

Storage Technologies

IT403

Prepared by
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Lecture 1



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Introduction to Information Storage and Management

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Course Learning Outcomes

After learning the course, the students should be able to:

- Describe the information lifecycle.
- To explain the design of a data center and storage requirements.
- To discuss the various types of storage and their properties.
- To explain physical and virtualized storage.
- To explain the backup and archiving regarding recovery and business continuity.
- Describe the components of an intelligent storage system.
- Discuss Data Protection Technologies and Applications.
- Design Storage Business Continuity Solutions and Storage System Operation Management.

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 Storage Products and Solutions.

Outlines

- Data and Information
- What is storage?
- Structure of Storage
- Storage Architecture Development
- Data Storage Types
- Storage System Components
- Data Storage Applications
- Cloud Storage: Distributed Storage
- Storage Virtualization

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Data and Information



What is Data

- SNIA (Storage Networking Industry Association) defines data as the digital representation of anything in any form.



Email



Digital music



Digital video

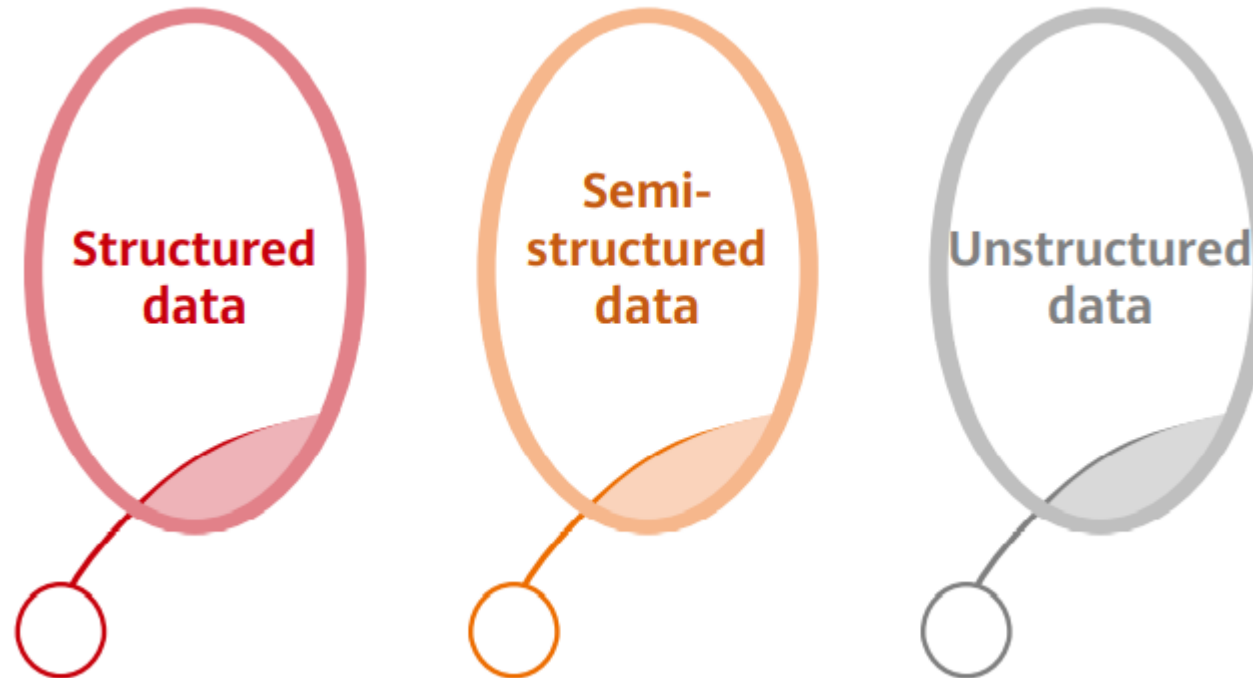


Ebook

Format in which data is stored

```
0101001010100010000011
1100011100010001110001
1100000111101010100101
0101001010100101001010
1001010101001010100010
1010010101001010101010
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0101001010101010100101
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0101010010100101001000
1010101001001010010010
```

Data Types



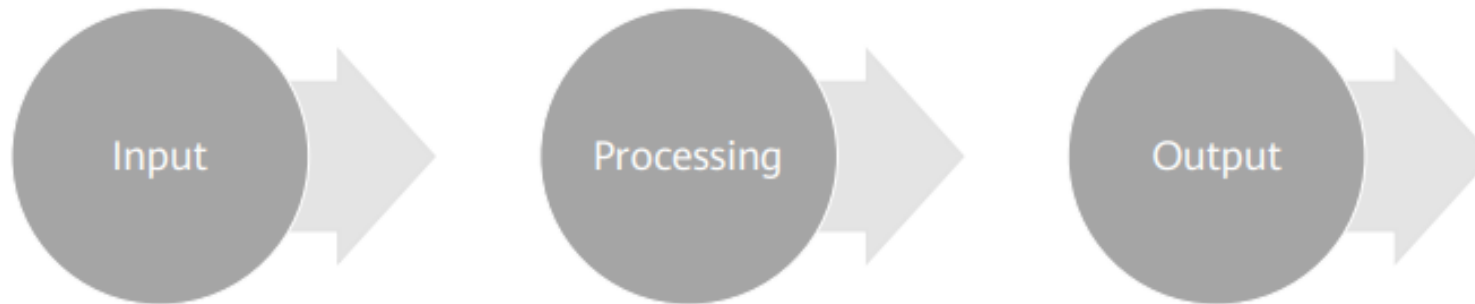
Data Types

Based on Data storage and management modes, data is classified:

- **Structured data:** It can be represented and stored in a relational database and is often represented as a two-dimensional table.
 - SQL Server, MySQL, Oracle.
- **Semi-structured data:** It does not conform to the structure of relational databases or other data tables but uses tags to separate semantic elements or enforces hierarchies of records and fields.
 - XML, HTML, JSON
- **Unstructured data:** It is not organized in a regular or complete data structure or does not have a predefined data model.
 - Texts, pictures, reports, images, audios, and videos

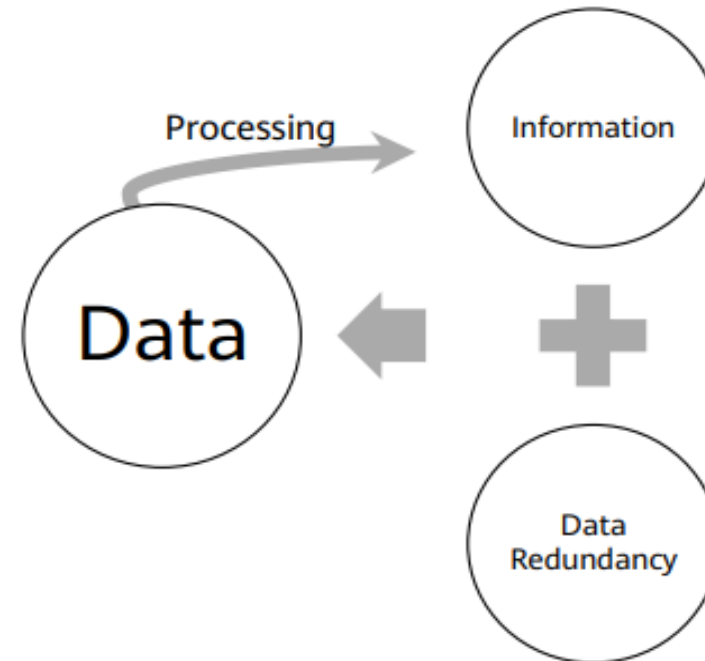
Data Processing Cycle

- Data processing is the reorganization or reordering of data by humans or machines to increase their specific value. A data processing cycle includes three basic steps: input, processing, and output.



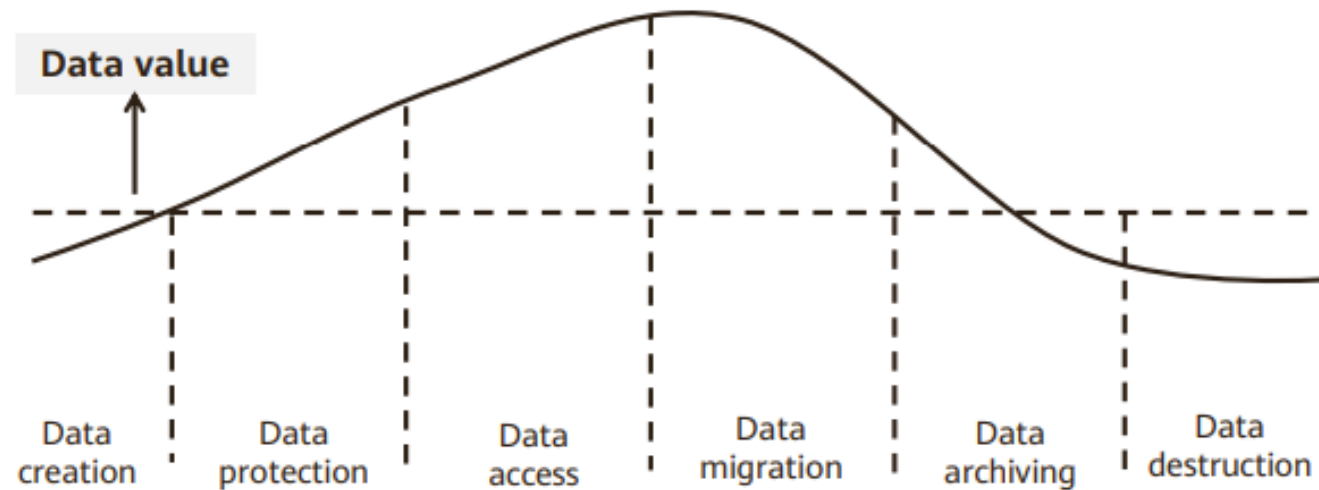
What is Information

- Information is processed, structured, or rendered in a given context to make it meaningful and useful.
- Information is processed data, including data with context, relevance, and purpose. It also involves the manipulation of raw data.



Information Lifecycle Management

- Information lifecycle management (ILM) refers to a set of management theories and methods from the stage in which the information is generated and initially stored to the stage where the information is obsoletely deleted.



Information Lifecycle Management

- ❑ **Data creation phase:** Data is generated from terminals and saved to storage devices.
- ❑ **Data protection phase:** A storage system provides data protection functions, such as RAID, HA, disaster recovery (DR), and permission management.
- ❑ **Data access phase:** Information must be easy to access and can be shared among organizations and applications of enterprises to maximize business value.
- ❑ **Data migration phase:** When using IT devices, you need to upgrade and replace devices and migrate the data from the old to new devices.

Information Lifecycle Management

- ❑ **Data archiving phase:** The data archiving system supports the business operation for enterprises by providing the record query for transactions and decision-making. Deduplication and compression are often used in this phase.
- ❑ **Data destruction phase:** After a period of time, data is no longer saved. In this phase, destroy or reclaim data that does not need to be retained or stored, and clear the data from storage systems and data warehouses.

Data vs. Information

- After being processed, data can be converted into information.
- In order to be stored and transmitted in IT systems, information needs to be processed as data.

Item	Data	Information
Feature	Raw and meaningless, with no specific purpose	Valuable and logical
Essence	Original materials	Processed data
Dependence	Data never depends on information	Information depends on data
Example	Meteorological data or satellite image data	Weather forecasts

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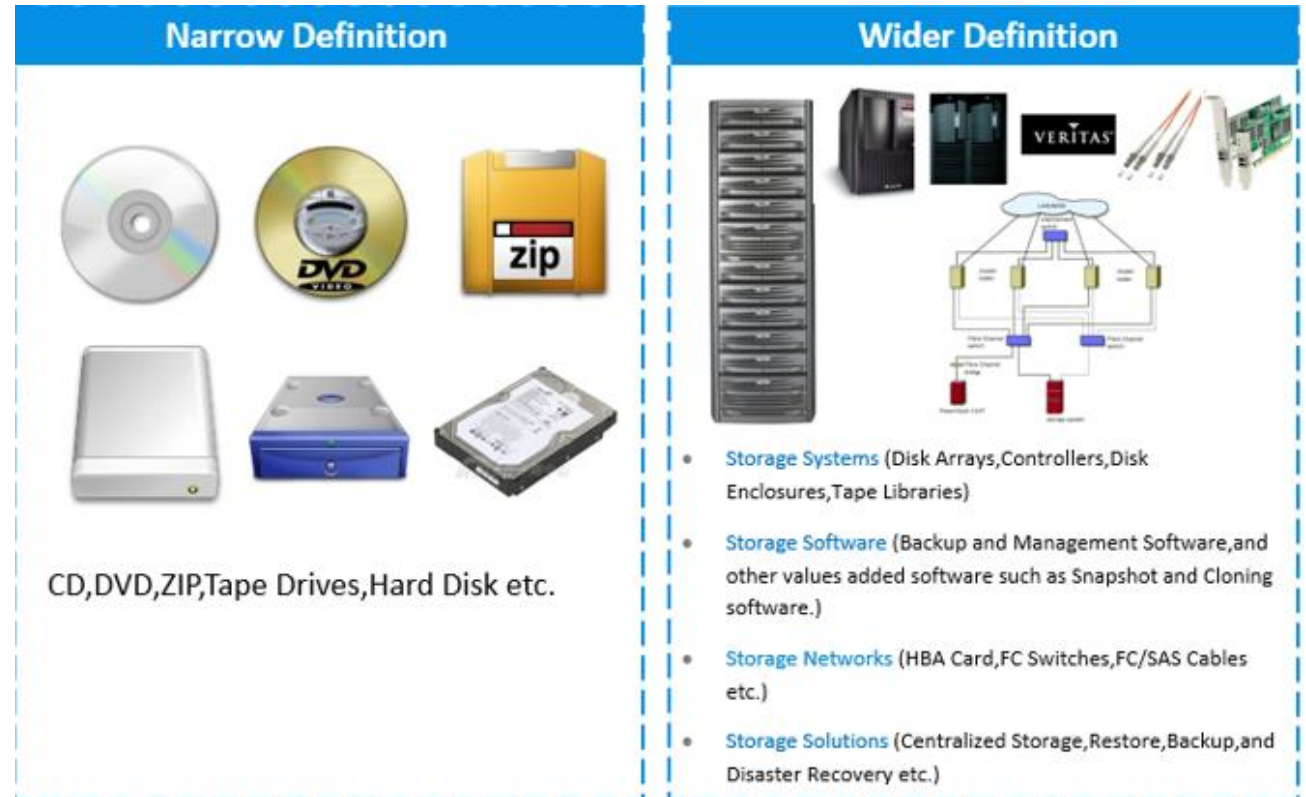
What is Storage?



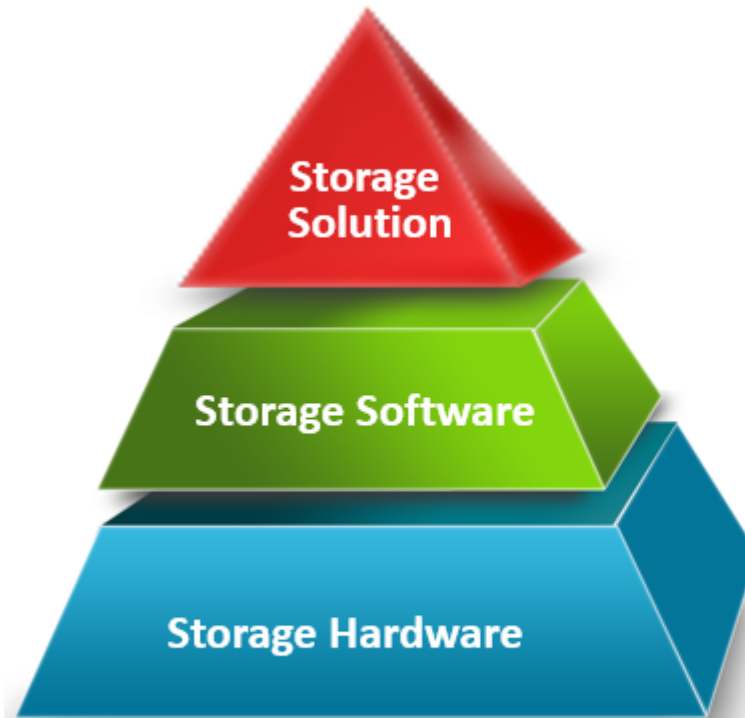
What is Storage?

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.



Data Storage System



-
- Disaster Recovery
 - Backup
-

- Storage Management(ISM)
 - Snapshot, Mirroring
 - Backup
 - Multipathing
-

- **External Storage Systems:**

- ▣ Disk Array
- ▣ NAS
- ▣ Tape Libraries
- ▣ Virtual Tape Libraries

- **Storage Connection Devices:**

- ▣ FC HBA Card
- ▣ FC Switches
- ▣ Ethernet Switches
- ▣ Connection Cables

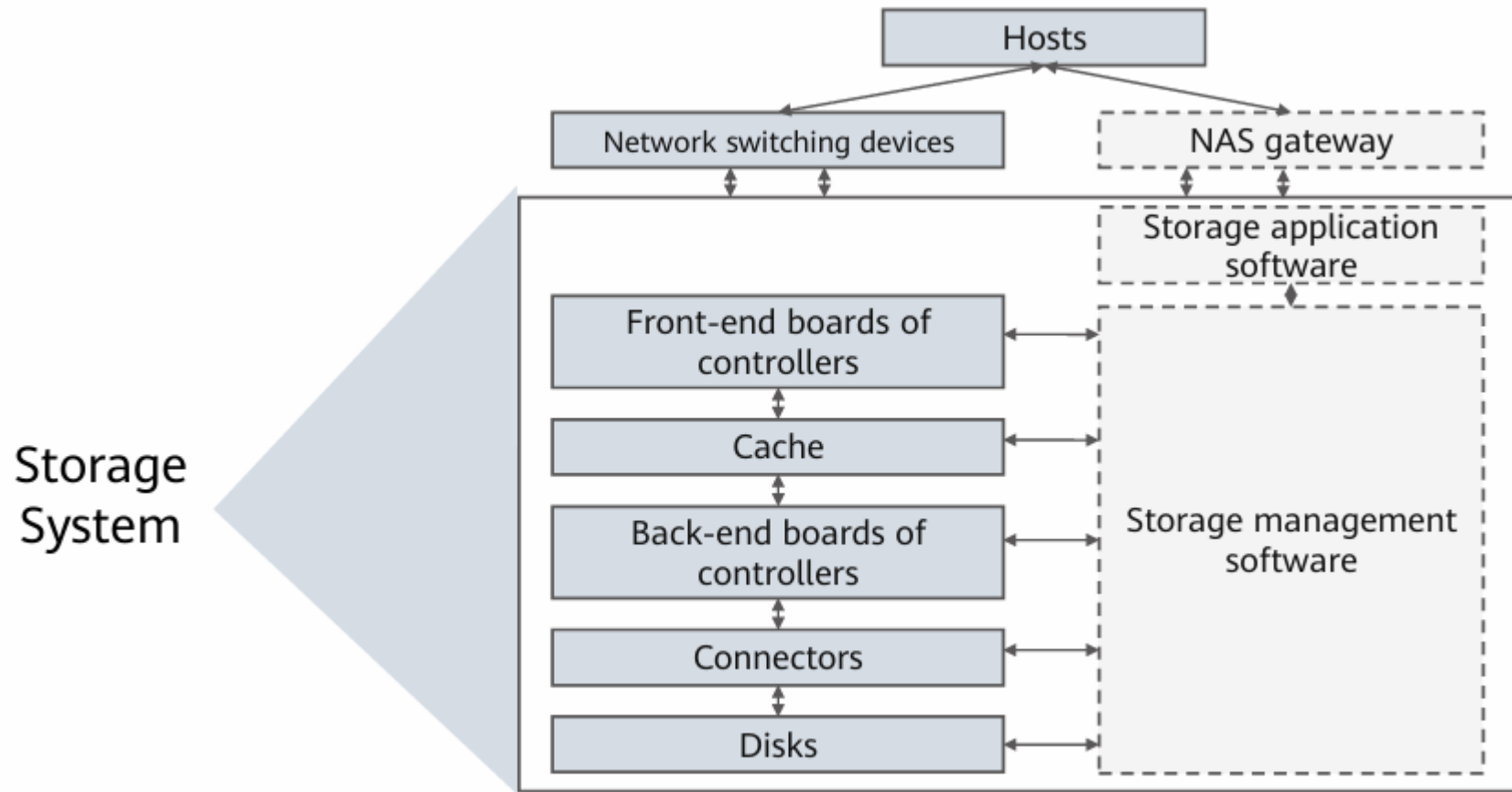
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Structure of Storage



Structure of Storage



Structure of Storage

- ❑ **Storage system** consists of the **disk subsystem**, **control subsystem**, **connection subsystem**, and **storage management software subsystem**.
- ❑ **In terms of the physical structure of storage**, disks reside in the bottom layer and are connected to back-end cards and controllers of the storage system via connectors such as optical fibers and serial cables.
- ❑ **The storage system** is connected to hosts via front-end cards and storage network switching devices to provide data access services.
- ❑ **Storage management software** is used to configure, monitor, and optimize subsystems and connectors of the storage system.

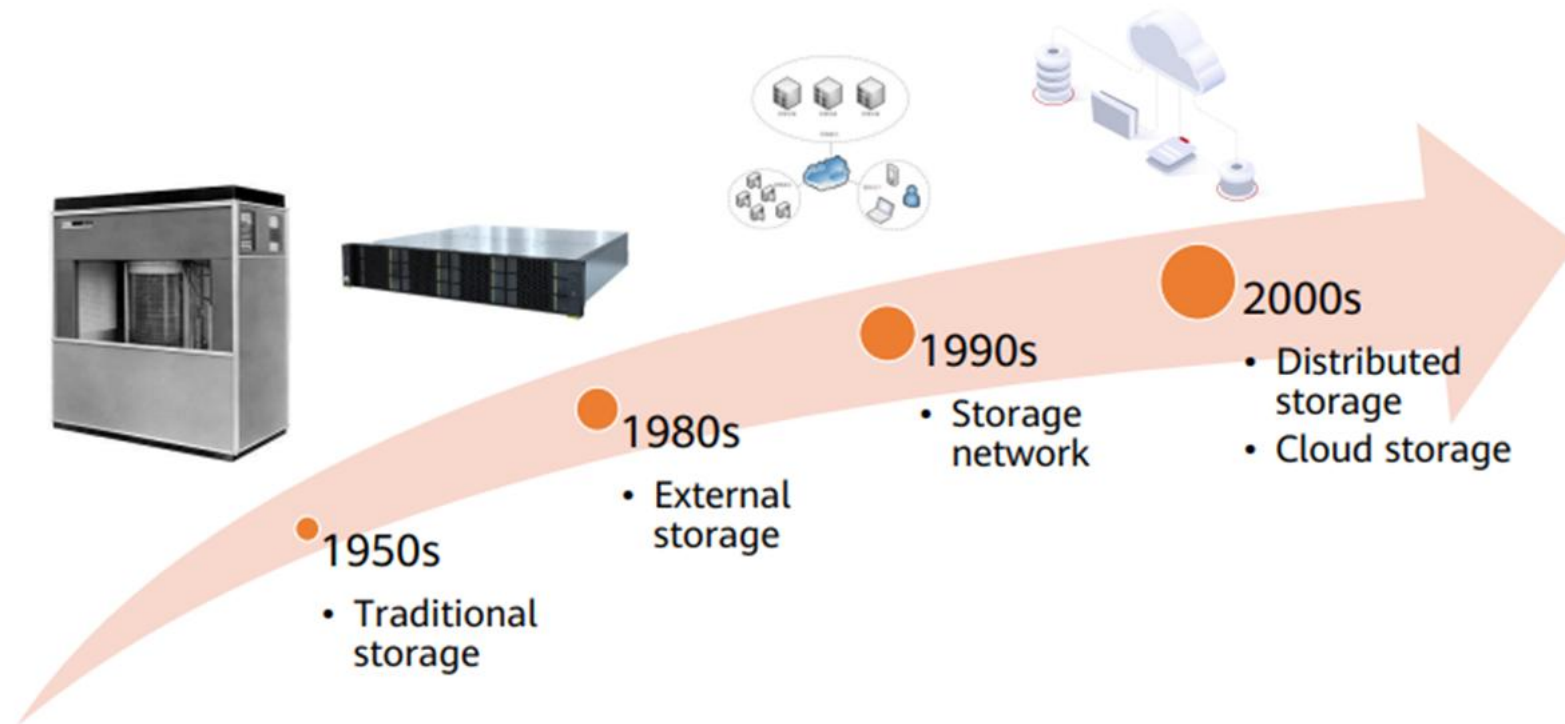
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Storage Architecture Development



History of Storage Architecture Development



Storage Architecture Development



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Data Storage Types

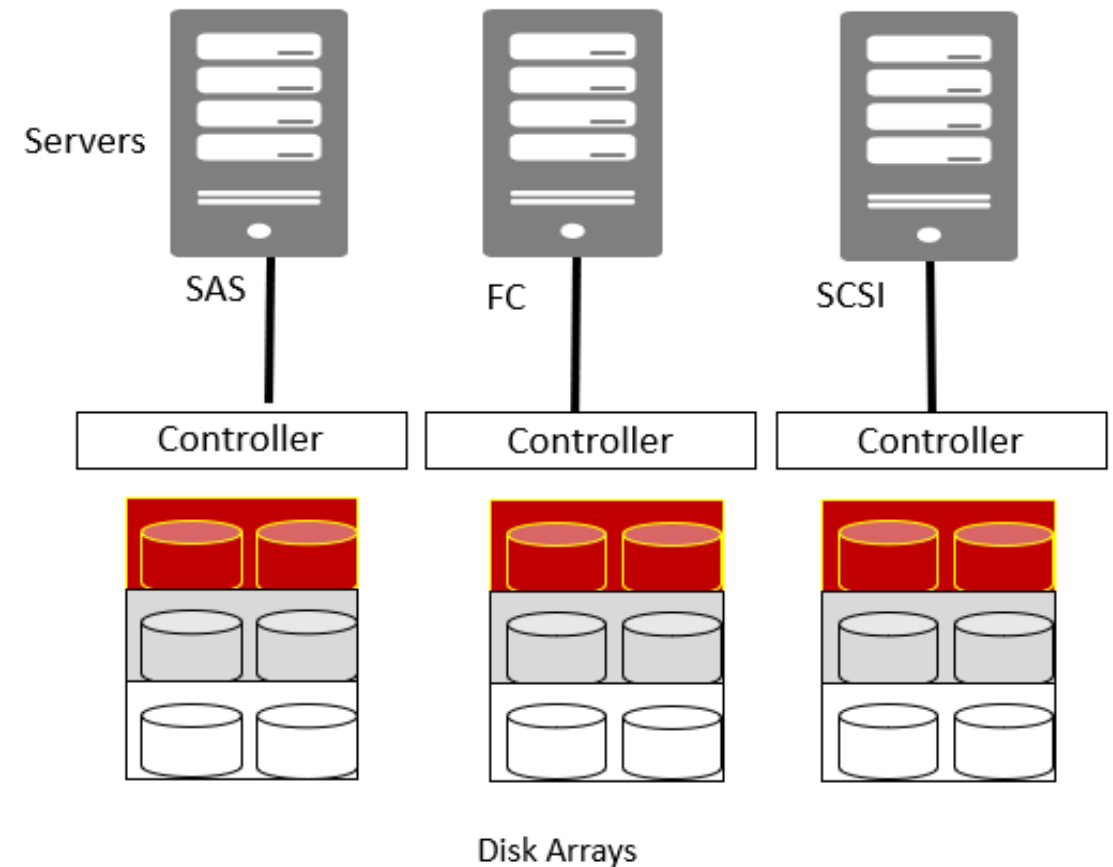


Data Storage Types

- **DAS Architecture.**
- **NAS Architecture.**
- **SAN Architecture:**
 - FC SAN Architecture
 - IP SAN Architecture

DAS Architecture

- ❑ **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.

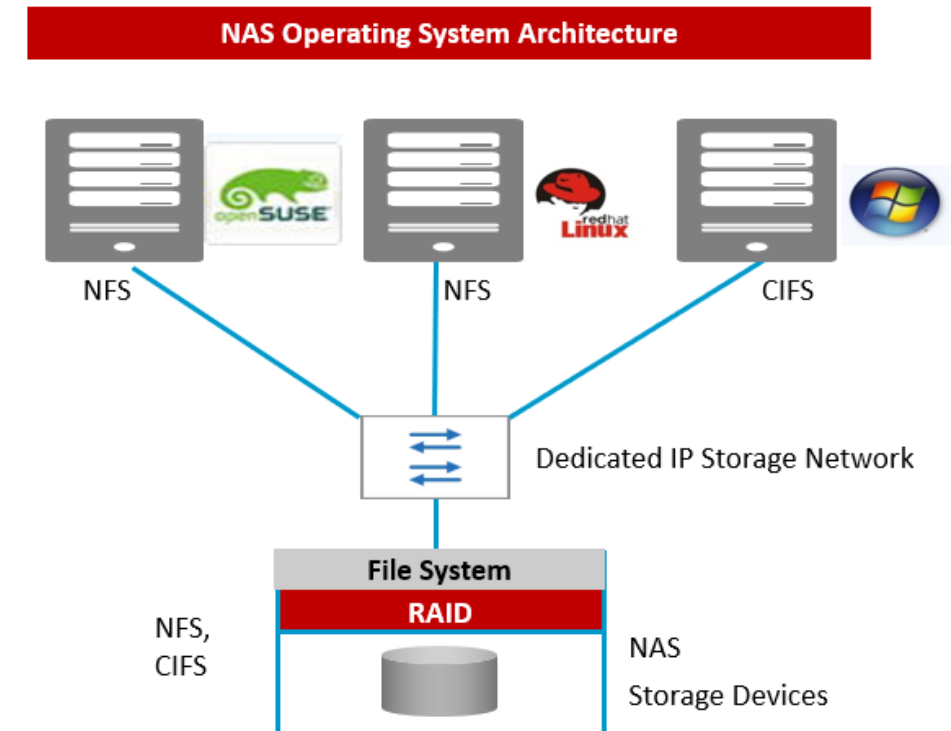


DAS Architecture

- ❑ **DAS** can be differentiated into **Internal DAS** and **External DAS** based on the location of the storage in relation to the servers.
- **Internal DAS:**
 - Storage devices are connected to servers via serial or parallel connections, but due to cable length limitations, they only support short-distance high-speed data transfers.
- **External DAS:**
 - In External DAS architecture, servers are directly connected to external storage devices, typically communicating via **FC** or **SCSI protocols**.

NAS Architecture

- ❑ Network Attached Storage (NAS) are IP-based file level storage devices that are connected to a local area network.
- NAS shares files quickly with lower storage management costs through **file-based data** access and sharing storage resources over a network.
- 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.

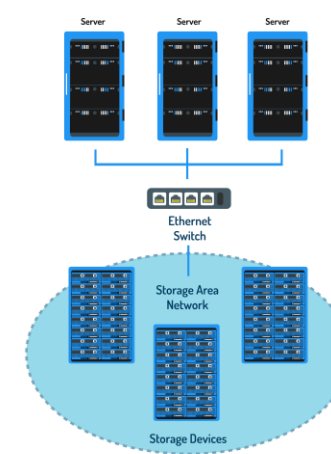
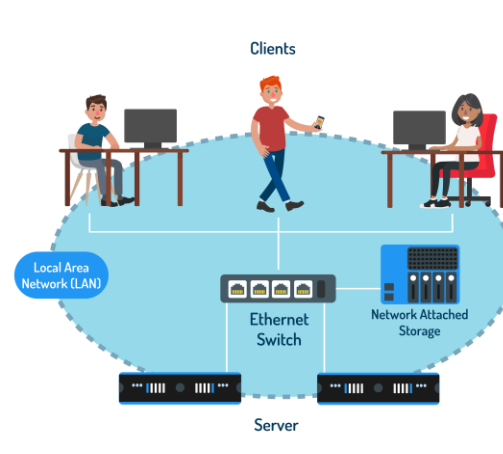
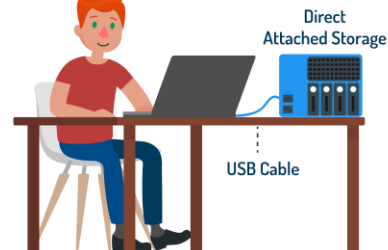


SAN Architecture

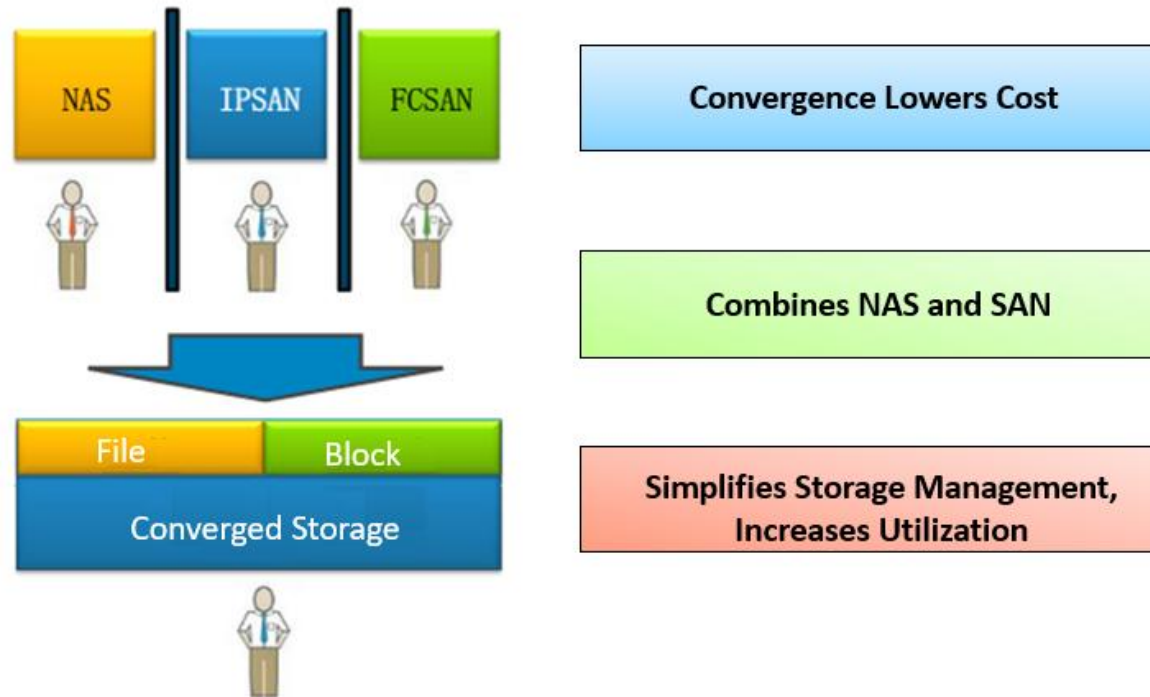
- ❑ Storage Area Network (SAN) : is a dedicated high-performance network implemented between the server and storage resources. It has been optimized specifically for high amount of raw data transmission.
- ❑ DAS provides block-based storage.
- SAN can be differentiated into FC SAN and IP SAN.
 - The **default protocols** used by **FC SAN** is **SCSI and Fiber Channel**.
 - The **default protocol** for **IP SAN** implementation is **iSCSI** (Internet Small Computer System Interface).

Storage – Types of Data Center Storage

- **DAS** – Storage device is directly attached to a server (block-level)
- **NAS** – Storage device is attached to a network, servers on the network can access device (file-level)
- **SAN** – Clustered storage devices on their own network that servers can connect to (block-level)



Storage Architecture Trends: Converged Storage



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).

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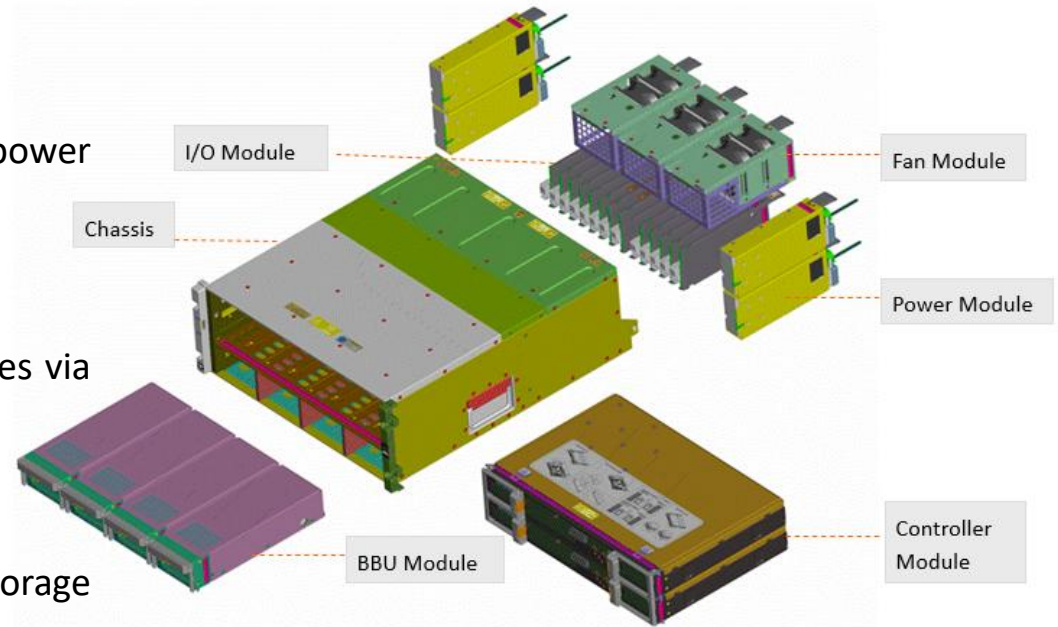
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Storage System Components



Storage System Components

- The diagram above shows the different components that makes up the controller and disk separated chassis.
- The **main components** consist of the chassis, I/O module, fan and power module and the controller and BBU (Backup Battery Unit) module.
- This **chassis** is connected to the external high density disk enclosures via the I/O module.
- **BBU** unit is the backup battery that provides power to the storage controller to save all the I/O cache into the coffer disks in the event of a power failure.



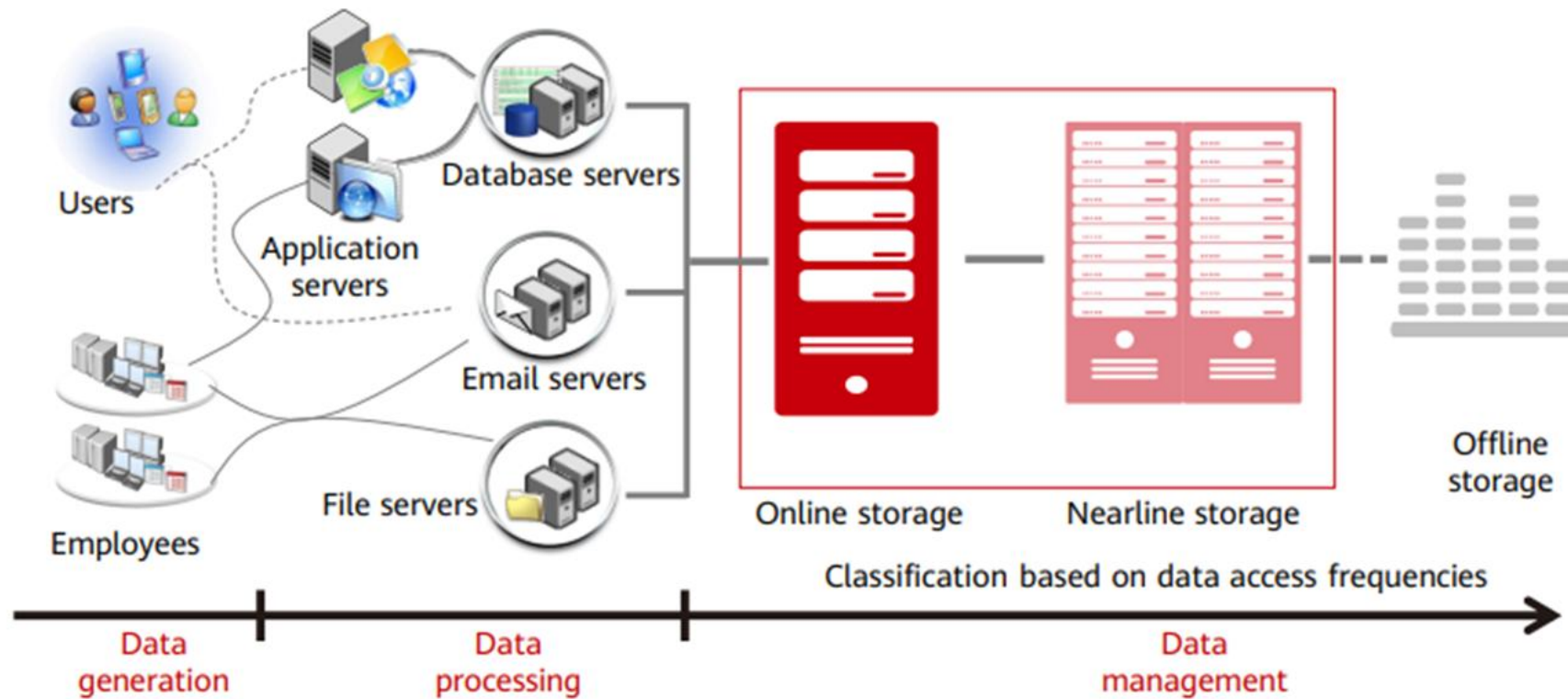
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Data Storage Applications



Data Storage Applications



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Cloud Storage: Distributed Storage



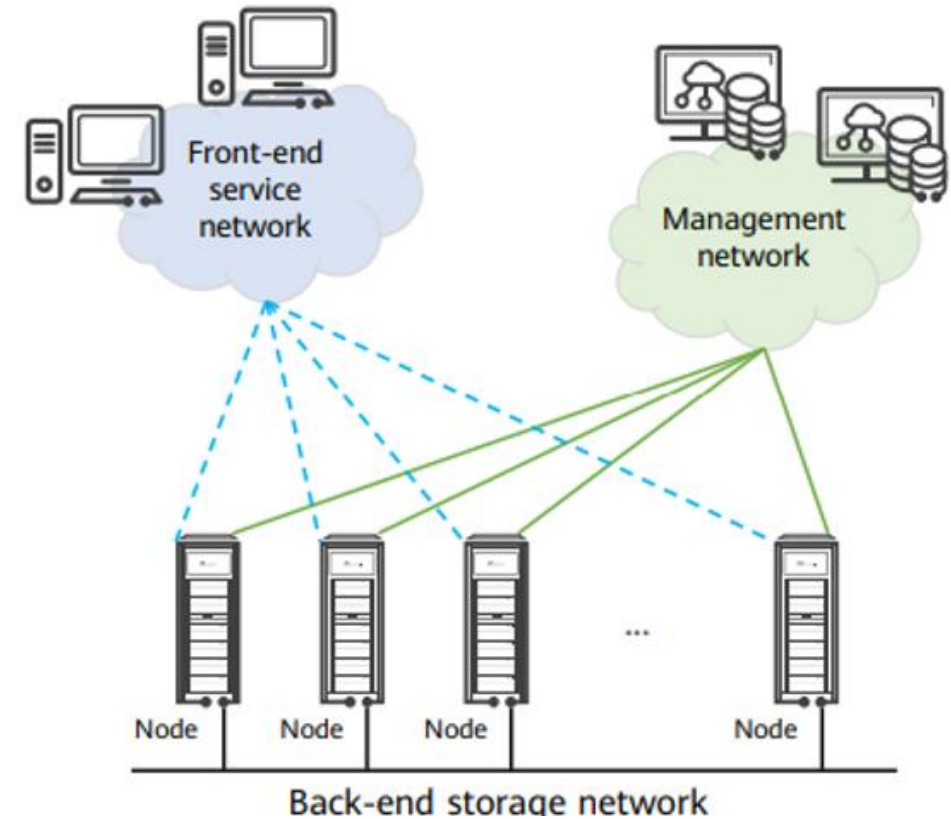
Cloud Storage

❖ The Importance of Cloud in Storage:

- **Scalability:** Cloud storage allows organizations to easily scale up or down depending on the amount of data.
- **Cost Efficiency:** Reduces the need for on-premise hardware and maintenance.
- **Accessibility:** Data can be accessed anytime, anywhere, from multiple devices.
- **Data Protection:** Built-in backup, redundancy, and disaster recovery options.
- **Collaboration:** Enables multiple users to access, edit, and share data in real-time.
- **Integration:** Works seamlessly with applications and services for analytics, AI, and business intelligence.

Cloud Storage: Distributed Storage

- ❑ **Distributed storage:** storing data in a distributed way across multiple data storage servers on a large-scale storage resource pool, such as internal HDD and SSD.
- Physical resources are organized using software to form a high-performance logical storage pool, ensuring reliability and providing multiple storage services.
- Generally, distributed storage scatters data to multiple independent storage servers in a scalable system structure. It uses those storage servers to share storage loads and uses location servers to locate storage information.



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Storage Virtualization

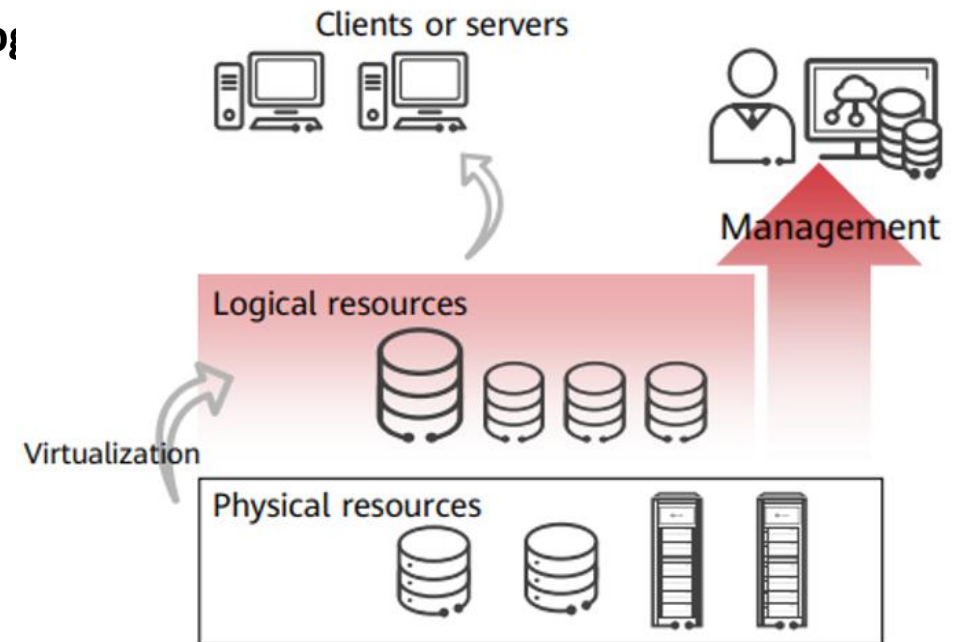


Storage virtualization

❑ **Storage virtualization** is the process of transforming physical storage resources (such as physical disks and servers) into logical (virtual) resources that can be easily managed and accessed.

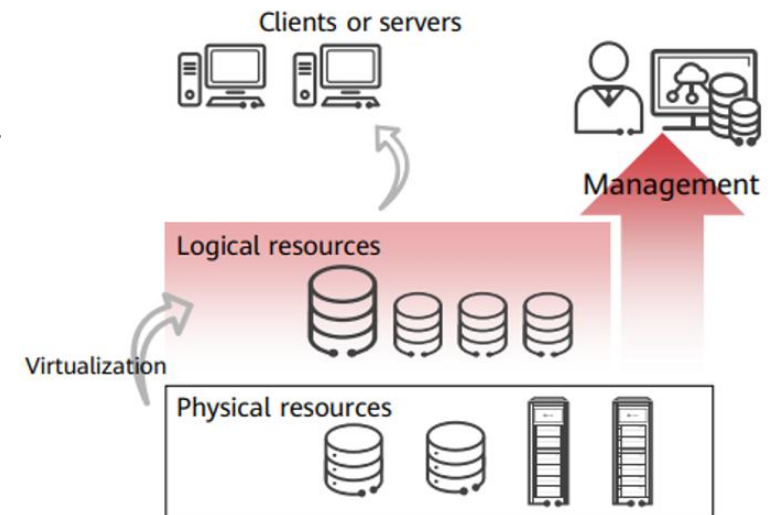
❑ **Main Benefits:**

- Simplified management
- Improved resource utilization
- Scalability
- Unified storage services across different devices



Storage virtualization

- ❑ In **storage virtualization**, a virtualization layer is added between the physical storage system and servers to manage and control all storage devices and provide storage for servers.
- The addition, deletion, replacement, splitting, and combination of storage hardware are transparent to servers.
- ❑ **Functions:**
 - Simplify the management of physical devices.
 - Integrate existing functions.
 - Eliminate the limitation of the physical capacity.



Summary

- **Data → Information** through lifecycle (Creation – Protection – Access – Migration – Archiving – Destruction)
- **Storage** = Backbone of Information Architecture (Hardware + Software + Networks)
- **Storage Architectures:**
 - **DAS** – Direct, Block-level
 - **NAS** – Network, File-level
 - **SAN** – Dedicated Network, Block-level
 - **Converged Storage** – Combines NAS & SAN
- **Trends:**
 - **Cloud & Distributed Storage** – Flexibility & Reliability
 - **Storage Virtualization** – Simplified management, Scalability, Higher efficiency



Thank You