01 Latest Storage Technologies and Trends

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Foreword

- This module briefly introduces the definition of storage, its development history and technological trends in storage. This module allows beginners to understand the how storage comes into existence and also know the direction of technological improvements in storage solutions.
- This module also briefly introduces the Huawei Storage Products and Solutions.

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Objectives

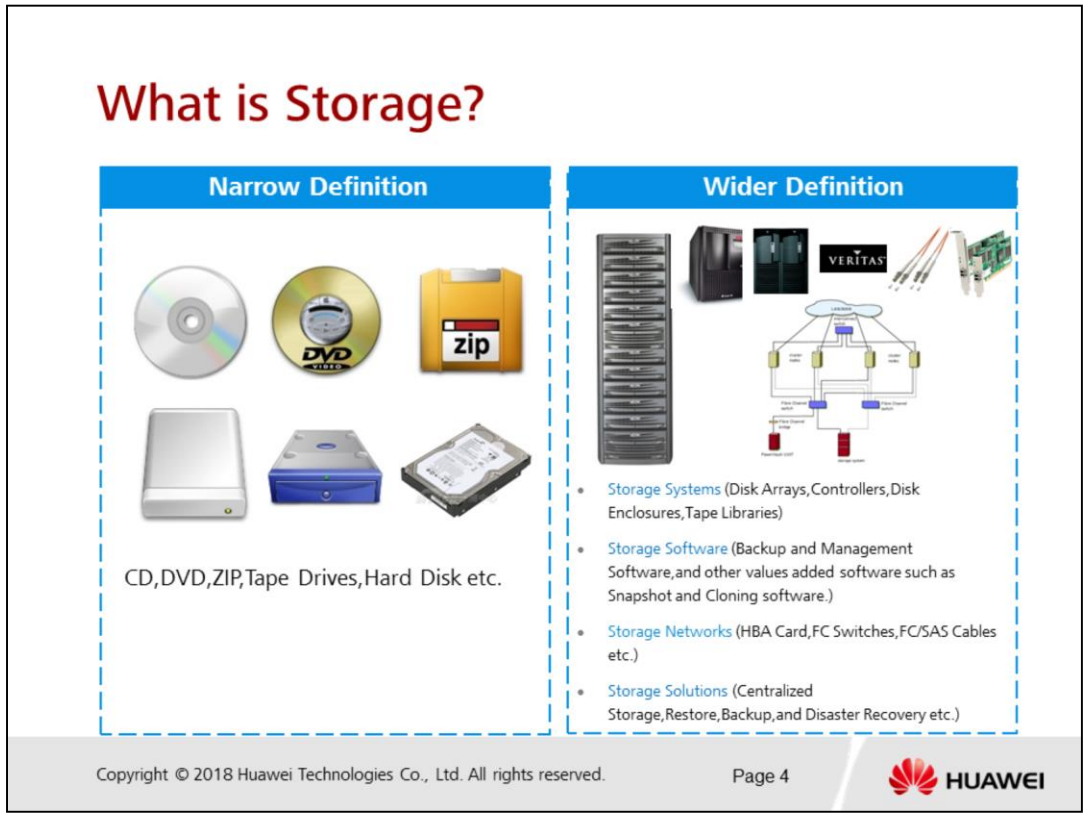
- On completion of this course, you will be able to:
  - Understand the definition of storage;
  - Understand the development history of storage technologies;
  - Understand the evolution of storage technologies and its development trends;
  - Learn about Huawei Storage Products and Solutions.

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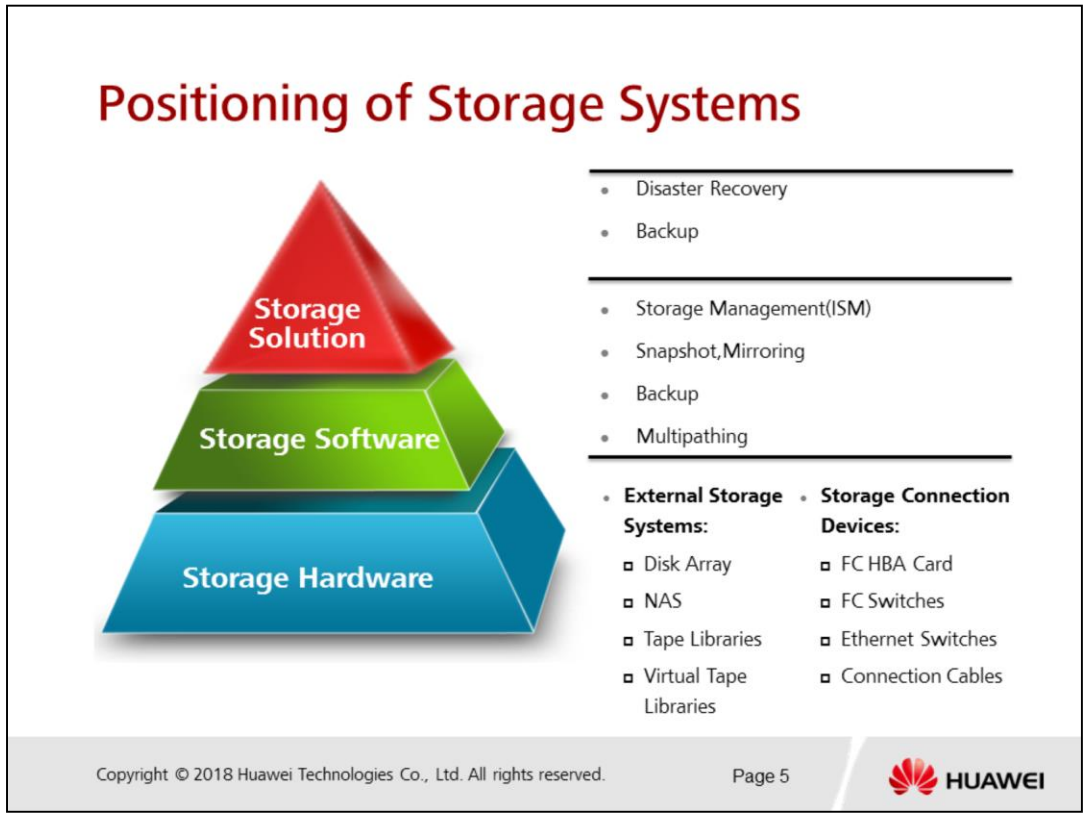
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2. Development History of Storage
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- A narrow definition of storage can refer to the physical storage devices such as floppy disks, CD/DVD, hard drives or even tape drives that are still used in some enterprises. A wider definition of storage refers to the storage devices used in Datacenters such as storage systems, storage software, storage networks and storage solutions.
- In reality, multiple storage systems, hardware and software work together to form a solution that could satisfy the needs of business that requires high levels of data management such as data integration, backups and disaster recovery solutions. Etc. Servers accesses the data on storage hardware via a storage network and storage software manages the data for data integration, backup and disaster recovery purposes.
- This module shall introduce the wider definition of complex storage systems used for storing and managing critical business data.

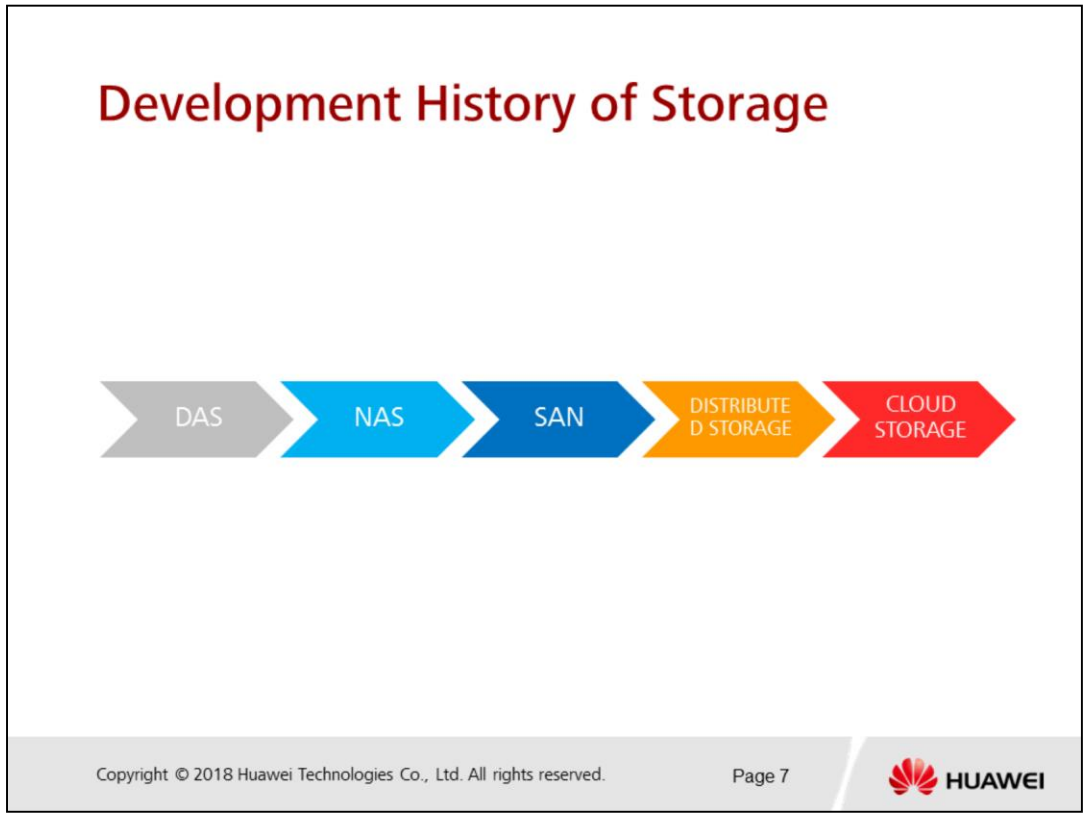


- Current storage technologies are no longer standalone systems, in reality, it consist of a series of components that makes it a complete storage system.
- Nowadays, storage systems are divided into 3 different components which are the storage hardware, storage software and storage solution. The storage hardware component is further divided into external storage hardware such as physical storage devices like disk arrays and tape libraries.
- Usability of storage systems are greatly increased due to the existence of storage software, features such as data mirroring, cloning, automatic backups and other data operational tasks can be managed and completed via storage software.
- A well designed storage solution ensures that data storage operations are conducted easier, however an excellently designed storage solution not only will allow easier storage system deployment, it also lowers the total cost of ownership (TCO) for the customer and ensures that the customer has the best value and protection on their investments.

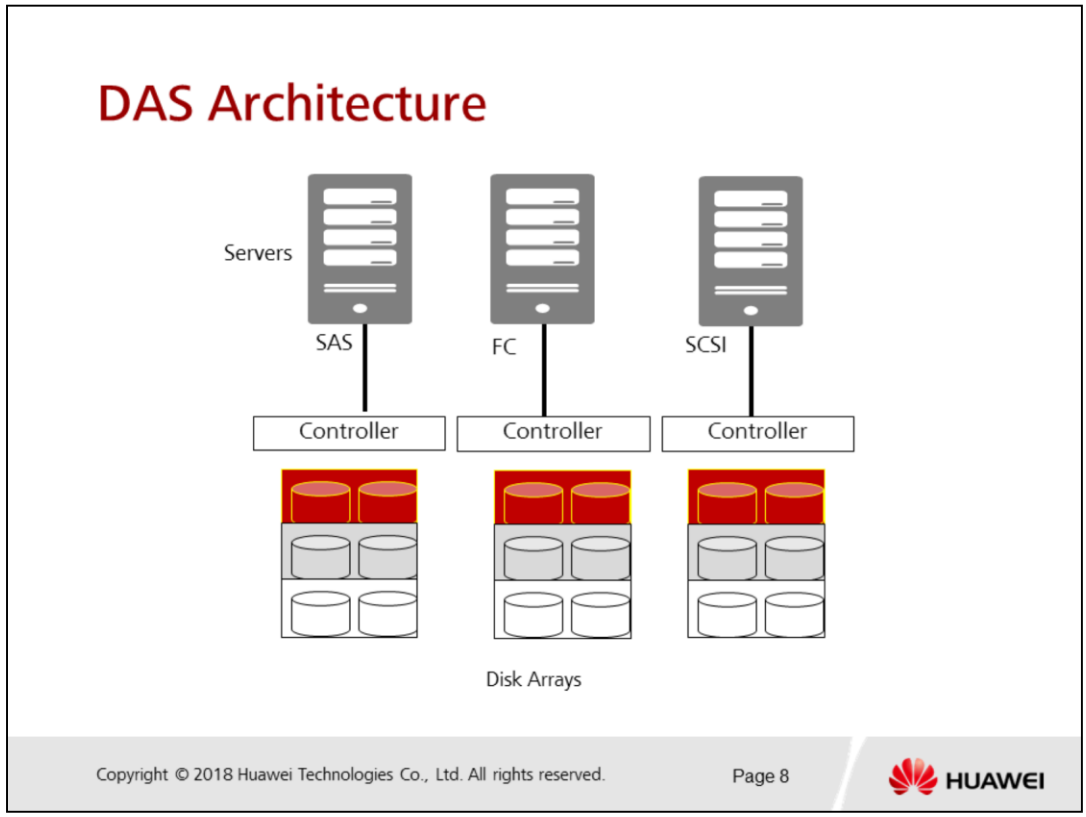
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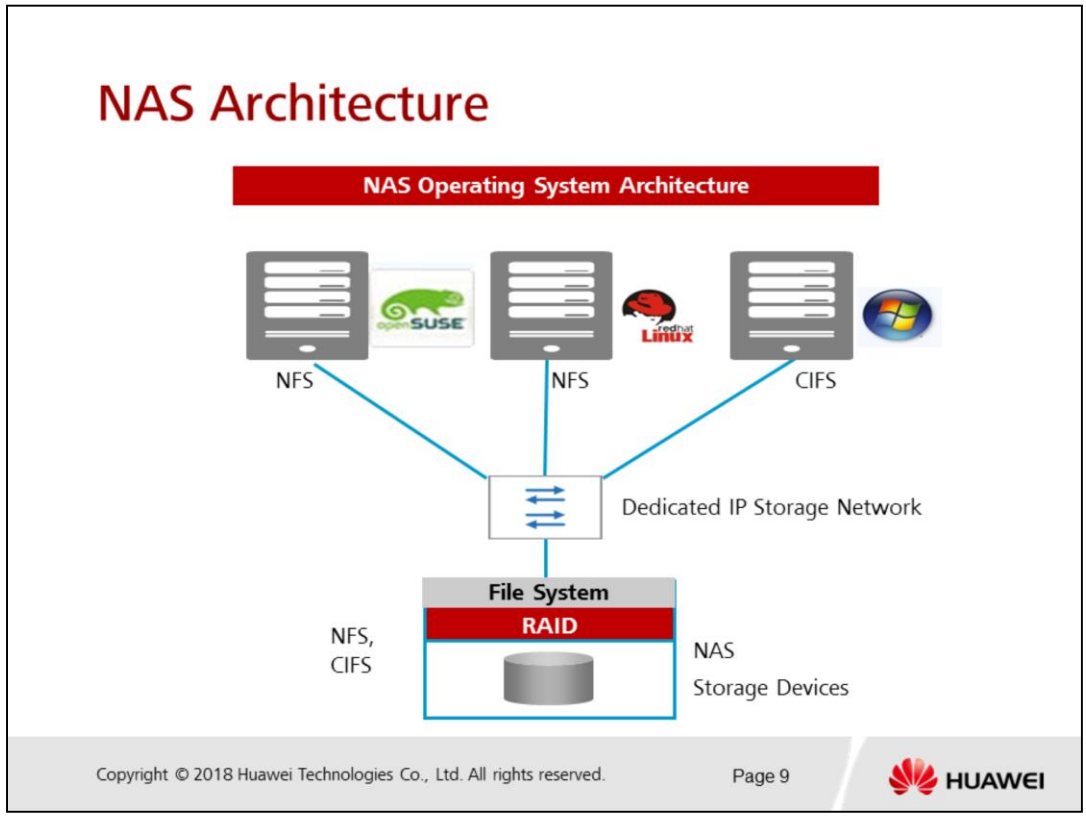
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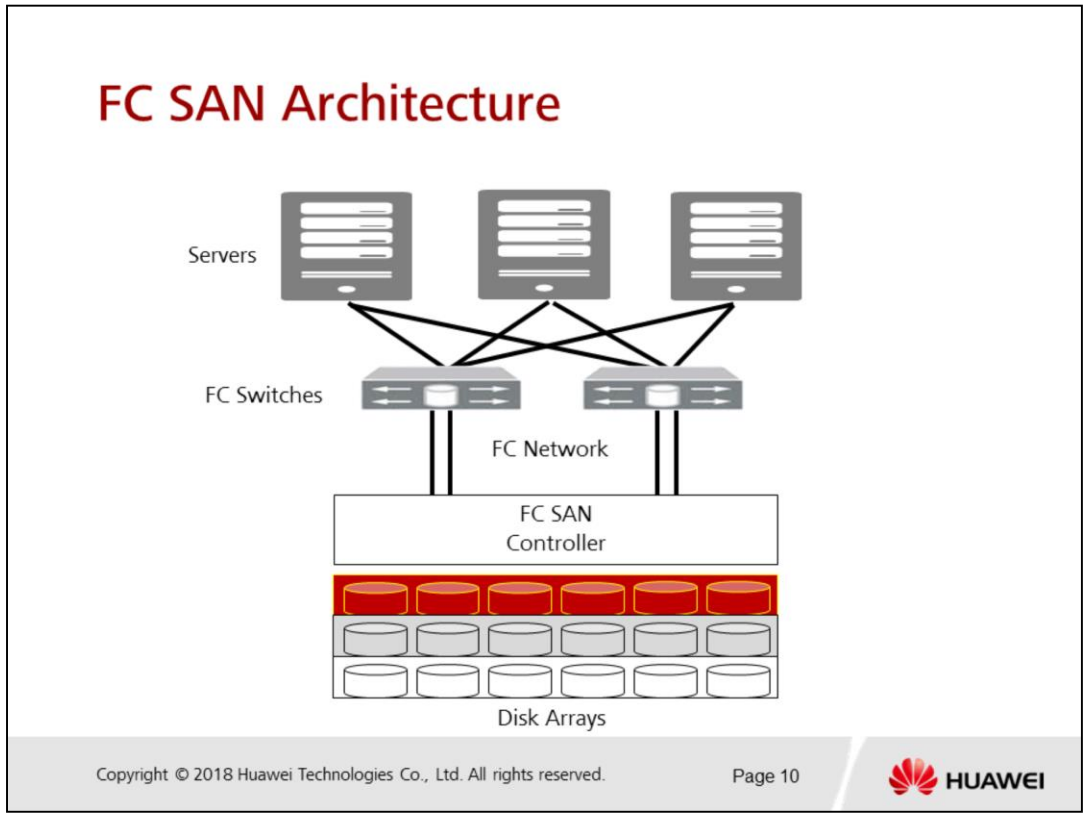
- Direct Attached Storage (DAS).
- Network Attached Storage (NAS).
- Storage Area Network (SAN).



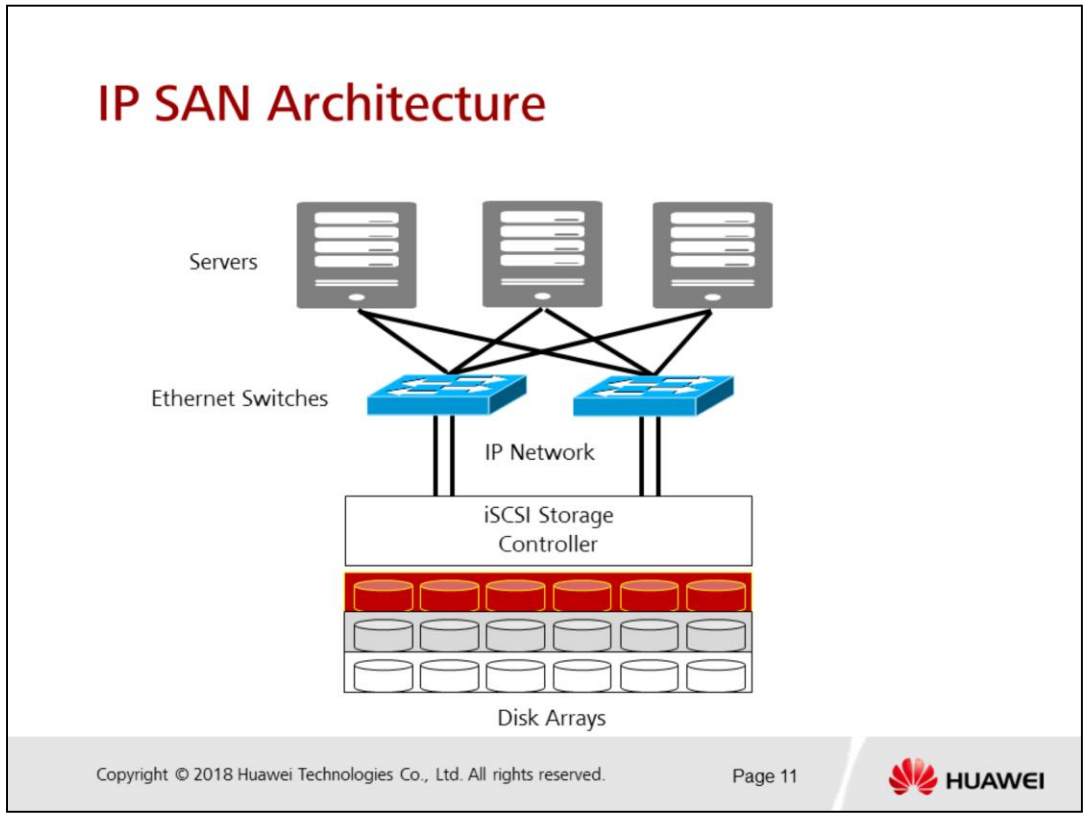
- Direct Attached Storage (DAS) : is a storage architecture that consist of storage devices are directly connected to the servers. DAS provides block-based storage for servers (Not File-based storage).
- Examples of DAS storage: Internal hard disk in servers, tape libraries that are directly connected to servers, and external hard drives that can be directly connected to servers. DAS can be differentiated into Internal DAS and External DAS based on the location of the storage in relation to the servers.
- Internal DAS:
  - In the architecture of the Internal DAS, storage devices are internally connected to the servers via serial or parallel connection to the internal bus, however, due to the physical limitation of the cables length, it only supports short distance high speed data transfers. Additionally, there are also limitation the number of devices that can be connected to the internal bus, and storage devices will also take up lots of space in the servers if they are placed within the servers, making maintenance of other parts within the servers difficult.
- External DAS:
  - In the architecture of External DAS, servers are directly connected to external storage devices. In most situations, they communicate to each other through FC or SCSI protocols. In comparison to internal DAS, external DAS has overcome the limitation of short distance and devices limit faced by internal DAS. Additionally, external DAS can even provide centralized management of the storage devices, making management of those storage devices easier.



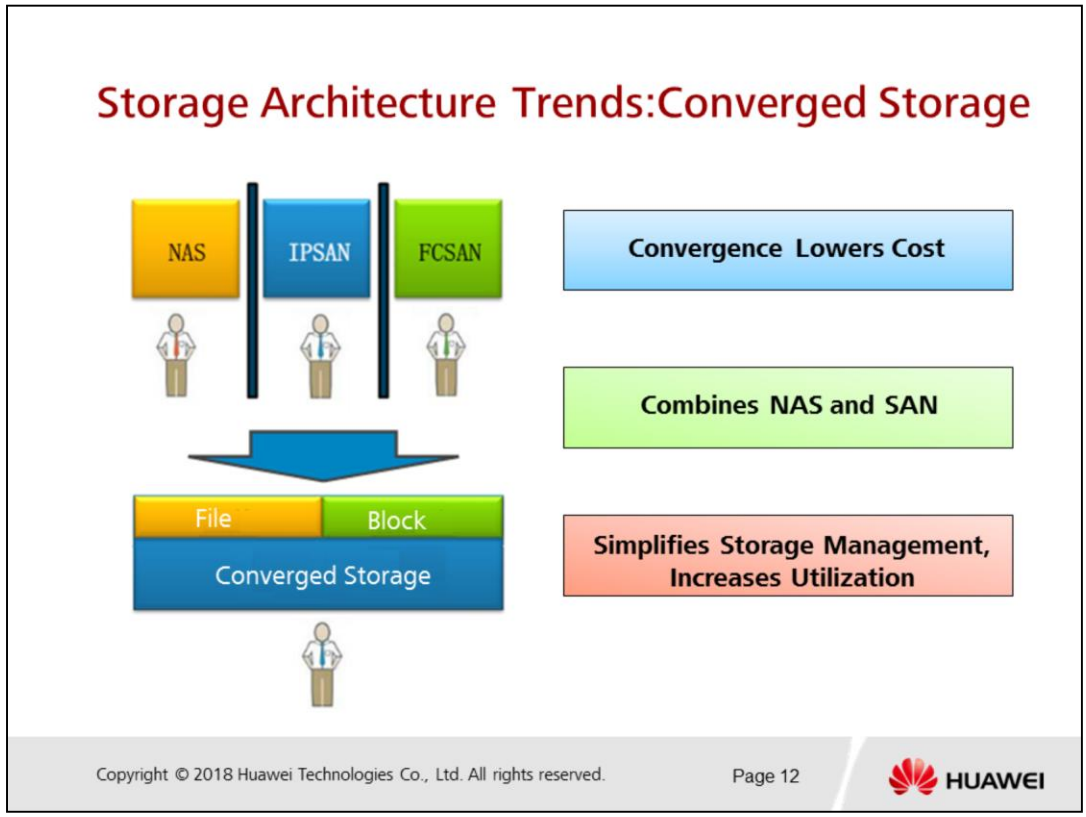
- Network Attached Storage (NAS) are IP-based file level storage devices that are connected to a local area network. NAS allows customers to share files quickly with lower storage management cost through file-based data access and sharing storage resources over a network. By utilizing NAS, there is no need to set up multiple file servers and it is one of the preferred file-sharing storage solutions. NAS also eliminates the issue of performance bottleneck faced when customers are accessing the file servers. NAS uses the network and file sharing protocols to implement data archiving and data storage. Among the protocols used by NAS also includes the TCP/IP protocols used for data transmission and CIFS and NFS protocols for remote file management.
- UNIX and Windows user can share data seamlessly through NAS and usually can do so via the sharing methods such as NAS and FTP. When NAS is shared, UNIX usually uses NFS protocol for file management while Windows uses CIFS protocol. With the advancement of network technologies, NAS has expanded to fulfill enterprises needs for high performance and high reliability data access. NAS devices are usually dedicated, high performance, and high speed devices with a single purpose of providing file service and storage. NAS devices uses their own operating system and integrated hardware and software to fulfill specific file service requirements. NAS optimizes its underlying operating system and file I/O (input/output) processes, making it perform file I/O better than common file servers. NAS devices can connect to more clients compared to traditional file servers which allows it to achieve the purpose of aggregating multiple traditional file servers with less NAS devices.



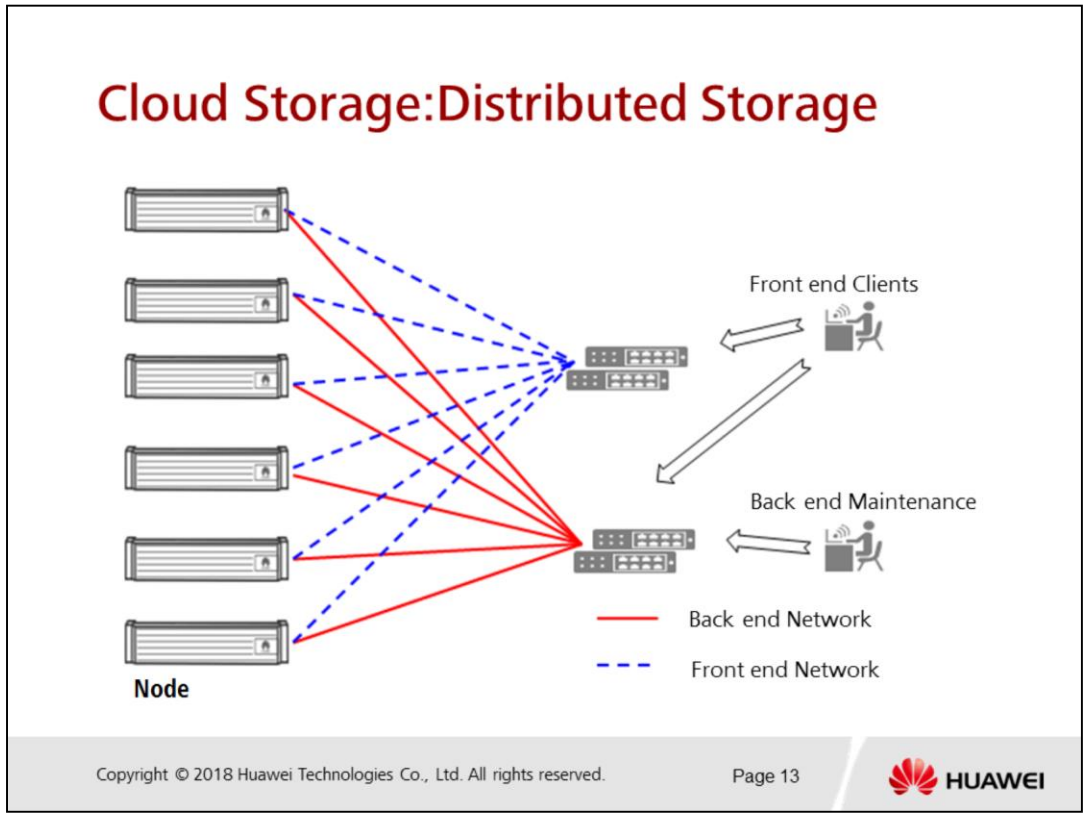
- Storage Area Network (SAN) : is a dedicated high performance network implemented between the server and storage resources. It has been optimized specifically for high amount of raw data transmission. Hence, FC SAN can be seen as an expanded form of SCSI protocols in terms of long distance application. The default protocols used by FC SAN is SCSI and Fiber Channel. Fiber Channel is especially suitable for SAN implementation due to the fact that it is capable of transmitting large blocks of data and is also capable of long distance transmission.
- The market for FC SAN is mostly centered at high end enterprise grade storage devices implementations. These storage implementations has high requirements for performance, redundancy and availability. Etc. storage arrays and backup devices.



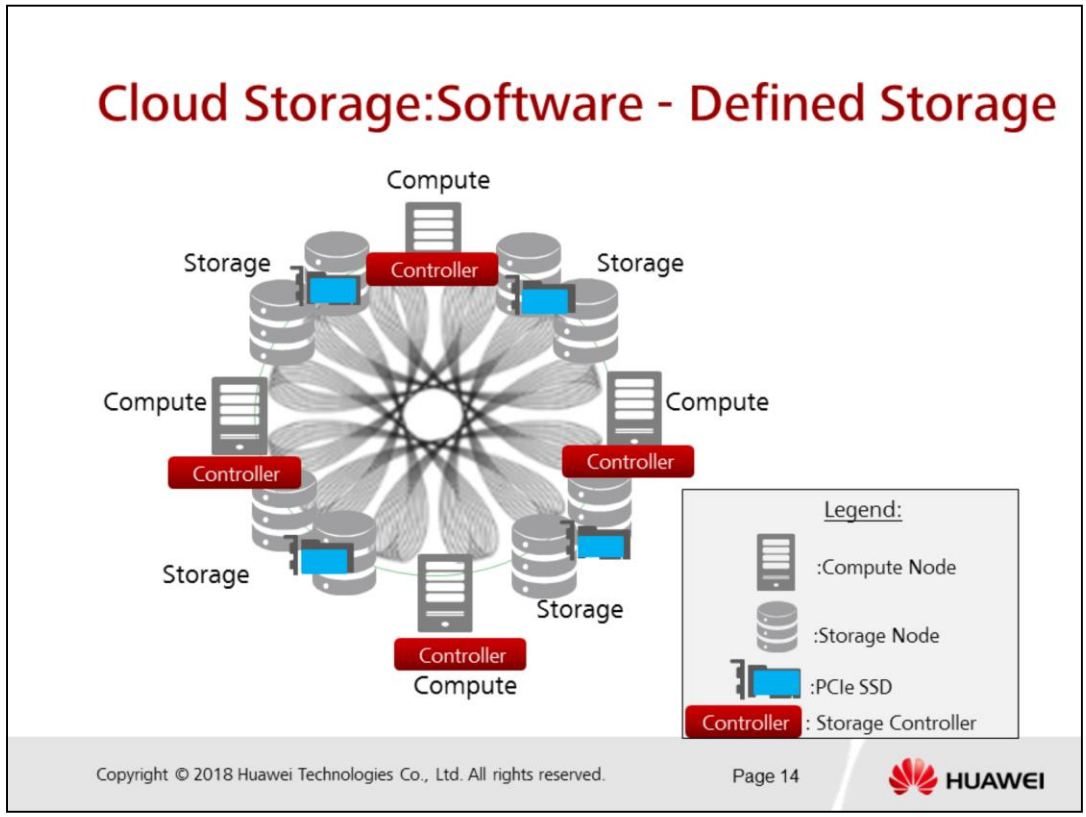
- IP SAN (Storage Area Network) : is a storage area network architecture based on TCP/IP protocols for data transmission using Ethernet as the medium.
- The default protocol for IP SAN implementation is iSCSI (Internet Small Computer System Interface), which is a protocol that encapsulates SCSI commands and transmit it over IP networks.



- Converged Storage combines both SAN and NAS storage, fulfills elastic business development, simplifies service deployment, increases storage resources utilization and effectively reduces total cost of ownership (TCO).



- Distributed Storage in simpler terms can be defined as storing data in a distributed way across multiple data storage servers on a large scale storage resource pool built using standard x86 server's storage media such as internal HDD and SSD.
- Current Distributed storage systems are mostly built upon Google's experiences in building a distributed file system across multiple servers, and implementing data storage services on this distributed file system.

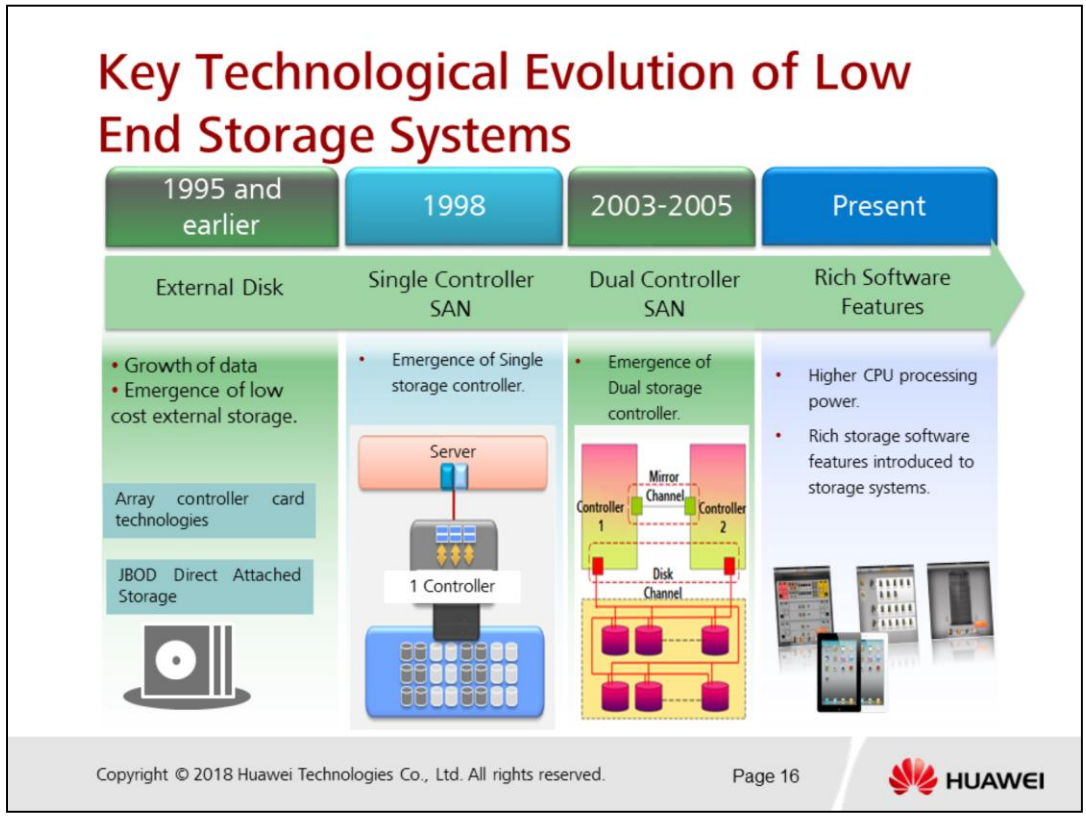


- Software-defined storage uses distributed technology to build a large scale storage resource pool using storage media of X86 servers such as HDD and SSD, and provides industry standard SCSI and iSCSI ports to non-virtualized applications and virtual machines.

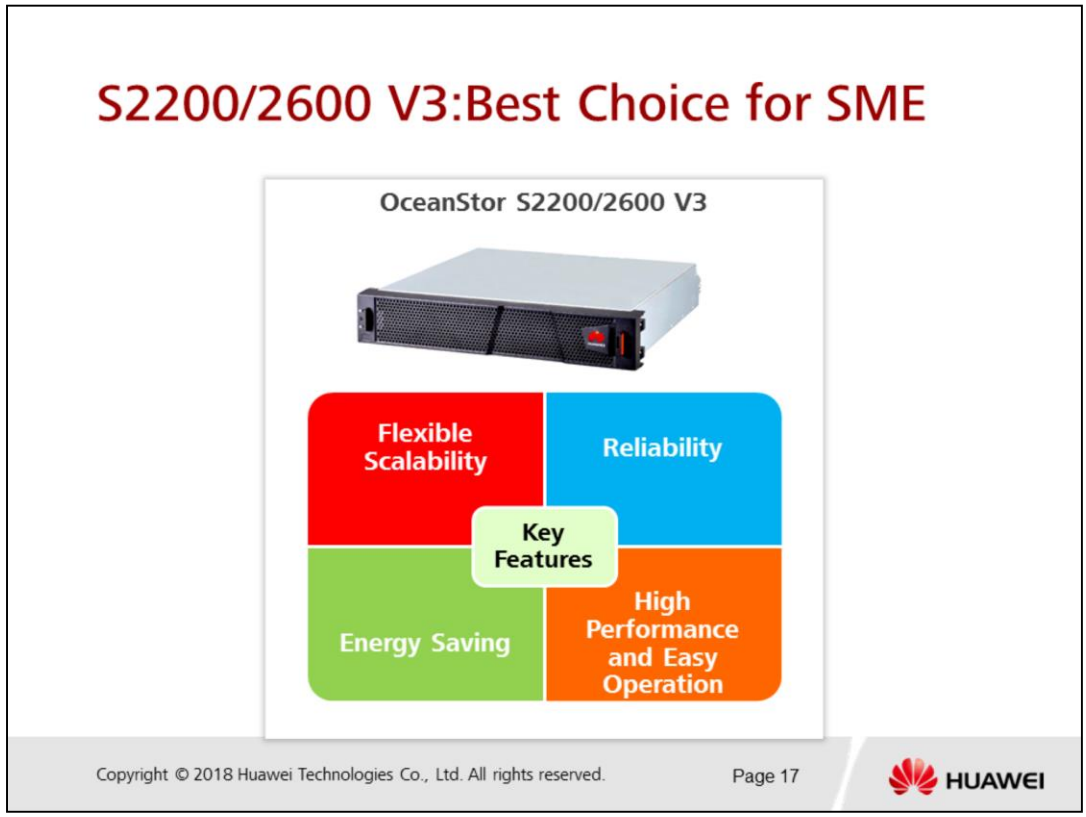
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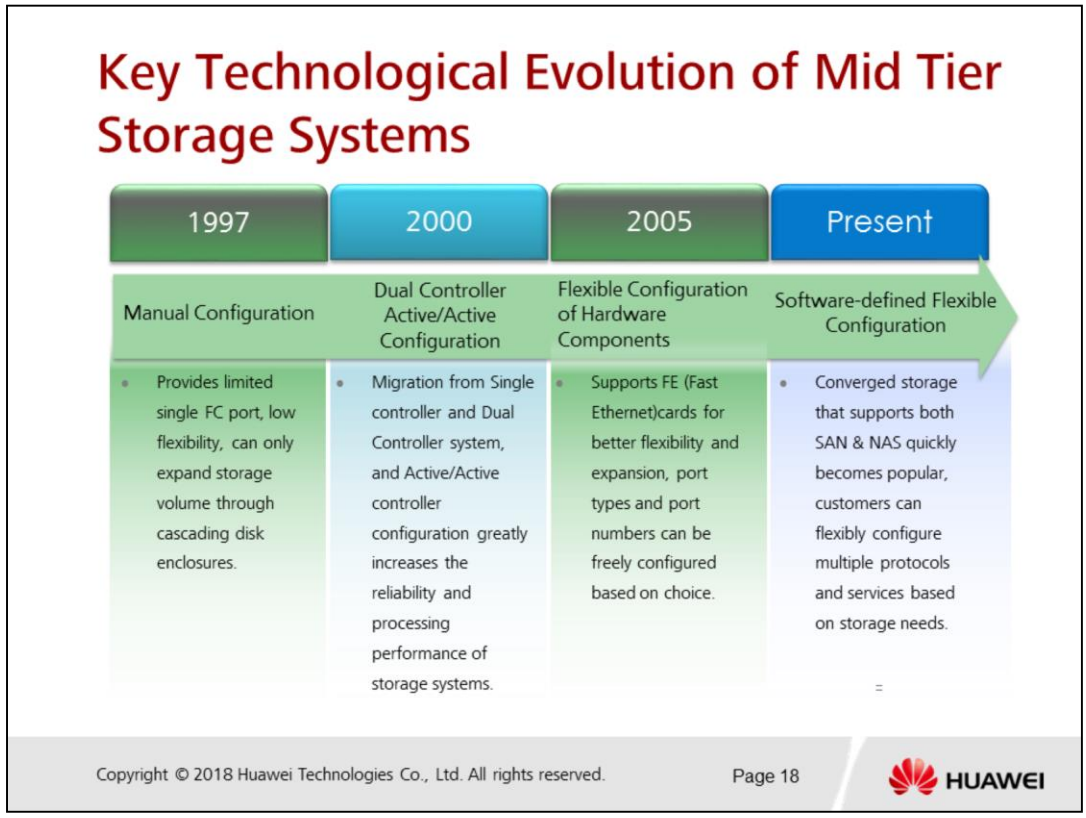
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- Low end storage devices has characteristics such as simple, economical and easy to use, it is capable of running extendedly for 24x7 period, and it satisfies enterprises requirement for availability and data protection. It is considered as an entry level professional storage platform for enterprise datacenters.
- As of year 1995 and earlier, with the growth of data, local server storage is no longer able to fulfill enterprise requirements. Emergence of low cost external storage devices causes servers to be connected to multiple hard drives. Array controller card technologies was introduced which allows storage arrays to have more disks connected and managed. JBOD(Just a Bunch Of Disks) direct attached storage was also introduced in this period which increases the limit of storage hard disks that can be connected to servers.
- As of year 1998, single storage controllers was introduced into storage systems. Single Controller in SAN runs the RAID, Cache and Utility Software, which frees up the servers processing power.
- During the period of year 2003 to 2005, Single Controller SAN is slowly replaced by Dual Controller SAN due to decreasing cost, existence of single point of failure, low reliability, and poor scalability. Dual Controller SAN consist of 2 storage controllers which eliminates the single point of failure, has more reliability and much more scalable compared to single controller SAN.
- In the present, with the increase in CPU processing capabilities, low end storage devices can provide more and more service and features. This caused software features to move down from mid range to low range storage devices. Previously, only Mid tier storage system has the high CPU processing power to run multiple storage features, but as the low range storage systems is having more CPU power, these systems are also capable of running these features to a certain extent.



- Flexible and Reliable:
  - Flexible scalability based on needs: Start small and scale up flexibly along with the growth of the enterprises and their needs for storage.
  - Fully Redundant System Design: Full redundancy with dual controllers architecture, ensuring the highest amount of system stability and data protection.
  - Easy operation: Unified management interface using the DeviceManager, 5-steps basic configurations, supports remote management using IPad, and one-click system upgrade for easier operation of your storage.
- Energy Saving and High Performance:
  - High performance and High Standard: Supports both FC and iSCSI , and satisfies complex storage requirements.
  - Multiple Energy Saving features and lowers the Total Cost of Ownership(TCO): Automatically hibernates the hard disk based on service loads and lowers the energy consumption by 40%, 16-speed smart fan speed control technology, and smart CPU frequency adjustment based on service workloads.



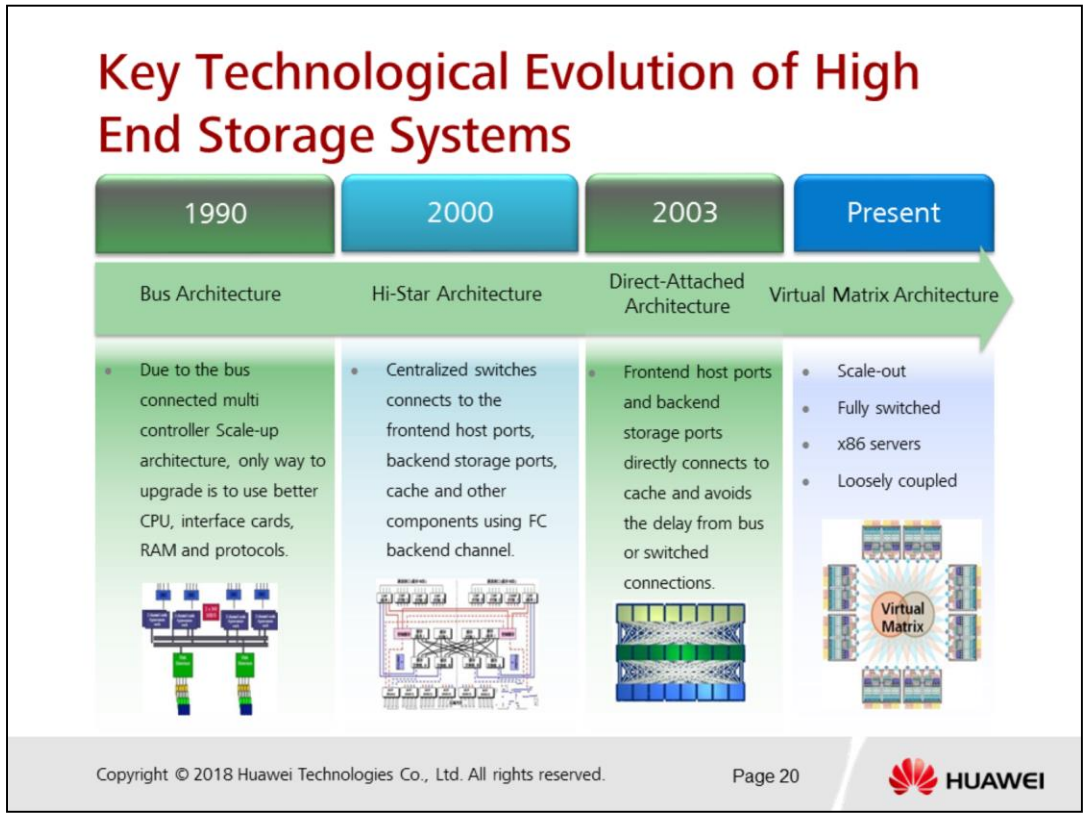
- Mid tier storage systems has the key characteristics of convergence, flexibility, and simple system architecture which consists of multiple features. It satisfies the ever changing storage needs and requirement of customers, ensures 24*7 availability for enterprise systems, and it is a commonly used storage platform for enterprise datacenters.

Converged Storage:Intelligent Multi Service Carrier



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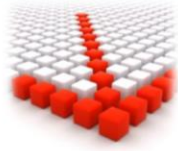
- High Flexibility: Converges and supports FC/ISCSI/NFS/CIFS/FTP/FCoE/IB protocols, virtualization and all major applications of databases.
- High Performance: Frontend and Backend bandwidth exceeds the industry by 50%, and SPC-1 performance exceeds the industry by 30%.
- High Expansion: Cache and Storage Volume expansion capabilities exceeds 3 times of normal industry capabilities .
- High Fault-Tolerance: 30minutes/TB data reconstruction, zero hotdisks, auto repairs bad sectors.
- Fine Granularity: SmartTier/SmartCache/SmartMotion fine-grained hot data analysis and auto data migration enabling 3 times higher performance, SmartThin copy-on-write(COW) and disk reclamation technologies increases disk space utilization by 3 times.
- Service Adaption: Supports multiple standards for VAAI/VASA/SRM/SMI-S/Energy saving/security access/application platform, and adapts to the customer service environment and provides data protection.
- Auto Recovery: Proprietary RAID 2.0+ technology allows it to flexibly control data through fully virtualized mechanism which work seamlessly on virtualized platforms for data auto recovery and reconstructions.
- Interoperability with High End Storages: Industry's only storage device that is capable to interoperate and copy data between high end storage systems.
- Intelligent Management: Can complete deployment of 100 logical unit number(LUNs) in 1 minute allowing 10 times increased efficiency and an unified management system for managing all Huawei storage devices.



- High end storage devices has high reliability, high expansion system architecture, has rich data management and data management features. It ensures high level of service continuity and high level of service quality standards. It carries the critical business applications and is the core of the storage platform in enterprise grade datacenters.

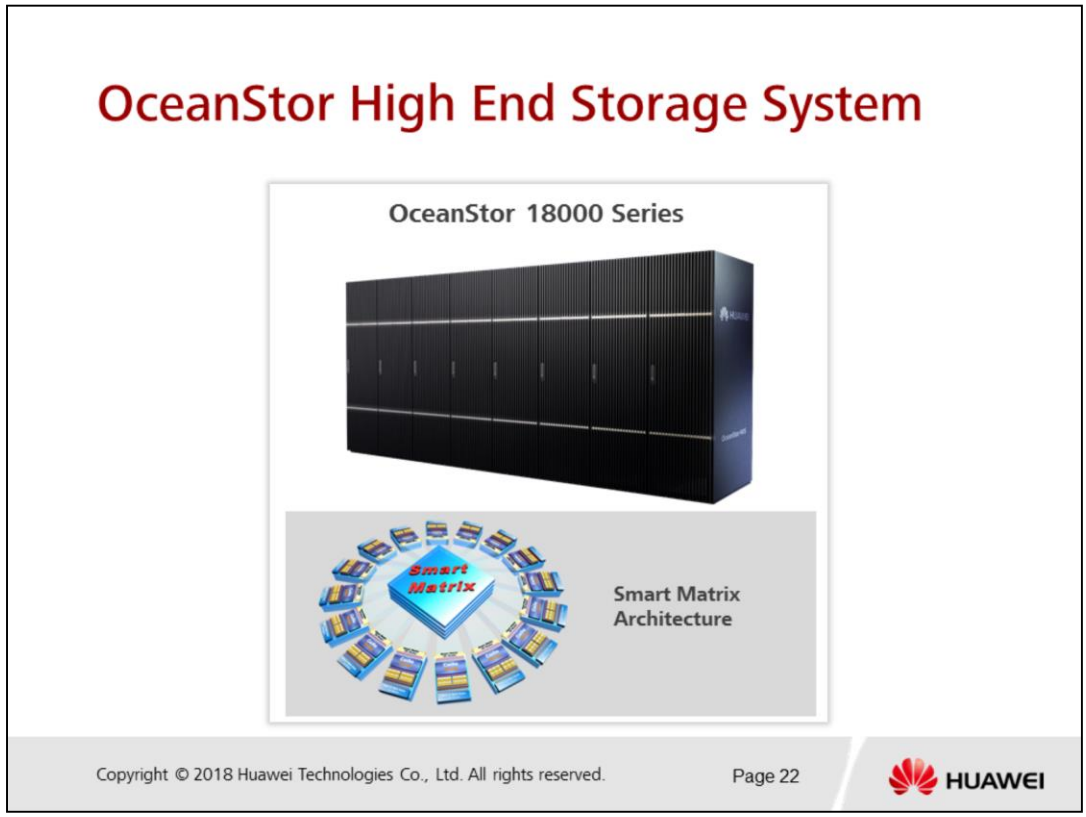
Current Features of High End Storage Systems

Core Storage Platform (Centralized)

System Architecture	Data Protection	Quick Response	Online Expansion
			
• Fully switched multi controller architecture • Global Cache • End to end verification • Limits number of disks in loop	• Local Snapshot Protection • Second-level copying	• Cache Partition, Global Cache • QoS • Auto data categorization • SSD Optimization	• Linear performance expansion • Online volume expansion • Virtualization

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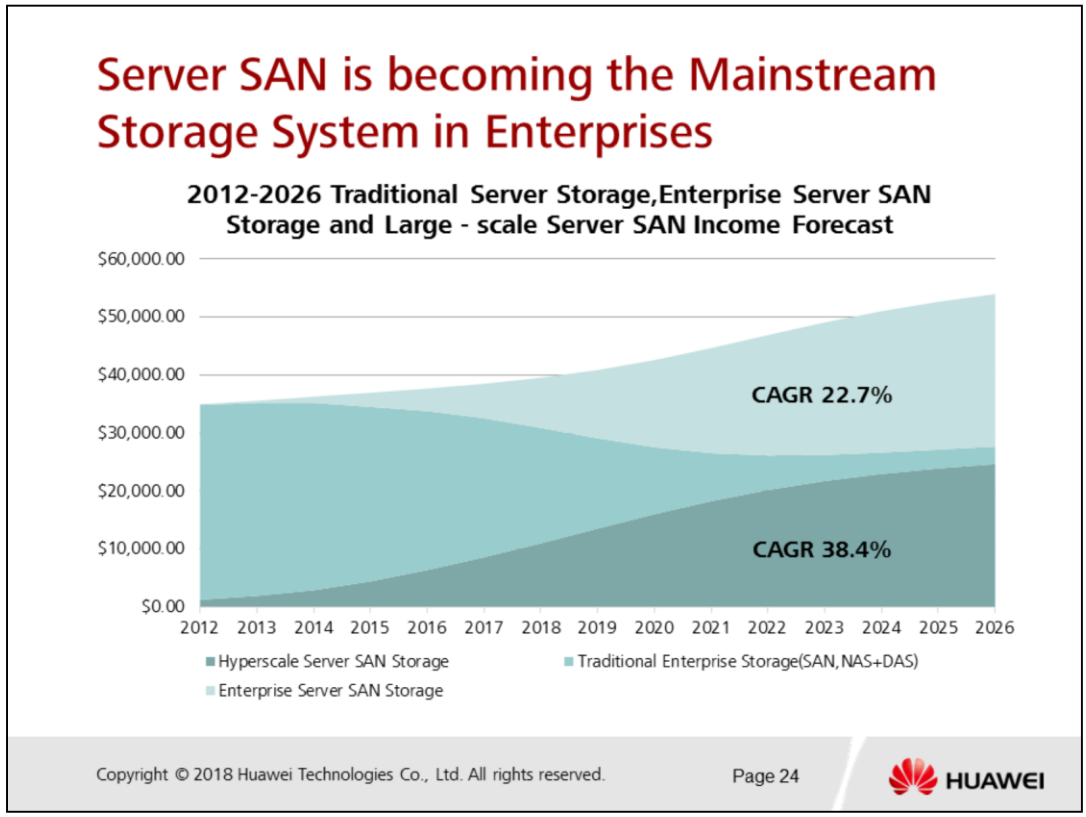


- Safe and Reliable:
  - Multi Controller Fully Redundant System Architecture: it eliminates single-point of failures (SPOF) Cache load balancing ensures stable operation of the system.
  - Based on RAID 2.0+ disk virtualization: Allows zero hotdisk, and 20 times data reconstruction speed which greatly enhances data reliability.
  - Complete Disaster Recovery Solution: Industry shortest 0~5 second Recovery Point Objective (RPO), with one-click disaster recovery management ensures highest degree of service continuity.
- Elastic and High Performance:
  - Elastic expansion of capabilities based on service need, which fulfills the storage needs for next 10 years.
  - Quickest Response: The only high end storage with millisecond level stable response, and increases the service processing speed by 10 times.
  - High Efficiency: Fine tuned for highest storage efficiency, and increases the storage utilization rate by 3 times.

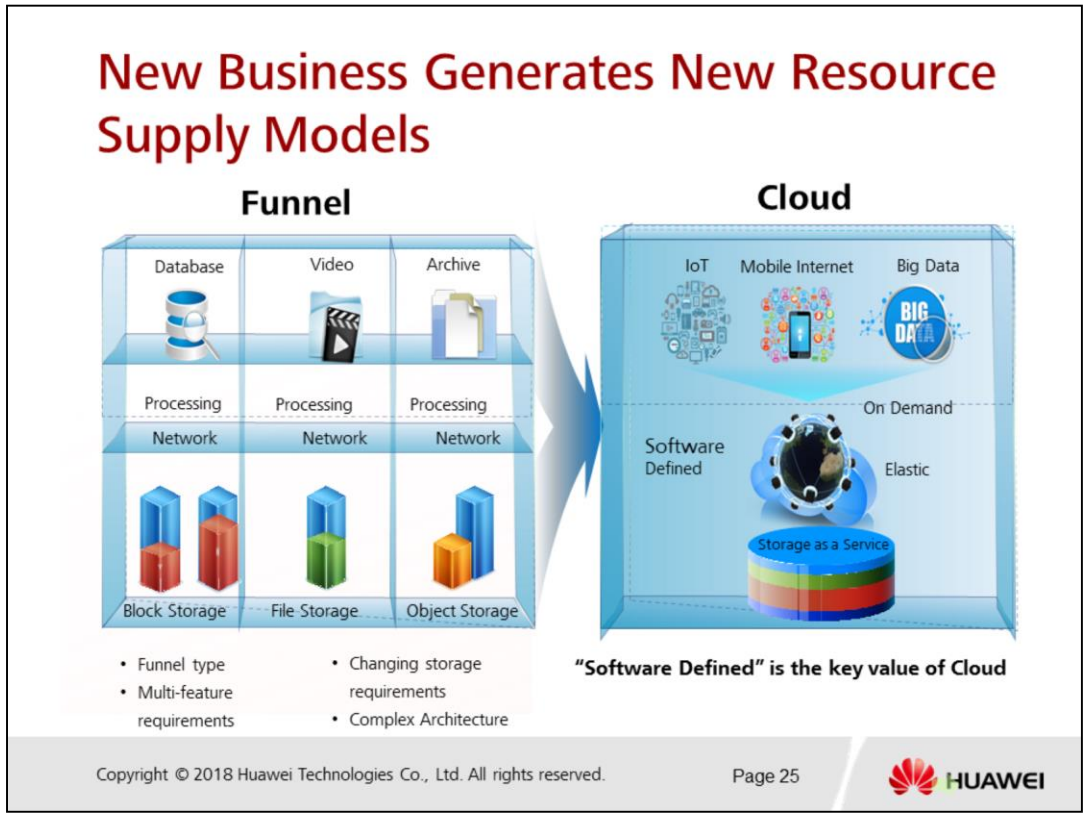
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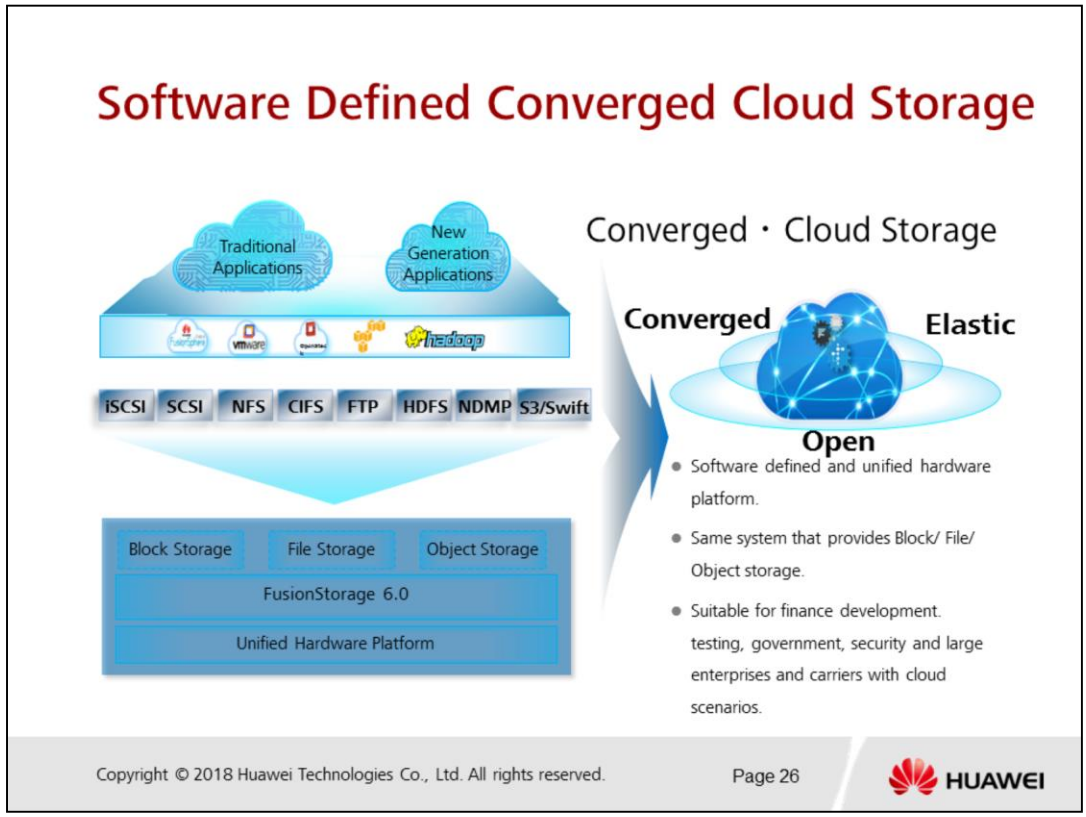
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- Cloud Storage Market: Quickly growing and expected to reach $29B by 2020.
  - Benefited from the requirements of centralized storage resource pools, lower TTM (time to market) and TCO (total cost of ownership). Public cloud and private cloud is growing by 22.7% and 38.4% CAGR respectively.
- Public Cloud: Aims at the emerging trend of increasing application performance and reliability.
  - Standard Scenarios: Web、VDI、HPC、IOT、RDS、Wed Disk.
- Private Cloud: focuses increasing efficiency on large scale VM/Containers storage pools.
  - Standard Scenarios: VSI、VDI、Big data.
  - Key Requirement: Cloning/Active-Active、Deduplication/Compression、High bandwidth and Virtual machines compatibility.



- Traditional storage are designed for single purpose or single scenario uses, and these funnels cannot satisfy the elastic expansion requirements. On the premise of cloudification, new business need new storage resources that supports elasticity, on demand and scalable expansion.



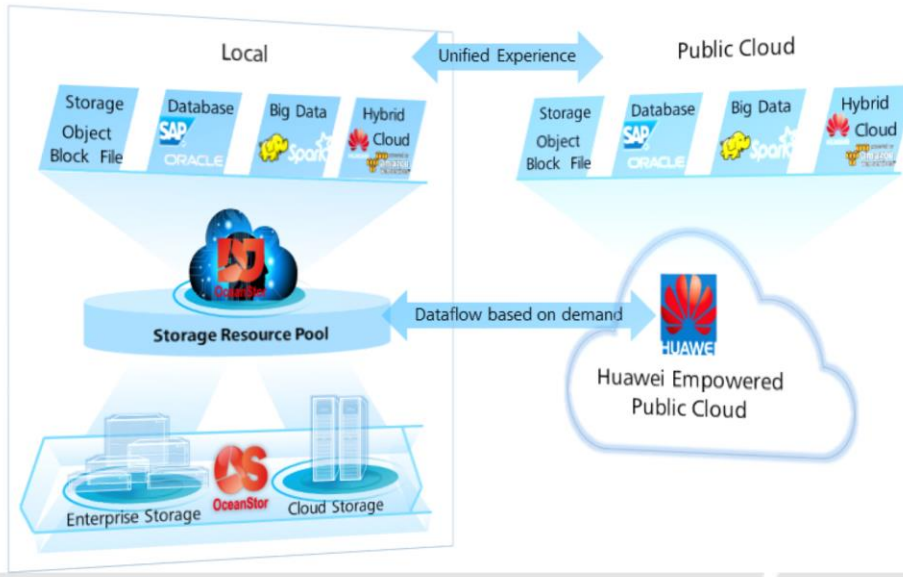
- FusionStorage Software Defined Converged Cloud Storage is based on standard X86 hardware platform for high performance, high scalability and open compatibility with storage resource pools to provide file/block/object based storage for finance, government, and new businesses.
- The product has the high performance, elasticity and flexibility of distributed storage architecture for meeting agile business needs, and also has the reliability and usability of enterprise grade products to easily face the challenges of globalization, cloudification and big data applications.
- All new products are built based on demands and Cloud Storages are no exception. Enterprise Cloud datacenters has hundreds or even thousands of application that presents data in different service formats and data structures such as structures data and unstructured data. Traditional and New generation applications along with Big Data applications also coexist at the same time in the cloud datacenters.
- Huawei FusionStorage6.0 cloud storage system consist of multiple types of resource pools converged together to provide support for multi protocols data access. It also provides agile resource supply and file services such as block/file/object storage to higher level applications.
    - If you are building a Cloud Datacenter, choosing Huawei Cloud Storage not only allows you to fulfill current storage resource pool needs, it also helps in fulfilling future storage needs, volumes and TCO requirements.
    - If your Datacenters has large amount of databases applications, Huawei Cloud Storage resource pools can provide a highly efficient data storing and reading services.
    - If your Cloud Datacenter has applications based on Openstack or Hadoop, Huawei Cloud Storage can fit in seamlessly due to its open architecture.
    - Hence, software defined cloud storage can help protect your investments in datacenters and help realize the best match for resources and value.

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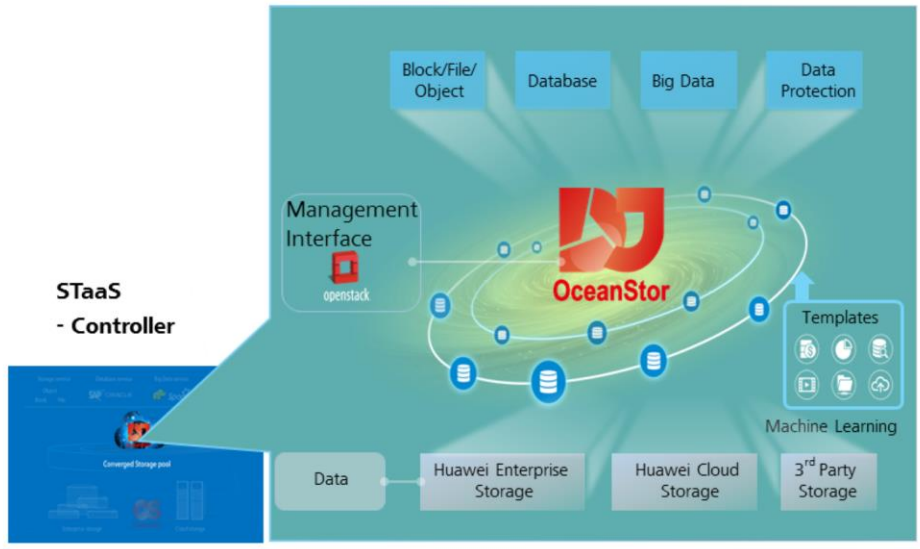
STaaS:Storage as a Service Solution



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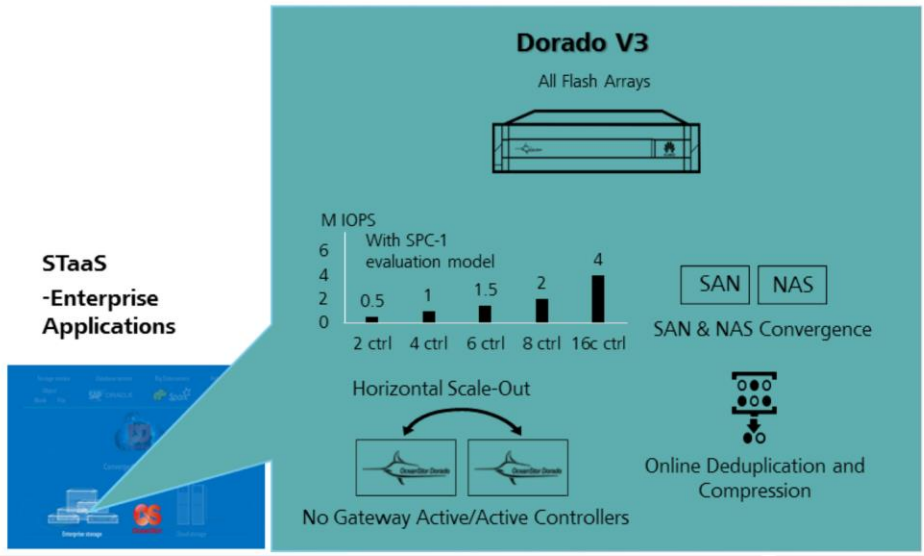
OceanStor DJ:Easy,Intelligent,Open



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OceanStor Dorado V3:Fast & Reliable



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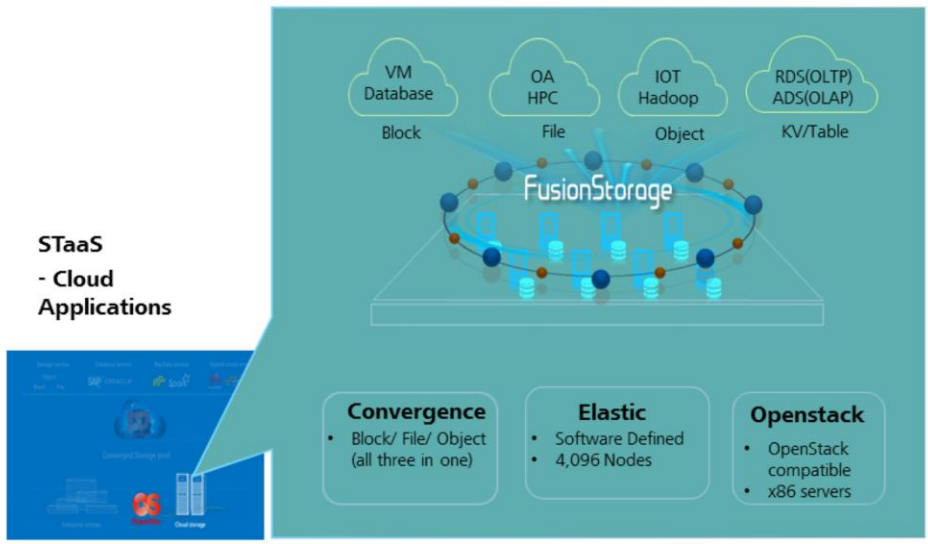
OceanStor V3:Converged Storage for Agile Business



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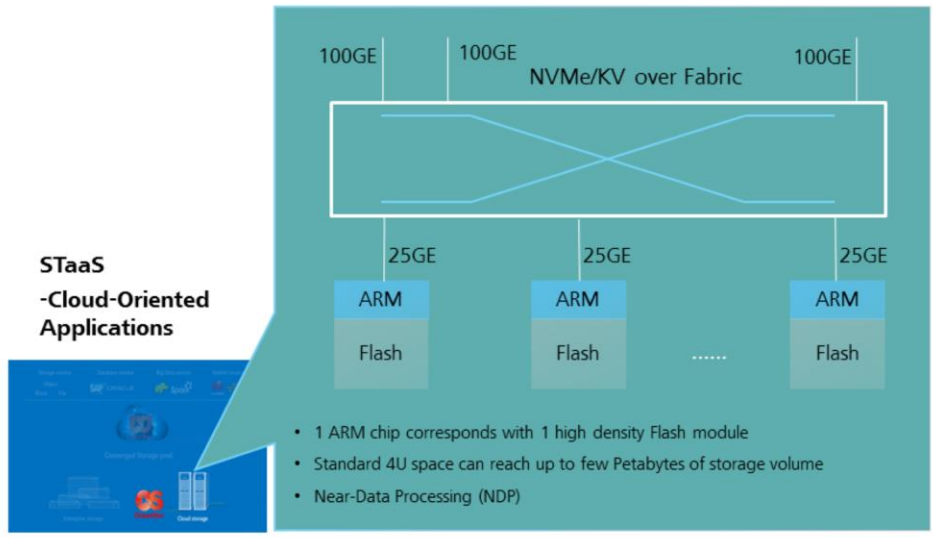
FusionStorage:Converged Cloud Storage



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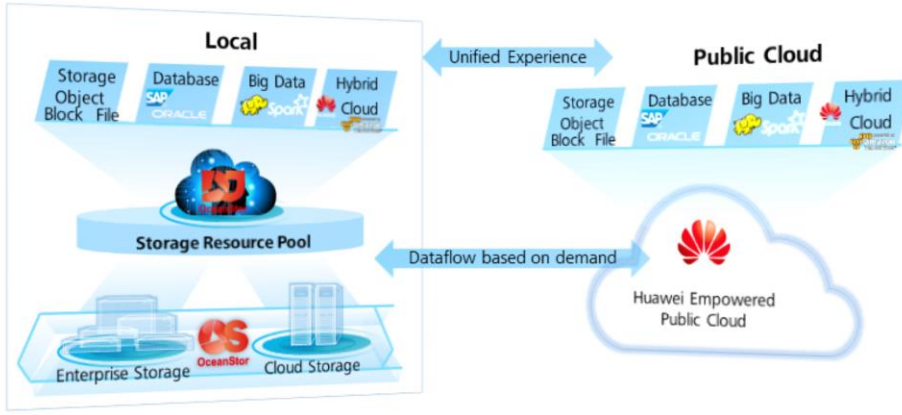
Berreleye:Cloud - Oriented New Generation Hardware Architecture



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STaaS:Hybrid Cloud Solution



Unified Management

- Unified Management of Local and Public Cloud Storage
- Storage as a Service

Dataflow based on Demand

- Incremental backup, supports CDP
- Logs replication, second-level RPO
- Online data replication

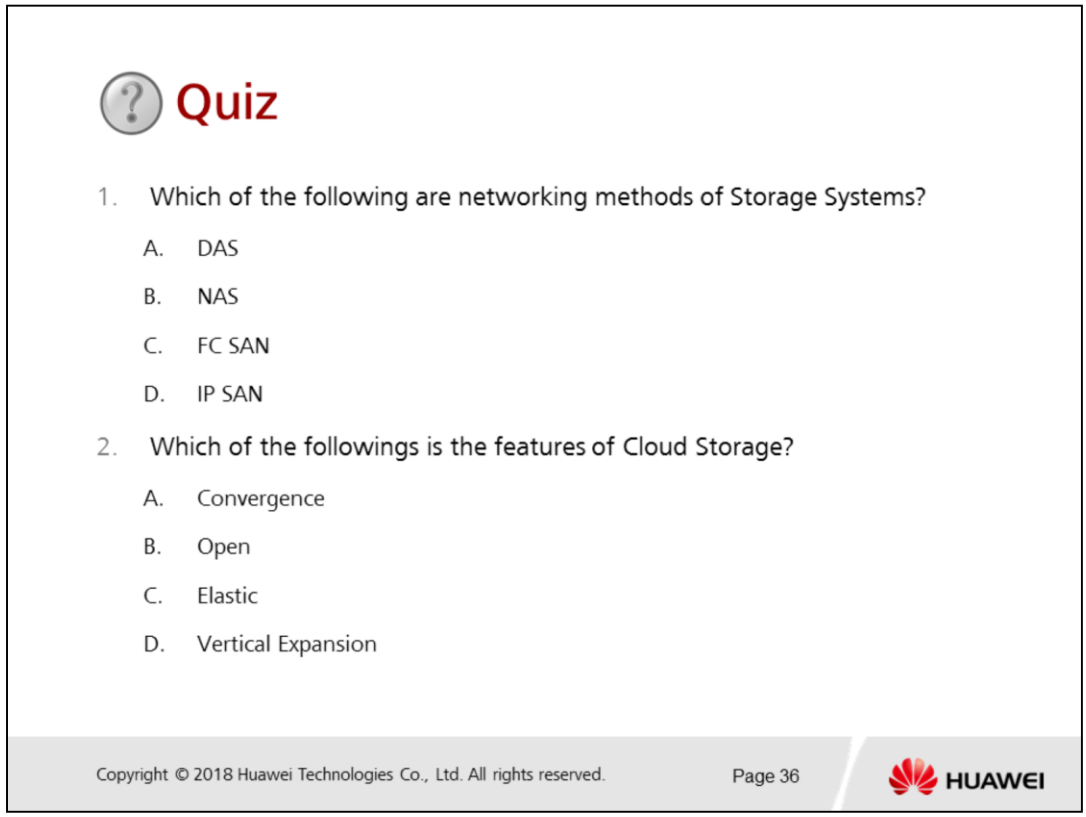
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Section Summary

- This module mainly introduces the definitions, development history, technological evolution and technological trends of storage systems.
- This module also briefly introduces the different types of Huawei storage solutions.

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- Answers:
  - ABCD
  - ABC

Thank You

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