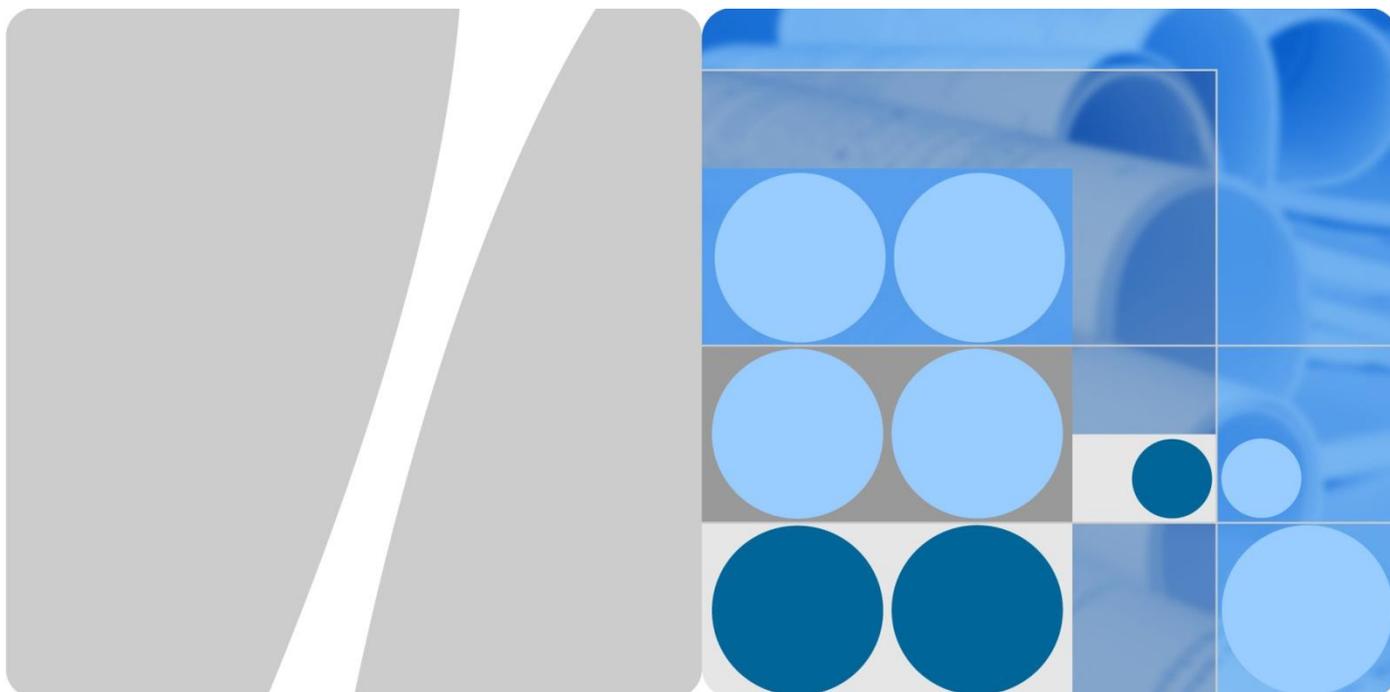


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OceanStor T Series Product Technical White Paper

Issue V1.0
Date 201205

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Revision History

Date	Revision	Description	Prepared By

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1 Executive Summary

In the perspective of development of storage technologies and combined with customers' requirements, this document elaborates the functions and highlights of Huawei S5500T/S5600T/S5800T/S6800T in terms of high performance, high reliability, powerful scalability, and green features. It aims at describing the unique features of the S5500T/S5600T/S5800T/S6800T and its values for customers.

2 Introduction

Fast development of IT technologies brings explosive amount of data. Heterogeneous networks, separated departments, and complex service systems lead to a complicated IT architecture. Device management and maintenance are exposed to formidable challenges as well.

The survey from an authoritative organization indicates that nowadays, the IT O&M is becoming more and more complicated. The O&M cost in the IT budget accounts for 70% of the total IT investment, only 30% of the investment, however, is used to add new facilities.

More problems are naturally brought out, such as, complicated network environment, performance bottleneck suffered by a single storage system, and balance of cost and performance. For this reason, how to solve these problems becomes the focus in the IT industry.

Huawei will release the S5500T/S5600T/S5800T/S6800T storage product that is designed based on the concepts of high performance, high reliability, powerful scalability, and green features. It meets customers' requirements, protects customers' investments, and maximizes customers' values.

3 Solution

With the development of the IT industry, storage gradually grows as an independent category. It is inevitable that storage develops with the fast development of computing technologies.

Technical development brings new concepts and new standards that directly affect the development trend of related industries. According to the analysis of experts, the storage industry is developing in the following directions:

- **New standards of the PCI-E bus dramatically improve storage performance.**

Compared with the mainstream PCI-E, the data transfer rate of the PCI-E 2.0 is doubled. The unidirectional rate is improved from 2.5 Gbit/s to 5.0 Gbit/s. The release of the PCI-E 2.0 standard widens the bus bandwidth that is available to the storage system.

- **SAS technologies are widely applied.**

SAS adopts the serial and interconnected architecture. It allows enterprise customers to flexibly expand and manage their storage systems. As the SAS storage data transfer rate develops from the 3 Gbit/s to 6 Gbit/s, the faster transfer rate and the higher reliability are realized.

- **Solid State Disks (SSDs) bring new features for storage.**

As the cost of the integrated circuit decreases, the SSD draws more attentions in the storage industry. The SSD has its own advantages:

- A. The data transfer rate is fast because the access speed of the NAND flash is 30 to 40 times as that of the traditional mechanical disk.
- B. The SSD has good shockproof capability because the flash chip is used to replace mechanical parts. In this way, the SSD can normally work even under fast movement.
- C. Power is saved because the IOPS power consumption of the SSD is much lower than that of the mechanical disk.

In one word, as more and more SSDs are added into the storage system, the advantages become obvious.

- **Diversified interface types improve storage scalability.**

The advent of 8 Gbit/s and 10 Gbit/s FC brings diversified storage interface cards. The enterprise-level 2.5 inch disk brings chances for disk update in the storage industry.

- **IPv6 widens Internet space.**

The fourth version of the Internet Protocol (IPv4) is a popular protocol as the foundation of modern Internet technologies. The fast development of the Internet in the recent ten years has nearly dried up Ipv4 addresses. That seriously confines the Internet development.

IPv6 designed by Internet Engineering Task Force (IETF) is the latest Internet protocol version. It is replacing IPv4. An IPv6 address has 128 bytes. IPv6 address space increases by 2^{96} compared with IPv4 address space.

- **Green Storage becomes reality.**

The purpose of Green Storage is to enhance the storage utilization, reduce construction and O&M costs, and improve the energy efficiency of all network storage devices. The global financial crisis starting from 2009 and current tense situation of energy force most enterprises to consider how to construct a green data platform.

To follow the industry tendency and to meet customers' requirements, Huawei will release OceanStor™ S5500T, OceanStor™ S5600T, OceanStor™ S5800T, and OceanStor™ S6800T (the S5500T/S5600T/S5800T /S6800T for short). This series of products are new generation products designed for the high-end storage market. The S5500T/S5600T/S5800T/S6800T products have powerful hardware specifications and integrate with the high density disk design, I/O modular hot-swappable design, and advanced multi-layer data protection technology. They meet requirements of various service applications, including large database OLTP/OLAP, high performance computing, digital media, Internet operation, centralized storage, backup, disaster recovery, and data migration, which effectively ensures the security and continuity of services for customers. Figure3-1 shows the appearances of the S5500T/S5600T/S5800T/S6800T.

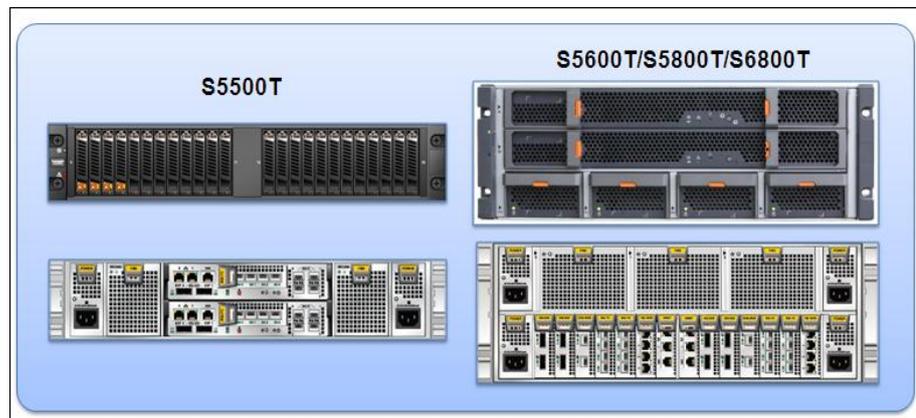


Figure3-1 S5500T/S5600T/S5800T/S6800T

In addition, the S5500T/S5600T/S5800T/S6800T delivers unique features on high performance, high reliability, powerful scalability, and green features.

High Performance

- **New generation high-speed bus and I/O channel**

The S5500T/S5600T/S5800T/S6800T storage products adopt the new generation PCI-E 2.0 bus technology and the SAS 2.0 high-speed I/O channel technology and provide a maximum of 36 Gbit/s internal exchange bandwidth, which helps to improve the overall performance of the storage system. Figure3-2 shows the hardware architecture of the S5500T. Figure3-3 shows the hardware architecture of the S5600T/S5800T/S6800T .

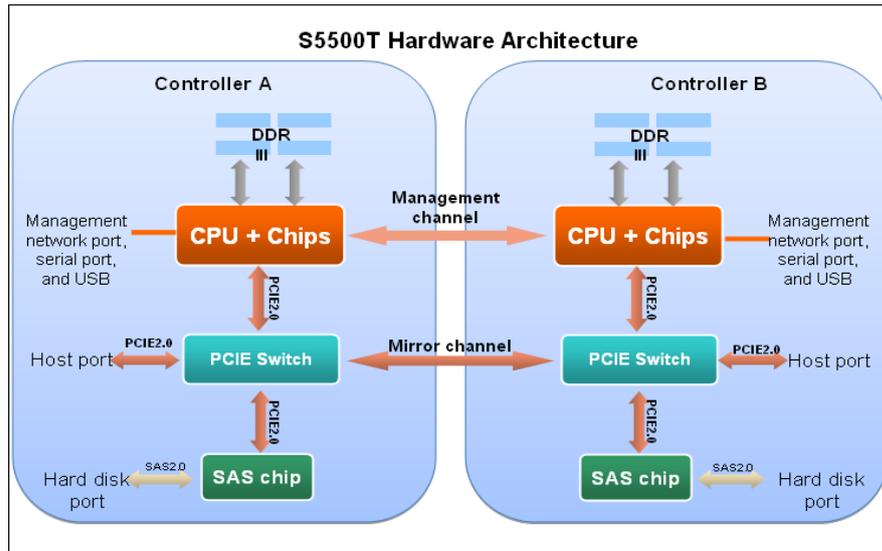


Figure3-2 S5500T hardware architecture

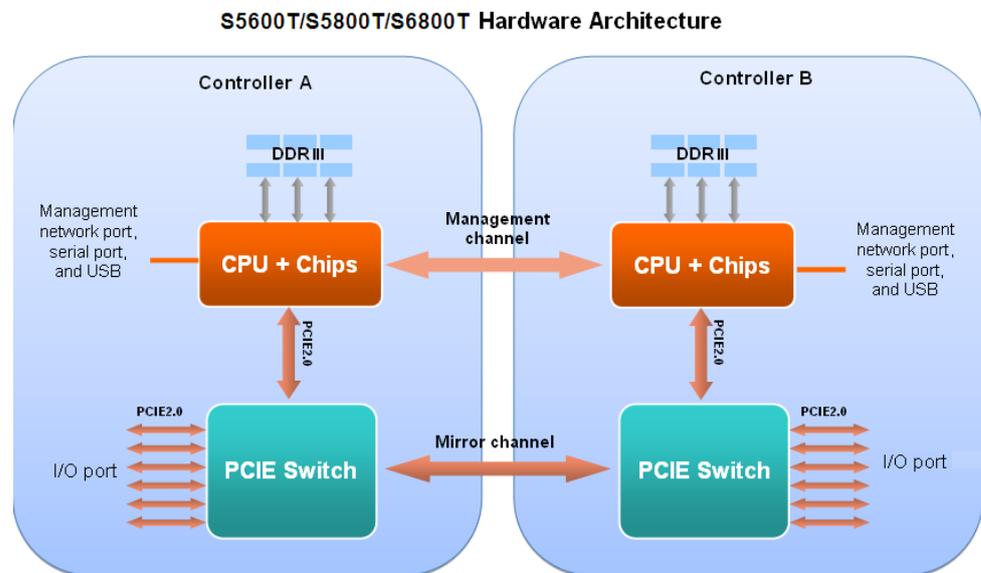


Figure3-3 S5600T/S5800T/S6800T hardware architecture

- **Multi-core CPU and multi-channel memory**

- Multi-core CPU: The storage system that uses the multi-core CPU has better processing capability.
- Multi-channel memory: Each CPU in the S5500T/S5600T/S5800T/S6800T maps to a maximum of three memory channels. Compared with the previous two-channel design, the design of three-channel memory improves the communication bandwidth between the memory and CPU, smashes the performance bottleneck due to limited memory bandwidth, and expands the memory capacity to the maximum. The S6800T supports up to 192 GB memory. The design of mass capacity memory meets the high performance requirement in various applications.

- **SmartCache**

The concept of the SmartCache technology is to use one or more SSDs to form a SmartCache resource pool. The hotspot data blocks that the host frequently accesses are migrated from the mechanical disk to the SmartCache resource pool according to the real-time statistics on the access frequency of data blocks. The SmartCache technology makes use of the fast processing capability of SSDs to improve the read performance and access efficiency of the host. Figure3-4 shows the principle of the SmartCache technology.

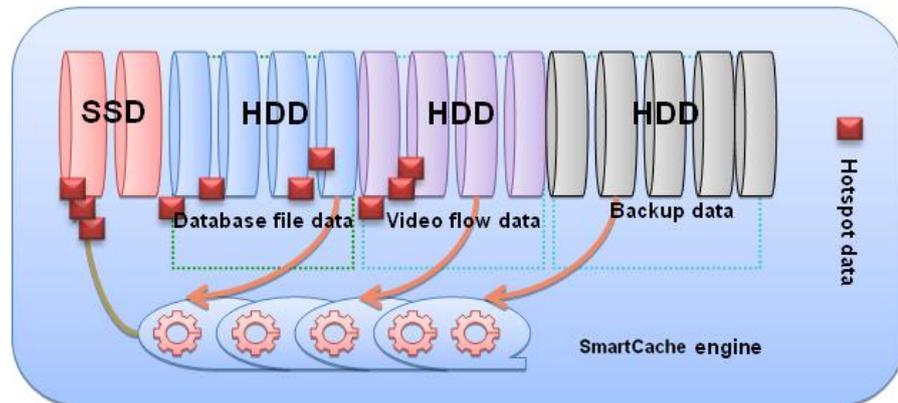


Figure3-4 SmartCache technology of the S5500T/S5600T/S5800T/S6800T

The SmartCache technology features high performance, high availability, and powerful scalability.

- High performance: The test result indicates that the SmartCache technology improves the random read performance by several times for the applications of Web server and file server.
- High availability: The SmartCache resource pool consists of multiple SSDs; therefore, the failure of one SSD does not affect the functions of the SmartCache.
- Powerful scalability: The SmartCache supports adding SSDs online. In addition, the installation and uninstallation of the SmartCache do not affect the running of services.

- **Application-oriented cache intelligent prefetch**

- The S5500T/S5600T/S5800T/S6800T adopts the application-oriented cache intelligent prefetch technology that can automatically identify the current I/O sequence, enable or disable the cache prefetch function according to different service models, and automatically set the optimal prefetch length according to different application scenarios. The cache prefetch technology of the S5500T/S5600T/S5800T/S6800T improves the read performance of the host as well as reduces the access frequency of hard disks, and thus extends the service life of hard disks.

- **Active-active dynamic load balancing**

The controllers of the S5500T/S5600T/S5800T/S6800T work in active-active mode and execute the concurrent I/O requests from the application host. In this way, the storage services are balanced on two controllers to avoid the situation that one controller shoulders large load while the other is idle. Therefore, the active-active mode reduces the load of one controller as well as makes full use of the system resources at the same time, improving the system efficiency and performance.

- **VAAI technology: acceleration of virtual machine performance**

Because of development of the server virtualization technology, more customers use virtual machines to replace traditional servers when they deploy their service systems. Virtual machines dramatically slash customers' investments and set up a sound basis for subsequent service system consolidation, service data migration, and data backup. In the virtualization server family, the VMware stands out. According to the relevant statistics, the VMware takes up more than 60% of the market share till now and keeps the increasing tendency.

Compared with traditional servers, virtual machines also have a disadvantage, that is, most I/O operations on a virtual machine are processed by software. Therefore, a large number of resources such as CPUs, memory, and network bandwidth are required to process I/O operations. This disadvantage is obvious with the wide application of virtual machines. To solve the problem, the hardware acceleration concept is put forward. A dedicated VMware vStorage APIs for Array Integration (VAAI) plug-in interacts with a disk array. The disk array authenticated on compatibility takes over the I/O operations on virtual machines, improving the overall performance.

Currently, the S5500T/S5600T/S5800T/S6800T storage system has passed the certification on compatibility with the VMware and passed the test of interaction with the VMware VAAI plug-in. The performance is satisfactory. Interacted disk array and VMware can implement the following functions:

- **Zeroing function:** The most common operation on a virtual machine is to clear virtual disks. This job occupies large part of DMA buffer and CPU period, and consumes shared resources of the virtual machine. When an S5500T/S5600T/S5800T/S6800T disk array interacts with the VMware, data block zeroing operations on the virtual machine are transferred to the disk array. Based on the powerful CPU performance of the disk array, clearing operations are quickly completed. This function reduces the I/O operations between the disk array and the ESX server by more than 10 times and accelerates the virtual disk initialization, improving the overall performance of the service system.
- **Replication function:** When the data on virtual disks is migrated or cloned, the virtual machine copies a large number of data blocks. It takes a few hours to clone xx GB files. That consumes many host resources and occupies the network bandwidth for a long time, deteriorating the overall system performance. When an S5500T/S5600T/S5800T/S6800T disk array interacts with the VMware, the data block replication operation on the virtual machine is transferred to the disk array. The array hardware controls the replication operation within seconds and reduces the CPU load of the ESX server. In this way, the host software can make full use of virtual machine resources. This function reduces the I/O operations between the disk array and the ESX server by more than 10 times, improves the Storage vMotion operation speed, and simplifies the deployment of virtual machines.
- **Assisted locking function:** In a cluster, to ensure the data consistency on virtual machines, the locking mechanism is employed to control resource occupation upon concurrent access. Traditionally, when an ESX server accesses a LUN, the system locks the LUN. Therefore, write I/O operations on other ESX servers are suspended and the overall write performance deteriorates a lot. In addition, a series of commands need to be executed to obtain and release the lock. The entire process prolongs I/O latency. When an S5500T/S5600T/S5800T/S6800T disk array interacts with the VMware, virtual machines access data blocks rather than LUNs. That improves concurrent write performance, shortens write I/O latency, enables more virtual machines to access a single LUN, and further improves the overall performance of the service system.

High Reliability

- **Dual plane power supply**

The S5600T/S5800T/S6800T releases the advanced design of dual plane power supply. The two planes power the two controllers respectively and provide 2+2 redundancy. Single point failures on the planes do not affect the running of the services. In addition, short circuit of one plane does not affect the other plane. Figure3-5 shows the dual plane power supply of the S5600T/S5800T/S6800T series.

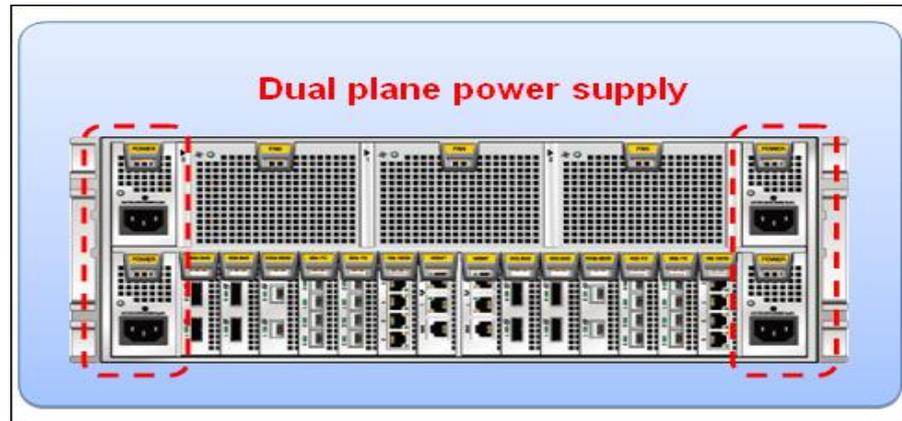


Figure3-5 Dual plane power supply of the S5600T/S5800T/S6800T series

- **Built-in BBU and coffer disks**

To avoid the negative effect on the system due to the failure of external power supply, the S5500T/S5600T/S5800T/S6800T adopts the built-in BBU and coffer disks. The built-in BBU features small size, low cost, redundancy, and hot swap. Once the external power supply fails, the built-in BBU powers the controller and coffer disks at the same time so that the data in the cache can be written into hard disks, ensuring the data integrity and reliability. Figure3-6 shows the built-in BBU of the S5600T/S5800T/S6800T.

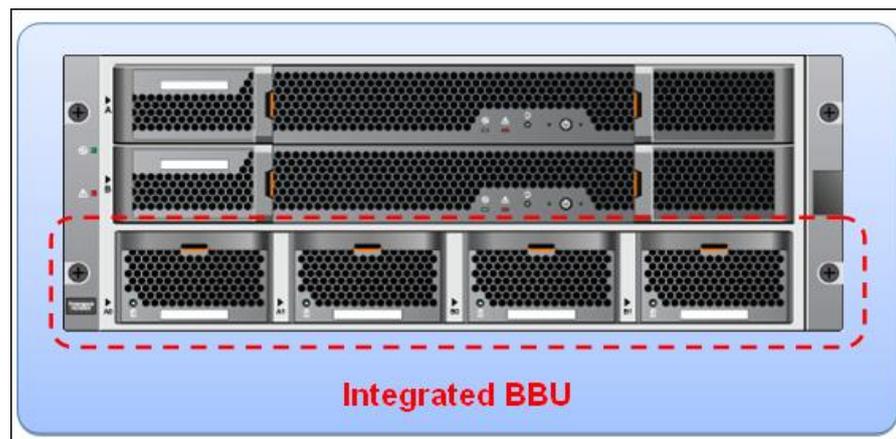


Figure3-6 Built-in BBU of the S5600T/S5800T/S6800T

- **Disk pre-copy**

The storage system uses RAID algorithm to improve the data reliability. However, to a great extent, the reliability of RAID algorithm bases on the reliability of hard disks. If a hard disk is used for a long time, its failure rate increases. Especially the hard disks of the same storage system are purchased in a batch, so if one hard disk fails, the failure rate of the entire disk group begins to increase. Furthermore, any RAID algorithm only allows a limited number of hard disks to fail simultaneously. If the hard disk to be faulty is not detected timely and processed correctly, the system security is under high risks. In addition, when a hard disk fails, it takes time for the RAID group to reconstruct. Therefore, the overall performance of the system is affected.

To prevent or reduce the effect on the storage system due to hard disk failure, the S5500T/S5600T/S5800T/S6800T adopts the disk pre-copy technology. This technology obtains the latest information about disk status through disk prediction. The information is usually from the S.M.A.R.T properties. The S.M.A.R.T judges the disk operation status through the pre-copy algorithm to obtain the failure possibility of disks. It copies the data on the disk under high risks to the hot spare disk. The whole pre-copy process preferentially performs during the system idle time period, so it protects data without affecting the host services. This prediction function shortens or even avoids the long disk reconstruction time after disk failures and reduces the risk of repeated disk failures during the reconstruction, which effectively enhances the storage security and ensures the service continuity of system.

- **Intelligent restoration of bad sectors**

According to the statistics of authority institutes in the industry, the fault rate of hard disks accounts for the biggest part of all faults in the storage system. The intelligent bad sector restoration technology of the S5500T/S5600T/S5800T/S6800T detects bad sectors by analyzing the S.M.A.R.T information of hard disks and reserves disk space to provide resources for bad sector restoration. This reduces the disk fault rate and prolongs the service life of hard disks.

- **Advanced data protection**

The S5500T/S5600T/S5800T/S6800T has the most comprehensive data protection capability in the industry, including HyperImage, HyperCopy, HyperMirror/S, and HyperMirror/A, meeting the requirements of various applications, such as, user backup, disaster recovery, and data migration.

- **HyperImage:** HyperImage of the S5500T/S5600T/S5800T/S6800T generates a virtual image that is consistent with the source LUN at a certain point in time, thus quickly obtaining a consistent duplicate of the data on the source LUN without interrupting services. The duplicate is available right after being generated. Writing data to or reading data from the duplicate have no impact on the source data. Therefore, HyperImage realizes online backup, data analysis, and application tests.
- **HyperCopy:** HyperCopy of the S5500T/S5600T/S5800T/S6800T supports full and incremental LUNCopy, LUNCopy of FC and IP links, LUNCopy in a storage array and over different storage arrays, and LUNCopy of heterogeneous storage devices. It meets multiple data backup demands and is available to data migration services.
- **HyperMirror:** HyperMirror is one of the data mirror technologies. It can maintain several data duplicates on two or more sites and prevent data loss caused by disasters by making use of the long distance. HyperMirror of the S5500T/S5600T/S5800T/S6800T is divided into HyperMirror/S and HyperMirror/A.
- **HyperClone:** The HyperClone technology employed by the S5500T/S5600T/S5800T/S6800T storage system creates a complete physical copy

of the LUN data of a storage system at a certain point in time without interrupting services. After the HyperClone, the access to the physical copy does not affect the data on the original LUN. HyperClone implements online backup, data mining, and application test.

Powerful scalability

- **TurboModule**

TurboModule includes three technologies: hot-swappable modules, flexible distribution of front-end and back-end interface cards, and design of high density interfaces and interface cards.

- **Hot-swappable modules:** The S5500T/S5600T/S5800T/S6800T supports redundancy design of hardware. The redundant parts, including the controller, power supply, fan, integrated BBU, hard disk, and interface card, are all hot-swappable. Figure3-7 show the hot-swappable modules of the S5500T/S5600T/S5800T/S6800T.

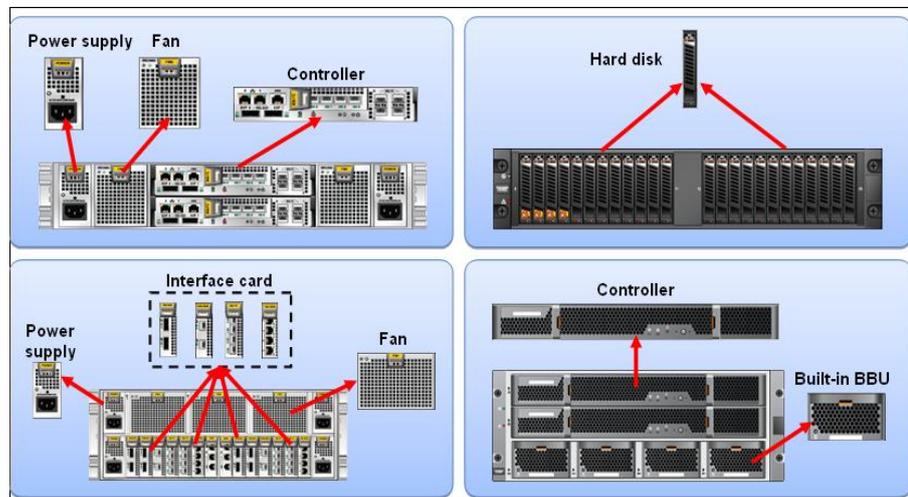


Figure3-7 Hot-swappable modules of the S5500T/S5600T/S5800T/S6800T

The hot-swappable I/O interface card is a unique design in terms of powerful scalability. The I/O interface card of the S5500T/S5600T/S5800T/S6800T can be expanded online with the increase of services. The available ports can be added without adding switches, thus reducing the cost. For maintenance, the faulty I/O module can be replaced online without interrupting the services, thus ensuring the system reliability and service continuity.

- **Flexible distribution of front-end and back-end interface cards:** The S5500T/S5600T/S5800T/S6800T supports up to 12 I/O interface cards. The front-end and back-end interface cards can be flexibly distributed according to the service type.
- **Design of high density interfaces and interface cards:** The S5500T/S5600T/S5800T/S6800T supports five interface types: 4 Gbit/s FC, 8 Gbit/s FC, 1GE, 10GE, and 4 x 6 Gbit/s SAS. The total number of front-end and back-end interfaces is up to 48, thus minimizing customers' purchase and maintenance costs.

- **Multiple disk specifications**

The S5500T/S5600T/S5800T/S6800T supports FC disks, SAS disks, NL SAS disks, SATA disks (2.5- and 3.5-inch hard disks), and SSDs. Customers can make the optimal choice according to different services.

- **Two specifications of the disk enclosure**

The S5500T/S5600T/S5800T/S6800T supports 2U and 4U disk enclosures. Both types of disk enclosure adopt the design of high density slots (24 slots/enclosure). In average, 1U space houses up to 12 2.5-inch hard disks. Figure3-8 shows the disk enclosure of the S5500T/S5600T/S5800T/S6800T.



Figure3-8 Disk enclosure of the S5500T/S5600T/S5800T/S6800T

- **HyperThin technology**

The S5500T/S5600T/S5800T/S6800T storage system provides a thin provisioning function, HyperThin. This function enables users to flexibly plan host capacity and assign virtual storage space according to specific service requirements. HyperThin also implements smooth capacity expansion without service interruption to meet the increase of data amount. The expansion process is transparent to upper-layer applications.

The HyperThin technology reduces investment and O&M costs for customers and simplifies service system management.

- **IPv6: new generation Internet protocol**

IPv6, a new generation Internet protocol, aims to resolve the problem that the IPv4 addresses are to be used up. IPv6 redefines the address space. An IPv6 address has 128 bytes and the address space increases by 2^{96} compared with IPv4 address space. Available IP addresses are almost unlimited.

The S5500T/S5600T/S5800T/S6800T storage system supports the IPv6 protocol. If customers need to upgrade their systems from IPv4 to IPv6, the compatibility problems of storage devices can be smoothly resolved without changing storage disk arrays, protecting customers' investment.

- **Green features**

- **Green features design**

The S5500T/S5600T/S5800T/S6800T adopts the Green features design that contains multiple energy-saving measures, including, CPU frequency control, intelligent fan speed control, and intelligent disk spin-down.

-
- **CPU frequency control:** The CPU frequency control technology of the S5500T/S5600T/S5800T/S6800T can dynamically adjust the CPU frequency according to the CPU utilization rate to reduce the overall power consumption of system. When the CPU utilization rate is above 80%, the CPU frequency is improved. When the CPU utilization rate is below 20%, the system smoothly changes the CPU frequency according to the policy of frequency reduction delay to stabilize the system performance. In addition, the frequency adjustment mechanism provide sufficient voltage for the stable operation of the CPU during the intelligent frequency adjustment. Therefore, the process of CPU frequency adjustment has no impact on the services.
 - **Intelligent fan speed control:** The design of intelligent fan speed control in the S5500T/S5600T/S5800T/S6800T deploys temperature monitors in all heat-sensitive parts to monitor the temperature in each heat-sensitive part and smoothly adjust the rotational speed of the fan. The policy 2 °C/gear intelligent fan speed control and 16 gears are provided to effectively improve the efficiency of heat dissipation, reduce noise, dust, and power consumption, and prolong the service life of the fan.
 - **Intelligent disk spin-down:** A great deal of running disks consume a large amount of power. The S5500T/S5600T/S5800T/S6800T adopts the intelligent disk spin-down technology that spins down the idle hard disks in part of near-line or off-line applications according to different service loads. Therefore, the power is saved. The disk spin-down technology does not frequently change the working mode of hard disks, thus protecting hard disks and prolonging their service lives.

In addition, Huawei provides OceanStor™ ISM software (the ISM for short) that can be used to manage OceanStor series storage devices. The ISM provides a secure and convenient GUI on which users can perform all O&M operations for storage devices, such as, service configuration wizard, one-key upgrade, and alarm report.

Besides the user-friendly O&M interface, the ISM has many more advantages, including, quick deployment, easy management, standard interfaces, and safe operation.

- **User-friendly O&M interface**

- **Friendly management interface:** The style of the ISM interface is consistent with that of the Windows OS and conforms to the use habit of most users. Figure3-9 shows the ISM interface.



Figure3-9 ISM interface

-
- **Rich alarm management methods:** The ISM supports the real-time check of events and alarms, statistics mechanism, and multiple alarm methods, including, indicators, short messages, and emails.
 - **Quick deployment**
 - **Service configuration wizard:** The ISM provides the service configuration wizard function. Users can quickly finish all deployments according to the configuration wizard and default typical configuration options, and even the users who use the ISM for the first time can easily finish the initial configurations of OceanStor storage devices.
 - **Batch deployment:** The ISM supports the batch discovery and configuration of devices to reduce repeated operations, shorten the configuration time, and simplify the daily maintenance.
 - **Synchronous configuration:** The ISM provides the synchronous configuration function, which enables users to configure the same data over different devices, such as, configuring alarm short messages and mail boxes to improve the configuration efficiency over different devices.
 - **On-key upgrade:** The ISM provides the one-key upgrade function. Users can upgrade all parts of the system through one key. The upgrade progress and the details about the upgrading parts can be displayed, thus reducing the operation difficulty and improving the maintenance efficiency.
 - **Easy management**
 - **Direct-viewing topology:** The ISM provides the device topology that is consistent with the actual scenario to help users quickly learn the running status of devices. In addition, the ISM device manager provides various management functions to enable users to learn the progresses of all services on devices.
 - **Collection of the critical information:** The ISM summarizes the critical information, such as, hardware status, storage resources, mapping relations, and critical alarms. It also supports the statistics export, self-defined performance statistics items, and capacity pre-alarm. The summary of the critical information directly displays the current status of devices and helps users make decisions.
 - **Standard interfaces**
 - **Unified management:** The ISM achieves the central management of Huawei storage devices, including SAN, NAS, and virtual gateway, on the same interface. The unified interface is easy to learn and use.
 - **Safe operation**
 - **Hierarchical operation management:** The ISM analyzes the effects brought by all configuration operations and defines four operation levels. Correct operations are designed according to four levels of effects to dramatically reduce risks caused by misoperations. Figure3-10 shows the ISM alarm levels.

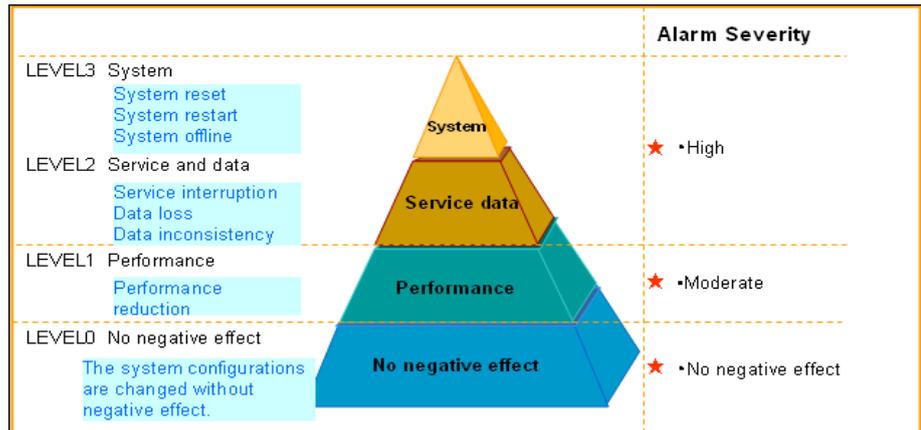


Figure3-10 Definition of ISM alarm levels

4 Promotion

By collecting the requirements of key industries and customers, Huawei summarizes their typical service applications and challenges.

Carriers

- **Typical applications:** RBT, MMS, IPTV, MDN, video surveillance, comprehensive system of operation and accounting, and comprehensive value-added services.
- **Problems and challenges:** access performance bottleneck of the hotspot data, performance guarantee of core services at concurrent access.

Governments

- **Typical applications:** construction of disaster recovery system for social security and finance, OA, and mails.
- **Problems and challenges:** backup of critical data, security and consistency of disaster recovery data

Education/Medical treatment

- **Typical applications:** construction of Medicare information system, digital library construction, and high performance computing.
- **Problems and challenges:** security of data storage, smooth capacity expansion of storage.

Financial industry:

- **Typical applications:** decision support system,. R&D test system, and transaction data.
- **Problems and challenges:** performance bottleneck of randomly accessing mass data, data security, and smooth capacity expansion of storage

Energy/Broadcast and TV/NSP

- **Typical applications:** MIS/ERP system, OA, mail system, edit broadcast system, and storage of game data
- **Problems and challenges:** large traffic, concurrent access performance

The S5500T/S5600T/S6800T offers typical solutions of high performance, high reliability, high availability, and high cost effectiveness through thorough analysis of customers' demands.

High performance solution: integrated storage meeting different performance requirements

➤ **Typical requirements**

Database server: structural data, high requirement on performance, data security, and data reliability

Mail server: High requirement on random concurrent access, storage performance, and data security

Video server: large storage capacity, powerful continuity of data access, high continuous bandwidth

File server: comparatively low requirement on performance and bandwidth

➤ **Solution values**

Tiered storage: flexible choices of FC and iSCSI networking modes, tiered storage of SSD/FC/SAS/SATA

Investment protection: scientific integration of critical data and subordinate data, choosing proper storage media and networking modes according to application requirements

➤ **Solution networking:** It is shown in Figure4-1.

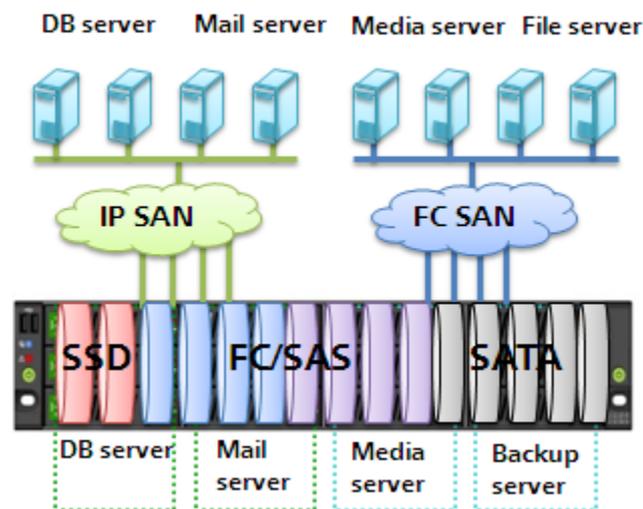


Figure4-1 High performance solution

High density virtual machine solution: applying to the environment of high density virtual machines

➤ **Typical requirements**

Deployment of a mass of virtual machines: With the increasing popularization of computing virtualization, a great deal of non-core applications and virtual desktops will be deployed with virtual machines. Virtual machines are deployed with increasing high density, and the requirements on storage capacity, performance, and scalability are also increased.

➤ **Solution values**

Supporting various protocols and rates: 1/10GE, 4 Gbit/s FC, and 8 Gbit/s FC.

Providing high density I/O interfaces: A maximum of 48 I/O interfaces meets the requirements of deploying high density virtual machines.

Slashing the TCO: A single device can bear hundreds of virtual machines through expansion cards, thus saving the investment on network switches.

➤ **Solution networking:** It is shown in Figure4-2.

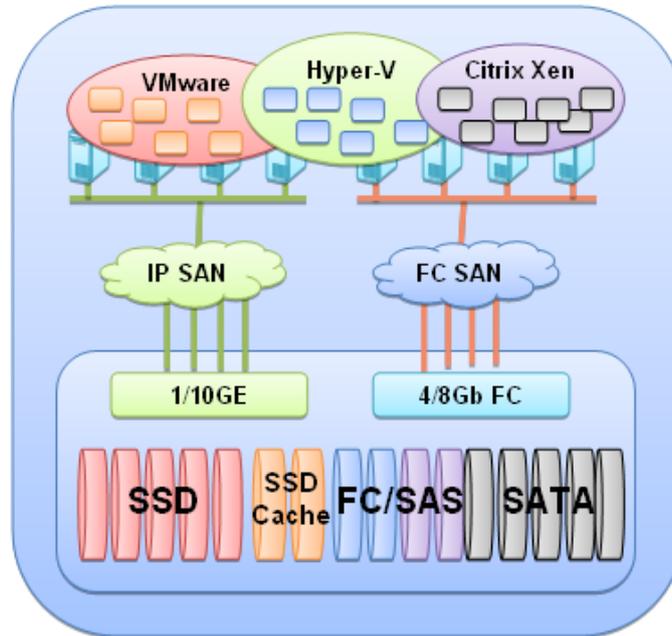


Figure4-2 High density virtual machine solution

High reliability solution: data disaster recovery

➤ **Typical requirements**

Data security: If all data is stored in one place, unexpected natural disasters, such as earthquake, flood, and fire will cause irrecoverable data loss. It is necessary to set up a disaster recovery center in another place to ensure the data security. After disaster, data can be quickly recovered, thus reducing loss to the largest extent.

➤ **Solution values**

Ensuring the data security: The HyperMirror function provided by the storage array transfers the data to the remote backup storage array. The disaster recovery function realizes quick data recovery and ensures the data security.

➤ **Solution networking:** It is shown in Figure4-3.

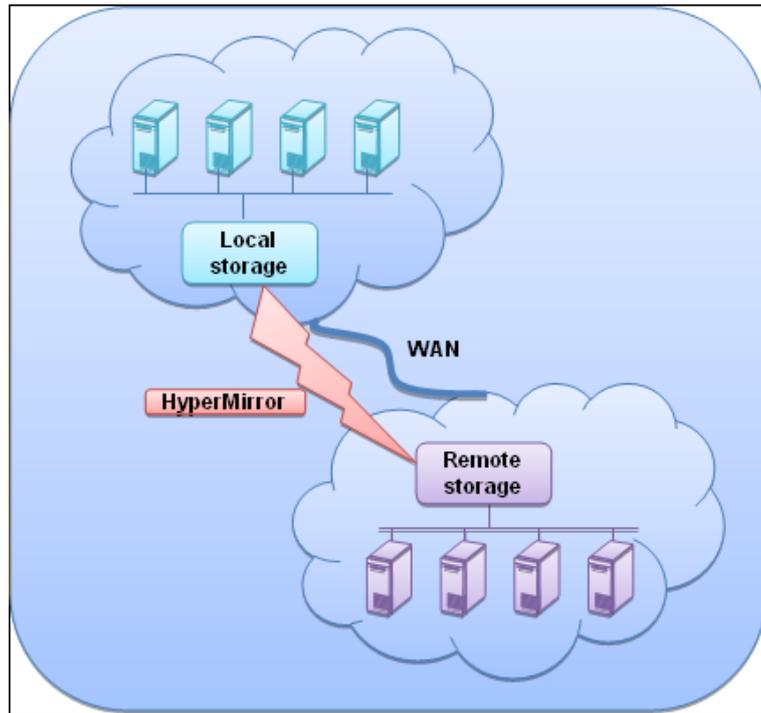


Figure4-3 High reliability solution

High availability solution: applying to the high availability cluster

➤ **Typical requirements**

Database server and mail server: Two or more servers build up a cluster that has a high requirement on data availability. For example, it requires 24-hour uninterrupted services and no single point of failures in the system.

➤ **Solution values**

High availability: This solution supports applications of mainstream clusters and ensures high availability of applications. The multipathing software ensures the high availability of data links.

Redundancy and reliability: All parts are redundant. For example, when a controller fails, all applications can be immediately switched over to another controller.

➤ **Solution networking:** It is shown in Figure4-4.

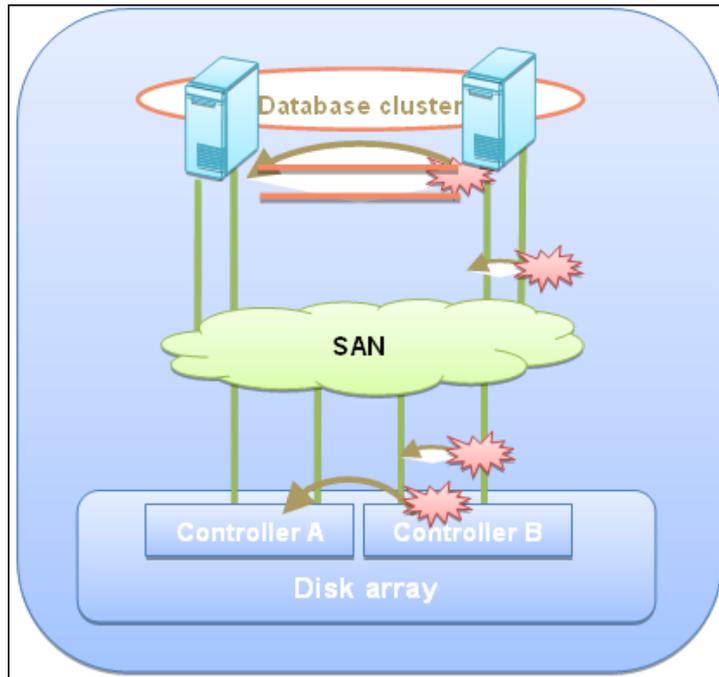


Figure4-4 High availability solution

High cost-effectiveness solution: tiered storage

- **Typical requirements**

Application characteristics: a large number of application servers, large system capacity, high concurrent access, and obvious "Eighty-Two" phenomenon (20% of data is frequently accessed, while 80% of data is rarely accessed) of service data

- **Solution values**

High cost-effectiveness solution: The resources are properly allocated by setting different service data respectively onto SAS disks, SATA disks, and SSDs. The hotspot data is continuously monitored and migrated from the mechanical disks to SSDs through the SmartCache function to improve the system performance.

- **Solution networking:** It is shown in Figure4-5.

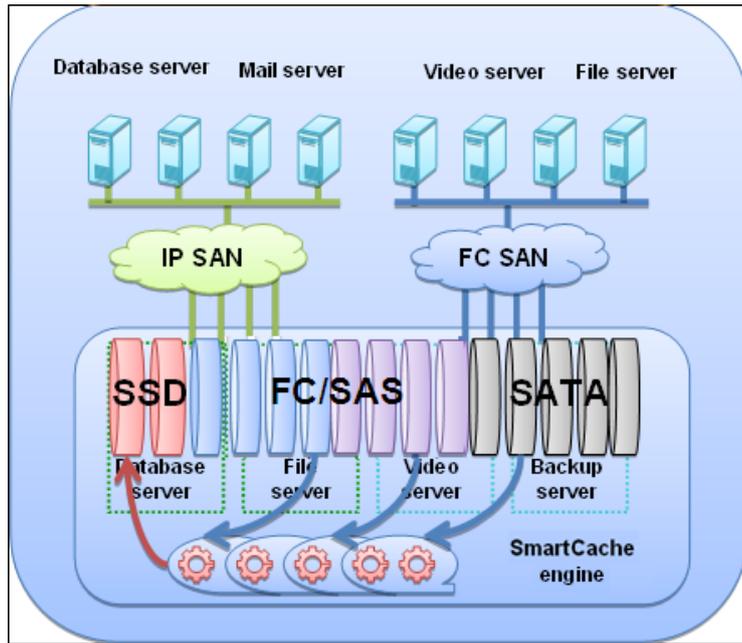


Figure4-5 High cost-effectiveness solution

5 Conclusion

Huawei is dedicated to providing high quality storage products and user-friendly services for customers. Based on the concept, the S5500T/S5600T/S5800T/S6800T fully meets customers' requirements, and maximizes customers' values in terms of functions, performance, and green features.

6 Acronyms and Abbreviations

Table 6-1 Acronym and abbreviation list of the S5500T/S5600T/S5800T/S6800T

Acronym	Full Spelling
FC	Fiber Channel
LUN	Logical Unit Number
RAID	Redundant Array of Independent Disks
S.M.A.R.T	Self Monitoring Analysis And Reporting Technology
SAS	Serial Attached SCSI
SATA	Serial Advanced Technology Attachment
SSD	Solid State Disk
SCSI	Small Computer System Interface
BBU	Backup Battery Unit
OLTP	On-Line Transaction Processing
OLAP	On-Line Analytical Processing
MIS	Management Information System
ERP	Enterprise Resource Planning
MDN	Mobile Directory Number