

Storage Technologies

IT403

Prepared by
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Lecture 2



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ICT Architecture and Storage Technologies for AI, Big Data and Cloud

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Objectives

Upon completion of this module, you will be able to:

- Understand the development trends of ICT.
- Understand what is the Cloud, Big Data and AI.
- Learn about storage technologies and its application in the Cloud.
- Learn about storage technologies and its application in AI and Big Data.

Outlines

- ICT Technologies Development Trends
- What is ICT ?
- Features of ICT
- Storage Architecture Development
- Characteristics of Storage in Intelligence Era
- Cloud Computing
- The Era of Big Data
- Changes In Storage Technologies

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ICT Technologies Development Trends



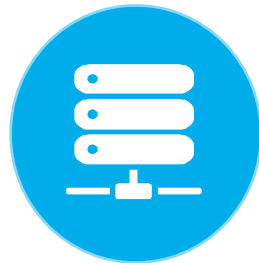
IT and CT

- **Information Technology (IT)** involves technologies for collecting, processing, transmitting, and applying information. It includes three main components: sensors, computing, and communication.
- **Communication Technology (CT)** focuses on transmitting and exchanging information quickly, accurately, securely, and reliably between people.
- **Information Technology (IT)** consist of basic information collection, information processing, information transmission (communication), and information application. The purpose of **Communication Technology (CT)** is also to serve IT.

New Industrial Revolution Requires New ICT



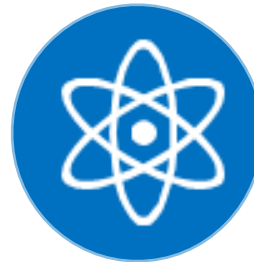
Cloud



Big Data



Social



IoT



CPS



Mobility

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Features of ICT

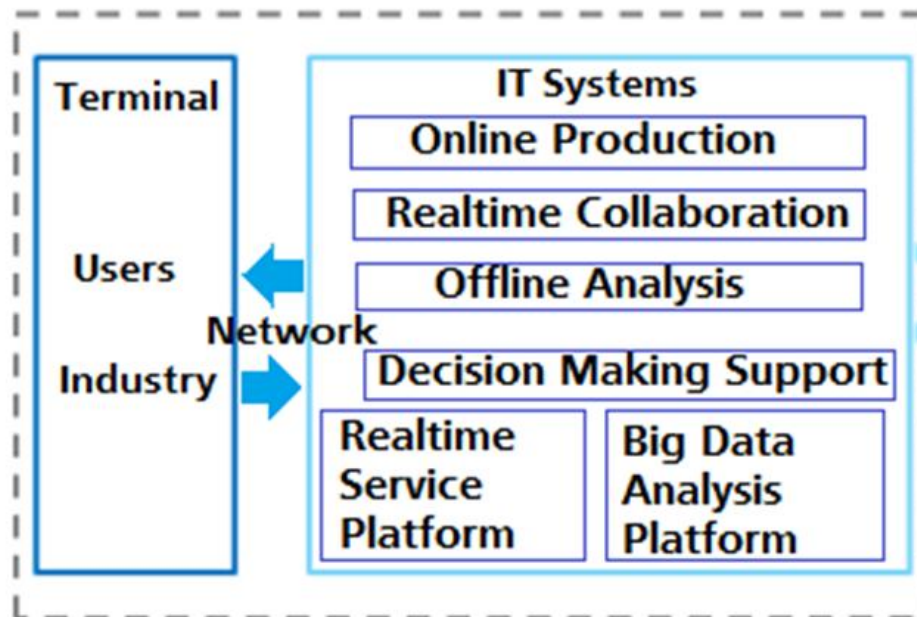


Features of ICT

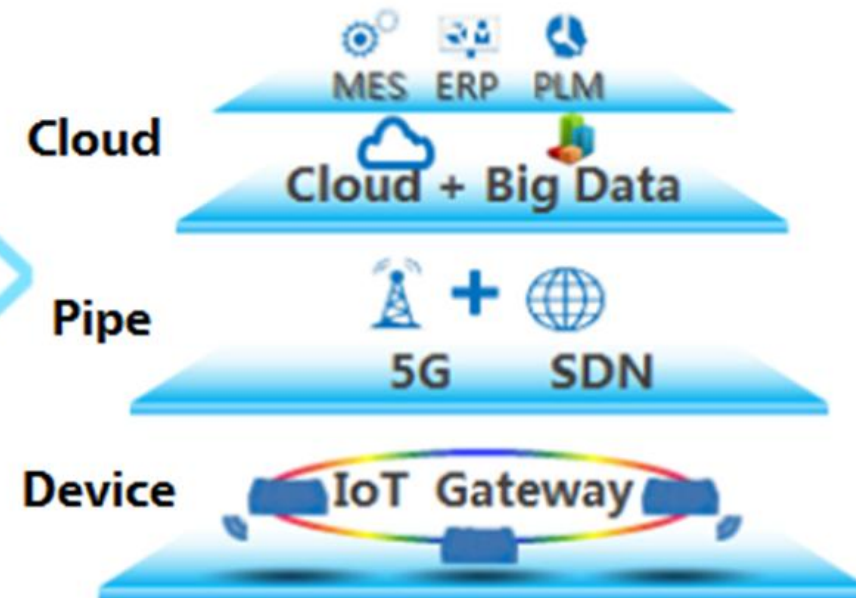
- **Speed:** Fast collection, processing, and transfer of information.
- **Flexibility:** Access data anytime, anywhere.
- **Cost Reduction:** Lower expenses with higher efficiency.
- **Easy Communication:** Simplifies interaction between people and organizations.
- **Wide Application:** Essential in education, healthcare, banking, and business.

Features of ICT

Future Digital Enterprise IT System Architecture



Device to Device ICT System Reconstruction and Innovation



ICT Becoming The Engine of Transformation for Traditional Industry

The Intelligence Era is Coming



Steam Age



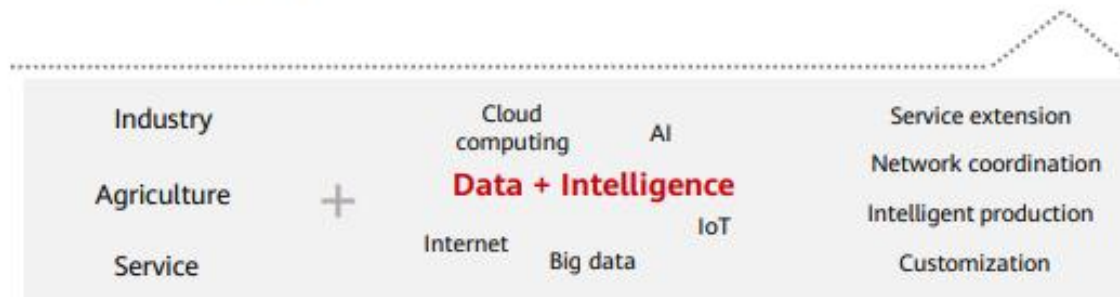
Electricity Age



Information Age



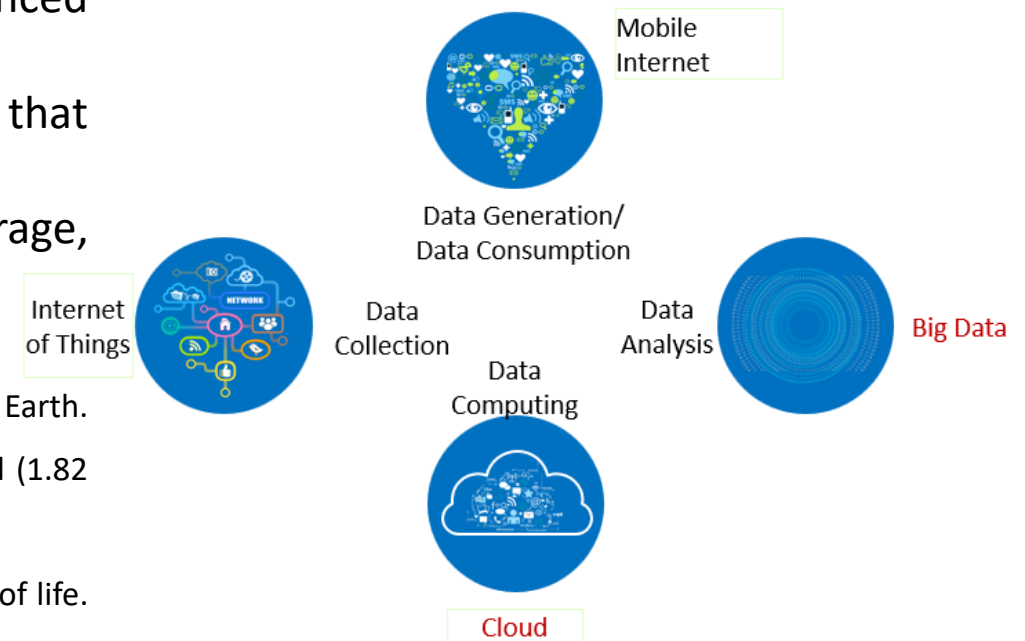
Intelligence Age



4 Biggest IT Trends That Are Rebuilding The World

- **Mobile Internet:** Access to the internet through mobile devices, connecting billions of users worldwide.
- **Big Data:** Extremely large datasets that require advanced tools to store, process, and analyze.
- **Internet of Things (IoT):** Network of connected devices that collect and share data.
- **Cloud Computing:** Online platforms that provide storage, processing, and services over the internet.

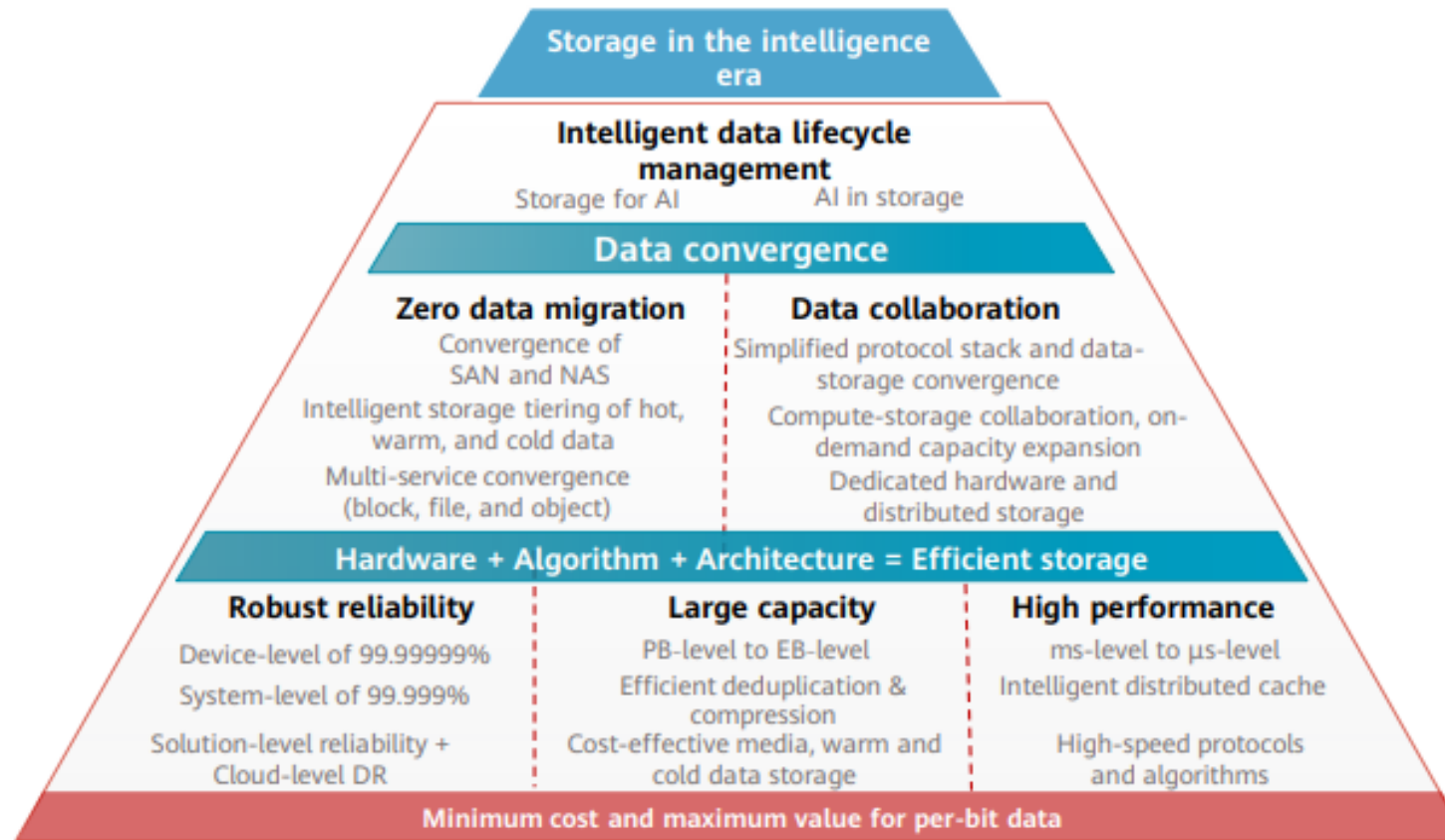
- Mobile Internet: 7 billion mobile users, which is near to the total population on Earth. 78% CAGR of data growth and the total number of smart phones in the world (1.82 billion) has exceed the number of PC (1.78 billion).
- Internet of Things: Social Business and Social Media changed the people's way of life. 86% of enterprises are developing their business in social media sites.



Characteristics of Storage in Intelligence Era



Characteristics of Storage in Intelligence Era



Optical Storage Technology

Blu-ray storage



Long service
life

High
reliability

100 GB+ per
disk

Gold nanostructured glass



Low power
consumption

Long-term
stable storage

10 TB per
disk

50 years >>> 600 years

DNA Data Storage

- A small number of synthetic DNA molecules can store a large amount of data, and can freeze, dry, transport, and store data for thousands of years.
- Advantages of using DNA as storage media:
 - Small size
 - High density
 - Strong stability
- Bottlenecks and limitations:
 - High costs of DNA molecular synthesis
 - Slow data read and search



Atomic Storage

- In 1959, physicist Richard Feynman suggested that it was possible to use atoms to store information if they could be arranged the way we wanted.
- Because an atom is so small, the capacity of atomic storage will be much larger than that of existing storage media in the same size.
- With the development of science and technology, arranging the atoms the way we want has become a reality.
- Bottlenecks and limitations:
 - Strict requirements on the operating environment



Quantum Storage

- Now, information in electronic devices is stored and moved through the flow of electrons.
- If electrons are replaced by photons, the movement of information within a computer may occur at the speed of light.
- Although the storage efficiency and service life are improved, the quantum storage is still difficult to be widely applied at present.
- Quantum storage cannot meet the following requirements:
 - High storage efficiency
 - Low noise
 - Long service life
 - Operating at room temperature



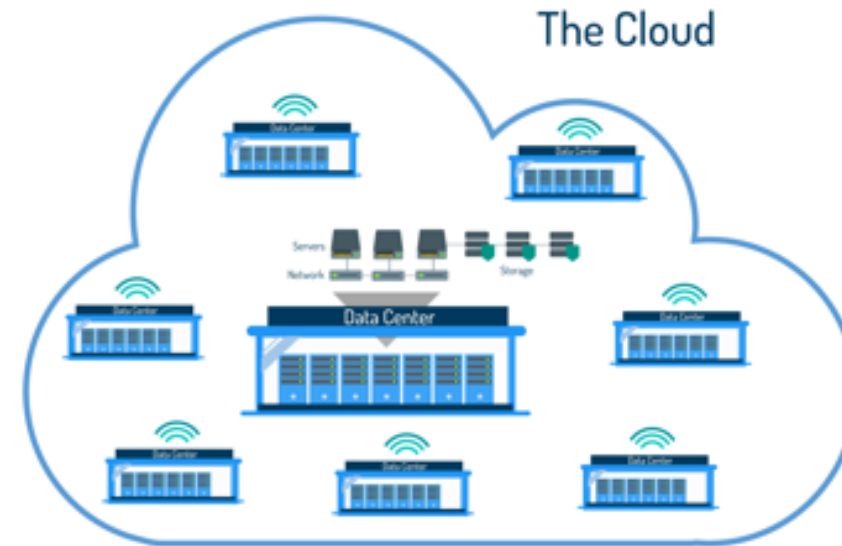
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Cloud Computing



Cloud Computing

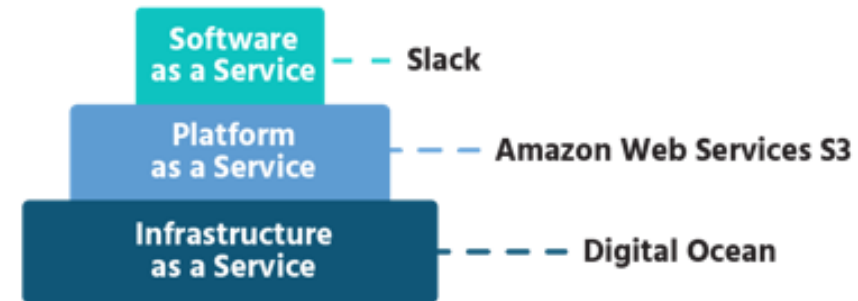
- Cloud computing is the delivery of shared computing resources (software and/or data) on-demand through the internet



Types of Cloud Computing

Cloud computing is categorized into different service models. The major types of cloud computing are:

- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Infrastructure as a Service (IaaS)



SaaS :Using ready-made applications over the internet without the need to install them, such as Gmail and Google Docs.

PaaS: Providing an environment and tools for developers to build and run applications without managing the underlying infrastructure.

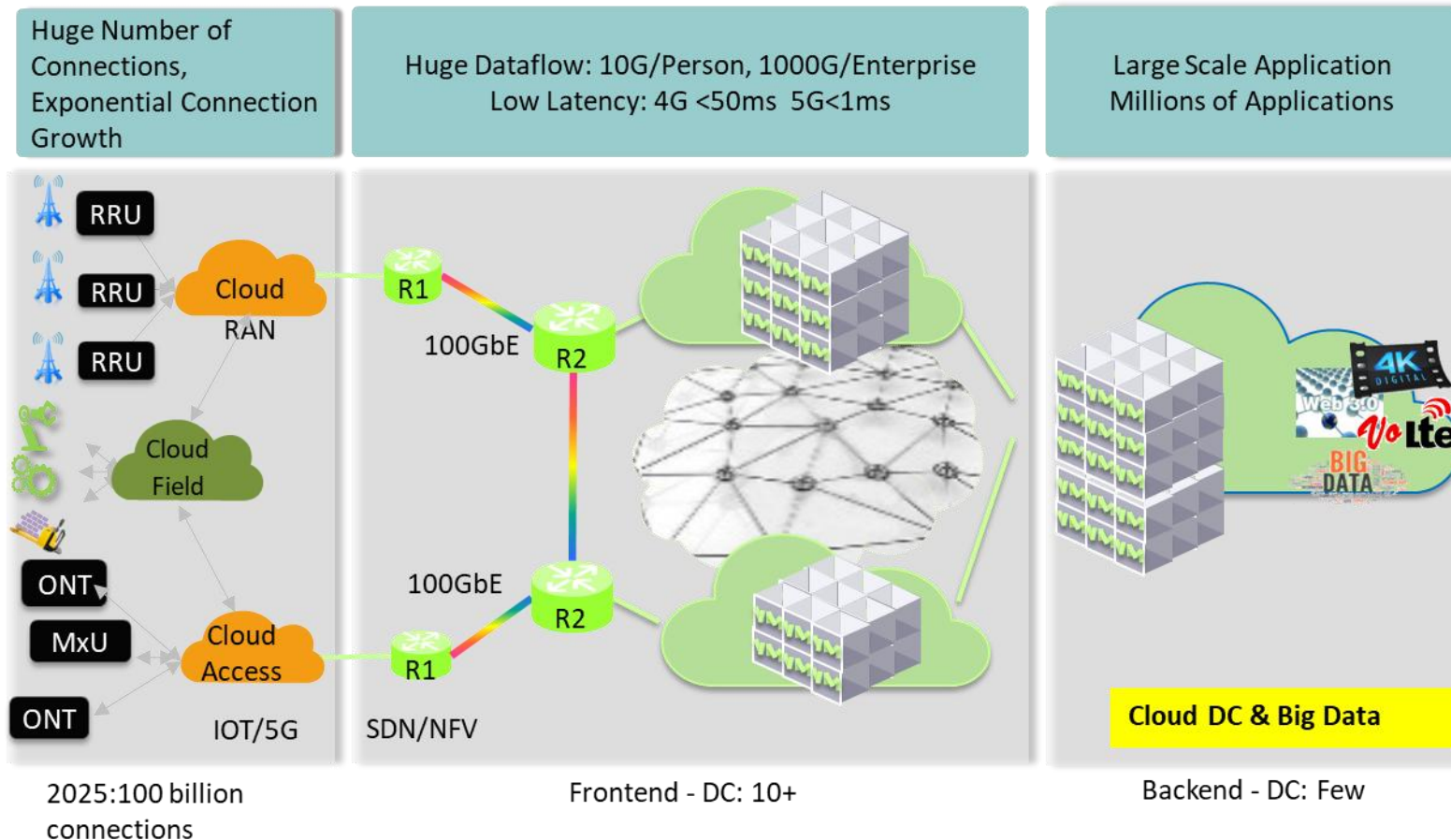
IaaS: Providing computing resources such as servers and storage over the internet with full control for the user.

Cloud Data Center is Everywhere



660+ Data Centers are built globally, in which 255+ are Cloud Data Centers.

Positioning and Function of the Cloud in ICT Industry Layout



Migration of Traditional Businesses to the Cloud Platform (1)

❑ **Virtualization** refers to running multiple operating systems on a computer system simultaneously.

❑ **Infrastructure:**

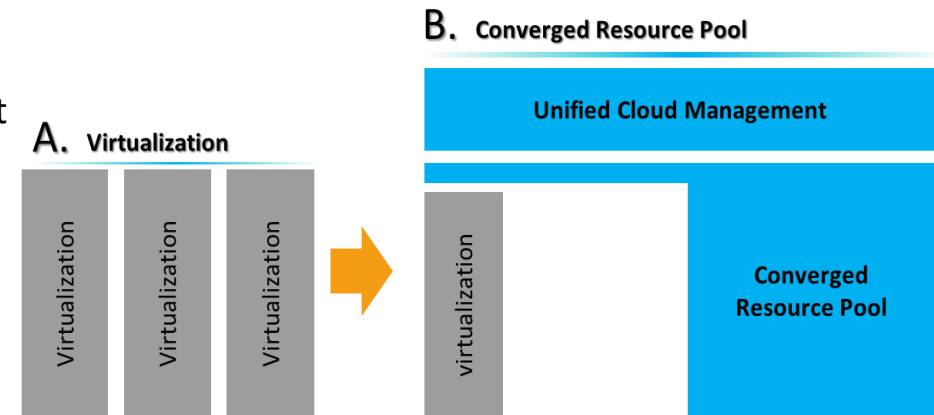
- Interconnection and evolution of existing networks.
- Security isolation and security protection.
- Building a differentiated resource pool that is able to satisfy different business needs.

❑ **Management:**

- Management of existing resource pools.
- Unified management of virtualized and physical resources.
- Set resource pool management standard practices, standardized use of resources.

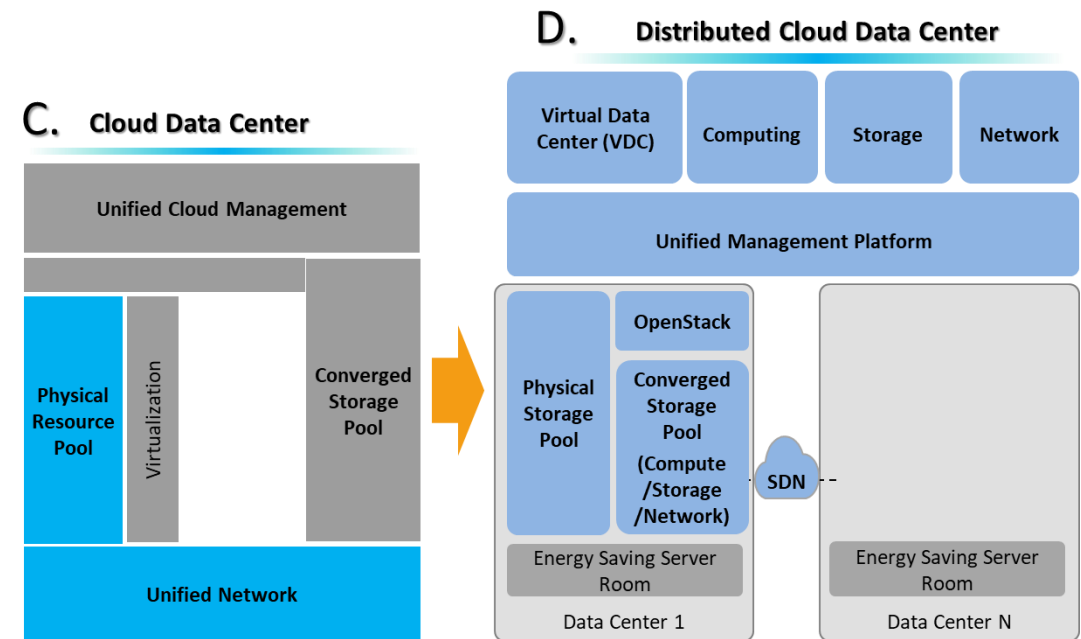
❑ **Migration of services:**

- Smooth migration of old physical machines and data.
- Smooth migration of virtual machines and data.

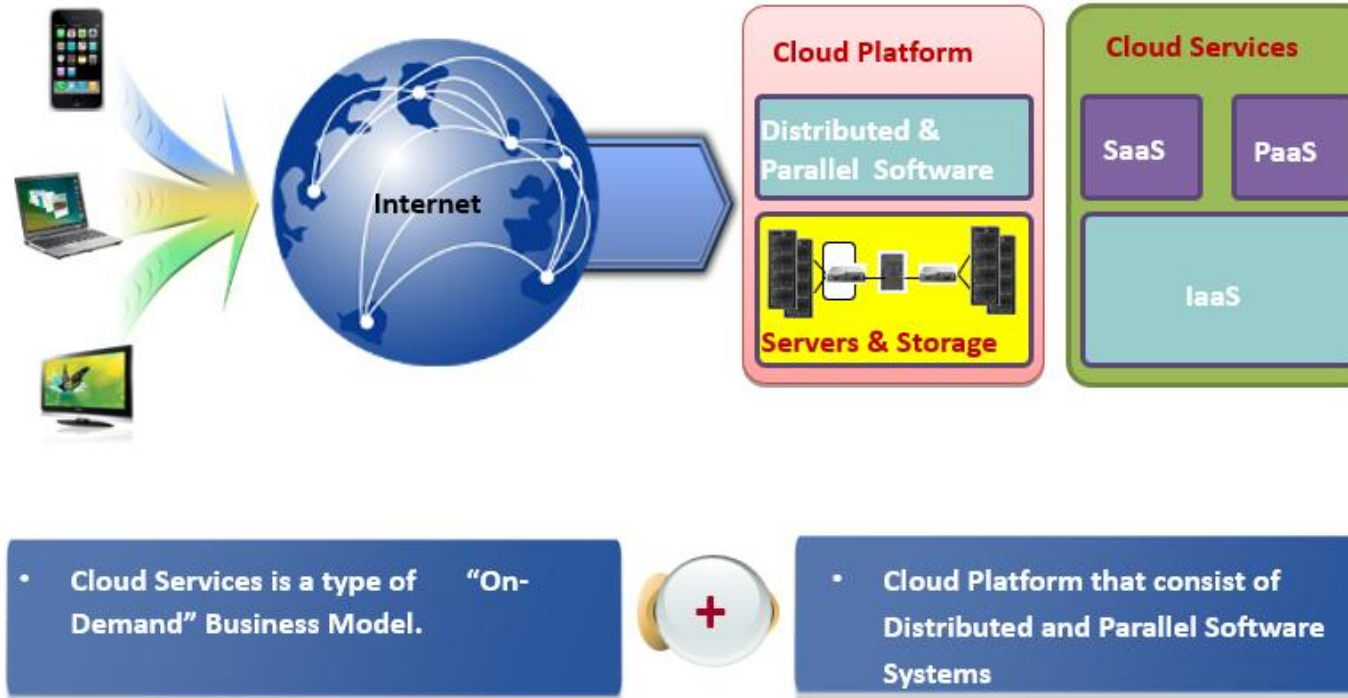


Migration of Traditional Businesses to the Cloud Platform (2)

- ❑ **Software-defined networking (SDN)** is an approach to designing, building, and managing networks that makes the network more flexible and agile, enabling it to support the virtualized server and storage infrastructure of modern data centers.
- ❑ **OpenStack** is a cloud operating system that manages large pools of compute, storage, and networking resources in a data center through a dashboard, which allows administrators to control these resources while enabling users to provision them via a web interface.

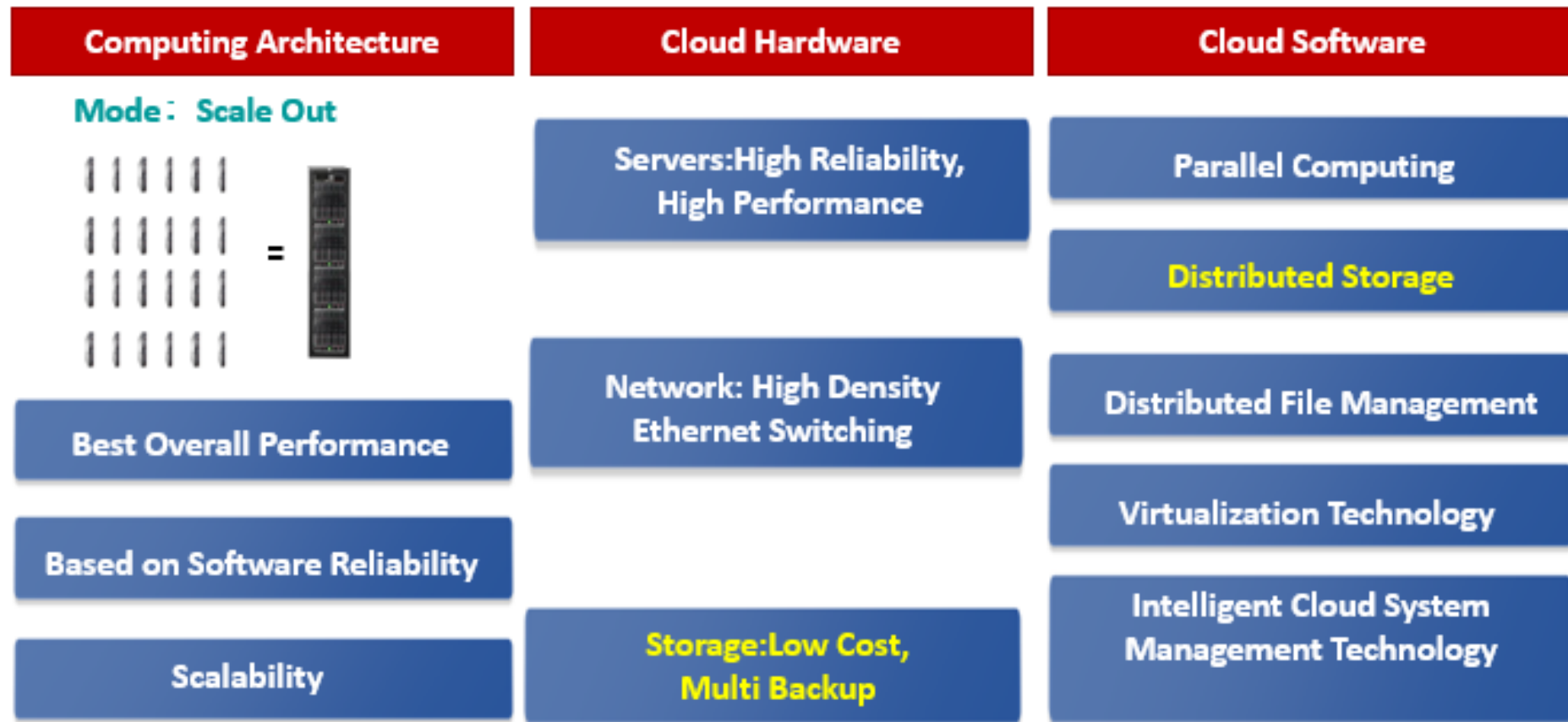


Cloud computing is the Unification of Business Model and Technological Concepts

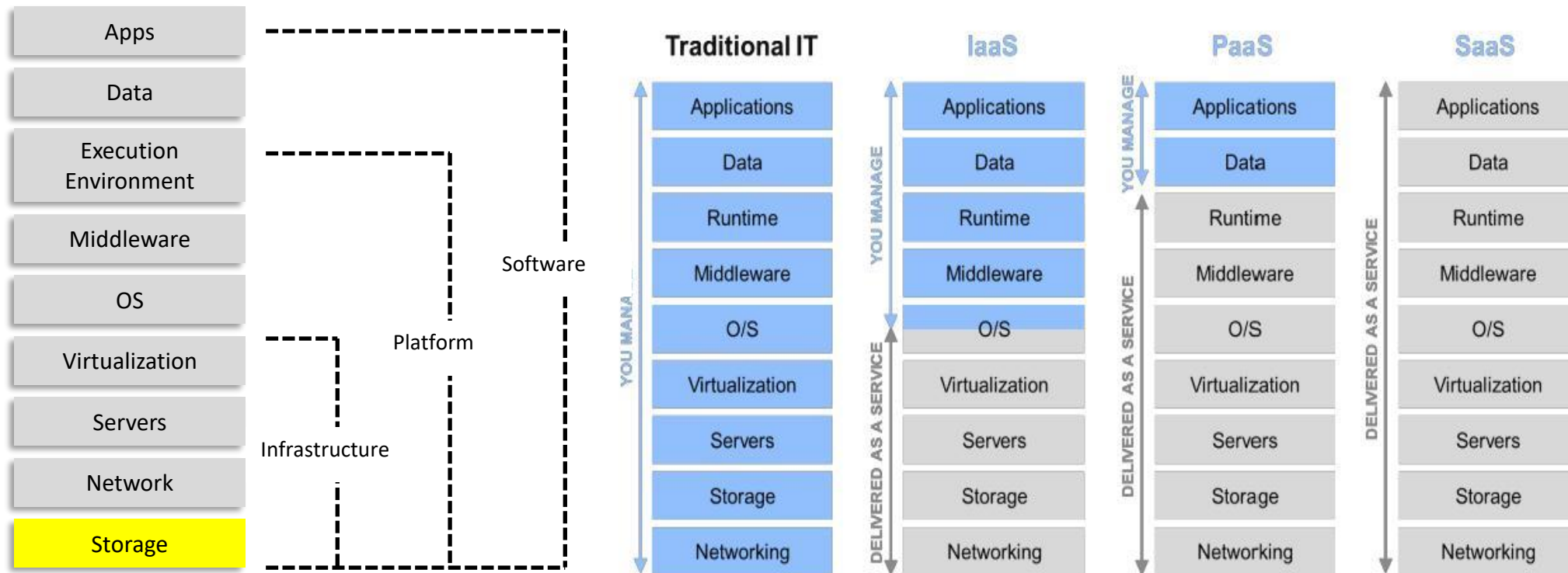


The “**on-demand**” business model is a business model where services are obtained based on the customer’s demand, and corresponding payments are collected for the services offered to the customers.

Key Technologies of the Cloud



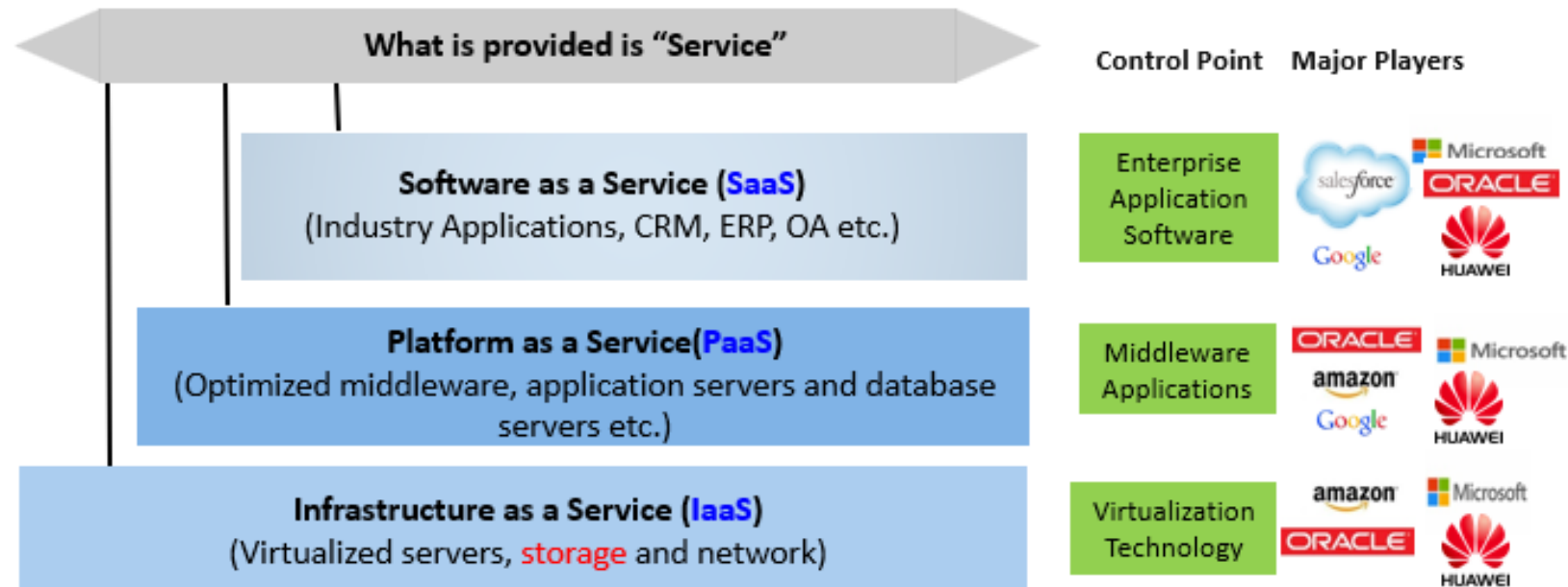
Cloud Service Models



Source: Microsoft.

Service is the Essence of the Cloud

A computing model that provides scalable and highly elastic IT related capabilities in the form of service over the network/web.



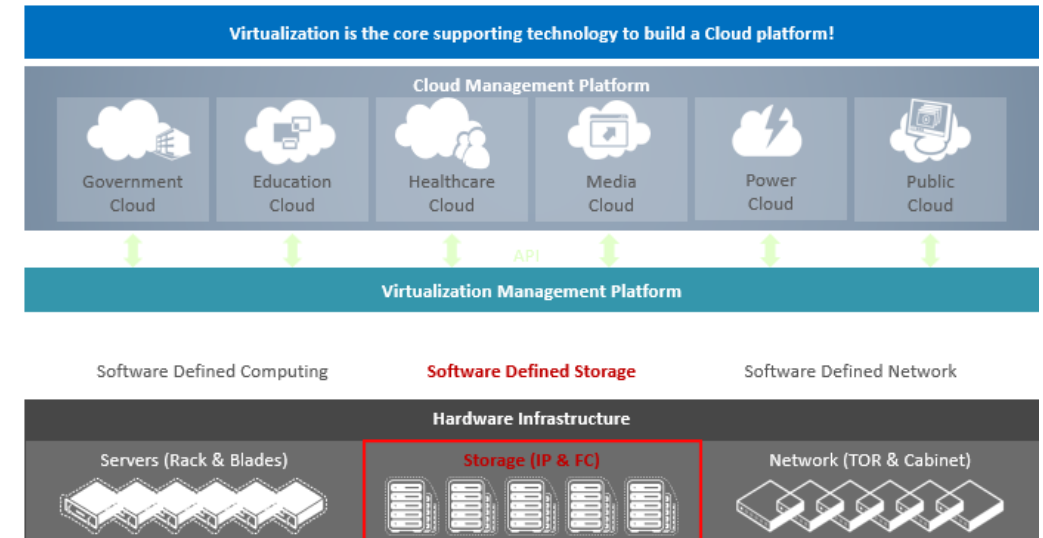
Cloud Platform (Wide Definition) = **Storage** + Networking + Computing + Distributed Software + Web Application

The Key Technology of the Cloud - Virtualization

❑ **Definition of Virtualization:** Abstraction and isolation management technology towards physical resources in order to achieve the purpose of the highest utilization rate of the physical resources.

❑ **Types of Cloud Deployment:**

- **Private Cloud:** Enterprise-owned independent cloud infrastructure.
- **Public Cloud:** Cloud infrastructure owned by cloud service providers that provides cloud service to the public or enterprises.
- **Hybrid Cloud:** A combination of private and public cloud infrastructure through dedicated connection technologies to achieve data and application sharing.



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The Era of Big Data



The Era of Big Data Is Here



An era of mass production, sharing and application of data is beginning...

-Kenneth Cukier (Author of the book "Big Data: A Revolution That Will Transform How We Live, Work, and Think "

Where Does Big Data Comes From?



Social Data

Machine Data

What is Big Data?

- ❑ **Big data:** is a massive, high-growth and diversified information asset that requires new processing models for greater decision-making, insight, and process optimization capabilities.
- ❑ **Big data challenges** include capturing data, data storage, data analysis, search, sharing, transfer, visualization, querying, updating and information privacy.
- ❑ The dimensions to big data is known as **Volume, Variety, Velocity and Value.**



Variety

- **Multi Source:** Within Enterprise, Internet, IoT etc.
- **Multi Format:** Not limited to structured data, but also includes unstructured data such as music, video and pictures.



Velocity

- **Quick Growth:** Data is growing exponentially, IDC estimates a growth up to 50 times in the next ten years.
- **Quick Processing:** It is time sensitive, must identify and respond quickly to adapt to business needs.



Volume

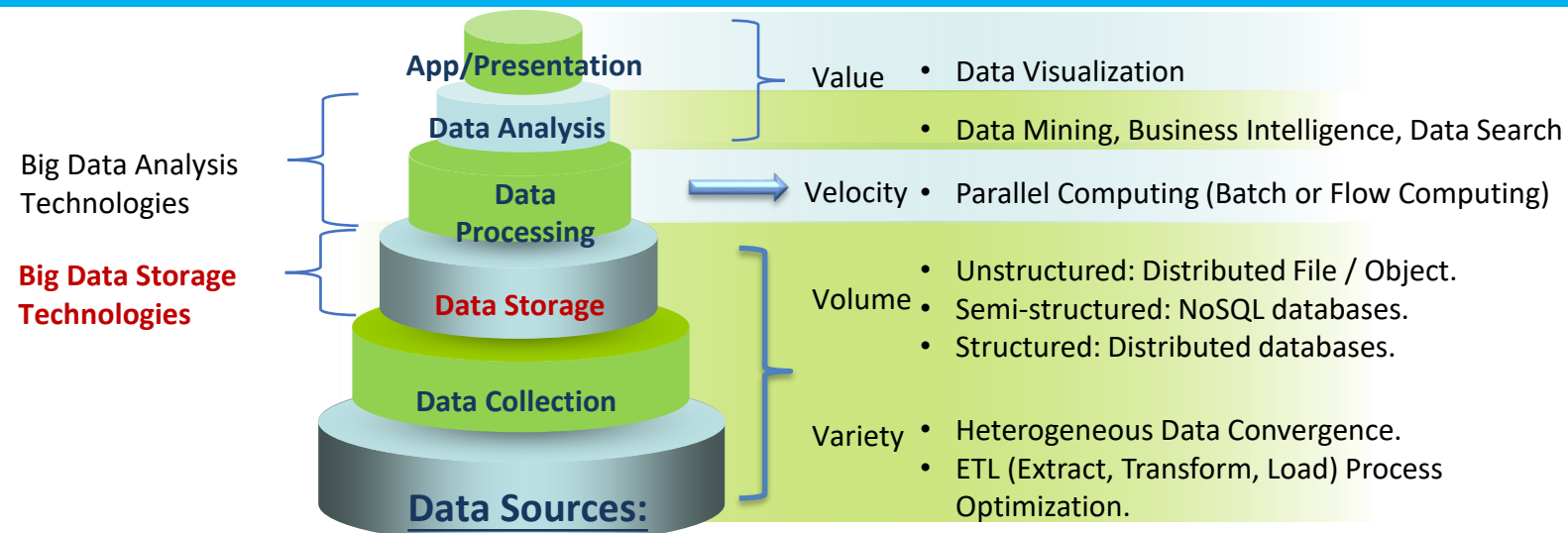
- **Large Storage Volume:** Filled with different types of data, often in the level of PB(1000TB) of information.
- **High Compute Volume:** Requires real-time response toward massive data extraction and analysis.



Value

- Although it requires large amount of effort, but it has high gains in value. Even though the data value density is low, but the final resulting value generated from Big Data is staggering.

Technological Architecture of Big Data

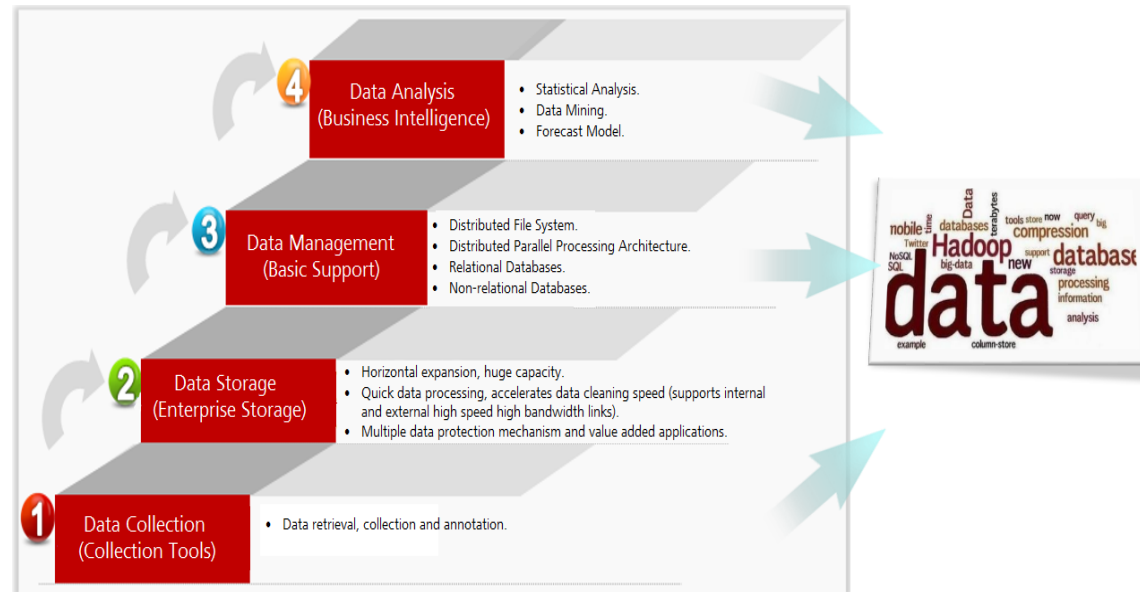


A typical big data processing system can be divided into **5 layers**: Data Collection, Data Storage, Data Processing, Data Analysis and Application or Presentation of Data.

The data types and models of Big Data:

- **Unstructured Data**: refers to data that is not easily presented in the form of a database or 2D logical charts, including all the formats of office files, text, pictures, XML, charts, images, music, and video.
- **Semi-structured Data** refers to the data that sits between structured data and unstructured data (such as sound and images). HTML files can be considered as semi-structured data.
- **Structured data**: refers to data that can be stored within databases and represented or visualized in the form of a 2D logical chart.

Big Data Processing Requires Wide Range of Technical Support



The process of processing big data is basically the same as **the process of general data processing**, which includes the **four process of data collection, data storage, data management and data analysis**.

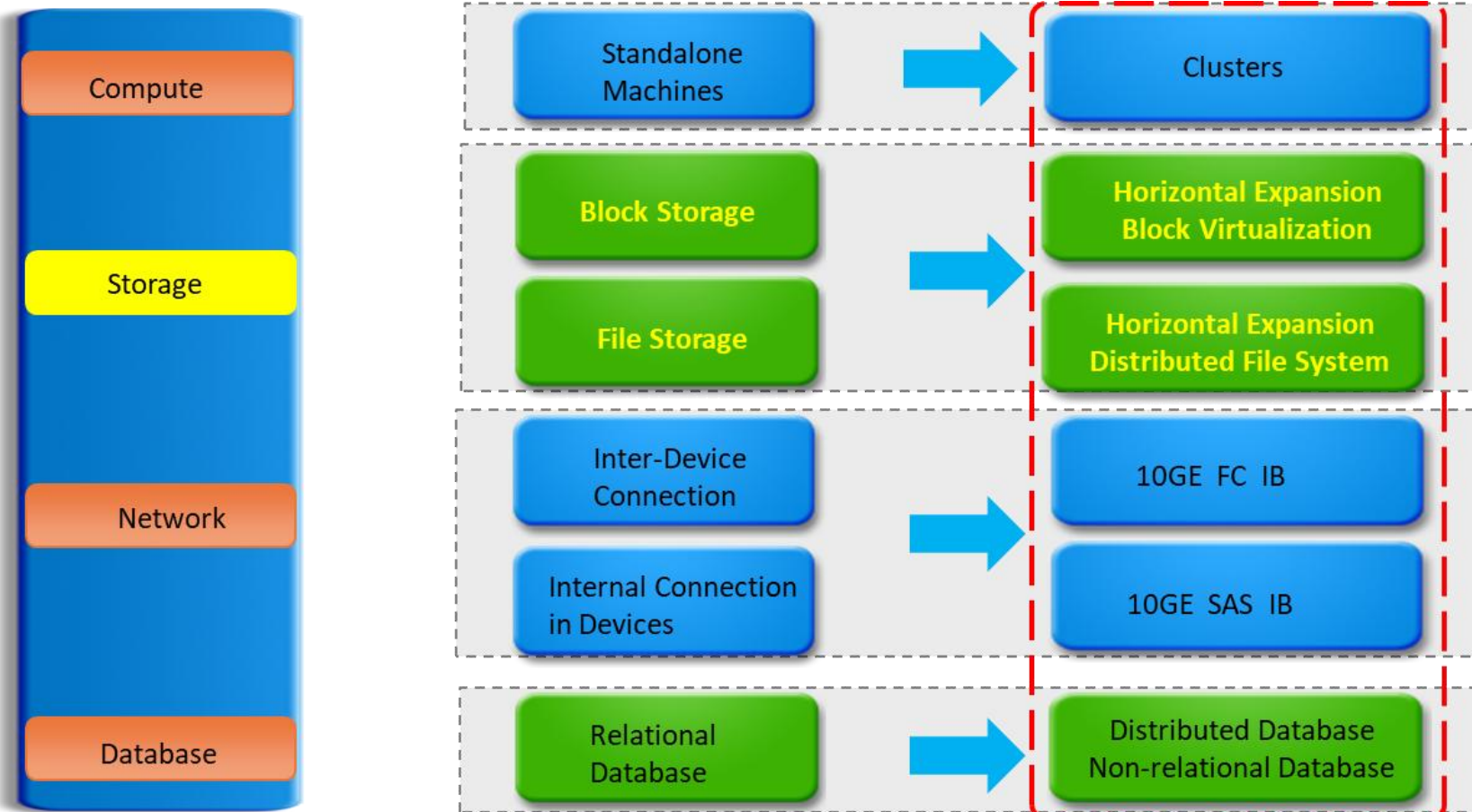
- The **data collection** process refers to collecting the required data for subsequent analysis through various sources.
- The **data storage** process refers to the transmission and storage of data that was collected in the earlier process.
- **Data management** builds on data storage by further organizing and refining the stored data. It enables more precise data segmentation and generates metadata, which makes future data analysis faster and more efficient.
- The **data analysis** process refers mainly to the utilization of analysis methods, models, and tools to analyze the data and getting a final analysis result that satisfies the common analytical needs.

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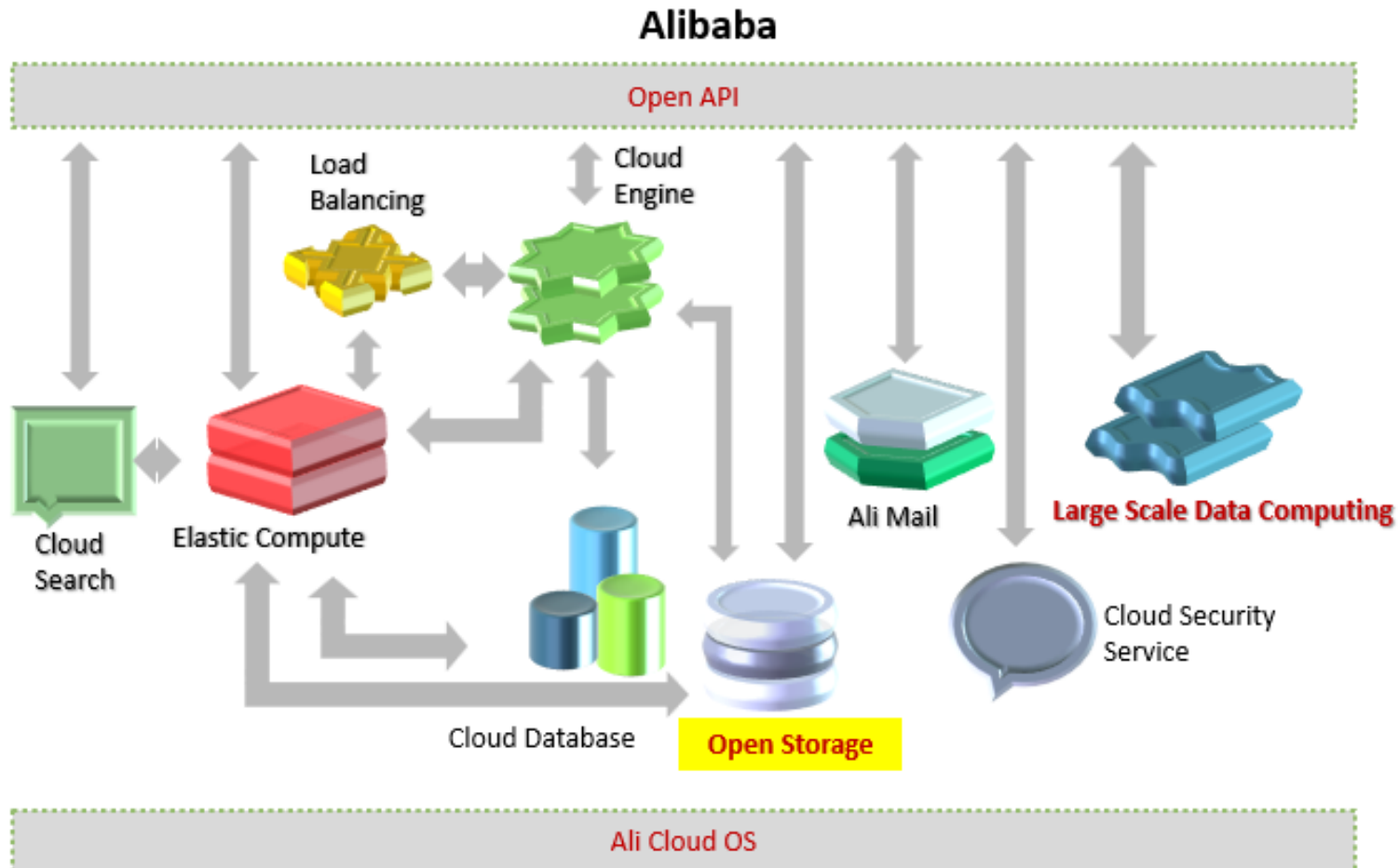
Changes In Storage Technologies



Changes In Storage Technologies



Deep Convergence of Big Data and the Cloud



Summary

- We explored the **ICT architecture** that supports AI, Big Data, and Cloud.
- Understood **the evolution of data**: from mainframes to the Era of Big Data.
- Learned about the **sources of Big Data and its four dimensions** (Volume, Variety, Velocity, Value).
- Discussed **Big Data architecture**: Collection, Storage, Processing, Analysis, and Presentation.
- Highlighted **storage technology changes** that enable scalability and performance.
- Saw **how Cloud Computing** empowers Big Data through flexibility, virtualization, and scalability.
- **Case study**: Alibaba as an example of deep convergence of Big Data and Cloud.



Thank You