HUAWEI OceanStor Dorado
THE WORLD'S *FASTEST* SELLING ALL FLASH STORAGE

LEADING **NEW ICT**

HUAWEI
YOY Growth 529%

Brand A Brand B Brand C Brand D Brand E

*Data from Gartner Market Share Report, 2018 H1.

INDEX

MOVING TOWARD THE ALL-FLASH STORAGE DATA CENTERS

In today's competitive business environment, IT organizations need to provide a high-quality and productive IT environment for continuously growing internal users and external customers. In addition, enterprise application environments have become increasingly unpredictable as their IT infrastructure requirements grow in complexity and size. Mission-critical business application performance is highly sensitive to storage performance and latency, and highly dependent on the resilience of the enterprise IT environment.

Driven by the advancements in different technologies, the storage infrastructure will be fundamentally different in the future. Solid-state Disks (SSDs) and all-flash storage are transformational technologies that increase performance and storage utilization by up to two orders of magnitude.

SSDs and all-flash storage delivers high performance, low cost, and high reliability, which are regarded as unobtainable in traditional storage scenarios. Many commonly accepted rules will be no longer applicable. All-flash storage helps customers save on O&M costs while improving administration productivity and infrastructure efficiency thanks to its data reduction mechanism. This results in a flat storage infrastructure with only one storage tier, consisting of SSDs.

In addition, the application of NVMe and 3D XPoint will help improve the all-flash storage performance by ten folds with a doubled density and 50% lower unit capacity price in the next year, reducing the costs of all-flash storage and making it more accessible than ever before.

The progress in all-flash storage has created a level of maturity, reliability, and cost-effectiveness that exceeds hybrid disk arrays in all characteristics except raw capacity, providing data centers with higher agility and service capability.

HUAWEI

PERFORMANCE, RELIABILITY, EFFICIENCY

Best Performance

FASTER THAN EVER
With an architecture built around NVMe, dedicated controller chips, and intelligent algorithms, the OceanStor Dorado V3 unleashes the full potential of flash. This lightning-fast storage brings the ultimate user experience to every application.

Up to **7 million** SPC-1 IOPS™	Down to **0.5 ms** latency	Up to **3x** business performance
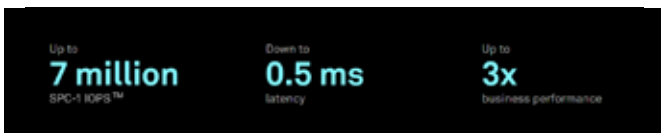
Highest Reliability

ALWAYS ON. WORRY FREE.
Because data integrity is the top priority, OceanStor Dorado V3 builds industry-leading reliability in every detail. Multi-level assurance mechanisms protect your data everywhere, even in the cloud.

99.9999% proven availability	**24/7** business continuity	**100%** data protection
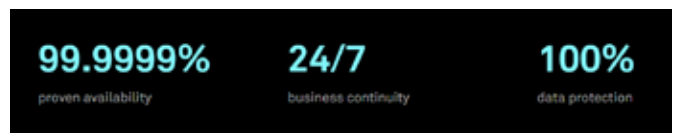
Extreme Efficiency

REDUCE OPEX. SMART. SIMPLE.
Flash is affordable, with a TCO lower than that of HDDs. Using inline compression and deduplication, OceanStor Dorado V3 can reduce your OPEX as much as 75%. Smart flash: Using AI makes O&M much easier.

66 sets in 55 racks
High-end HDD arrays with thousands of disks

75% OPEX ↓

23 sets in 9 racks
Huawei OceanStor Dorado18000 V3

85% space savings
Before
After

74% electricity savings
Before
After

74% cooling savings
Before
After

94% maintenance savings
Before
After

In March 2018, Huawei launched smart flash storage for enterprise mission-critical applications, including the OceanStor F V5 all-flash series and OceanStor V5 hybrid-flash series.

In March 2018, Huawei high-end all-flash storage, OceanStor 18800F V5, passed the most authoritative SPC-1 performance benchmark test in existence with 6 million IOPS, indicating the highest performance ever recorded in SAN storage.

MARCH 2018

MARCH 2018

In January 2018, the revenue growth rate of Huawei's all-flash storage ranked first globally.

JANUARY 2018

In June 2017, Huawei's all-flash OceanStor Dorado V3 was awarded a Gold Medal at the Tokyo Interop Expo.

In March 2017, Huawei released the NVMe-based all-flash storage OceanStor Dorado5000 V3.

In September 2017, the ESG lab (a third-party authoritative organization) released an evaluation report for Huawei OceanStor Dorado, proving it is an ideal choice for mission-critical workloads.

SEPTEMBER 2017

JUNE 2017

MARCH 2017

HUAWEI'S ALL-FLASH STORAGE ROADMAP

In 2005, Huawei began to research and develop flash technologies.

2005

2008

In 2008, Huawei released the first SATA SSD disk, marking a milestone.

In May 2018, Huawei's eight all-flash storage products were given a Recommended ranking in DCIG 2018-19 All-Flash Array Buyer's Guide.

MAY 2018

In October 2018, the revenue growth rate of Huawei's all-flash storage ranked first globally.

OCTOBER 2018

In October 2018, Huawei next-gen high-end all-flash storage, OceanStor Dorado18000 V3, passed the most authoritative SPC-1 performance benchmark test in existence. 7 million IOPS on condition that compression is enabled, indicating the highest performance ever recorded in SAN storage.

OCTOBER 2018

In September 2016, Huawei released all-flash storage OceanStor Dorado5000 V3 and OceanStor Dorado6000 V3, with a gateway-free, active-active storage solution and Huawei-12 Gbit/s SAS SSD disks, providing excellent performance.

SEPTEMBER 2016

In May 2015, Huawei released its high-end converged storage system with SSD support, OceanStor 18000 V3, setting a benchmark for high-end storage with superb stability, excellent performance, and future-proof innovation.

MAY 2015

In 2011, Huawei released the first generation of all-flash storage Dorado 2100 and Dorado 5100, configured with Huawei-6 Gbit/s SAS SSD disks.

2011

In 2012, Huawei released the second generation of all-flash storage Dorado 2100 G2.

2012

In May 2014, Huawei released OceanStor V3 series converged flash storage, beginning an era of all-converged data architecture.

MAY 2014

This was a result of 5000 days of continuous efforts by 3000 Huawei storage engineers.
Huawei flash storage will continue to innovate for mission-critical enterprise applications and take the lead in the all-flash, all-cloud, and intelligent data storage era.

PURPOSE-BUILT CHIPS FOR ALL-FLASH STORAGE

OCEANSTOR DORADO V3 USES HUAWEI'S INTELLIGENT MULTI-PROTOCOL INTERFACE CHIP, INTELLIGENT SSD CONTROLLER CHIP, AND INTELLIGENT BMC MANAGEMENT CHIP TO IMPLEMENT AN END-TO-END SERVICE ACCELERATION PLATFORM THAT TRIPLES PERFORMANCE AND MAXIMIZES RESOURCE UTILIZATION.

The digital and intelligent transformation demands high-performance infrastructures, of which all-flash storage is an essential part. All-flash storage is the new engine for mission-critical services. Huawei OceanStor Dorado all-flash storage series, which adopts an intelligent multi-protocol processing chip, intelligent SSD controller chip, and intelligent device management chip to build an end-to-end service acceleration platform, delivering triple performance and maximizing resource utilization.

INTELLIGENT SSD CONTROLLER CHIP, ACCELERATING DATA READS AND WRITES

Since data is stored on SSDs, performance and stability of SSDs are critical. An SSD comprises of a control unit (SSD controller + DRAM) and a NAND flash storage unit. Control unit is responsible for data reads and writes.

To achieve ultimate in storage speed, Huawei leverages an innovative SSD controller chip to accelerate data reads and writes. Flash Translation Layer (FTL) algorithm is moved from control software layer to SSD controller chip, so that all FTL reads and writes are performed by the chip, significantly reducing number of software interactions and hence I/O response latency.

According to tests by Huawei's performance and interoperability lab, the read latency of Huawei SSDs is as low as 80 µs in low-load scenarios, which is only 60% of the comparable type of SSDs in the industry. This helps to boost performance to almost two times as compared with competition.

To achieve end-to-end acceleration, Huawei develops FlashLinkTM technology by combining proprietary SSD controller chip, SSDs, NVMe architecture, and storage operating system dedicated for flash. Huawei's Dorado storage can deliver 3x higher performance after enabling of value-added features such as deduplication, compression, and snapshot, while maintaining 0.5 ms latency, eliminating performance shortage issues in peak hours.

In addition, Huawei Storage has developed an innovative disk-controller collaboration algorithm. The innovative disk-controller collaboration algorithm enables a

OceanStor Dorado: Industry's Fastest AFA and First All-Level NVMe

SSD Controller Chip

Enable the FTL algorithm intelligently accelerates data access in SSD

Read latency: 80μs

storage controller to learn about the data layout in SSDs in real time and adjust the data layout to ensure consistent data layout between storage controller and SSDs. Data in the controller is written into SSDs in the format required by SSDs, avoiding subsequent data migration and garbage collection and ensuring consistently high performance of the flash storage system. This is the basic principle of disk-controller collaboration algorithm. The detailed technologies involved include the sequential write of large blocks, independent partitioning of metadata, and end-to-end I/O priority adjustment.

INTELLIGENT MULTI-PROTOCOL INTERFACE CHIP, ACCELERATING DATA READS AND WRITES OF FRONT-END NETWORK INTERFACES
Front-end interface modules are essential to a storage system. Application data is transmitted from servers to storage arrays through these modules. Currently, mainstream front-end interface modules include 8G/16G/32G FC, 1/10/25/40/100 GE, and 10G FCoE. Each front-end interface module supports only one protocol, which

is a kind of waste of resources. To improve efficiency, Huawei develops a multi-protocol interface chip that integrates GE/10GE/FC/FCoE protocol interfaces. Customers can use one interface chip to transmit data carried over IP and FC protocols. On a 10GE or 8/16G FC network, only optical module components need to be replaced, instead of entire module. The flexible conversion between protocols greatly improves network flexibility and reduces network construction and maintenance costs of data centers.

More importantly, internal hardware logic module of intelligent multi-protocol interface chip supports many protocol stack functions such as checksum and FC. The processing flow, logic, and functions are switched over from CPU software to chip, helping ensuring high I/O concurrences and low latency of storage services.

Intelligent multi-protocol interface chip offloads checksum and FC workloads from CPU, which can improve network processing performance, release x86 CPU processor resources, accelerate network access and data exchange, and improve overall storage

performance. Huawei's performance tests show that when configured with the same front-end interface module (16G FC) and test model (70:30 read/write, 8K I/O blocks), OceanStor Dorado can deliver 3x performance over competitors' products.

INTELLIGENT DEVICE MANAGEMENT CHIP, ACCELERATING FAULT MANAGEMENT AND RECTIFICATION
Being able to quickly identify and eliminate faults is the core indicator of the reliability of IT devices. The intelligent device management chip is the "heart" of OceanStor Dorado. It is built in with fault diagnosis and fault pre-warning libraries to improve fault diagnosis accuracy. Fast diagnosis is the prerequisite for fast recovery. The intelligent management chip provides a management computing capability of 2000 Dhrystone Millions of Instructions Per Second (DMIPS), which is five times higher than competitors. If a controller, front-end interface module, or management module fails, the switchover can be performed in seconds. No data is lost, services are not interrupted, and users are completely unaware of the switchover. ◼

FLASHLINK:
THE SECRET TO HUAWEI'S HIGH-PERFORMANCE ALL-FLASH STORAGE

OceanStor Dorado V3's new SSD-optimized design and disk/controller coordination technology enable storage controllers to detect data layouts in SSDs in real time and synchronize the data in controllers and SSDs. This coordination helps reduce performance losses caused by garbage collection and ensures rapid response to data read and write I/Os.

HUAWEI

According to a survey on hundreds of data system users, about 87% of system performance problems occur in the interaction between the storage subsystem and the application database. That is to say, the response latency and concurrent access traffic of the storage subsystem determine those of the application system. High latency and small concurrent traffic of a storage subsystem has become the performance bottleneck of the entire system, which is an infuriating reality for many enterprises.

So, storage systems are required to maintain low and predictable latency even during service peaks so to provide users with a consistent experience.

INNOVATIVE FLASHLINK TECHNOLOGY

Huawei lightning-fast and rock-solid OceanStor Dorado V3 delivers the industry-leading performance powered by the innovative FlashLink technology, and the high performance is maintained from three aspects: chip,

architecture, and operating system.

OceanStor Dorado V3 adopts three intelligent chips to achieve end-to-end service acceleration and provides a performance of 45% higher than SAS all-flash storage. Huawei is bringing continuously the latest architectural technology trends and even develops its own technologies. OceanStor Dorado V3 is one of the first all flash storage systems to use NVMe in commercial use. Further, OceanStor Dorado V3 adopts a brand-new SSD-optimized design and disk-controller collaboration technology to enable storage controllers to detect data layouts in SSDs in real time and synchronize data in controllers and SSDs. This helps reduce performance losses caused by garbage collection and ensures rapid response to data read and write I/Os. This helps in maintaining a predictable latency of 0.5 ms even under heavy workloads. The secret for such advancements is FlashLink, helping OceanStor Dorado to improve service performance by three times in comparison with traditional storage. 🔴

LIGHTNING-FAST ALL-FLASH STORAGE USHERS IN AN NVMe ERA

THE FAST PATH: NVMe ARCHITECTURE

Huawei is taking full advantage of the NVMe protocols with the industry's only end-end development of an NVMe flash controller, NVMe all-flash Operating System (OS), and NVMe SSDs. Powered by this NVMe architecture with finely tuned disk/controller coordination, Huawei's NVMe all-flash storage now ensures a stable latency of 0.5 milliseconds.

Speed is the ultimate weapon to survive and thrive in fierce competition. Today, NVMe is making the fastest speed possible to help you achieve your goals.

NVM Express formulated NVMe protocol standards, and replaced complex protocol layers such as I/O Scheduler and SCSI in the SAS system with lightweight NVMe protocol. As a result, NVMe is a quicker, smarter, and more intuitive option for enterprises, evident with its superb performance in all-flash arrays (AFAs).

Huawei has extensively researched the NVMe protocols, covering only end-end development of NVMe flash

controllers, NVMe all-flash OSs, and NVMe SSDs in the industry. Besides, powered by NVMe architecture with disk-controller collaboration, NVMe all-flash storage eventually ensures a stable latency of 0.5 ms.

- Non-native dual-PCIe ports. Dual-controller redundancy technology is used in enterprise storage to ensure system reliability. However, PCIe-based dual-port technology is a challenge for SSD designs. Currently, some vendors' SSDs do not use native dual-PCIe ports. For example, Intel's NVMe SSDs use dual-port PCIe ports implemented through the internal PCIe switches. Such technology shortcuts inevitably reduce system reliability.
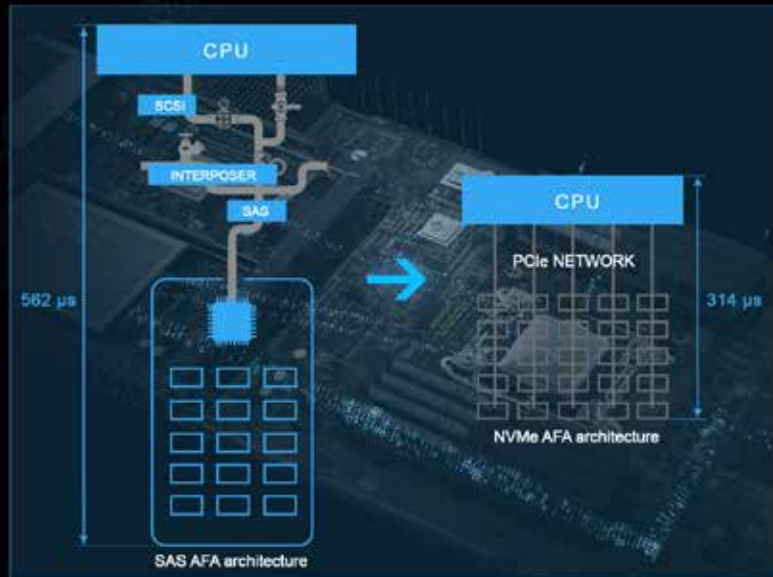
- Traditional PCIe hot plug with poor performance. Commercial NVMe SSDs must support non-disruptive replacement. However, traditional PCIe hot plug, particularly surprise hot plug, causes poor user experience due to system exceptions and service interruption.
- Data reliability guarantee pressure. As large-capacity disks are used, large amounts of data demand for higher reliability.
- Difficult cross-site reliability design. Reliability design for single points of storage has already been challenged. The cross-site reliability is going to be the same.

As one of the leading brands to successfully develop stable AFAs, Huawei continues to showcase its capabilities, evident in over 1000 NVMe all-flash success stories.

Key Huawei Innovations in NVMe All Flash Storage includes:

- At the interface layer, Huawei NVMe SSDs support native dual-port technology, with two independent PCIe 3.0 x2 links. This provides hardware basis for system recovery and exceptions, and ensures dual-

controller redundancy, helping improve the system reliability for enterprises.

- At the hot plug layer, the PCIe driver is designed to support SSD removal anytime and anyway, providing end-to-end PCIe system reliability if a single disk is replaced or a fault occurs.
- At the data protection layer, Huawei's innovative RAID-TP software technology is based on the Erasure Code (EC) algorithm. This enables Huawei storage system to operate even in the case of three disk failures and the system will not suffer from data loss or service interruption.
- OceanStor Dorado employs a global virtualization system able to reconstruct the data in a mere 30 minutes to fulfill requirements in ultra-large capacity profiles.
- At the cross-site data protection layer, Huawei NVMe all-flash storage provides comprehensive data protection technologies, such as snapshot, clone, and remote replication, to help customers in building a hierarchical data protection solution from local or intra-city DCs to remote DCs. Huawei gateway-free active-active solution in all-flash storage can achieve 99.9999 availability.

Get with the trend, prepare for the future
Traditional HDD storage has a latency of more than 10 ms due to the long seek time. However, SSDs reduce 50% of the storage system latency to about 5 ms by using electronic mapping tables.

Traditional storage controllers often provide the same OSs despite differences in HDDs disk form, meaning it is convenient to use even when the disk type changes. However, many of the HHDs and subsequent OSs have become redundant. That is why Huawei released AFAs, such as Pure Storage and OceanStor Dorado V3. Designed for SSDs, these AFAs effectively reduce the storage system latency to less than 1 ms.

In the future, faster storage media will undoubtedly be the next move for many enterprises looking to capitalize on innovative storage methods. Such is the benefits of using modern technologies. There is a large performance gap of 2 to 3 orders of magnitude between DRAMs and NAND SSDs, and even more between SCMs and DRAMs. All-flash storage using SCMs has the latency low to 250 µs, which ensures faster service response.

In addition to NVMe application in the local PCIe SSDs, NVM Express have also released the NVMe over Fabrics specification in June 2016. The new specification enables NVMe to be utilized over different fabric types, such as RDMA and FC, which can provide high-performance solutions for remote access to SSDs and remove resource sharing barriers among local SSDs.

Huawei uses NVMe over Fabrics to fully share SSD resources, and provides 32 Gbps FC and 100 GE full-IP networking design for front-end network connection, back-end disk enclosure connection, and scale-out controller interconnection. These functions decrease the storage latency and simplify storage network management by using one IP system to control the whole DC. This design avoids complex network protocol and planning, streamlines DC deployment, and reduces DC maintenance costs.

New SCM media are introduced to further improve system performance. With NVMe over Fabrics, SSD resources are fully shared, and front-end NVMe interfaces optimize hardware and software architectures. Ready to build the more competitive all-flash storage? Then think Huawei. ❀

WORLD'S FASTEST ALL FLASH STORAGE, BUILT FOR YOUR APPLICATION SCENARIOS

DATABASE

The OceanStor Dorado V3 all-flash database solution provides outstanding performance to triple the efficiency of applications.

After tested by using the simulated system for Oracle database online transaction, a dual-controller OceanStor Dorado V3 system can provide stable performance of 210, 000 IOPS at 0.5 ms latency, 10 times higher than that of traditional storage

VDI

The OceanStor Dorado V3 all-flash VDI solution supports rapid deployment of thousands of workspaces and ensures smooth user experience during peak hours.

OceanStor Dorado V3 storage reduces the time to deploy 2000 desktops from 20 hours to 8 hours compared to traditional storage, and lowers the startup storm time by 75% (60 minutes to 15 minutes).

Compared to traditional storage, the response time to open office applications is shortened by 50%.

SERVER VIRTUALIZATION

The OceanStor Dorado V3 all-flash server virtualization solution supports the rapid deployment of multiple business systems, and ensures predictable, stable performance regardless of the workload.

OceanStor Dorado V3 improves the performance density by three times compared to traditional storage, and by twice compared to other all flash array. OceanStor Dorado V3 delivers better performance in heavily-loaded virtualization scenarios and supports 500 IOPS/100 GB for a single VM.

SAP HANA TDI

The OceanStor Dorado V3 all-flash SAP HANA TDI solution allows SAP HANA databases to integrate more smoothly into existing data center architecture.

With the maturity of SAP HANA, hardware faces fewer restrictions than before. To better integrate SAP HANA into existing data centers of enterprises, SAP launches Tailored Datacenter Integration (TDI) reference architecture to integrate SAP HANA database more flexibly into existing data centers.

Huawei's SAP HANA TDI is a solution designed based on Huawei's powerful hardware capabilities and integration capabilities of the TDI solution.

Compared to other vendors' solutions, it has the following three features:

Scalable: In the latest SAP certification, Huawei's high-end all-flash storage system supports a maximum of 200 SAP HANA nodes, ranking top in the industry.

Reliable: Huawei all-flash storage can still meet SAP's high performance (1 ms latency) requirements after enabling the active-active design. Huawei's SAP HANA TDI solution can provide end-to-end SAP HA solutions

Efficient: With the lossless snapshot function, Huawei's SAP HANA TDI solution can quickly set up the development, testing, and sandbox systems. Response time to the business environment setup is reduced from 10 hours to 20 minutes compared to traditional solution.

SAP HANA TDI Solution
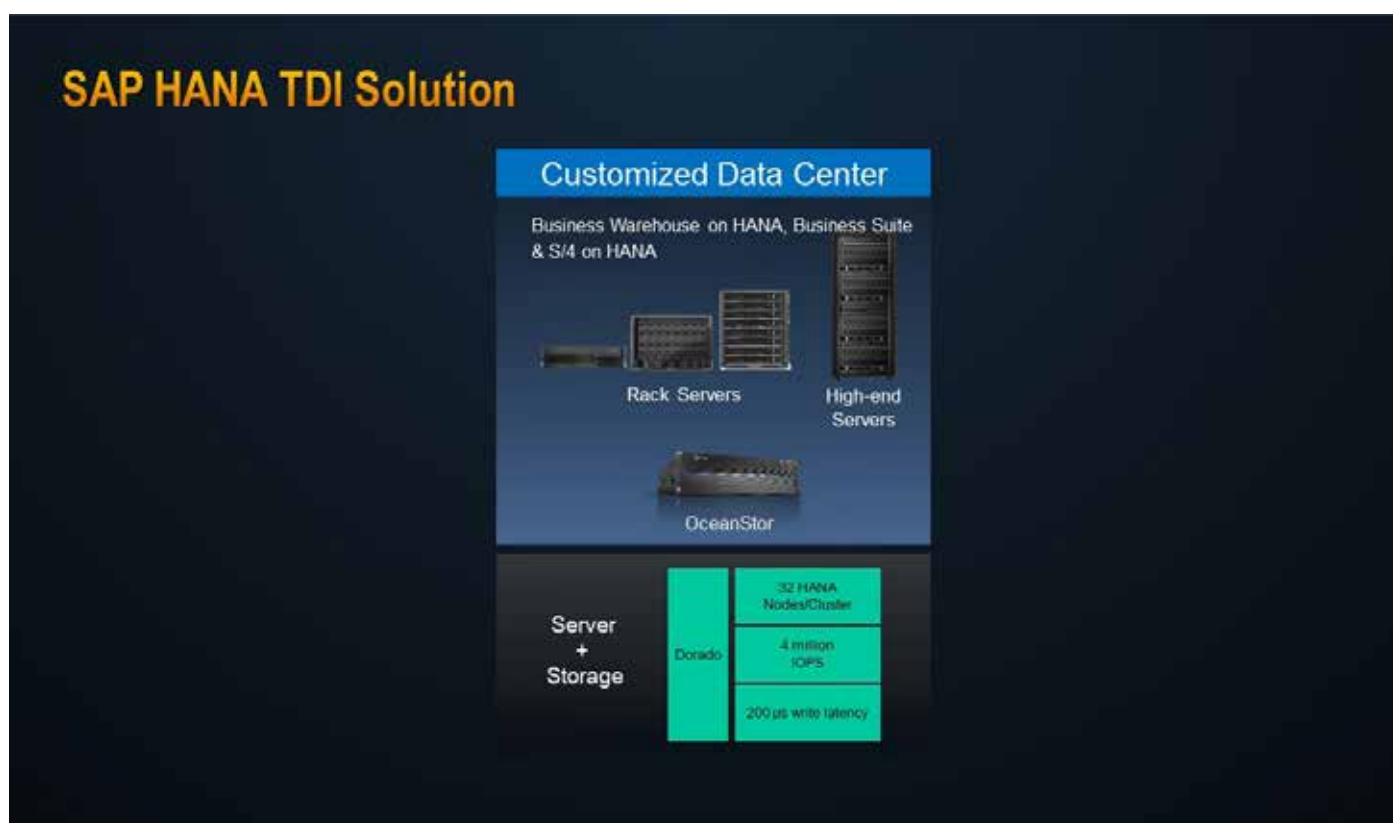
CLINIQUES UNIVERSITAIRES SAINT-LUC - FINDING WAYS TO ALLOW DOCTORS TO FOCUS ON PATIENT DIAGNOSIS AND TREATMENT

After deploying Huawei's storage solution, employee access to IT systems was accelerated by 500% while TCO dropped by over 50%. The solution ensures that critical services remain up and running around the clock.

Cliniques Universitaires Saint-Luc is the largest hospital in Brussels, Belgium. As the partner of the Université Catholique de Louvain (UCL), Saint-Luc is the first European hospital to be globally recognized for its clinical research, making it one of the top hospitals in Europe alongside the Karolinska Institutet in Sweden and Addenbrooke's Hospital in Cambridge,England.

According to the World Bank, Belgium has 3 doctors per 1000 inhabitants, slightly higher than the 2.5 doctors per 1000 inhabitants in the U.S. and 1.5 in China. Hospitals in Belgium provide the best healthcare and nursing services to its citizens, supported by a number of dedicated healthcare centers and world-renowned medical teams.

Saint-Luc attaches great importance to teaching and research, and is committed to providing patients with reliable and convenient healthcare services as well as state-of-the-art medical technologies. The hospital wants its doctors to spend more time with their patients, shorten the time it takes to search through medical records, and facilitate the access to and searching of research reports.

Transformation

The volume of data on the unified information platform at Saint-Luc is increasing by over 20% each year. After deploying Huawei's storage solution, employee access to IT systems was accelerated by 500% while TCO dropped by over 50%. The solution ensures critical services remain up and running around the clock.

Business Benefits

500% improvement in application performance

50% drop in O&M costs for storage equipment

24/7 reliability assurances keep critical services up and running around the clock

BYD AUTO BECOMES A LEADER IN NEW ENERGY WITH ALL-FLASH STORAGE

After replacing traditional mechanical disk storage with Huawei OceanStor Dorado all-flash storage, the applications in the ERP BW system is accelerated and the performance is more than doubled.

Founded in 1995, BYD engages in IT-related and automobile business for traditional fuel-powered vehicles and vehicles powered by new types of energy sources. With 30 production centers established around the globe, BYD is the only vendor worldwide that owns power battery and vehicle technologies in the new energy field.

The original and outdated HDD-based storage devices in the ERP system delivered poor access performance. BYD wanted to improve its business performance by 100% without changing the existing ERP system architecture. Smoothly migrating applications without disrupting application systems was a challenge for Huawei.

Based on the requirements and analysis results of BYD's live network, Huawei provided the OceanStor Dorado all-flash acceleration solution which leverages all-flash storage. Dural-controller Dorado6000 delivers 300K IOPS, fastest in industry. This allows the seamless replacement of existing HDDs, accelerating read and write I/Os of the ERP and BW systems and improving system efficiency. This solution does not change the architecture, database, host, ERP software, or O&M mode of the live network. The minimal change translates to minimal risks.

HUAWEI OCEANSTOR DORADO LEADS TO A THREE-FOLD INCREASE IN BYD

ERP PERFORMANCE

After the ERP system switches to Huawei OceanStor Dorado, the latency is reduced to less than 1 ms. With the query condition design and upper-layer platform of ERP, the data extraction time for BW data warehouses is reduced by 66%. Additionally, the report output speed of the MM, PP, SD, and FICO modules sees an increase of more than 200%. The time required to query material documents is reduced from 14 minutes to 4 minutes.

Inspired by the successful reconstruction of the ERP system, BYD once again chose Huawei's Dorado all-flash storage to upgrade and revamp its DMS system. Dorado's superb performance and robust stability have once again impressed BYD. It is expected that BYD and Huawei will further their cooperation through the smart manufacturing of "Made in China 2025". ❀

DCIG ALL-FLASH ARRAY BUYER'S GUIDE: AN AUTHORITATIVE REPORT

DCIG evaluated 32 mainstream All-Flash Arrays (AFAs) and gave the Huawei OceanStor Dorado the Highest Recommended Ranking based on performance, management, software, hardware, virtualization, and technical support.

All-flash storage has been positively affecting the digital transformation of enterprises. As per the DCIG 2018-19 All-Flash Array Buyer's Guide: "Any organization that has yet to adopt an all-flash storage infrastructure for all active workloads is operating at a competitive disadvantage".

The DCIG guide provides users with comprehensive and in-depth analyses and suggestions for product and technology procurement, helping buyers save time and money. The evaluations in the guide cover business value, integration efficiency, and data reliability. Many CIOs regard the guide as an important reference when planning for and purchasing data center infrastructures.

In this guide, DCIG scores and ranks 32 all-flash storage products from 7 mainstream storage vendors based on 57 evaluation items in terms of performance, management and software, hardware, virtualization, and technical support. Eight analysis steps are performed to classify and analyze the preceding evaluation items. The products of different vendors are given Recommended or Excellent rankings based on their scores. Only all-flash storage products with the best overall performance and highest scores are awarded a Recommended ranking.

Three models of OceanStor Dorado V3 series are listed with a Recommended ranking: Dorado 6000 V3, Dordo 5000 V3 (NVMe), Dorado 5000 V3 (SAS)

DCIG AWARDED HUAWEI OCEANSTOR DORADO A RECOMMENDED RANKING FOR THE FOLLOWING REASONS:

1. OceanStor Dorado5000 V3 is among the first batch of storage arrays that commercially used NVMe.
2. Huawei designed and manufactured SSDs and the disk controller collaboration of OceanStor Dorado arrays ensure high performance, low latency, and a long service life.
3. Huawei introduced the scale-out architecture of SmartMatrix to OceanStor Dorado, allowing it to support up to 16 controllers. In addition, Huawei increased the density and capacity by 1 to 4 times thanks to 15.36 TB SAS and NVMe SSDs. This allows a single cluster to provide up to 36.9 PB of raw flash capacity.

ESG TEST REPORT: HUAWEI OCEANSTOR DORADO V3 DELIVERS EXCELLENT PERFORMANCE FOR MAINSTREAM ALL-FLASH APPLICATIONS

ESG Lab performed hands-on testing of Huawei Oceanstor Dorado V3 all-flash storage. Their five-year TCO analysis highlights the system's financial advantages over hybird and first-generation all-flash systems from major vendors.

The ESG lab is a well-known IT consulting organization based in the United States. It performs IT analyses, research, and verification, and is renowned for its independent, rigorous, and practical laboratory tests.

In September 2017, the ESG lab tested the performance, reliability, cost-effectiveness, and total cost of ownership (TCO) of Huawei OceanStor Dorado V3. The ESG set up a real service environment and tested the performance and reliability of Huawei all-flash storage for applications such as VMs, databases, and mailboxes.

According to the ESG lab test data, Huawei Dorado V3 all-flash storage delivers a consistent latency of 0.3 ms under the pressure of 5000 Exchange users, 1000 VMware Horizon virtual desktops, and hundreds of Oracle users. Even if storage devices are faulty, upper-layer applications can automatically recover within 3 seconds by using the active-active solution, ensuring service continuity. In addition, the data reduction function

is always in the enabled state, making Huawei Dorado V3 an ideal choice for mission-critical workloads.

STABLE HIGH PERFORMANCE
The ESG lab has verified that the OceanStor Dorado V3 can integrate the most challenging workloads and mission-critical tasks into a high-performance and high-availability platform. When 5000 Exchange users, 1000 VMware Horizon virtual desktops, and hundreds of Oracle users are integrated into one OceanStor Dorado5000 V3 system, the integration environment has an average response time of 0.3 ms for these services.

HIGH AVAILABILITY WITH HIGH PERFORMANCE
Huawei OceanStor Dorado V3 all-flash platform ensures high availability and stable performance during planned maintenance and unexpected interruptions. The HyperMetro feature provides a 100-kilometer, gateway-free, active-active solution to ensure service continuity. RAID-TP technology

ensures services continue to run stably even if three disks in a single disk array fail.

In the ESG lab, HyperMetro is first tested in a campus environment. Two OceanStor Dorado V3 storage systems are configured with HyperMetro and run the Oracle RAC database to simulate OLTP transaction database traffic. The total traffic generated by the two servers is 50000 IOPS, the processing volume of a single disk array is 25000 IOPS, and the average I/O response time is 0.25 ms.

TCO SAVING FROM HIGH PERFORMANCE
The ESG lab simulated the expected storage TCO of a company that required a high availability hybrid service environment. The OceanStor Dorado5000 V3 has an obvious advantage in this area when compared with Huawei's hybrid storage arrays and the first-generation all-flash storage devices of other mainstream vendors. The five-year TCO was shown to be reduced by more than 75%.

The ESG lab acknowledges that Huawei OceanStor Dorado V3 provides stable high performance for its users. Huawei OceanStor V3 perfectly adapts to high-performance service applications and can run in a virtualization environment with high performance requirements. ■

HUAWEI OCEANSTOR DORADO V3 ALL FLASH STORAGE FAMILY

**H**uawei OceanStor Dorado V3 all flash storage is purpose-built for enterprises' mission-critical business.

Powered by intelligent chips, NVMe architecture, and Huawei FlashLink® intelligent algorithms, it delivers 0.5-millisecond consistent latency with inline compression, inline de-
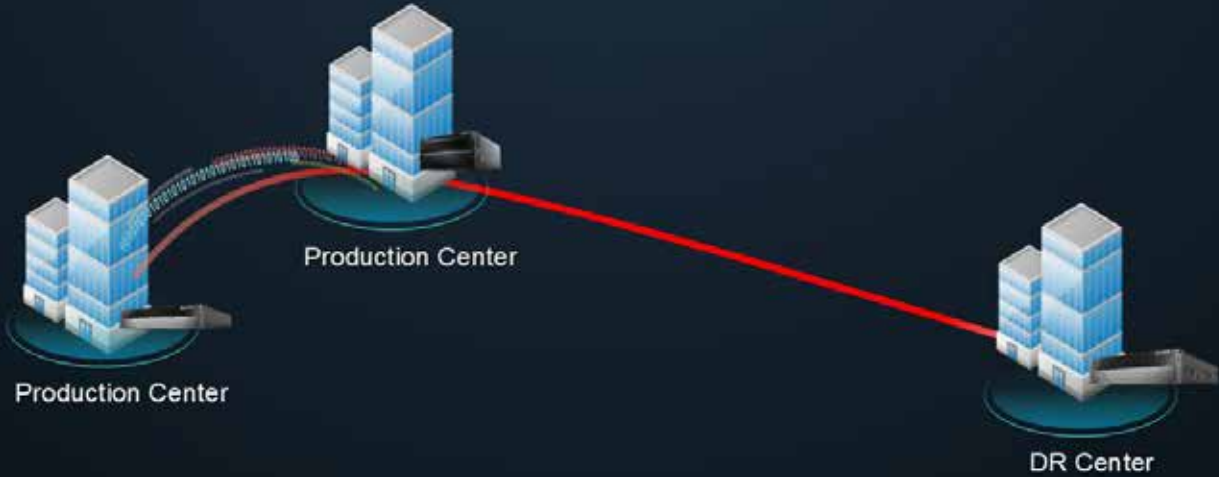

Up to 3:1 Data reduction
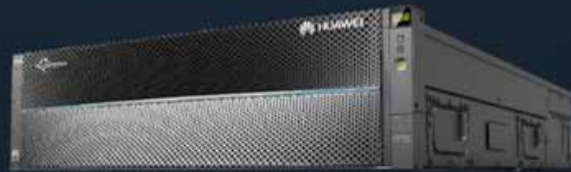
OceanStor Dorado: Industry's Fastest AFA and First All-Level NVMe

Faster in every step
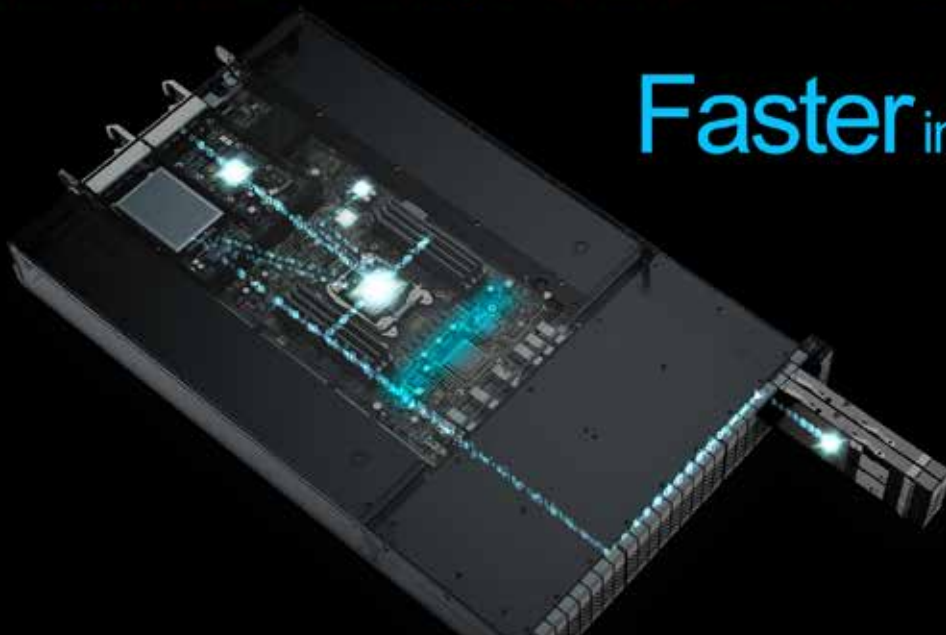
Gateway-free active-active solution upgradable to 3 DC Solution

HyperMetro Active-Active

24/7 Data Centers with Lowest Latency

duplication, and snapshot enabled, boosting application performance threefold. It is scalable to 16 controllers and supports 7 Million SPC-1 IOPS™. The OceanStor Dorado V3 supports comprehensive SAN and NAS features, delivering high-quality data services for databases and file systems.

It offers the HyperMetro gateway-free active-active solution, which can be smoothly upgraded to the 3DC or Converged Data Management (CDM) solution to achieve 99.9999% availability.

It also applies industry-leading inline compression and inline de-duplication technology, delivering a data reduction ratio up to 3:1 and

leading to 75% in OPEX savings.

The OceanStor Dorado V3 is ideal for use with databases, Virtual Desktop Infrastructure (VDI), Virtual Server Infrastructure (VSI), and SAP HANA. It has been designed to facilitate the transition to all-flash for customers in the finance, manufacturing, telecom, and other sectors. ❧

	Dorado5000 V3 NVMe PCIe	Dorado5000 V3 SAS	Dorado6000 V3 SAS	Dorado 18000 V3 SAS
Controllers(/ Array)	2-8	2-16	2-16	2-16
SSD (/Array)	200	1,400	2,400	3,200
Capacity (/ Engine)	1PB	1PB	2PB	2PB
Supported RAID Level	RAID 5, RAID 6, RAID 10, RAID-TP (tolerating simultaneous failure of 3 SSDS)			

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