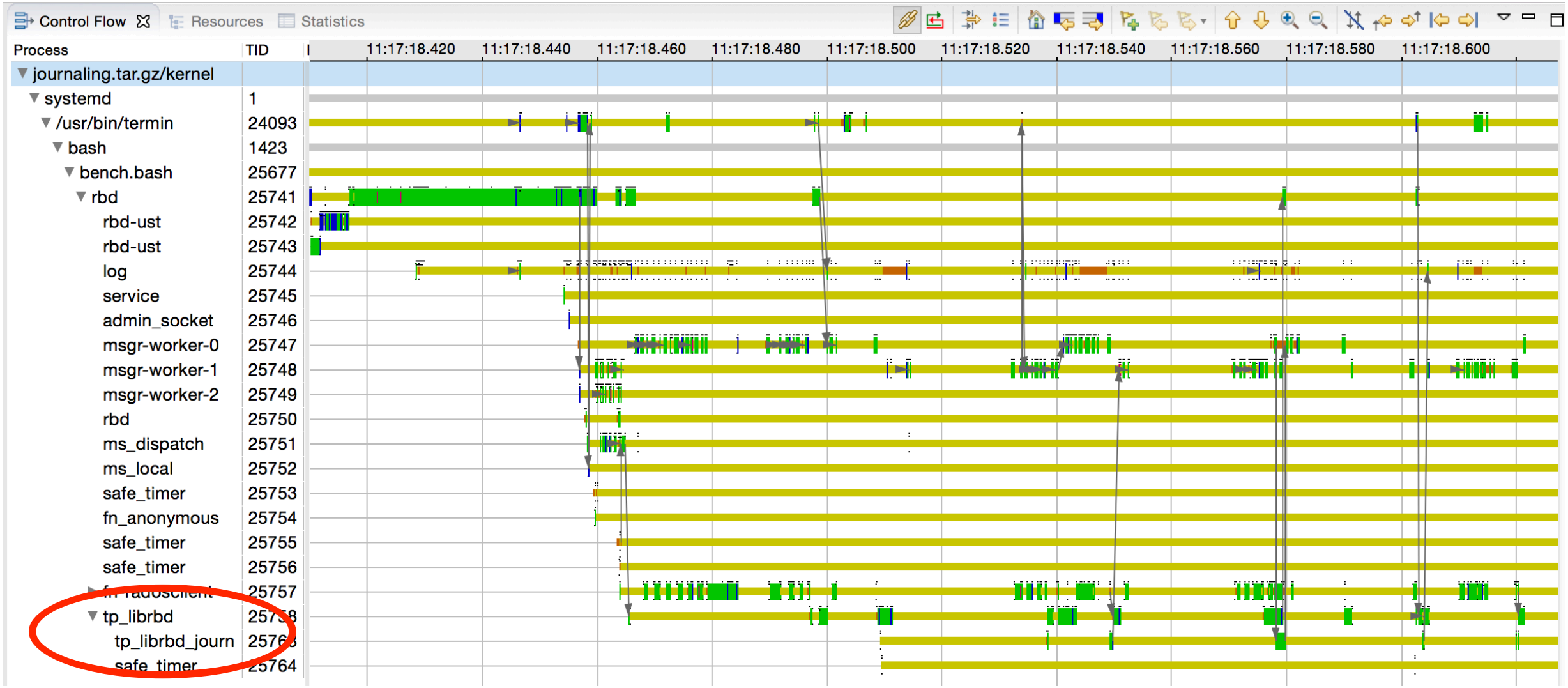
Eclipse base UI, easy to use, cross platform (java)

http://tracecompass.org/

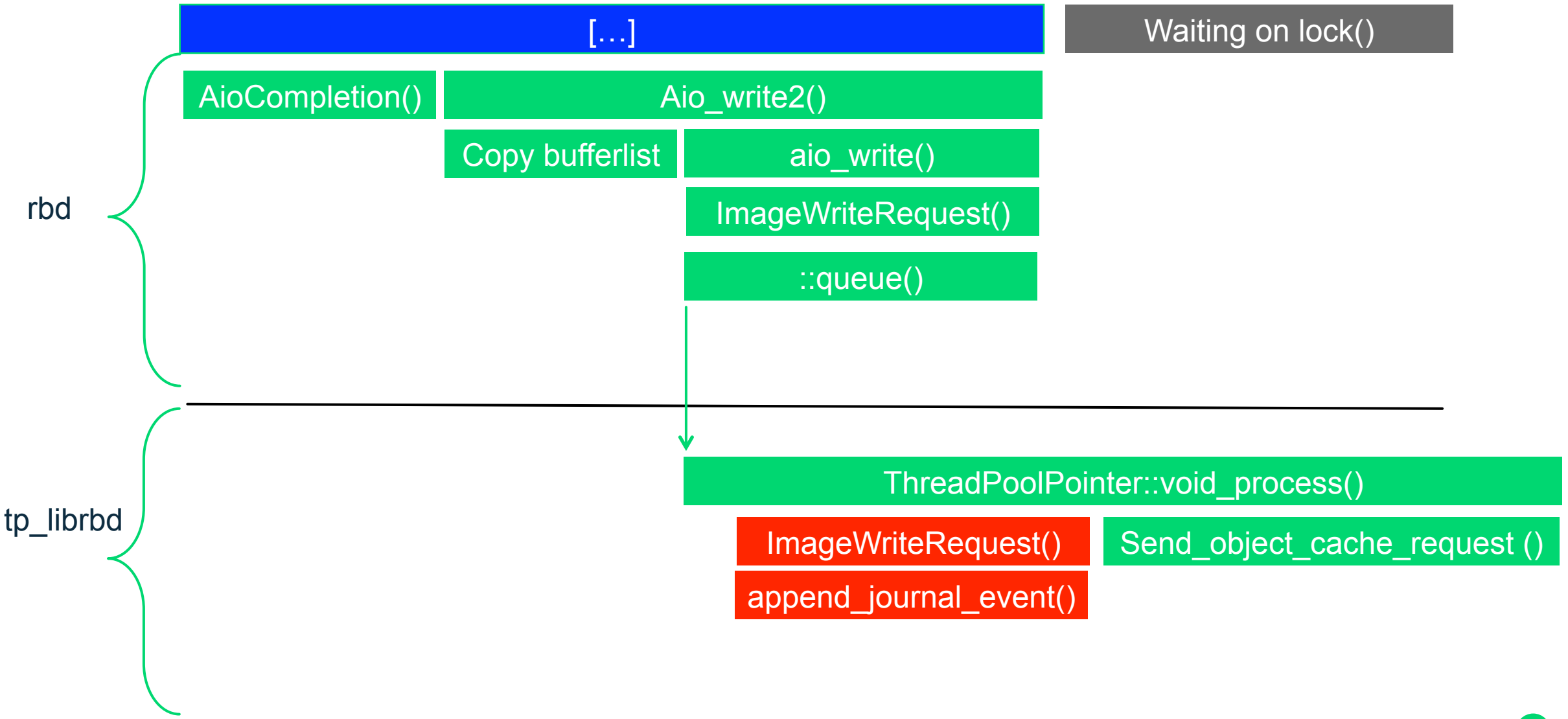
Regular Layering RBD “tp_librbd”



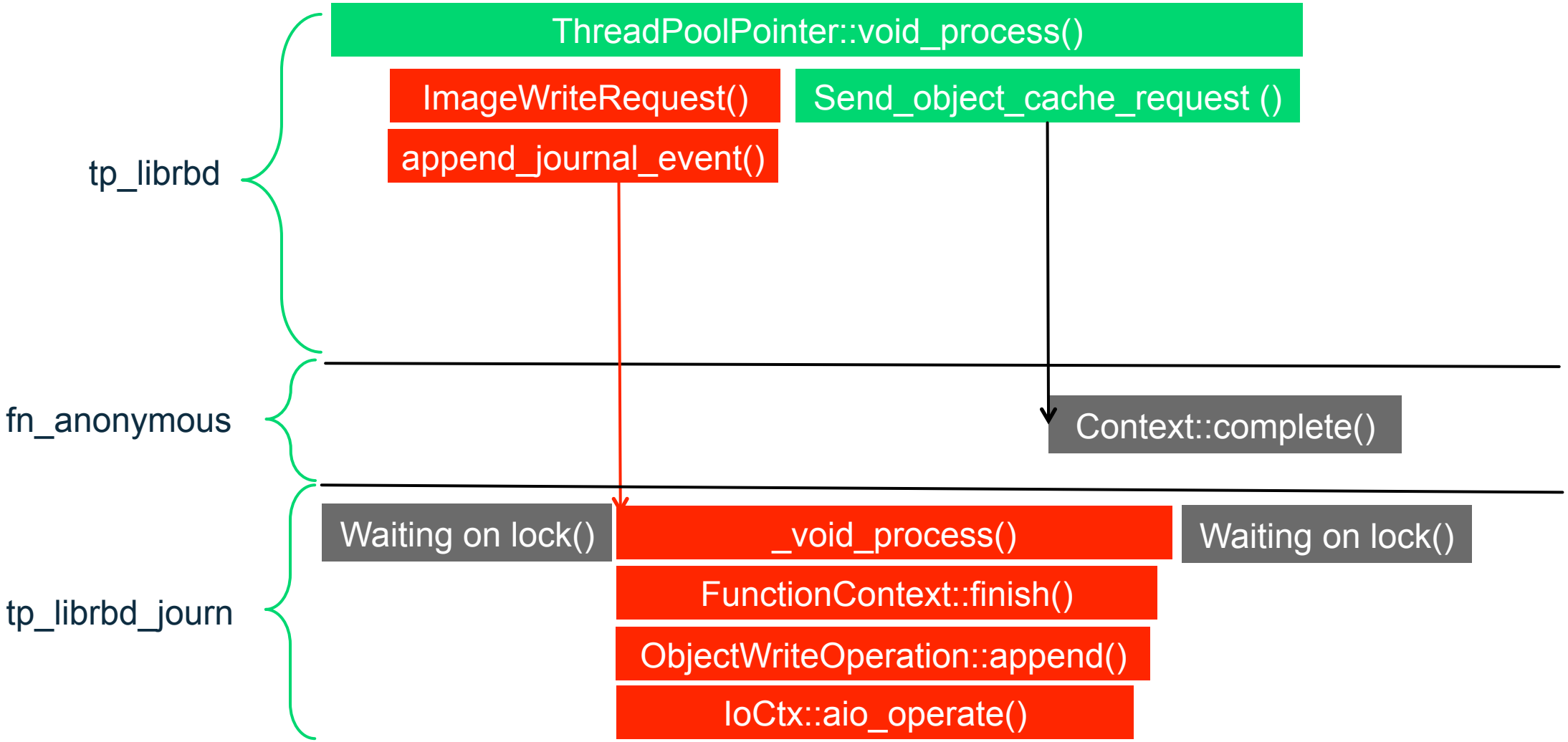
RBD with remote Journaling “tp_librbd_journ”



https://docs.google.com/drawings/d/1s9pRVygdPzBtQyYrvPueF8Cm6Xi1d4oy5gNMOjx2Wzo



https://docs.google.com/drawings/d/1s9pRVygdPzBtQyYrvPueF8Cm6Xi1d4oy5gNMOjx2Wzo



Let’s look at real trace

The Future?
以後的展望?

The Future

- Setup partner with production hardware in community that can run the non-intrusive test case in regular bases to compare with different ceph cluster.
- Include more client side multiple nodes tracing (container / cloud ready)
- Filestore and Bluestore with detail features on and off
- More in-depth ARM AArch64 ceph performance report
- Upstream is already doing a lot of recovery related to timing issue
- Chinese Translation related to performance analysis tools and method
- 提供服務給社區運作中的叢集非破壞式的測試方法, 給大家參考和對比差異
- 提供更完整的多點跟蹤功能 (容器內/雲內)
- 針對Filestore和Bluestore做更深人的測試,觀察打開不同功能後的性能比較
- 再深人去了解ARM64運作ceph時的性能報告
- 上游正著手觀察Recovery有關的不同選項做分析
- 翻譯有關這麼多不同性能測試工具和方法的文檔

硬體調優

- 使用 SSD 或者 NVMe SSD 作 Journal
- MON Node 數據放置在 SSD 上
- HDD 硬碟控制器修改為 write-back 模式
- 設定CPU為 performance 模式
- 設定CPU為HyperThread 模式

OS 調優

- 網絡設定: 使用 jumbo frame, 配置 MTU
- IO調整：deadline or noop
- NUMA 設定： 注意按 socket 分配 IRQs 到不同CPU上
- iSCSI 性能參數調整
- 內核參數調整

Ceph調優

一般原則

- 根据應用負載進行性能調整
- 使用不同的 pools設定一定的 pg 數
- 性能測試時 停用 OSD scrub
- 性能由最差的硬碟決定 – 定位每個硬碟的性能
- 禁用debug信息
- 禁用認証功能
- 如果RAID控制器有電源保護:
  - osd mount options xfs = nobarrier, rw, noatime, inode64, logbufs=8

Questions and Answers


SUSE
We adapt. You succeed.