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Optimizing Ceph Deployments For High Performance

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Agenda

1. Define Performance
2. Process and Tools
3. OS
4. Ceph Cluster
5. Clients

What Is Performance?

For storage

- Individual or aggregate
- Latency (quickness of response)
  - IOPS
- Throughput
  - MB/s

What Is An IOP?

I/O per second

- What size?
- Read/Write?

Single Stream Or Aggregate

- 10GB/s
- Single Stream = 1 user needing 10 GB/s
- Aggregate = 100 users needing 100 MB/s

- Ceph is designed for aggregate throughput

Process And Tools

Process Characteristics

Define the goal

What to measure and how

Incremental in nature

- Change one thing
- Measure
- Repeat

Document

Tools

- fio
- iostat
- ceph daemon perf dump
- iotop
- iftop
- iperf3

Pick The Right Hardware

- CPU options
- Network
- Storage bus
- Node count

How To Tune - Start With Base Server Hardware

- CPU
  - Disable C-States?
  - Performance impacting mitigations
  - Hardware performance bias
- Disk
  - Check both latency constrained and unconstrained
  - Write-cache on/off
  - 4k, 8k, 64k, 256k, & 1M
  - Individual and all at once
- Network
  - Jumbo Frames
  - Buffers, kernel network tunables, etc

How To Tune – Then The Cluster

Core OSD performance

- Use krbd and ceph tell osd bench
- Watch iostat on nodes for distribution. Uneven may indicate too few pgs or a slow device
- Watch ceph counters (ceph daemon perf dump)
- Do single stream and aggregate for scaling check

Tuning The OS

There Is A Lot To Gain

In lab testing, OS tuning doubled (or better) performance in some situations

There are lots of places to tweak the OS:

- IO schedulers
- Network buffers
- TCP congestion
- Multi-queue
- NIC and HBA drivers
- etc

Tuning Script Used During Some Testing

```
#!/bin/bash
salt 'sr6*' cmd.run 'setpci -s 5b:00.0 68.w=5936'
salt 'sr6*' cmd.run 'setpci -s 5b:00.1 68.w=5936'
salt '*' cmd.run 'ip link set bond0 mtu 9000'

salt '*' cmd.run 'for j in `cat /sys/class/net/bond0/bonding/slaves`;do LOCAL_CPUS=`cat /sys/class/net/$j/device/local_cpus`;echo $LOCAL_CPUS >
/sys/class/net/$j/queues/rx-0/rps_cpus;done'
salt '*' cmd.run 'ethtool -G eth4 rx 8192 tx 8192'
salt '*' cmd.run 'ethtool -G eth5 rx 8192 tx 8192'
salt '*' cmd.run 'sysctl -w net.ipv4.tcp_timestamps=1'
salt '*' cmd.run 'sysctl -w net.ipv4.tcp_sack=1'
salt '*' cmd.run 'sysctl -w net.core.rmem_max=2147483647'
salt '*' cmd.run 'sysctl -w net.core.wmem_max=2147483647'
salt '*' cmd.run 'sysctl -w net.core.somaxconn=2048'
salt '*' cmd.run 'sysctl -w net.ipv4.tcp_low_latency=1'
salt '*' cmd.run 'sysctl -w net.ipv4.tcp_fastopen=1'
salt '*' cmd.run 'sysctl -w net.ipv4.tcp_rmem="10240 87380 2147483647"'
salt '*' cmd.run 'sysctl -w net.ipv4.tcp_wmem="10240 87380 2147483647"'
salt '*' cmd.run 'sysctl -w net.core.netdev_max_backlog=250000'
#salt '*' cmd.run 'mlnx_tune -p HIGH_THROUGHPUT'
salt '*' cmd.run 'echo never > /sys/kernel/mm/transparent_hugepage/enabled'

salt 'sr650-*' cmd.run 'for i in `lsblk -oname`;do hdparm -W 1 /dev/$i;done'
salt 'sr650-*' cmd.run 'for i in `lsblk -oname`;do hdparm -A 1 /dev/$i;done'
#salt 'sr650-*' cmd.run 'for i in `lsblk -o name,model|grep SSDSC|cut -f1 -d" "`;do echo 4096 >/sys/block/$i/queue/read_ahead_kb;done'
#salt 'sr650-*' cmd.run 'for i in `lsblk -o name,model|grep SSDSC|cut -f1 -d" "`;do echo 512 >/sys/block/$i/queue/nr_requests;done'
salt 'loadgen*' cmd.run 'ethtool -A eth0 rx on;ethtool -A eth1 rx on'
salt 'loadgen*' cmd.run 'ethtool -G eth0 rx 4078 tx 4078;ethtool -G eth1 rx 4078 tx 4078'
for i in `cat osdnodes.lst`;do ssh root@$i 'for i in `ls /sys/block|grep -v "dm-"`;do echo "none" >/sys/block/$i/queue/scheduler;done';done
```

Salt State Used To Apply Kernel Tuning

```
dmb_kern_tune:
  file.replace:
    - name: /etc/default/grub
    - pattern: quiet.*
    - repl: splash=silent intel_idle.max_cstate=0 processor.max_cstate=0
idle=poll scsi_mod.use_blk_mq=1 mitigations=off"

grub2_mkconfig:
  cmd.run:
    - runas: root
    - name: grub2-mkconfig -o /boot/grub2/grub.cfg
    - onchanges:
      - file: dmb_kern_tune
```

Tuning The Cluster

Things To Try

- Increase OSD RAM allocation
- Disable logging
- Tune RGW
- Increase MDS Cache RAM
- In some situations, disable cephx authentication
- Erasure Coding algorithms

Ceph.conf General Section

```
debug ms=0
debug mds=0
debug osd=0
debug optracker=0
debug auth=0
debug asok=0
debug bluestore=0
debug bluefs=0
debug bdev=0
debug kstore=0
debug rocksdb=0
debug eventtrace=0
debug default=0
debug rados=0
debug client=0
debug perfcounter=0
debug finisher=0
```

Ceph.conf OSD Section

```
[osd]

osd_memory_target = 6442450944

osd_memory_cache_min = 4294967296

bluestore_min_alloc_size = 4096

osd_op_num_threads_per_shard = 5
```

MDS

Multiple Active MDS

Manual Pinning

```
ceph.conf
[mds]
mds_cache_memory_limit=17179869184 #16GB MDS Cache

[client]
client cache size = 16384 #16k objects is default number of inodes in
cache
client oc max objects =10000#1000 default
client oc size = 209715200 #200MB default, can increase
client permissions = true #default true, disable in limited exposure
environment
```

RGW

SUSE® Enterprise Storage Administration Guide Section 16.3

```
rgw thread pool size = 512 #default 100, increase for heavier load
rgw max chunk size = 4194304# default is 128k, increase to 4MB helps with larger objects
rgw_obj_stripe_size = 4194304 # (default 4M for luminous)
rgw_list_bucket_min_readahead = 4000 #(default 1000)
rgw_max_listing_results = 4000
rgw_cache_expiry_interval = 1800 #(default 900s)
rgw_enable_usage_log = false
rgw_enable_ops_log = false
rgw dynamic resharding = false
rgw override bucket index max shards = 50 # alternatively we reshard the bucket manually after
creation
rgw bucket index max aio = 16 # default 8
rgw cache lru size = 50000 #number of entries in the cache
rgw_gc_obj_min_wait = 21600 #in seconds(default 2_hr), decreasing will more actively purge objects
rgw gc processor period = 7200 #(default 1hr, decreasing more actively purges deletion)
rgw objexp gc interval = 3600 # default 10_min, we dont run swift objexp. so no need to run this
objecter inflight op bytes = 1073741824 # default 100_M, this is 1GB
objecter inflight ops = 24576
```

Cache Tiering

SSD/NVME in-front of spinners

- Ensure the working set fits within tier
- Good for workloads like media editing

SUSE Enterprise Storage Administration Guide section 14

Client Tuning

Client Stuff

Bad hardware choices can’t be fixed by software

Performance Thieves:

- Anti-virus
- Resource Competition
- Routed Connections
- Power saving tech

RBD

- Client-side write caching (write-back, write-through)
- Client-side read-ahead caching
- SUSE® Enterprise Storage Admin Guide is a good reference
- https://documentation.suse.com/ses/6/single-html/ses-admin/#rbd-cache-settings
- multi-queue block I/O

CephFS

There are the settings we did on the cluster side that affect clients

Mount options – understand the implications first

- noacl
- nocrc
- noatime
- nodiratime

Wrapping Up

Many Knobs

There are lots of things to watch and many knobs to twist

- Be methodical
- Record your results
- Share the knowledge

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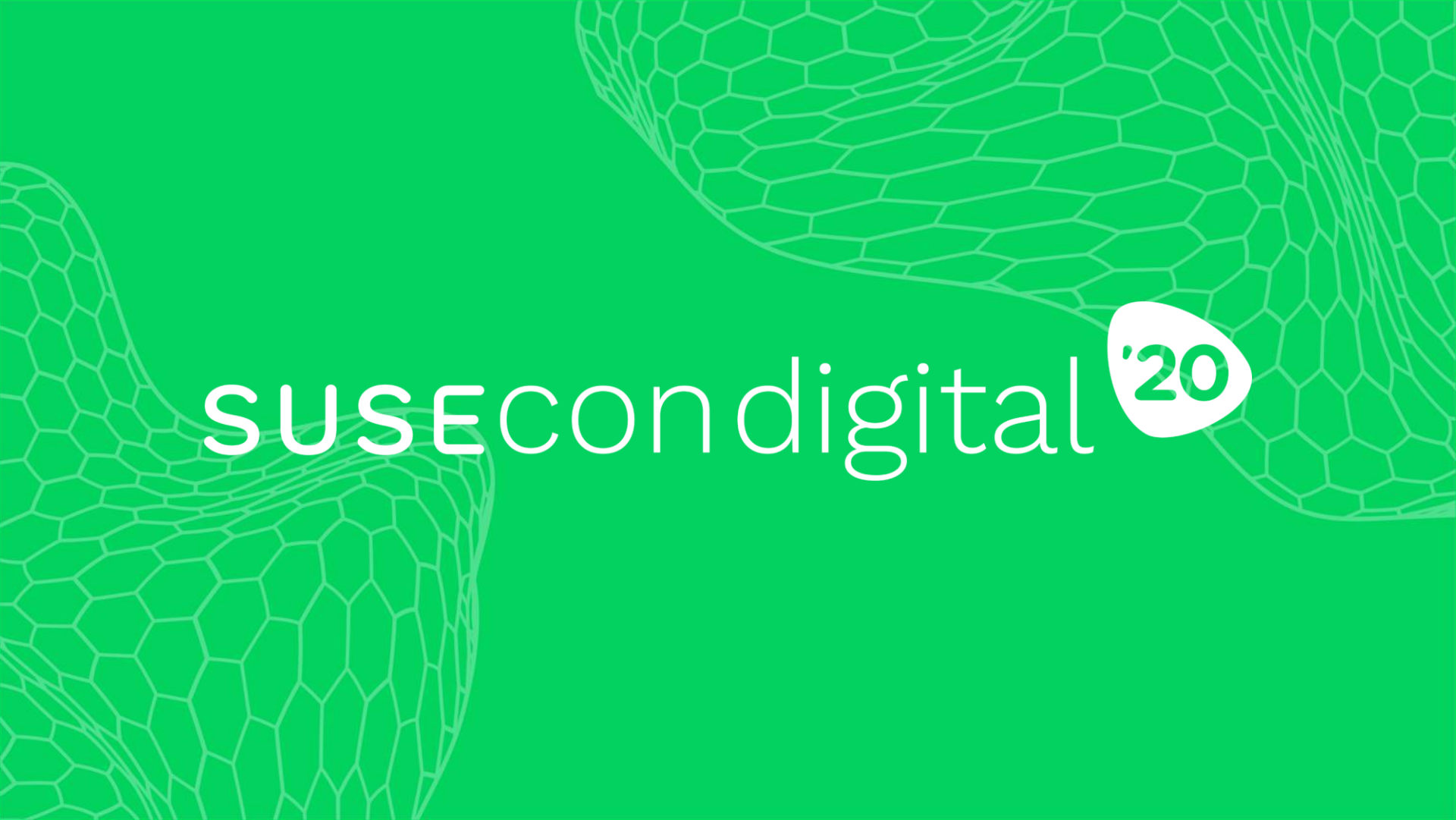
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