CeTune -- Benchmarking and tuning your Ceph cluster

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CeTune Overview

- What is CeTune?
  - CeTune is a toolkit/framework to deploy, benchmark, analyze and tuning ceph.

- CeTune's objective?
  - For beginners: Shorten landing time of Ceph based storage solution.
  - For performance engineer: Simplify the procedure to deploy, tune ceph, easily finding device bottlenecks, identify unexpected software behavior from processed data.
  - For Developers: Providing an easy way to verify codes with a quick stress test and a clear performance report.

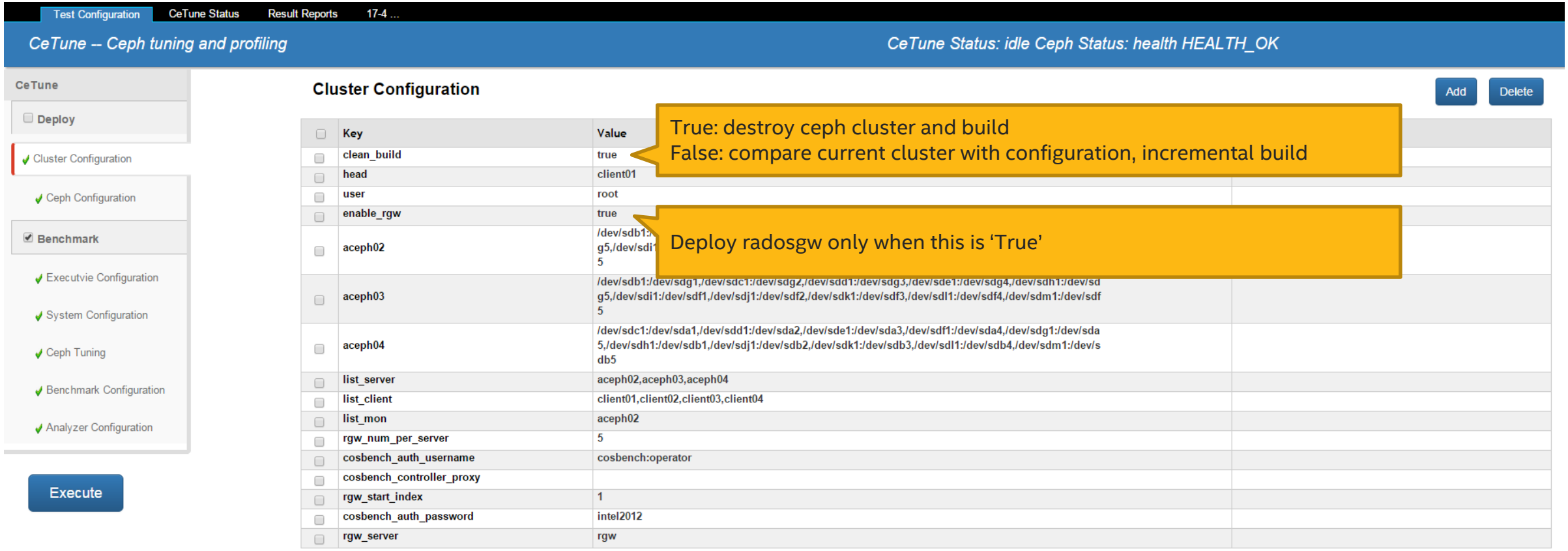
CeTune is open sourced today!!

- Github:
  - https://github.com/01org/CeTune
- License:
  - Apache License v2.0
- Main feature:
  - Manage CeTune Configuration and Execute CeTune with Webui
  - Deploy module: install ceph with CeTune Cli, deploy ceph with Webui
  - Benchmark module: support qemurbd, fiorbd, cosbench
  - Analyzer module: support iostat, sar, interrupt, performance counter
  - Report Visualize: Support Config download, csv download, all data present by line chart.
- Maillist:
  - maillist: cephperformance@lists.01.org
  - Subscribe maillist: https://lists.01.org/mailman/listinfo/cephperformance

CeTune Functionality Details

CeTune WebUI

- Configuration view: In this view, user can add cluster description, ceph configuration, benchmark testcase, etc. Then click 'Execute' to kickoff CeTune.



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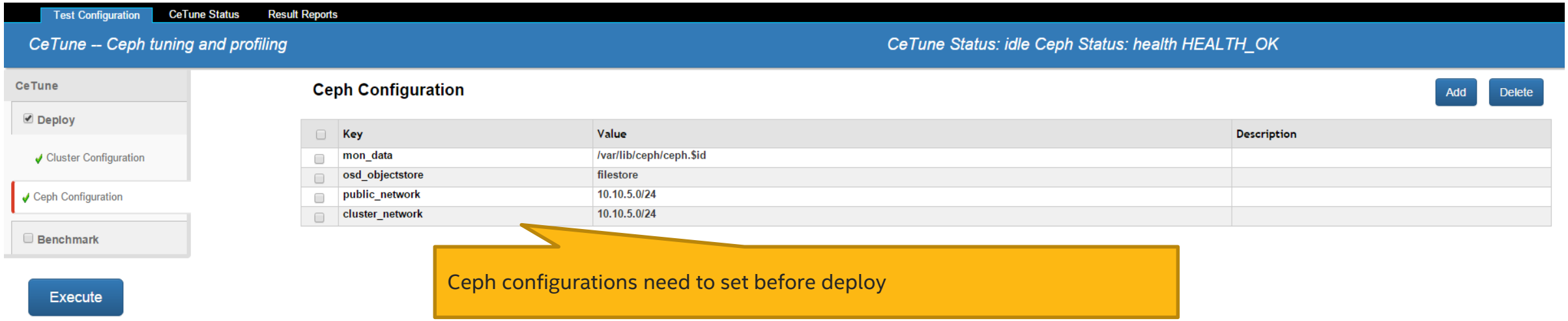

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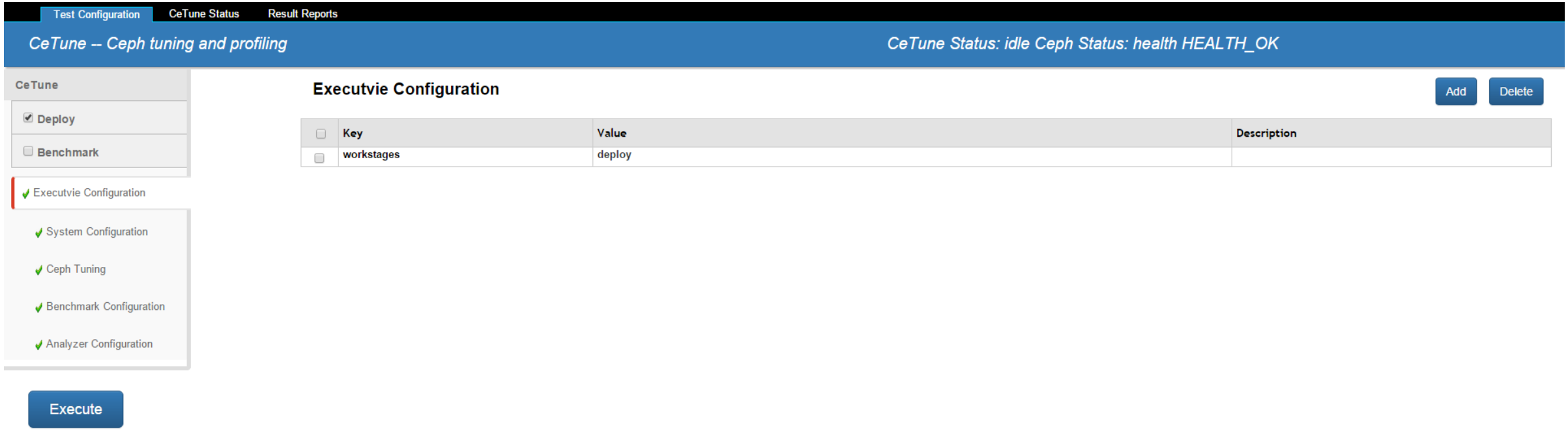

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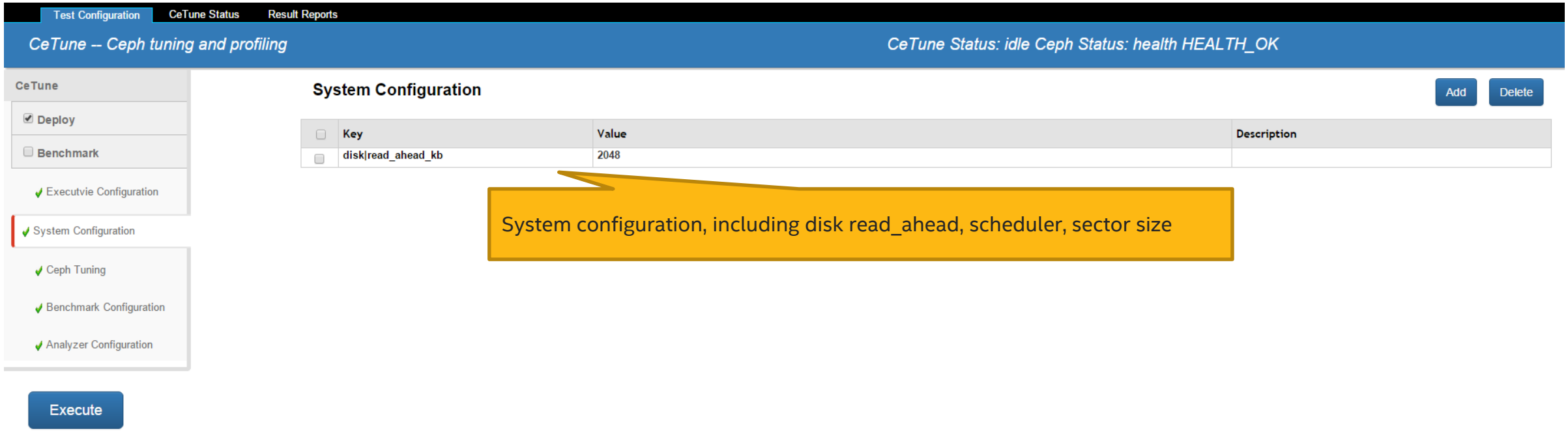

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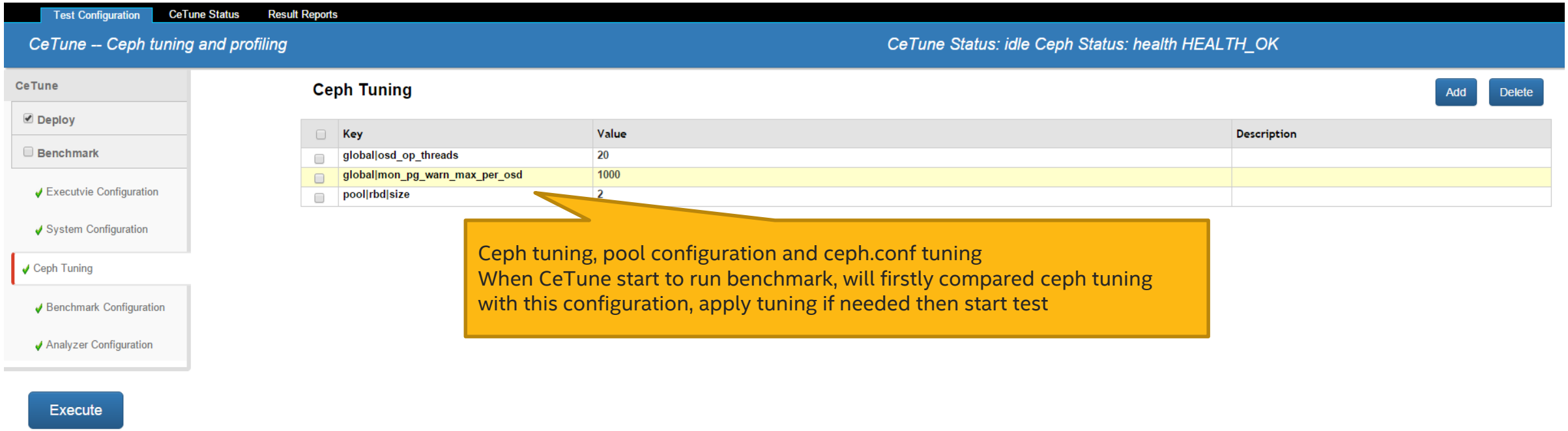

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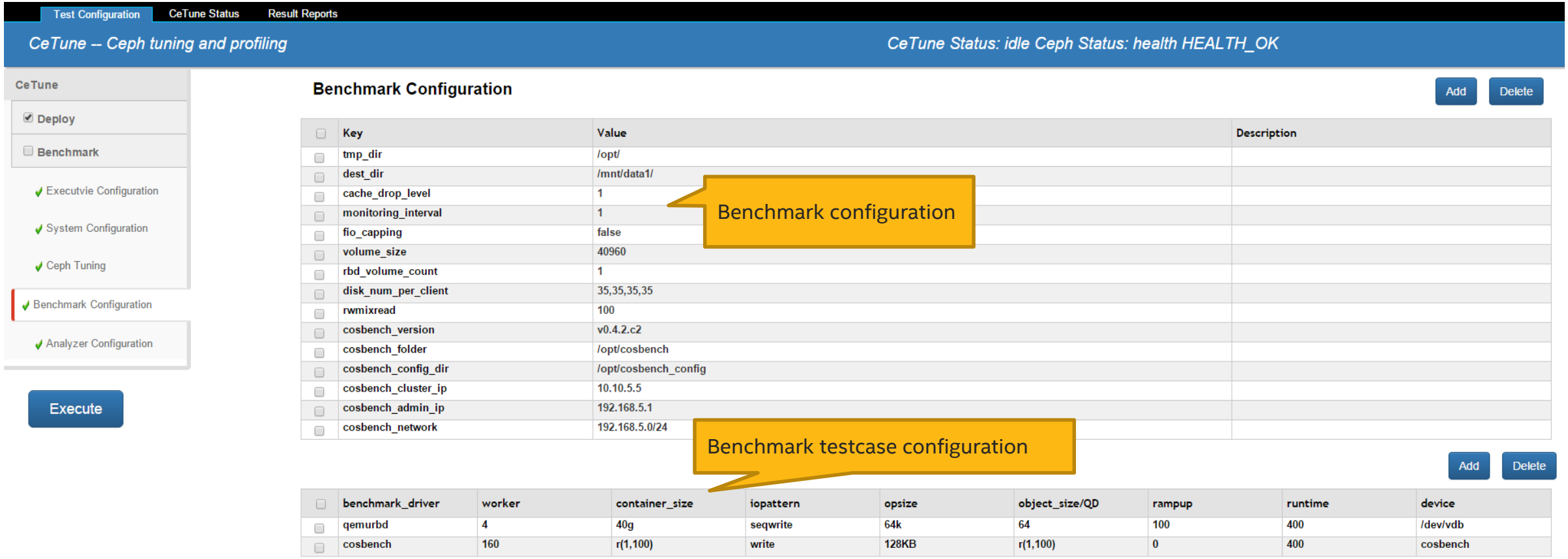

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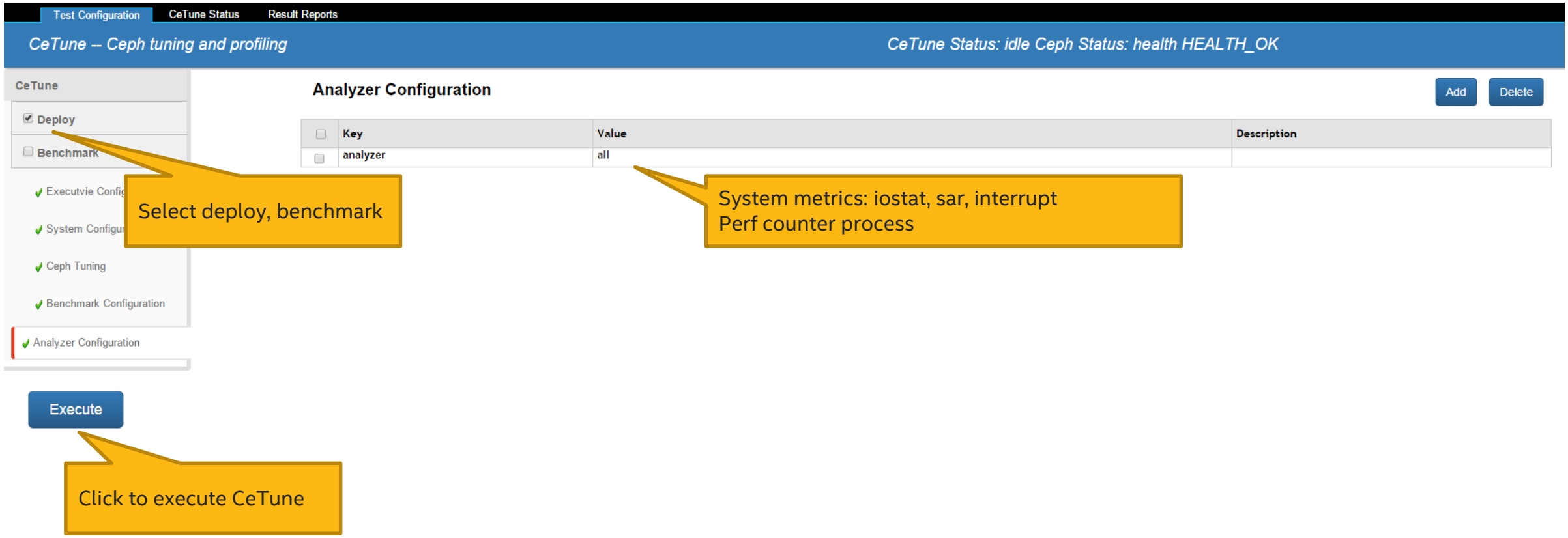


CeTune WebUI

- Status Monitoring View: Reports current CeTune working status, so user can interrupt CeTune if necessary.

CeTune WebUI

- Reports view: Result report provides two report view, summary view shows history report list, double click to view the detail report of one specific test run.

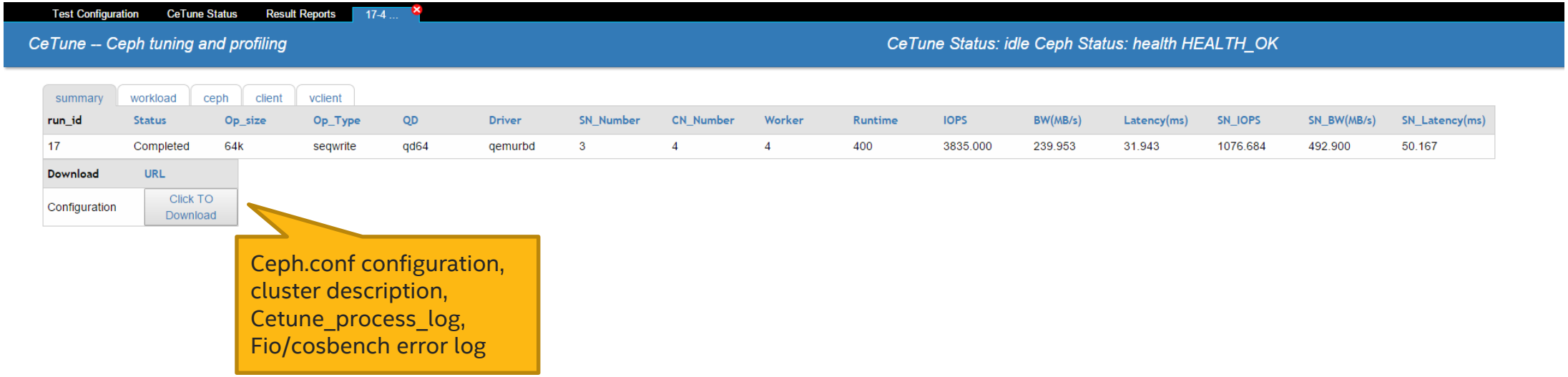
Test Configuration | CeTune Status | Result Reports

CeTune -- Ceph tuning and profiling — *CeTune Status:idle Ceph Status: HEALTH_OK*

runid	Status	Op_Size	Op_Type	QD	Driver	SN_Number	CN_Number	Worker	Runtime(sec)	IOPS	BW(MB/s)	Latency(ms)	SN_IOPS	SN_BW(MB/s)	SN_Latency(ms)
2	completed	512k	seqwrite	qd8	fiorbd	2	1	1	100	169.000	84.888	47.020	376.830	168.075	221.487
7	Interrupted	512k	seqwrite	qd8	fiorbd	2	1	1	100	0.000	0.000	0.000	312.606	142.987	325.264
8	Completed	512k	seqwrite	qd8	fiorbd	2	1	1	100	178.000	89.465	44.610	392.480	175.547	88.852
20	Interrupted	512k	seqwrite	qd8	fiorbd	2	1	1	60	0.000	0.000	0.000	332.069	140.860	175.668
21	Completed	512k	seqwrite	qd8	qemurbd	2	1	1	60	86.000	43.443	91.960	184.300	84.086	55.742
22	Completed	64k	seqwrite	qd64	qemurbd	2	1	1	100	1071.000	66.986	59.680	297.290	132.146	109.619
23	Unknown	64k	seqwrite	qd64	qemurbd	2	1	1	100	0.000	0.000	0.000	284.547	126.603	132.696
24	Completed	64k	seqwrite	qd64	qemurbd	2	1	2	100	1112.000	69.513	57.510	306.850	137.110	287.760
26	Completed	64k	seqwrite	qd64	qemurbd	2	1	1	100	1070.000	66.876	59.790	298.393	132.360	172.425
27	Completed	512k	seqwrite	qd8	fiorbd	2	1	1	100	167.000	83.585	47.750	385.080	164.420	171.115
29	Completed	64k	seqwrite	qd64	qemurbd	2	1	1	100	1132.000	70.779	56.490	317.650	140.303	61.132
30	Unknown	64k	seqwrite	qd64	qemurbd	2	1	1	100	0.000	0.000	0.000	210.434	102.087	56.139
31	Unknown	512k	seqwrite	qd8	qemurbd	2	1	1	100	0.000	0.000	0.000	176.449	80.089	62.904
34	Completed	512k	seqwrite	qd8	generic	2	1	1	100	353.000	176.767	22.550	0.000	0.000	0.000
35	Unknown	512k	seqwrite	qd8	generic	2	1	2	100	0.000	0.000	0.000	0.000	0.000	0.000
36	Interrupted	512k	write	qd8	fiorbd	2	1	1	100	0.000	0.000	0.000	375.862	169.453	191.704
38	Completed	64k	seqwrite	qd64	qemurbd	2	1	1	100	1148.000	71.759	55.720	316.040	142.924	144.671
40	Completed	64k	seqwrite	qd64	qemurbd	2	1	1	100	1132.000	70.753	56.510	306.370	139.551	127.109
41	Completed	64k	seqwrite	qd64	qemurbd	2	1	1	100	1137.000	71.095	56.230	312.200	140.228	150.494

CeTune WebUI

- Reports view: Result report provides two report view, summary view shows history report list, also user can view the detail report of one specific testrun.



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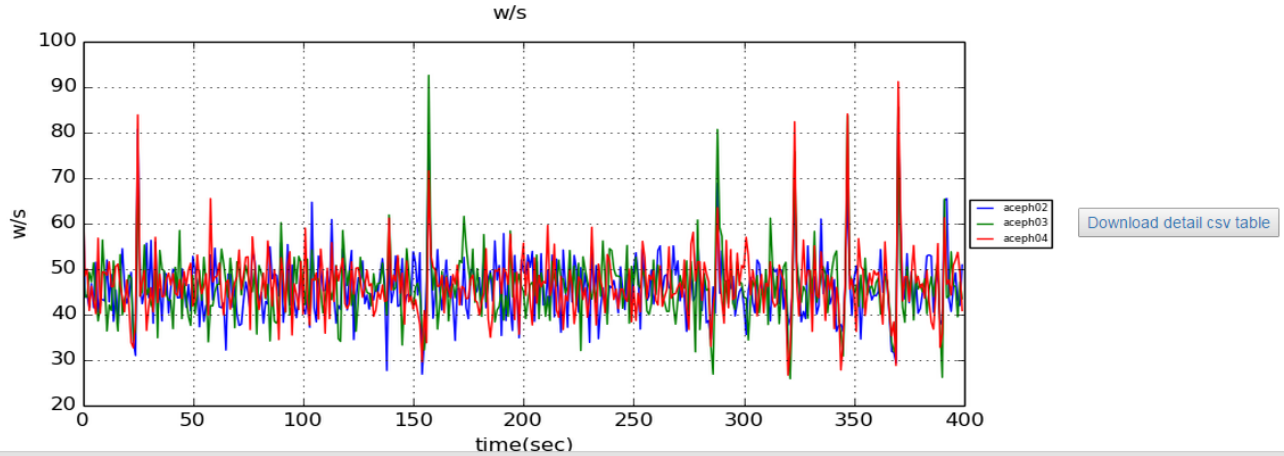
Test Configuration | CeTune Status | Result Reports | 17-4 ...

CeTune -- Ceph tuning and profiling — *CeTune Status: idle Ceph Status: health HEALTH_OK*

summary | workload | ceph | client | vclient

cpu	%usr	%nice	%sys	%iowait	%steal	%irq	%soft	%guest	%gnice	%idle
aceph02	12.093	0.000	5.324	6.197	0.000	0.000	0.419	0.000	0.000	75.966
aceph03	12.024	0.000	5.300	5.915	0.000	0.000	0.409	0.000	0.000	76.350
aceph04	12.041	0.000	5.340	6.387	0.000	0.000	0.416	0.000	0.000	75.815

journal	rrqm/s	wrqm/s	r/s	w/s	rMB/s	wMB/s	avgrq-sz	avgqu-sz	await	r_await	w_await	svctm	%util	disk_num
aceph02	0.000	0.000	0.000	45.990	0.000	16.037	707.382	0.125	2.698	0.000	2.698	0.828	3.854	10
aceph03	0.000	0.000	0.000	46.221	0.000	16.133	705.696	0.126	2.693	0.000	2.693	0.828	3.877	10
aceph04	0.000	0.000	0.000	46.568	0.000	16.235	707.856	0.127	2.710	0.000	2.710	0.835	3.923	10



memory	kbmemfree	kbmemused	%memused	kbbuffers	kbcached	kbcommit	%commit	kbactive	kbinact	kbdirty

CeTune WebUI

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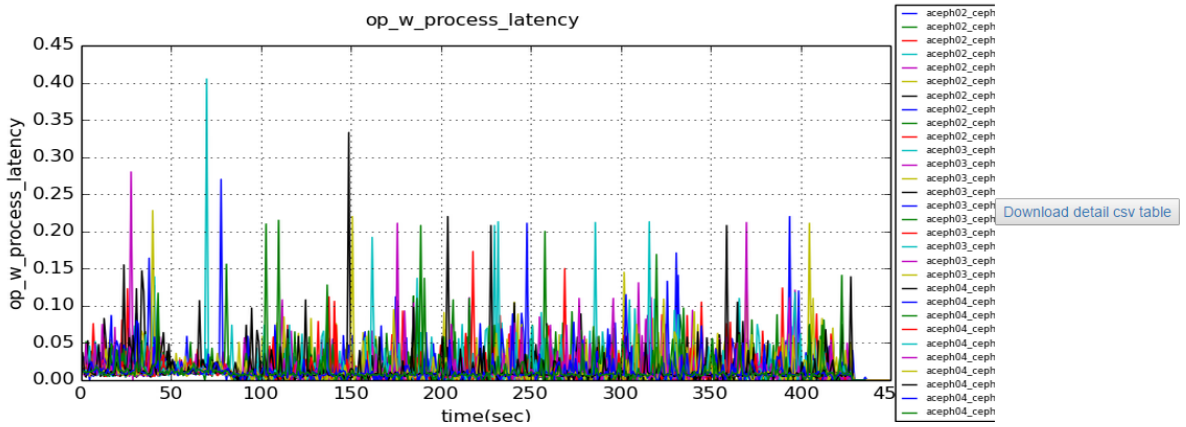
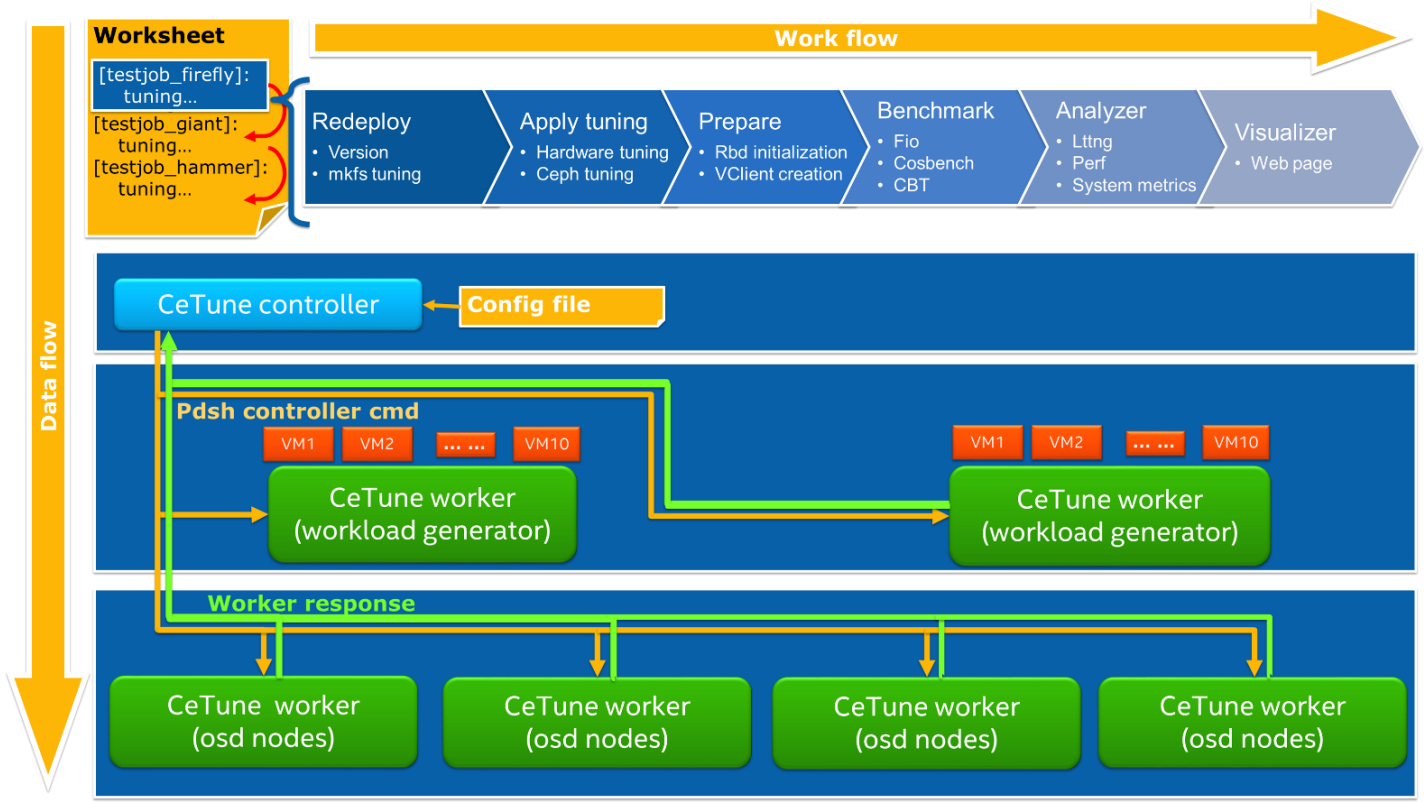
aceph03_ceph-osd.19.asok.txt	0.008	3531.069	0.014	0.006	3795651289.865	0.010	5059.379	2730152369.805	0.010	446.163	0.010	419.004	18294389056.989	981215950527.011	0.014	0.141	0.008	2730152369.805	3795654199.865	
aceph04_ceph-osd.20.asok.txt	0.008	4410.479	0.016	0.012	4404588884.418	0.011	5917.356	3486973172.977	0.012	470.327	379.880	22254882107.450	977255457476.550	0.016	0.158	0.008	3486973172.977	4404593045.418	5942.356	
aceph04_ceph-osd.21.asok.txt	0.008	5153.612	0.017	0.005	4596548937.100	0.010	6138.454	4012276479.039	0.012	480.097	0.012	382.084	22845696210.542	976664643373.458	0.017	0.169	0.008	4012276479.039	4596556645.100	
aceph04_ceph-osd.22.asok.txt	0.008	3958.550	0.017	0.003	4201536667.594	0.012	5514.349	3049298998.795	0.012	476.109	0.012	381.998	19809480176.699	979700859407.301	0.017	0.144	0.008	3049298998.795	4201548329.594	
aceph04_ceph-osd.23.asok.txt	0.016	976786960289.185	0.009	22723379294.815	4859209670.256	644384.767	0.011	0.009	0.000	0.116	3630543254.984	4859209670.256	644384.767	6488.557	157.274	0.012	0.016	4710.205	0.000	
aceph04_ceph-osd.24.asok.txt	0.008	4480.386	0.019	0.014	4706469669.701	0.013	6345.267	3413317172.212	0.014	492.048	380.872	21340181957.246	978170157626.754	0.019	0.131	0.008	3413317172.212	4706472882.701	6364.267	
aceph04_ceph-osd.25.asok.txt	0.017	977667332234.443	0.008	21843007349.557	4206734080.694	646569.087	0.011	0.008	0.000	0.158	3699564277.425	4206730109.694	644930.087	5563.893	162.388	0.013	0.017	4731.103	0.000	
aceph04_ceph-osd.26.asok.txt	0.008	4406.525	0.017	0.010	4337477703.936	0.012	5832.169	3457001486.742	0.013	476.337	0.013	380.959	20886391929.169	978623947654.831	0.017	0.151	0.008	3457001486.742	4337496634.936	
aceph04_ceph-osd.27.asok.txt	0.008	4569.429	0.017	0.006	4285844221.959	0.011	5715.852	3529147986.144	0.012	444.870	0.012	382.538	22017680887.646	977492658696.354	0.017	0.139	0.008	3529147986.144	4285844221.959	
aceph04_ceph-osd.28.asok.txt	0.008	4589.651	0.016	0.009	3950713229.516	0.011	5274.292	3545602719.571	0.011	407.850	0.011	379.553	20827125038.873	978683214545.127	0.016	0.176	0.008	3545602719.571	3950716412.516	
aceph04_ceph-osd.29.asok.txt	0.008	3876.790	0.018	0.013	3988665263.824	0.012	5171.034	3031876963.952	0.013	426.211	380.762	19200876113.346	980309463470.654	0.018	0.133	0.008	3031876963.952	3988673399.824	5216.034	



CeTune Internal

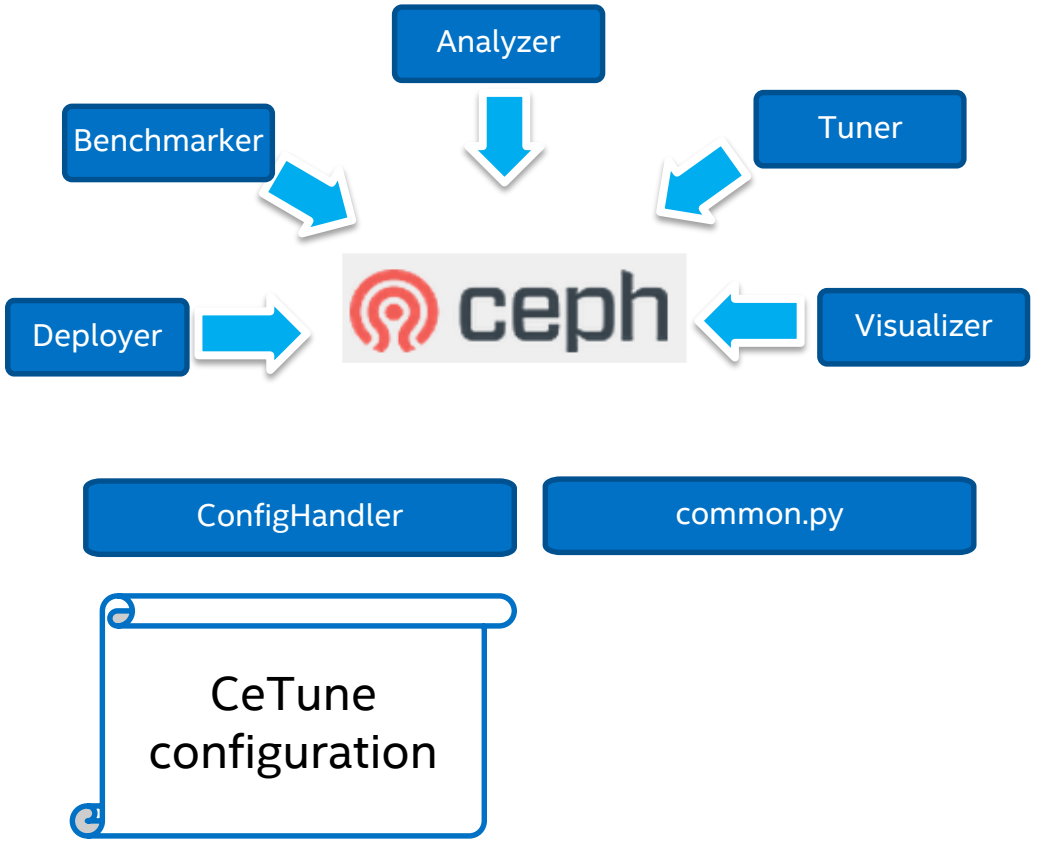
Terms definition

- Cetune controller
  - reads config files and controls the process to deploy, benchmark and analyze the collected data;
- Cetune workers
  - controlled by CeTune controller working as workload generator, system metrics collector.
- CeTune Configuration files
  - all.conf
  - tuner.conf
  - testcase.conf



Modules

- Deployment:
  - clean build, incremental build
  - ceph cluster, radosgw
- Benchmark:
  - qemurbd, fiorbd, cosbench
  - seqwrite, seqread,randwrite,randread, mixreadwrite
- Analyze:
  - System_metrics: iostat, sar, interrupt
  - Performance_counter
  - Latency_breakdown (WIP)
  - Output as a json file
- Tuner:
  - ceph tuning after comparing
  - pool tuning
  - disk tuning
  - Other System Tuning?
- Visualizer:
  - Read from json file
  - Output as html



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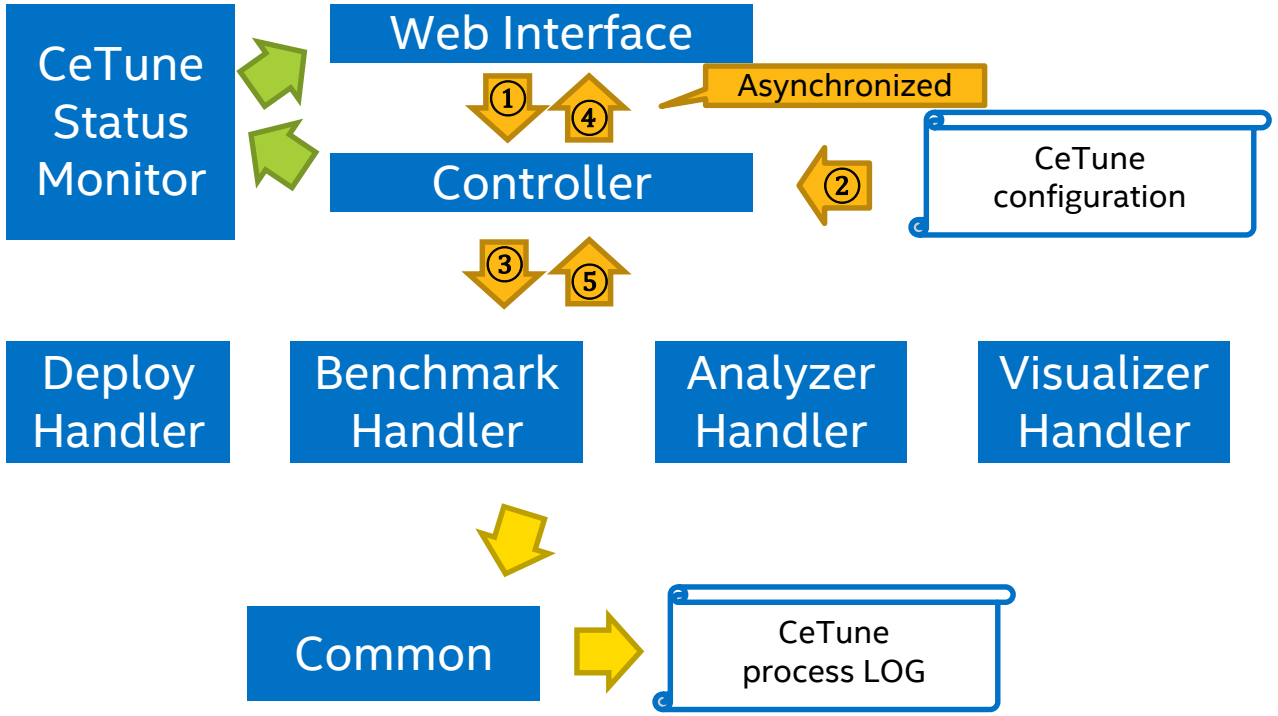


Deployment

- Ceph Package installation:
  - Use ceph-deploy to do installation.
  - Check and maybe reinstall nodes defined in CeTune description file to make sure all nodes under same Ceph Major release.
    - Ex: if some nodes are 0.94.3, some are 0.94.2 won't reinstall 0.94.2 nodes

- Deployment:
  - Clean_build: Remove current osd, mon, and radosgw then deploy ceph cluster from zero.
  - Incremental_build(Non clean build): compare current ceph cluster with desired configuration, then add osd devices, new node, radosgw daemon if necessary.

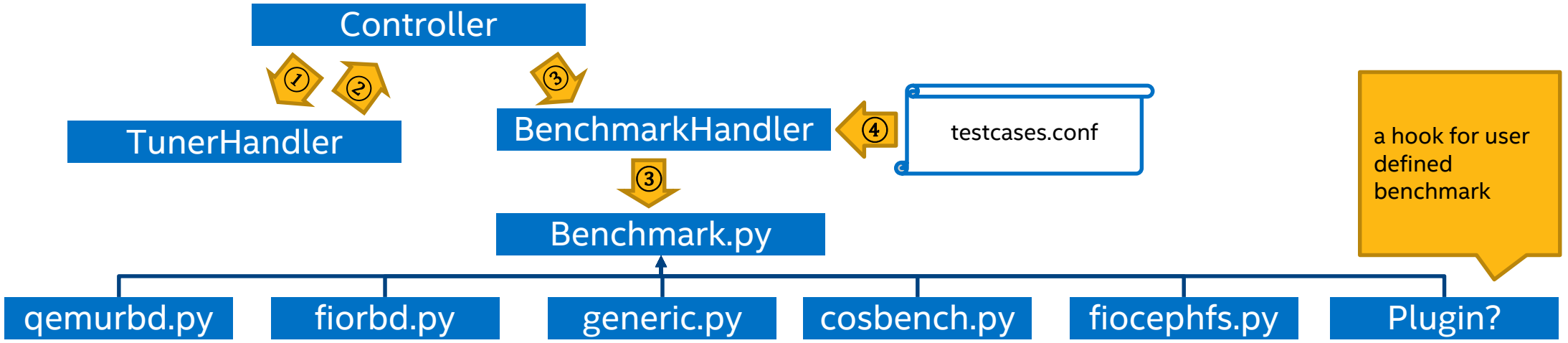
DeployHandler

Deploy.py

Deploy_rgw.py

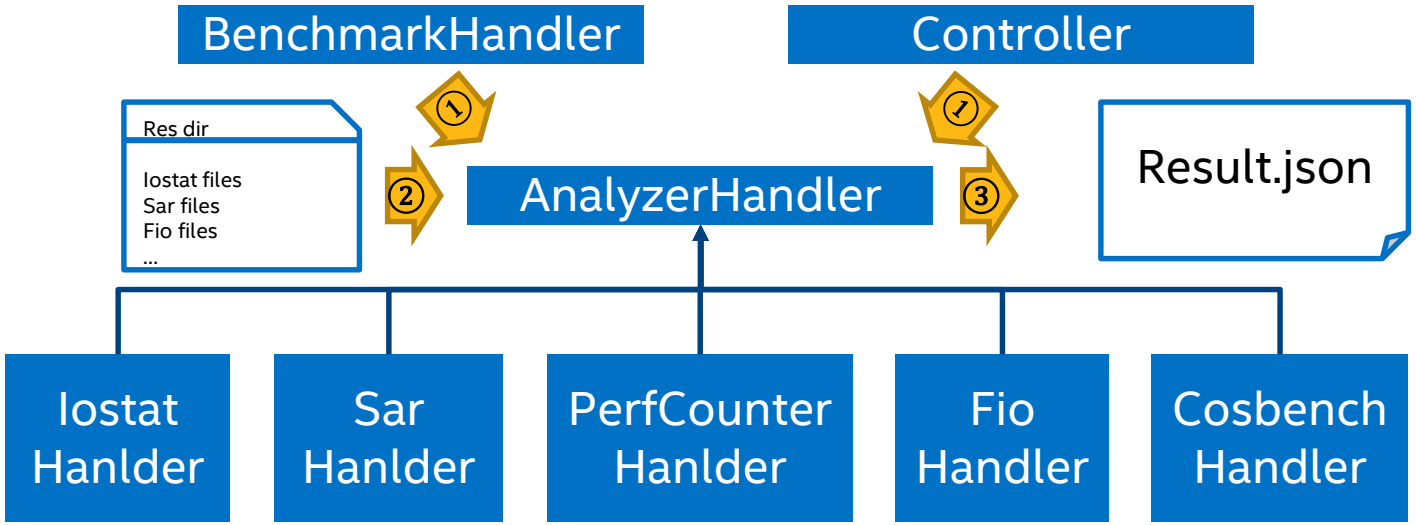
Benchmark

- RBD
  - Fio running inside VM, fio-rbd engine
- Cosbench
  - Adopts Radosgw to test object
- Cephfs
  - Fio cephfs engine(not recommend, will working on a more generic benchmark at CeTune v2)
- Generic devices
  - Distribute Fio test job to multi nodes multi disks.



Analyzer

- System metrics:
  - iostat: partition
  - Sar: cpu, mem, nic
  - Interrupt
  - Top: raw data
- Performance counter:
  - Indicates software behavior
  - Stable and well format in ceph codes
  - Well supported in cetune



- Lttng(blkin):
  - Better reveal of code path
  - Current lttng codes lack of an uniform identifier to mark one op, but doable by chaining thread id and object id.
  - Blkin branch is not merged to ceph master by now.
  - Not fully supported in CeTune, but have experience on visualize/process blkin lttng data, and able to help.

Visualizer

- Read from result.json
- Output as html

Result.json

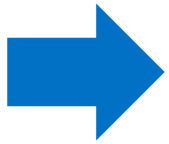
tab

table

row

colume, data

```
  1 {
  2    "summary": {
  3       "run_id": {
  4          "2": {
  5             "Status": "Completed\n",-
  6             "Op_size": "64k",-
  7             "Op_Type": "seqwrite",-
  8             "QD": "qd64",-
  9             "Driver": "qemurbd",-
 10              "SN_Number": 3,-
 11              "CN_Number": 4,-
 12              "Worker": "20",-
 13              "Runtime": "100",-
 14              "IOPS": "12518.000",-
 15              "BW(MB/s)": "782.922",-
 16              "Latency(ms)": "102.758",-
 17              "SN_IOPS": "3687.939",-
 18              "SN_BW(MB/s)": "1556.812",-
 19              "SN_Latency(ms)": "50.789"
 20           }
 21       },-
 22       "Download": {}
 27    },-
 28    "workload": {},-
292    "ceph": {},-
138624 "client": {},-
150080 "vclient": {},-
227790 "runtime": 100,-
227791 "status": "Completed\n",-
227792 "session_name": "2-20-qemurbd-seqwrite-64k-qd64-40g-0-100-vdb"
227793 }
```



Test Configuration | CeTune Status | Result Reports | 17-4 ...

CeTune -- Ceph tuning and profiling

summary | workload | ceph | client | vclient

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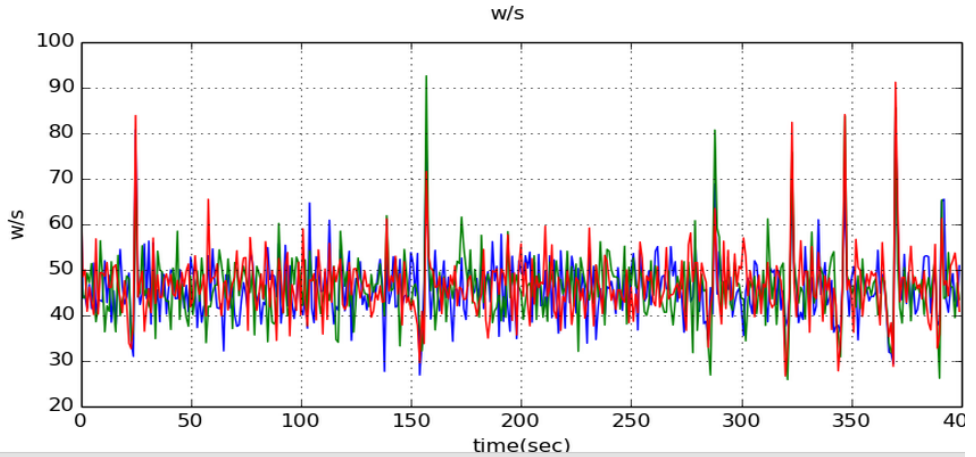
aceph03	12.024	0.000	5.300	5.915	0.000	0.000	0.409
aceph04	12.041	0.000	5.340	6.387	0.000	0.000	0.416

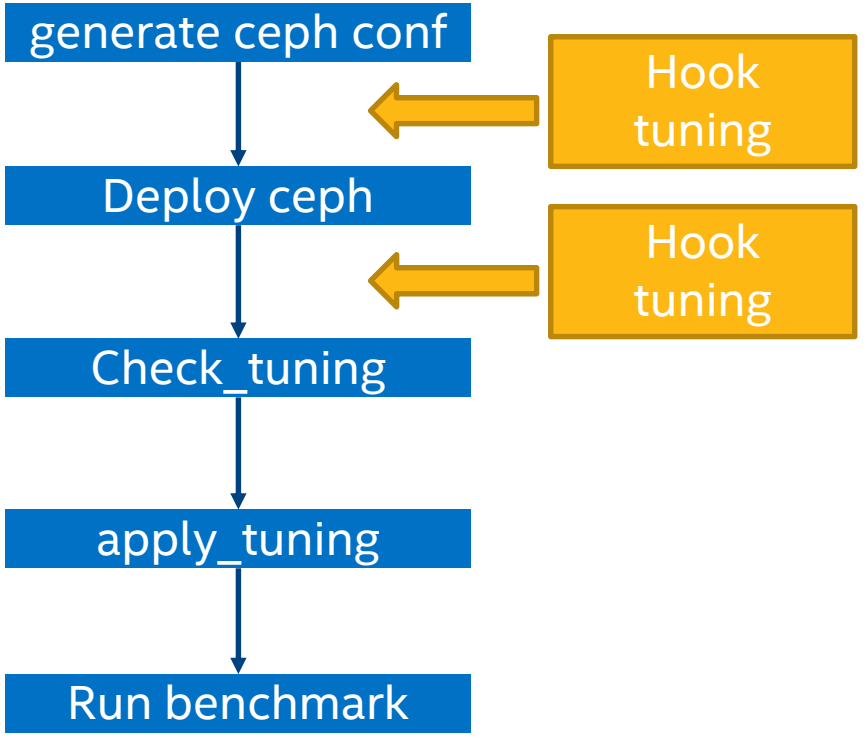
journal	rrqm/s	wrqm/s	r/s	w/s	rMB/s	wMB/s	avgrq-sz
aceph02	0.000	0.000	0.000	45.990	0.000	16.037	707.382
aceph03	0.000	0.000	0.000	46.221	0.000	16.133	705.696
aceph04	0.000	0.000	0.000	46.568	0.000	16.235	707.856



memory	kbmemfree	kbmemused	%memused	kbbuffers	kbcached	kbcommit	%commit

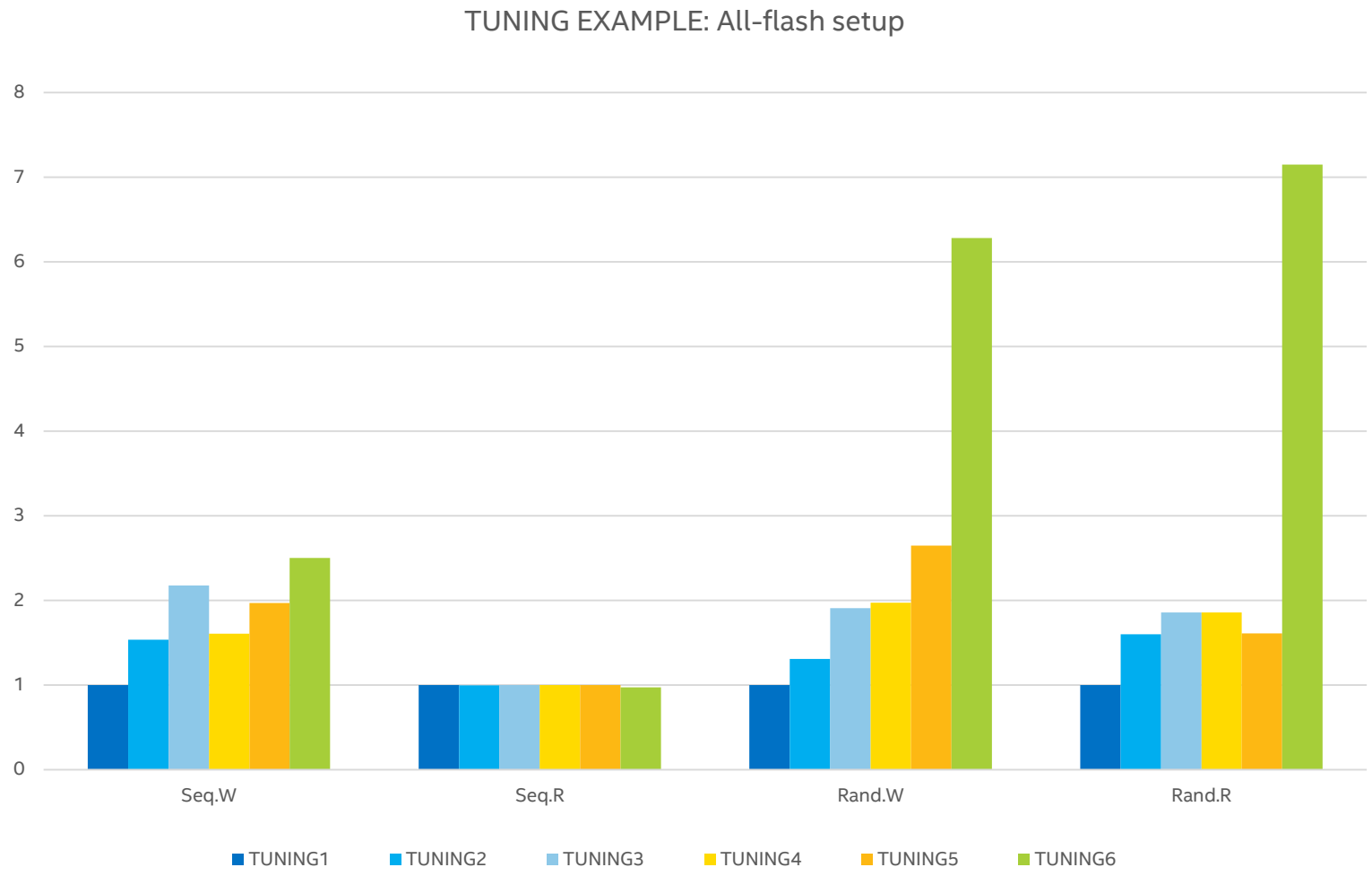
Tuning

- Current CeTune Supports:
  - POOL tuning
  - Ceph.conf tuning
    - Debug to 0
    - Op_thread_num
    - Xattr size
    - Etc.
  - Disk tuning
- To be extend:
  - Mount omap to a separate device
  - Multi osd daemons on one physical device
  - Adopting flashcache device as osd
  - Multi pools ?

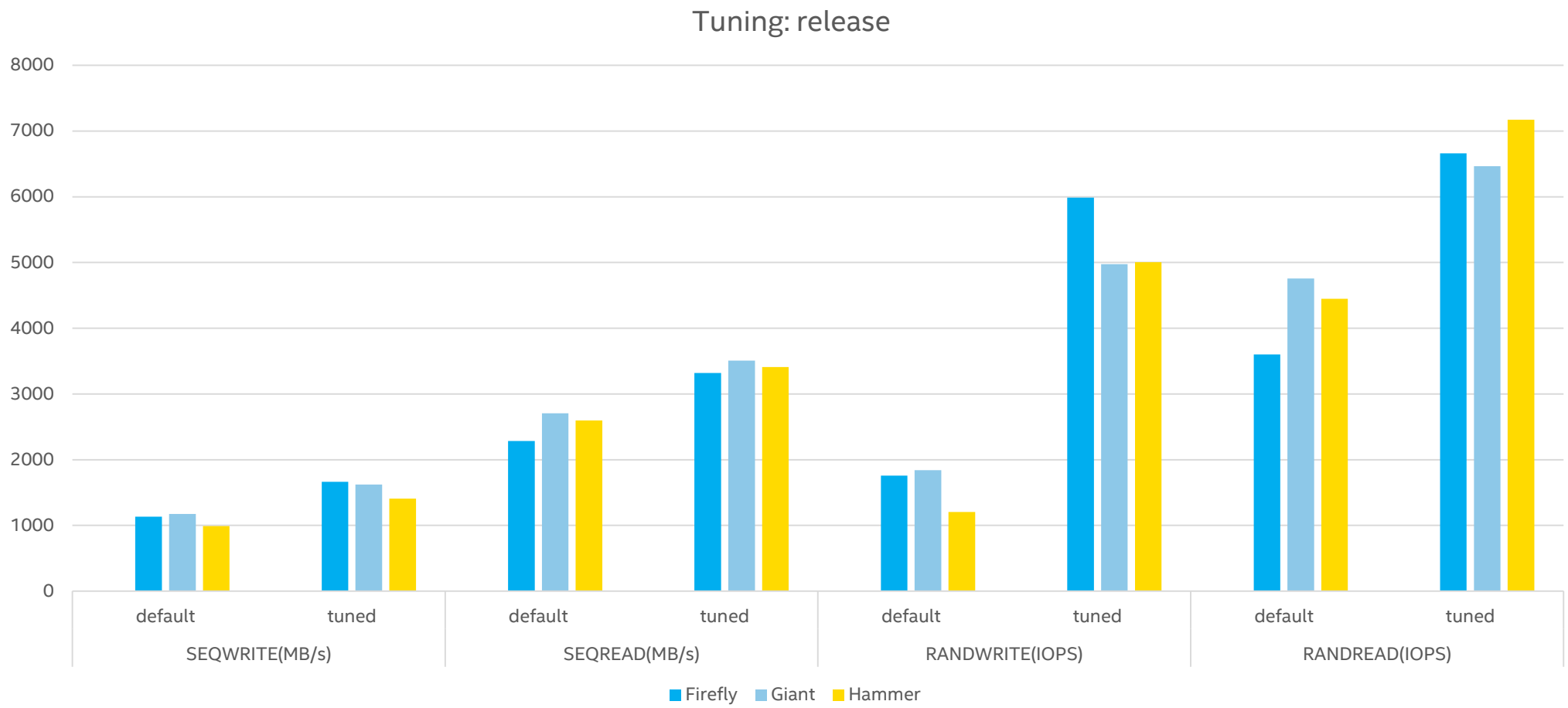


Tuning(All flash Setup)

Case	Tuning Items
TUNING1	Default
TUNING2	2 OSD instances running on 2 partitions of same SSD
TUNING3	Case-2 + Set debug log to 0
TUNING4	Case-3 + Set throttle values to 10x of default value
TUNING5	Case-4 + disable RBD cache, OPtracker, tuning FD cache size to 64
TUNING6	Case-5 + Replace Tcmalloc with Jemalloc



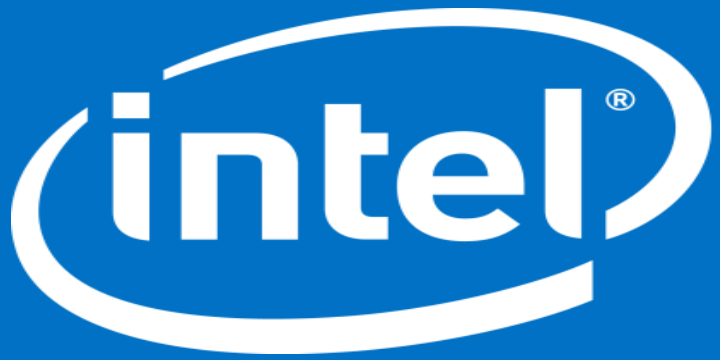
Tuning(releases)



Next Step

Next step

- Benchmark:
  - Cephfs benchmark - vdbench
  - Third party workload hook
- Failover test
- Analyzer:
  - BLKIN(lttng support) support
- Tuning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Backup

All Flash Setup Configuration Details

Client Cluster	
CPU	Intel(R) Xeon(R) CPU E5-2699 v3 @ 2.30GHz 36C/72T
Memory	64GB
NIC	10Gb
Disks	1 HDD for OS

Ceph Cluster	
CPU	Intel(R) Xeon(R) CPU E5-2699 v3 @ 2.30GHz 36C/72T
Memory	64 GB
NIC	10GbE
Disks	4 x 400 GB DC3700 SSD (INTEL SSDSC2BB120G4) each cluster

Ceph cluster	
OS	Ubuntu 14.04.2
Kernel	3.16.0
Ceph	0.94.2

Client host	
OS	Ubuntu 14.04.2
Kernel	3.16.0

- *Ceph version is 0.94.2*
- **XFS** as file system for Data Disk
- 4 partitions of each SSD and two of tem for OSD daemon
- replication setting (2 replicas), **2048 pgs/OSD**

Tuning release Configuration Details

Ceph Nodes	
CPU	1 x Intel Xeon E3-1275 V2 @ 3.5 GHz (4-core, 8 threads)
Memory	32 GB (4 x 8GB DDR3 @ 1600 MHz)
NIC	1 X 82599ES 10GbE SFP+, 4x 82574L 1GbE RJ45
HBA/C204	{SAS2008 PCI-Express Fusion-MPT SAS-2} / {6 Series/C200 Series Chipset Family SATA AHCI Controller}
Disks	1 x INTEL SSDSC2BW48 2.5" 480GB for OS 1 x Intel P3600 2TB PCI-E SSD (Journal) 2 x Intel S3500 400GB 2.5" SSD as journal 10 x Seagate ST3000NM0033-9ZM 3.5" 3TB 7200rpm SATA HDD (Data)

Client Nodes	
CPU	2 x Intel Xeon E5-2680 @ 2.8Hz (20-core, 40 threads) (Qty: 3)
Memory	128 GB (8GB * 16 DDR3 1333 MHZ)
NIC	2x 10Gb 82599EB, ECMP (20Gb), 64 GB (8 x 8GB DDR3 @ 1600 MHz)
Disks	1 HDD for OS

Client VM	
CPU	1 X VCPU VCPUPIN
Memory	512 MB

Ceph cluster	
OS	Ubuntu 14.04
Kernel	3.16.0

Client host	
OS	Ubuntu 14.04
Kernel	3.13.0

Client VM	
OS	Ubuntu 12.10
Kernel	3.5.0-17