

# Decoupling Storage from Compute in Apache Hadoop\* with Ceph\*

An eye opening possibility for big-data storage emerges with a new proof-of-concept built on Intel® technologies, Quanta Cloud Technology (QCT) hardware, and Ceph.



Most organizations need to keep expanding their storage capacities in response to persistent data growth. But for many large companies, it can be challenging to efficiently acquire resources to meet the growing storage needs. If the data footprint of a large enterprise already approaches petabyte levels, even a low rate of annual data storage growth can amount to an increase of hundreds of terabytes every year. At such a scale, any inefficiencies in capital expenditures (CapEx) and resource allocation are greatly magnified.

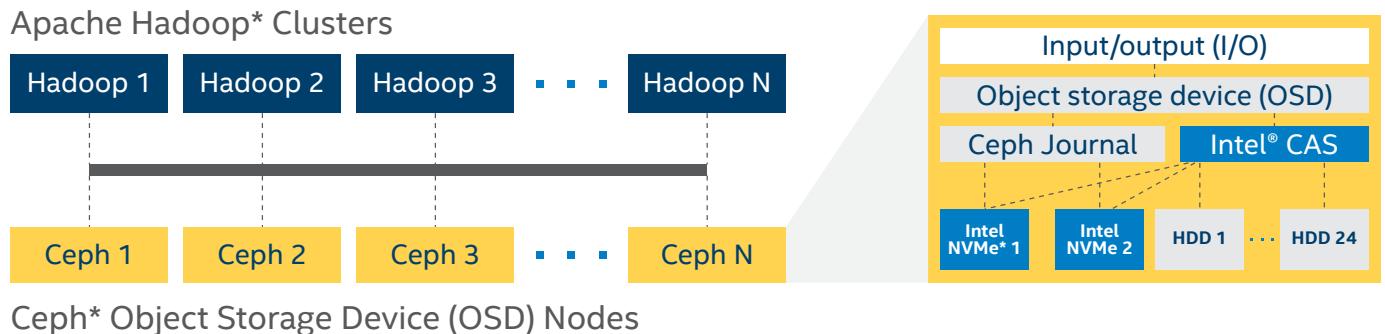
## Inefficiencies of Scaling Hadoop

When it comes to acquiring storage capacity, IT decision makers commonly choose to archive data in Hadoop Distributed File System\* (HDFS\*) so that they can perform analytics and gain business-relevant insights from that data. The problem? Storage and compute resources in Apache Hadoop\* are bound together, so when organizations acquire more Hadoop storage, they end up purchasing compute resources that they might not need. Over time, these purchasing habits lead to more and more compute capacity going unused, which is a waste of processing cycles and IT spending.

Acquiring Hadoop storage is also inefficient in another important respect: Hadoop storage can be used only for Hadoop workloads. If a company needs storage for other types of workloads, the company needs to purchase additional capacity dedicated to storage technologies other than HDFS.

## Advantages to Disaggregating Compute and Storage in Hadoop

Hadoop and HDFS were originally designed with direct-attached storage (DAS) in mind. But if it were possible to separate Hadoop compute and storage, enterprises could be more agile and flexible in responding to customer needs, and they could reduce operational expenditures (OpEx) and CapEx. For example, compute servers could be virtualized to provide faster deployments, enhanced security, and multitenancy. Disaggregating storage and compute could also allow companies to scale these resources independently and purchase only what they need of each.



Ceph\* Object Storage Device (OSD) Nodes

**Figure 1.** Logical configuration for the Apache Hadoop\* and Ceph\* solution

## Advantages of Ceph as a Storage Solution

Ceph is an open-source software platform designed to provide a unified, scale-out storage solution on commodity hardware for object, block, and file-based data. Ceph is free, and it can therefore provide a cost-effective storage solution that can support many different workloads and applications.

As Ceph adoption increases in the enterprise market, more companies are looking to Ceph as a potential alternative to DAS storage for Hadoop. Such a solution would fulfill the promise of scaling storage and compute independently in Hadoop and allow companies to grow in a more cost-effective, efficient manner.

## Intel and QCT Propose a New Storage Solution

Recently a large online retailer informed Intel and other tech companies that it has been experiencing the problems of scaling Hadoop first-hand. The retailer's storage needs have been growing at a much faster rate than its processing needs. As a result, the more the company purchases new machines for additional Hadoop storage, the more it is left with unneeded compute capacity.

The problems have been severe enough that the retailer has sought a company-wide redesign of its storage architecture. A goal of the redesign is to break apart compute and storage in Hadoop to enable the company to scale these resources independently, while still maintaining high performance.



### Quanta Cloud Technology (QCT) hardware used in the proof-of-concept (PoC) storage solution:

#### Servers:

QuantaPlex T41S-2U\* (4-node)  
QuantaGrid D51PC-1U\*  
QuantaGrid D51B-1U  
QuantaGrid D51B-2U

#### Storage JBOD:

QuantaVault JB4242\*

#### Switches:

QuantaMesh T3048-LY9\*  
QuantaMesh T5032-LY6  
QuantaMesh T1048-LY4A

**Figure 2.** Two-rack proof-of-concept (PoC) built by Intel and QCT

## Solution Brief | Decoupling Storage from Compute in Apache Hadoop\* with Ceph\*

Specifically, the company has been looking at Ceph as a potential way to standardize storage so that one storage solution can be used across Hadoop analytics and other workloads.

The large online retailer's particular needs prompted Intel and Quanta Cloud Technology (QCT) to propose building a proof-of-concept (PoC) solution that would disaggregate compute and storage while preserving performance strong enough to meet any existing service-level agreements (SLAs). The solution would replace native DAS storage in Hadoop with flexible, independent, and open-source Ceph storage.

The joint Intel and QCT solution would be built on QCT servers, storage, and network products, with Intel® Xeon® processors, Intel® Solid State Drives (SSDs) using high-speed Non-Volatile Memory Express\* (NVMe\*), and Intel® Cache Acceleration Software (Intel® CAS).

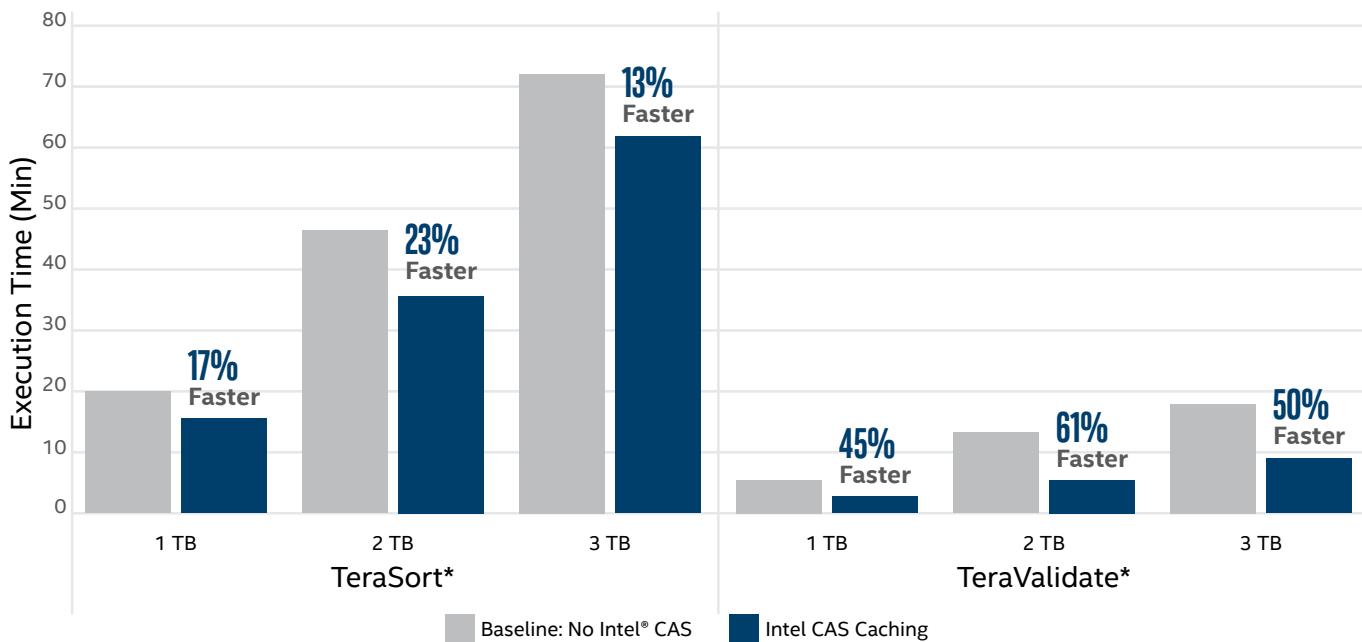
## Test Results

After the design and planning phase, the team built and tested the two-rack functioning solution shown in Figure 2, which connects a Hadoop cluster to Ceph storage.

Testing showed that the proposed solution was fully functional and highly performant in practice and could therefore meet the goals of the storage architecture redesign. The joint Intel and QCT testing proved that Hadoop disaggregation could work on QCT hardware and Intel technologies, such as Intel CAS and NVMe SSDs, with performance strong enough to meet existing user SLAs. In fact, as shown in Figure 3, Intel testing showed that Intel CAS on NVMe SSDs delivered up to a 60 percent improvement on TeraSort\* and TeraValidate\* performance tests, compared to performance without these technologies.<sup>1</sup>

As a result of this success, QCT will bring to market a pre-integrated, well-tuned Hadoop on Ceph solution based on this PoC.

## Apache Hadoop\* Test Results (Lower Is Better)<sup>1</sup>



**Figure 3.** Optimizing performance and capacity utilization of NVMe\* Intel® SSDs on Ceph\*

## Summary

With innovative architecture that uses Ceph, QCT hardware, and Intel® technologies, the joint Intel and QCT proof of concept demonstrates that storage and compute in Apache Hadoop\* can be successfully disaggregated and independently scaled, all the while maintaining high performance. This new architecture allows IT decision makers to reduce CapEx, increase operational efficiency, and improve organizational agility.

To learn more about Intel® Cache Acceleration Software (CAS) and request a trial copy, visit:  
[intel.com/content/www/us/en/software/intel-cache-acceleration-software-performance.html](http://intel.com/content/www/us/en/software/intel-cache-acceleration-software-performance.html)

To find the Intel® SSD that's right for you, visit:  
[intel.com/go/ssd](http://intel.com/go/ssd)

To learn about QCT's Ceph\* solution, visit:  
<http://www.qct.io/Solution/Software-Defined-Infrastructure/Storage-Virtualization/QxStor-Red-Hat-Ceph-Storage-Edition-p365c225c226c230>



<sup>1</sup> Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark\* and MobileMark\*, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products.

Configurations: Ceph\* storage nodes, each server: 16 Intel® Xeon® processor E5-2680 v3, 128 GB RAM, twenty-four 6 TB Seagate Enterprise\* hard drives, and two 2 TB Intel® Solid-State Drive (SSD) DC P3700 NVMe\* drives with 10 GbE Intel® Ethernet Converged Network Adapter X540-T2 network cards, 20 GbE public network, and 40 GbE private Ceph network.  
Apache Hadoop\* data nodes, each server: 16 Intel Xeon processor E5-2620 v3 single socket, 128 GB RAM, with 10 GbE Intel Ethernet Converged Network Adapter X540-T2 network cards, bonded.

The difference between the version with Intel® Cache Acceleration Software (Intel® CAS) and the baseline is that the Intel CAS version is not caching and is in pass-through mode, so software only, no hardware changes are needed. The tests used were TeraGen®, TeraSort®, TeraValidate®, and DFSIO, which are the industry-standard Hadoop performance tests. For more complete information, visit [intel.com/performance](http://intel.com/performance).

Intel does not control or audit third-party benchmark data or the web sites referenced in this document. You should visit the referenced web site and confirm whether referenced data are accurate.

Optimization Notice: Intel's compilers may or may not optimize to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include SSE2, SSE3, and SSSE3 instruction sets and other optimizations. Intel does not guarantee the availability, functionality, or effectiveness of any optimization on microprocessors not manufactured by Intel. Microprocessor-dependent optimizations in this product are intended for use with Intel microprocessors. Certain optimizations not specific to Intel microarchitecture are reserved for Intel microprocessors. Please refer to the applicable product User and Reference Guides for more information regarding the specific instruction sets covered by this notice.

Notice Revision #20110804

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your system manufacturer or retailer or learn more at [intel.com](http://intel.com).

Intel, the Intel logo, Intel. Experience What's Inside, the Intel. Experience What's Inside logo, and Xeon are trademarks of Intel Corporation in the U.S. and/or other countries.

QCT, the QCT logo, Quanta, and the Quanta logo are trademarks or registered trademarks of Quanta Computer Inc.

Copyright © 2016 Intel Corporation. All rights reserved.

\*Other names and brands may be claimed as the property of others.

Printed in USA 0816/HC/PRW/PDF Please Recycle 334764-001US