

Storage Technologies

IT403

Prepared by
Dr. Ahmed El-Douh

Lecture 10



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IT403
Modern Data Center

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Foreword

- This module mainly introduces the development history of Data Centers, and the basic modules and components of Data Centers. This module also introduces the evolution and trends of Cloud Data Centers.

Objectives

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

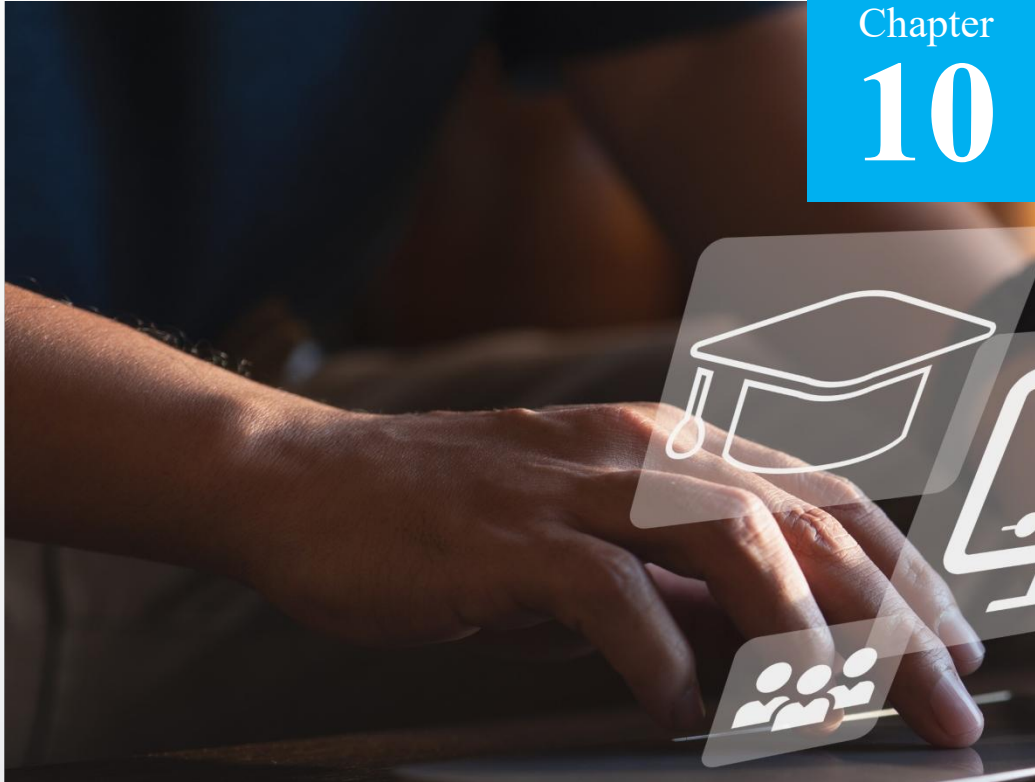
- Understand the history of Data Centers.
- Familiar with the basic components and modules of the Data Center.
- Understand the evolution and current trends of cloud Data Centers.

Outlines

- History of Data Centers.
- Basic Components and Modules of Data Centers.
- Data Center Architecture
- Challenges of Cloud Data Centers and its Development Trends.
- Innovation Data Center
- Cloud Data Center Development Trend

Chapter
10

History of Data Centers



Evolution of Data Centers



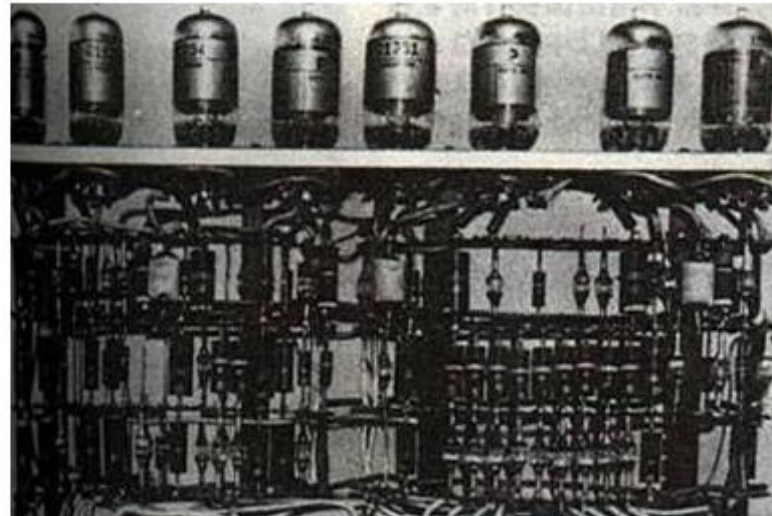
Earliest Development of Data Centers - ENIAC

- ENIAC (Electronic Numerical Integrator And Computer) was developed in 1946 for calculating the artillery firing tables for the United States Army's Ballistics Research Laboratory.
- At that moment, there was no other computer that can accomplish the task required for those calculations. ENIAC had 17468 vacuum tubes, 7200 crystal diodes, 70000 resistors, 10000 capacitors, 1500 relays, and more than 6000 switches. It can perform 5000 simple addition and subtraction operations or near to 400 multiplication operations in a second. It was 1000 times faster than a calculator and 20000 times faster than manual hand calculations.



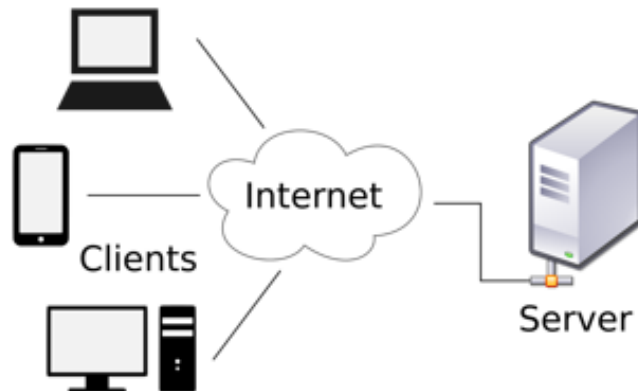
Commercialization of Virtualization Technologies in Data Centers - TRADIC

- Unlike vacuum tube systems, the first transistor based computer (TRADIC) was developed in 1954, but more advanced commercial systems appeared in the 1960s and lead to a breakthrough in mainframes technology such as the IBM System Mainframe. Mainframes are primarily developed for government and military use at the time and have unique requirements for environmental sites and security systems. With the increasing demand for system performance, people are hoping to provide support for additional features and implement resource sharing on the same system. As a result, virtualization technologies gradually came into the attention and viewpoint of the market.
- The concept of virtualization quickly gained traction and was further refined by the multitasking processor mechanism in the mainframes. The first commercially available virtualization technology was implemented on the IBM VM/370 Operating System in 1972.
- As one of the most important technologies of the data center, the development of virtualization technology also becomes an important part in the entire Data Center development process.



C/S Architecture Computing Model and the Internet

- 20 years ago, the microcomputer industry flourished, older generation of PC lost its charms and slowly faded from the market, and was slowly replaced by connected network devices, especially when Client/Server technology model emerged, which led to gradual emergence of external hosting and external Data Centers.
- In the mid of 1990s, the emergence of the Internet brought a huge impact on the market and provided more choices for the deployment of Data Centers in the next decade or so. With the company's needs for support for Internet business applications, network connectivity and collaboration services becomes the must-have IT services to deploy by businesses. Network providers and colocation vendors have been widely adopted in the creation of hundreds of data centers, and the data center as a service model is already accepted by most companies by that time.



Emergence of Modular Data Centers

- In the recent years, Data Center has evolved into a new form which is the modular data center. It deploys Data Center servers and devices typically in containers, hence it is also known as Container Data Center. One of the best known modular Data Center is the Sun Blackbox, where its 280 servers are deployed in standard 20 feet containers and shipped around the world.
- These types of modular Data Center lacks in outer appearance compared to the well designed traditional Data Center, but it takes up only 1% of the cost of building a traditional Data Center. It has flexible mobility and dramatically reduces the time in deployment cycles, making deploying Data Centers in remote regions faster and more efficient.



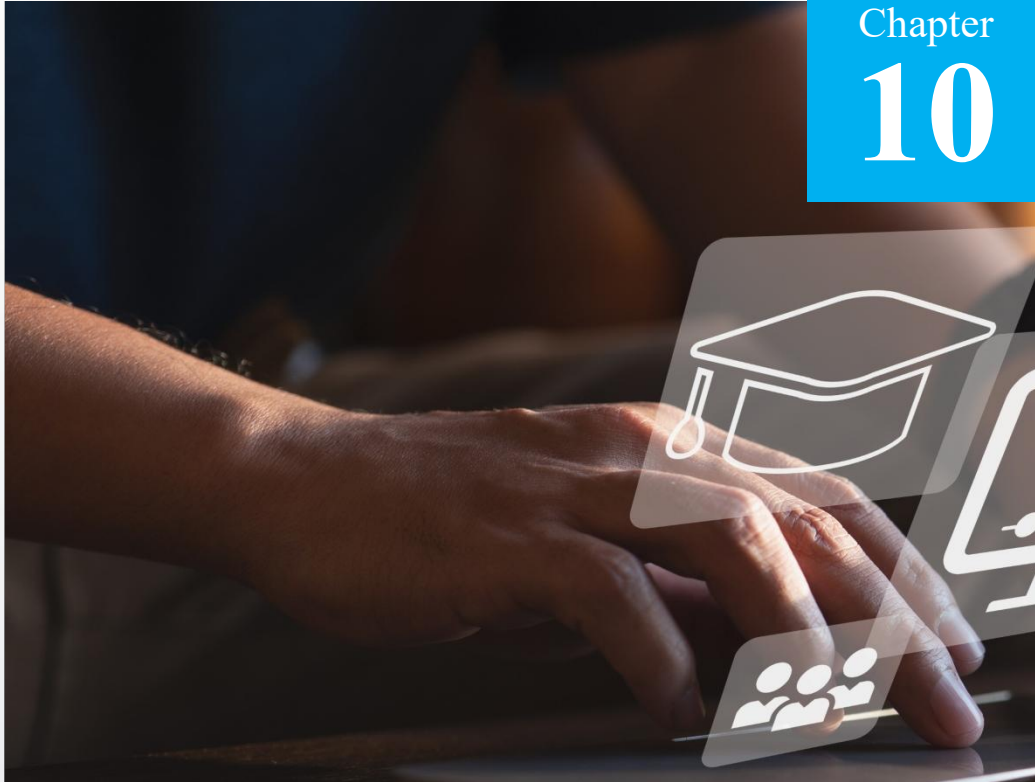
Cloud Data Centers

- **Software as a Service (SaaS)** marked the shift of the demand for computing resources brought by infrastructure to the on-demand ordering model. This business model leverages the network infrastructure and data center operators to jointly deliver large-scale expandable data bandwidth resources to users. They are able to provide a variety of IT services through these resources in the cloud data centers.
- Although in the beginning, everyone did not realize that this kind of development will be so rapid, but cloud service providers such as Amazon and several other infrastructure as a service providers which are based on the cloud data center platform turned out to have mass number of subscribers for their services.



Chapter
10

Basic Components and Modules of Data Centers



What is a Data Center ?

- **Data Center** usually refers to a physical space that centrally process, store, transmit, exchange and manage information. Computers, servers, network and storage equipment are generally considered as key Data Center equipment. The environmental factors that are required for the operation of these key Data Center equipment are the power distribution systems, cooling systems, cabinet systems, fire protection systems, and monitoring systems which are generally considered as key physical infrastructures of Data Centers.



Types of Data Center

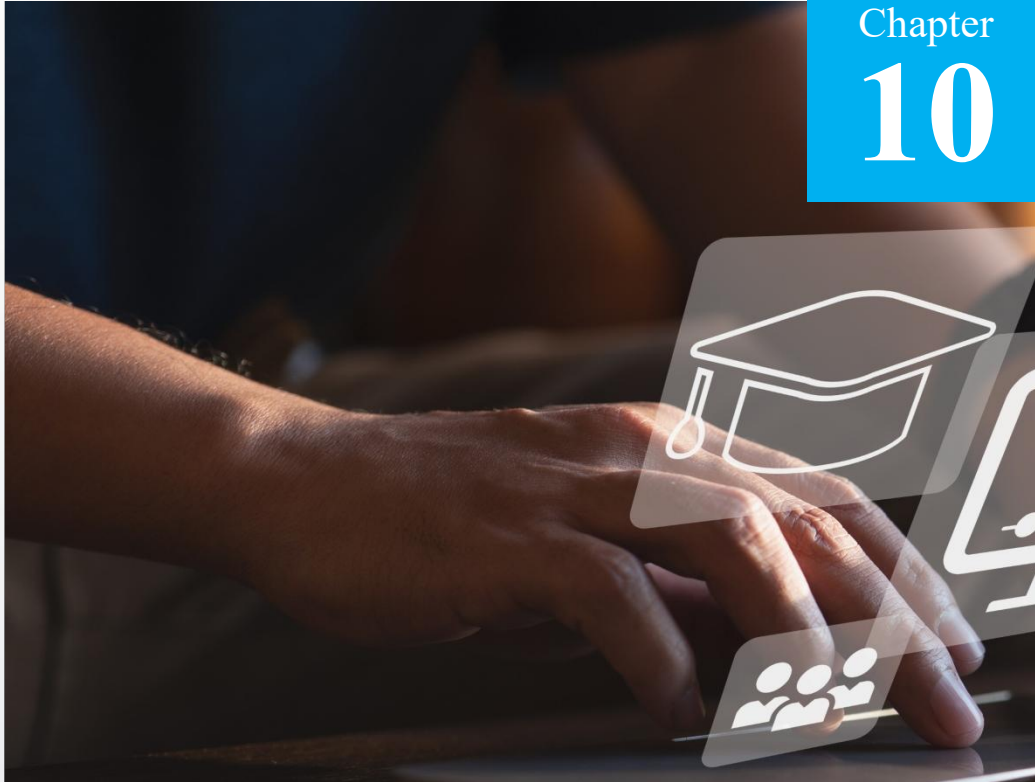


Components of Data Center

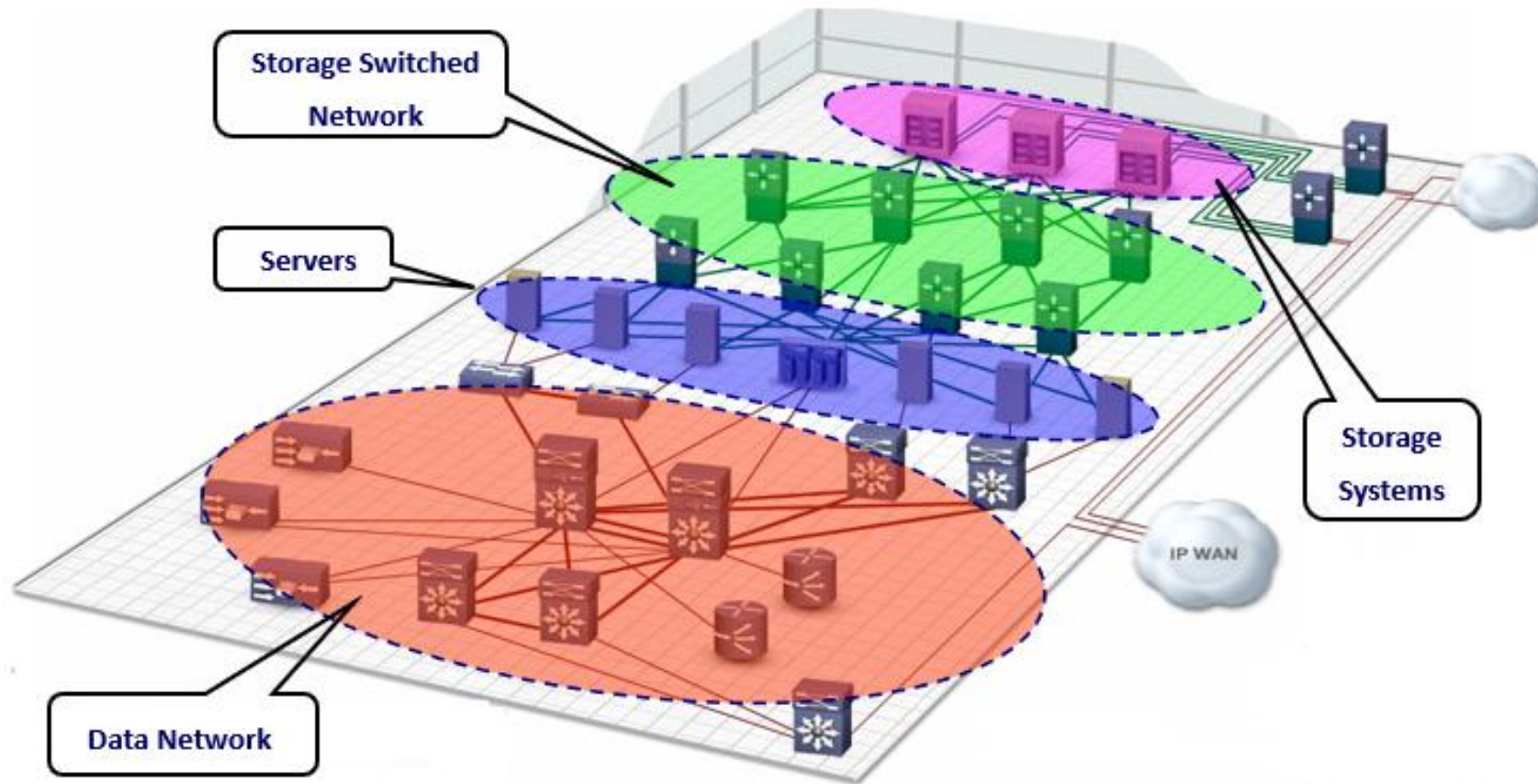
- ❑ **Data center** is a business-oriented infrastructure that is the core to supporting enterprise business operations and future growth, it mainly includes the following components:
 - Safe Web Architecture.
 - Reliable Supporting Equipment (Server Room, Generator, UPS, Air Conditioning etc.)
 - Unified Server/Application Platform.
 - Centralized Storage and Backups.
 - Unified System Management Platform.
 - Service-oriented Operation & Maintenance (O&M) Organization and Process.

Chapter
10

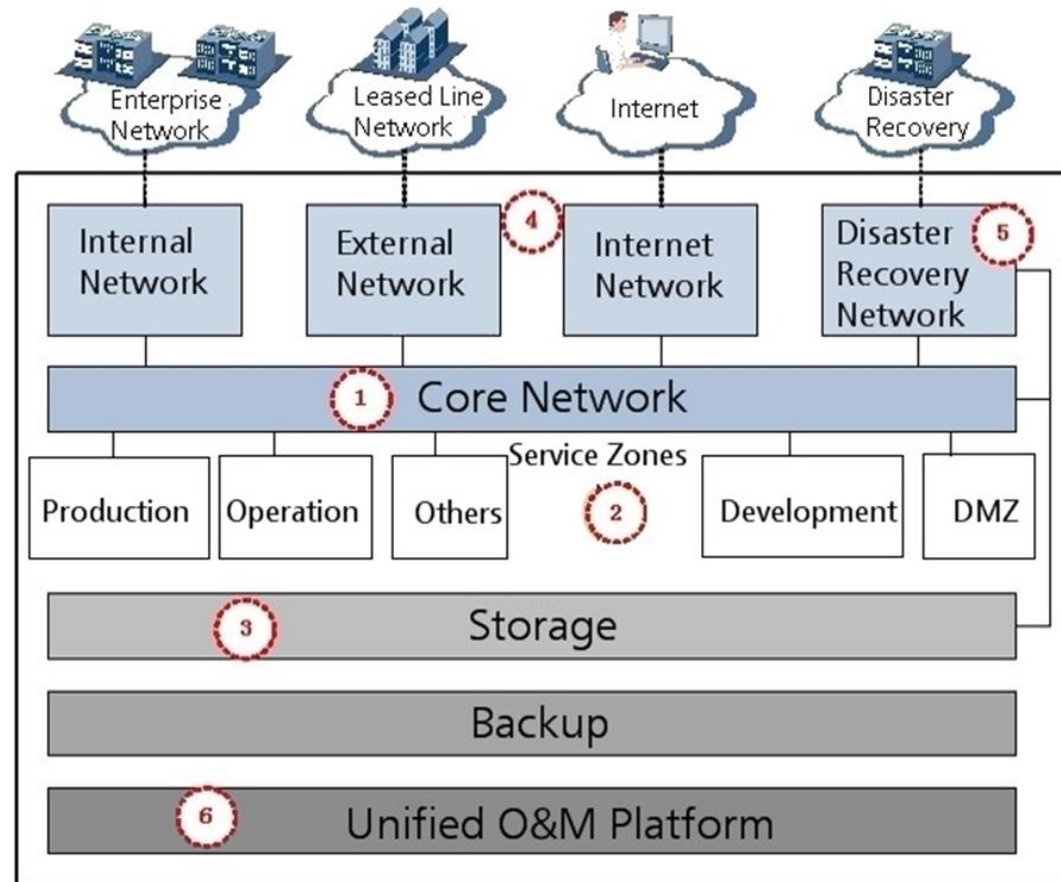
Data Center Architecture



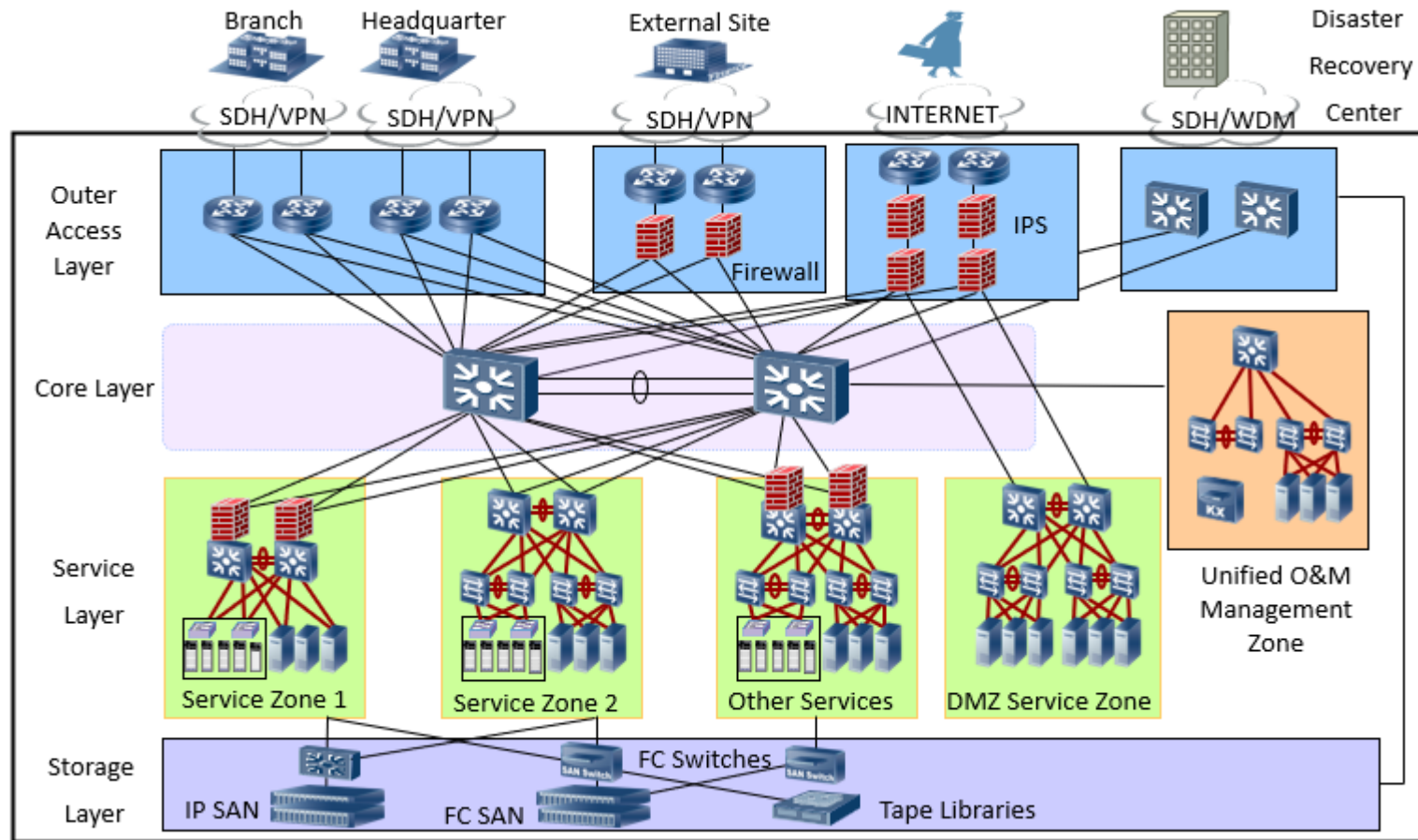
Standard Data Center Architecture



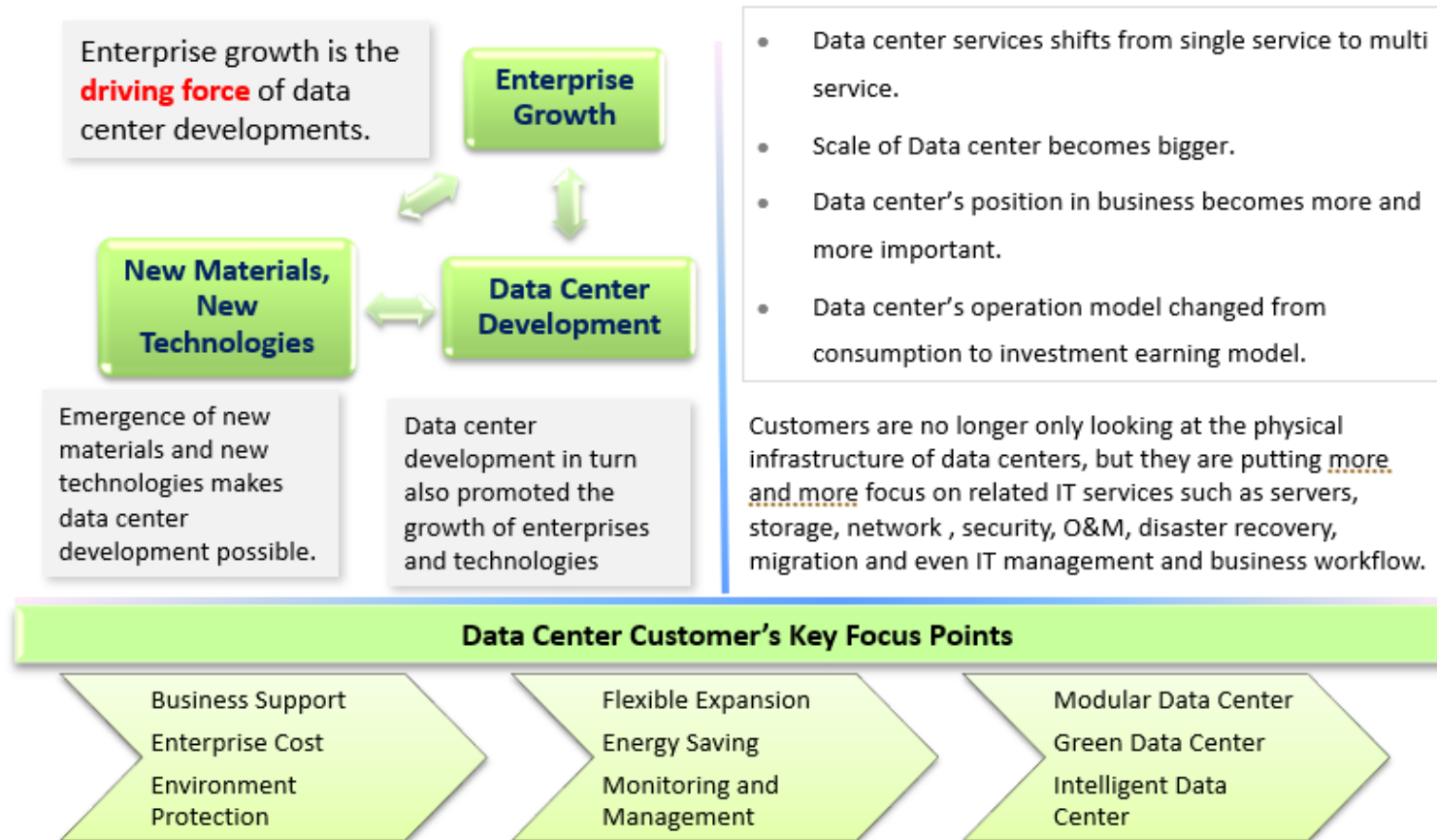
Logical Architecture of Data Centers



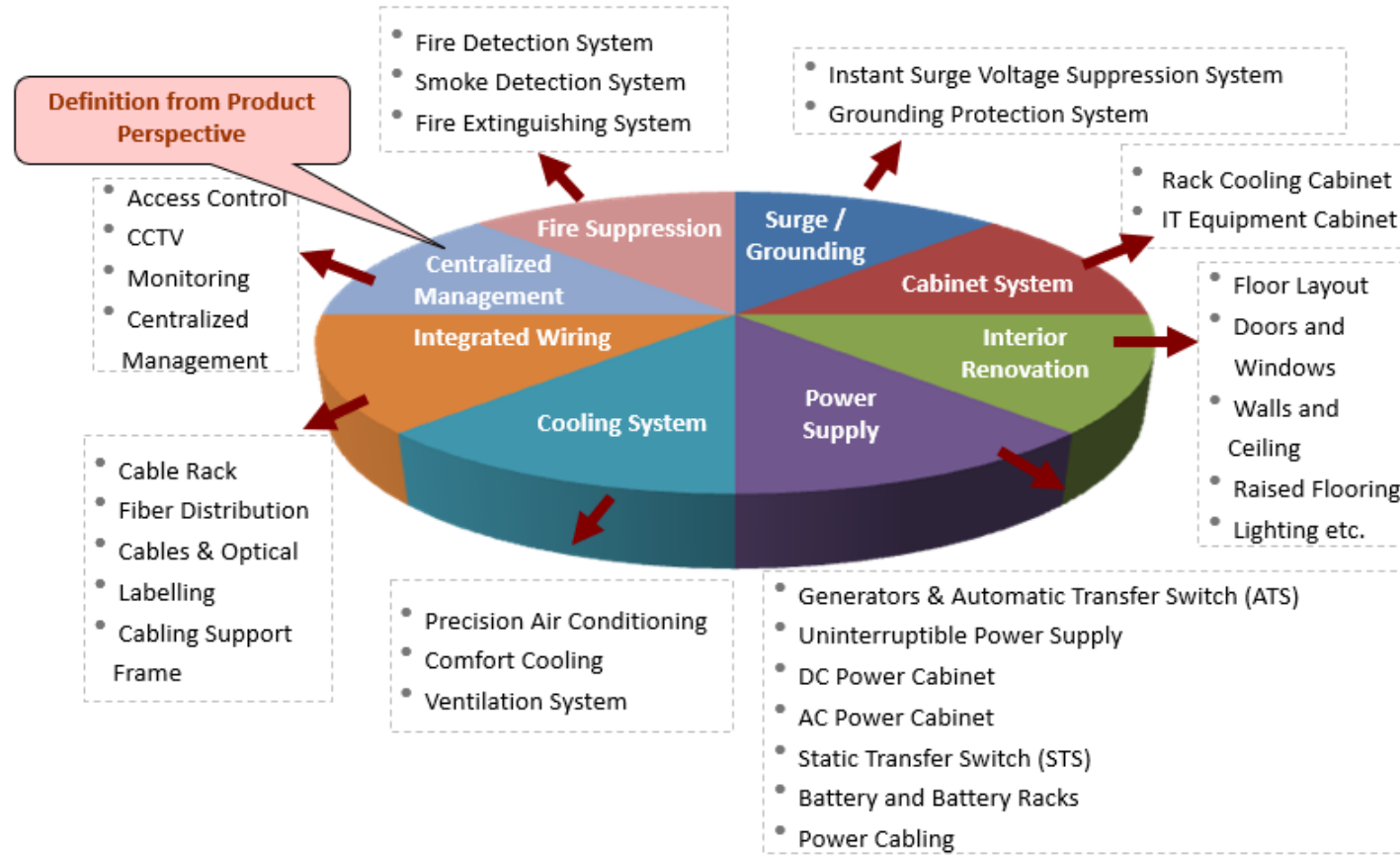
Physical Architecture of the Data Center



Data Center Infrastructure Development Trends



Components of Data Center Infrastructure

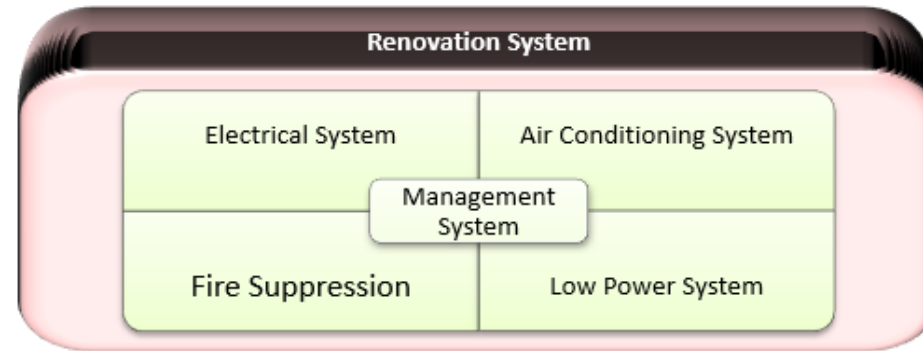


Classification of Data Center Infrastructure

Defined from System Perspective

Classification of departments in construction and design:

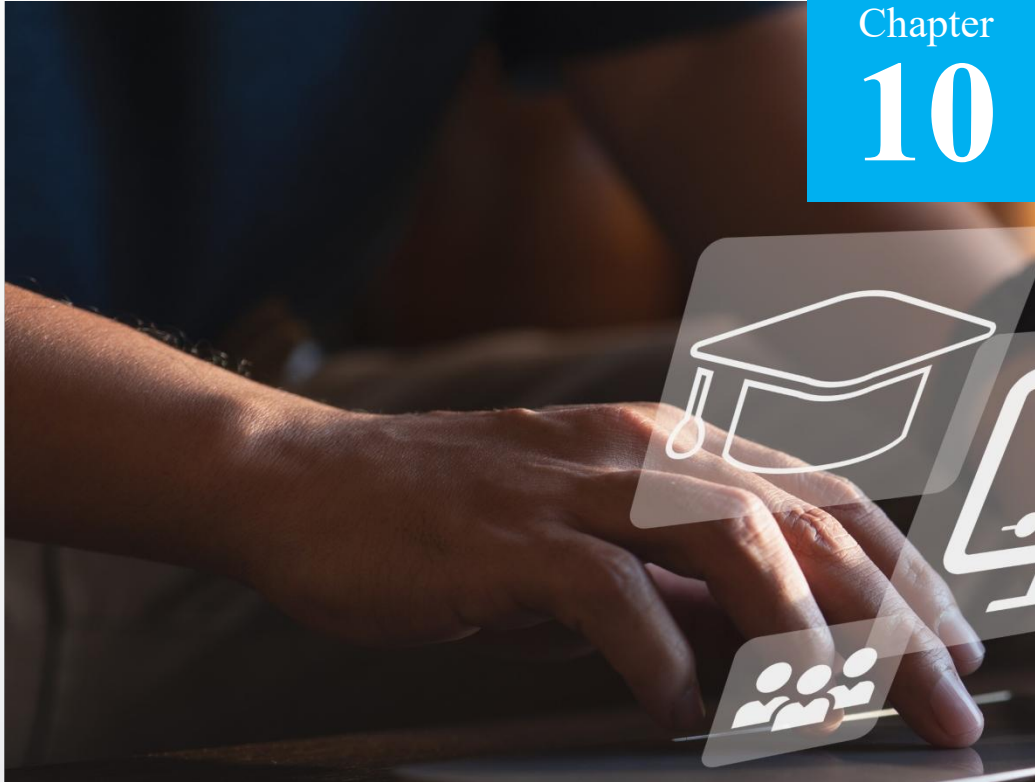
- Construction
- Structural
- Electrical
- HVAC
- Water Supply and Drainage



Renovation	Electrical	HVAC	Fire Suppression	Low Voltage
• Connecting all the subsystems through construction and renovation.	• Power Supply • UPS System • Power Distribution • Lighting • Surge protection & Grounding • Cabinet/Rack	• Precision Air Conditioning • Comfort Cooling • Fresh Air System • Ventilation System	• Fire Alarm • Fire Extinguishing System • Early Detection and Warning System	• Integrated Wiring • Security Monitoring • Environment Control • Equipment Monitoring
Management System: Monitoring Platform, Large Screen Display, Meeting System, KVM, RFID etc.				

Chapter
10

Challenges of Cloud Data Centers and its Development Trends

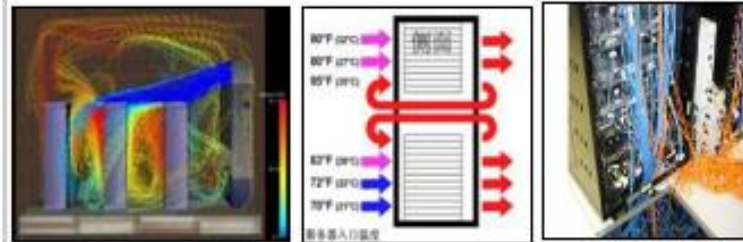


Challenges of Traditional Data Center

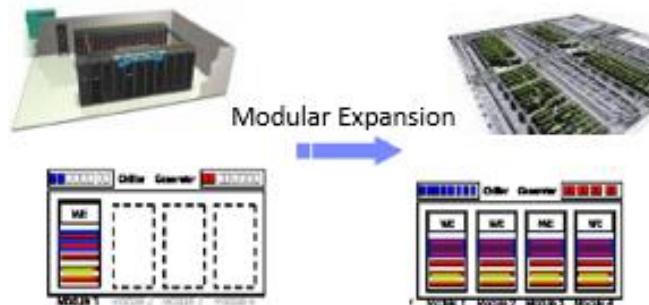
Rapid Growth of Business, Huge Increase in Power Consumption



Low Cooling Efficiency



Poor Expansion Capabilities

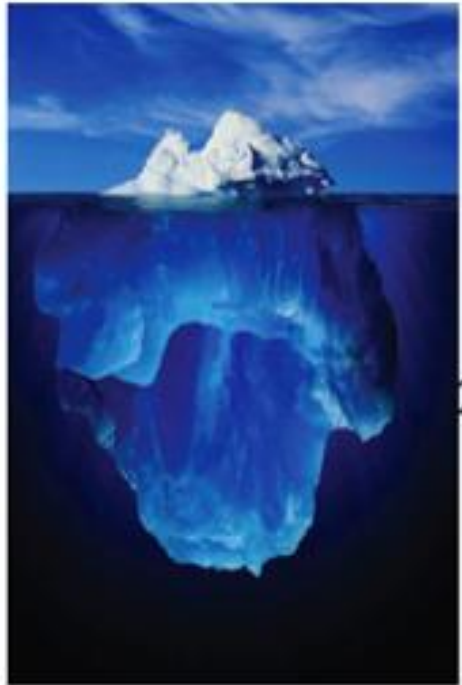


Lacks Unified Monitoring and Management



Challenges of Traditional Data Center - Maintenance Cost

- High Maintenance Cost



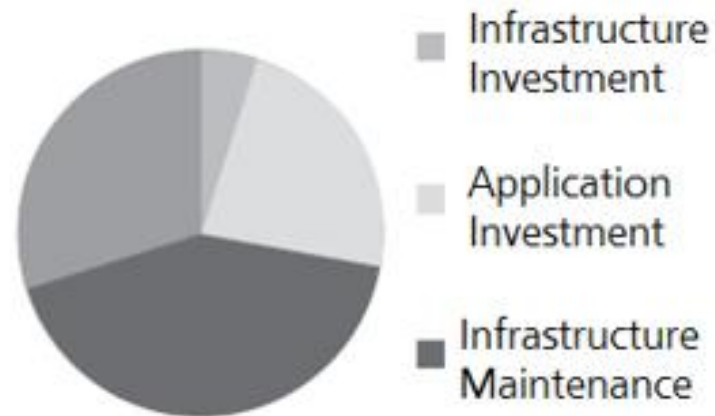
28% CAPEX



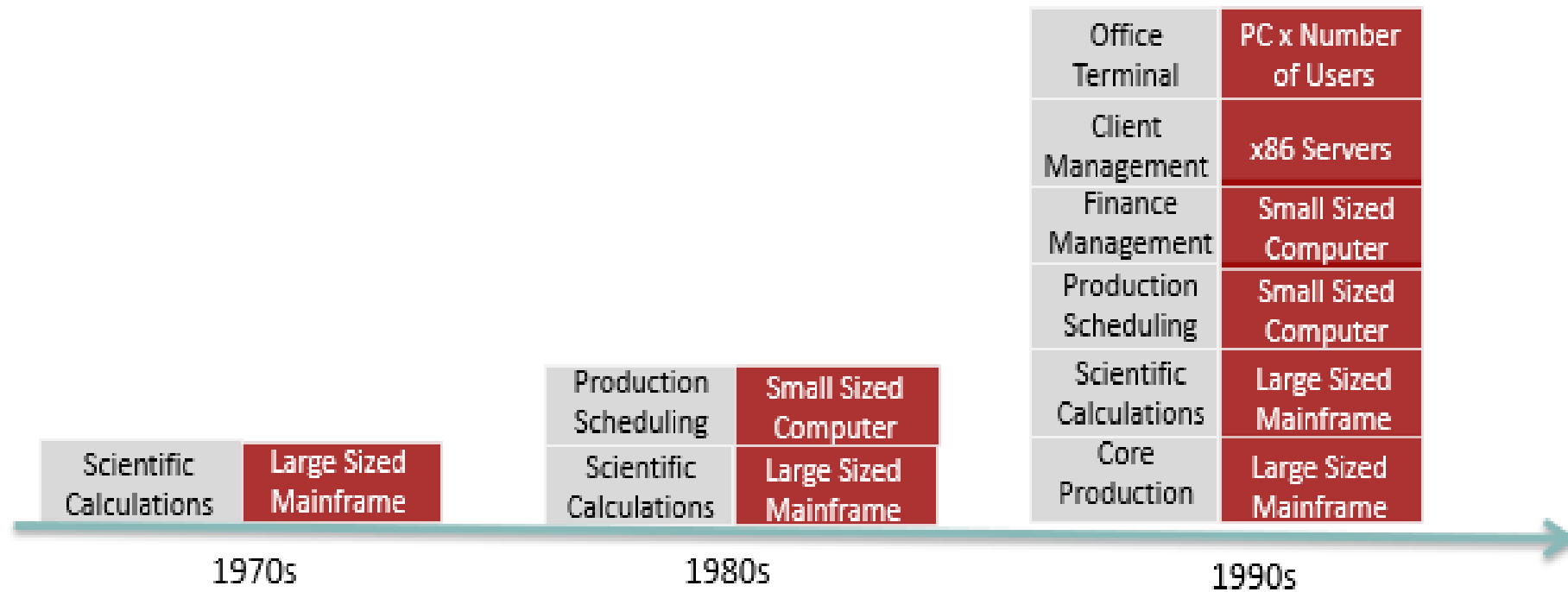
72% OPEX



IT Budget Distribution



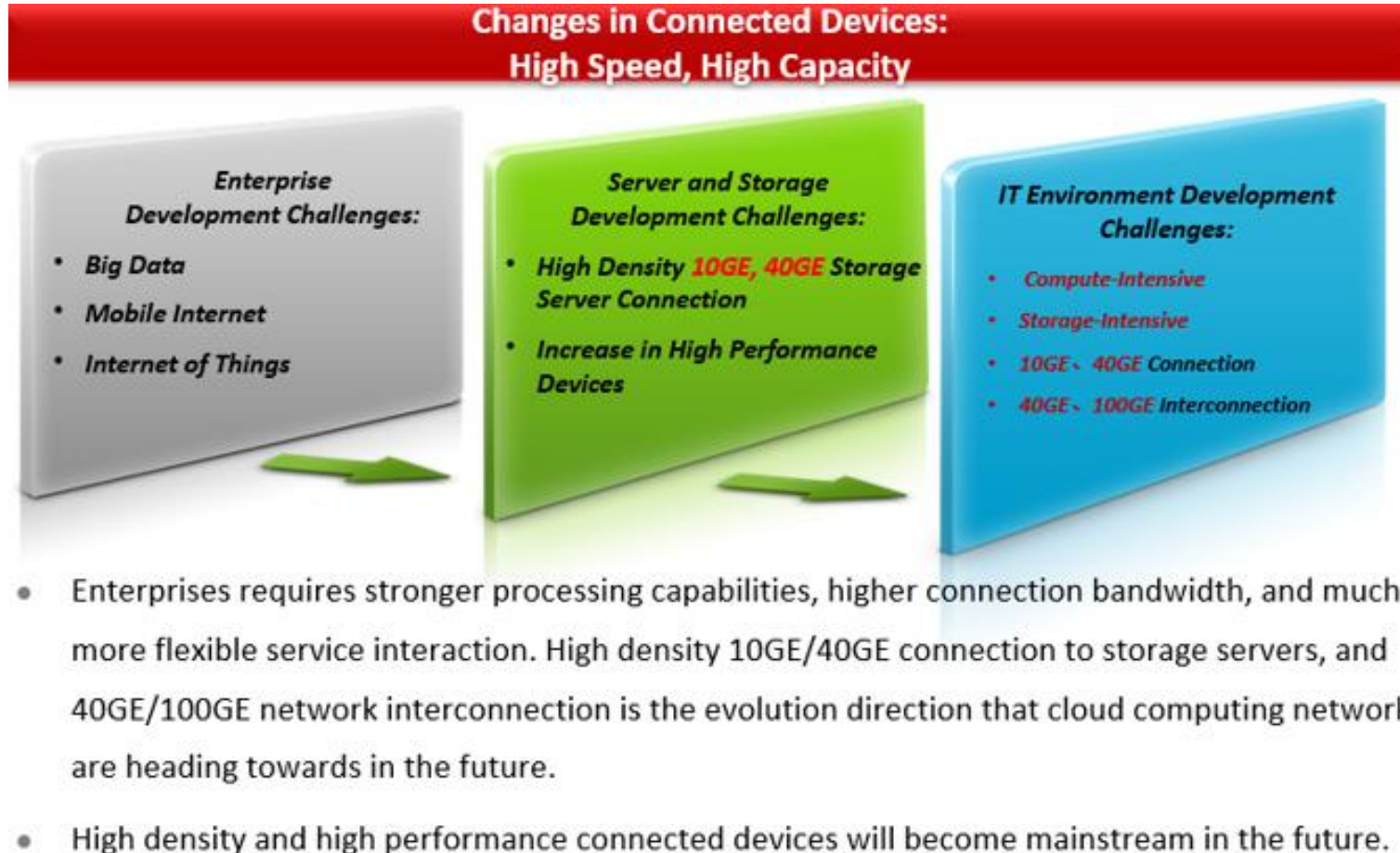
Challenges of Traditional Data Center - Increase in **Services and Equipment** (1)



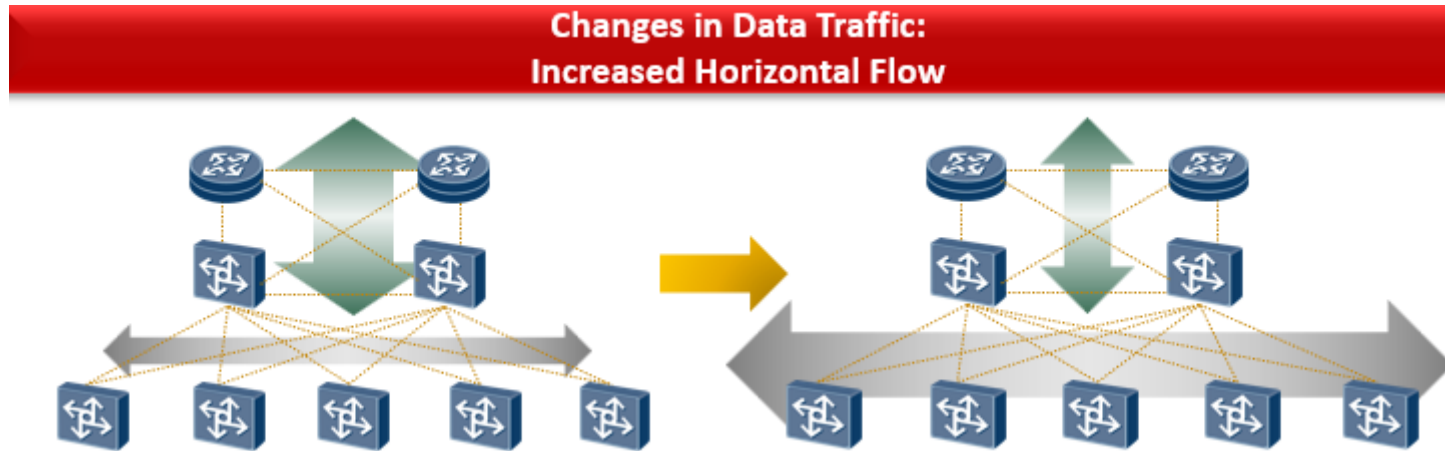
Challenges of Traditional Data Center - Increase in **Services and Equipment** (2)

Office Terminal	PC x Number of Users	BYOD	Mobile Device x Users
Corporate Website	x86 Servers	Office Terminal	PC x Number of Users
HR Management	x86 Servers	B2B, B2C	x86 Clusters
Client Management	x86 Servers	HR Management	x86 Servers
Decision Analysis	Small Sized Computers	Social Media Marketing	x86 Servers
ERP	Small Sized Computers	Big Data Analysis	x86 Clusters, Small Sized Computers
Finance Management	Small Sized Computers	ERP	x86 Clusters, Small Sized Computers
Scheduling Management	Small Sized Computers	Finance / Trading	x86 Clusters, Small Sized Computers
Scientific Calculations	x86 Clusters	Scheduling Management	x86 Clusters, Small Sized Computers
Core Production	Large Sized Mainframe	Scientific Calculations	x86 Clusters
		Core Production	x86 Clusters, Small Sized Computers
2000s		2010s	

Challenges of Traditional Data Center – Increase in Data Traffic (1)

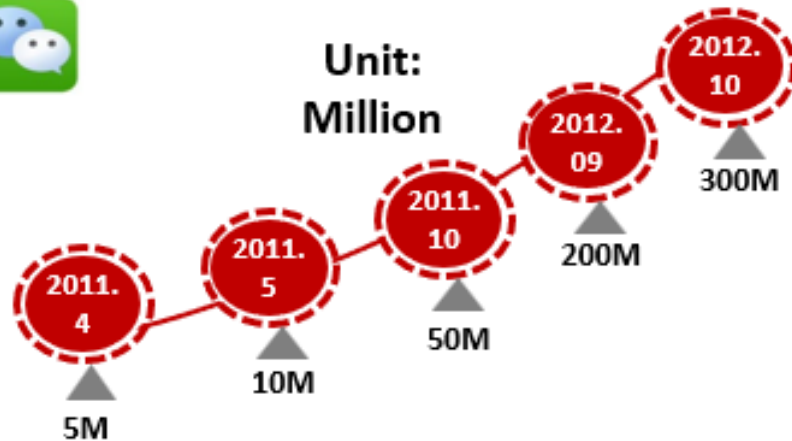


Challenges of Traditional Data Center – Increase in Data Traffic (2)



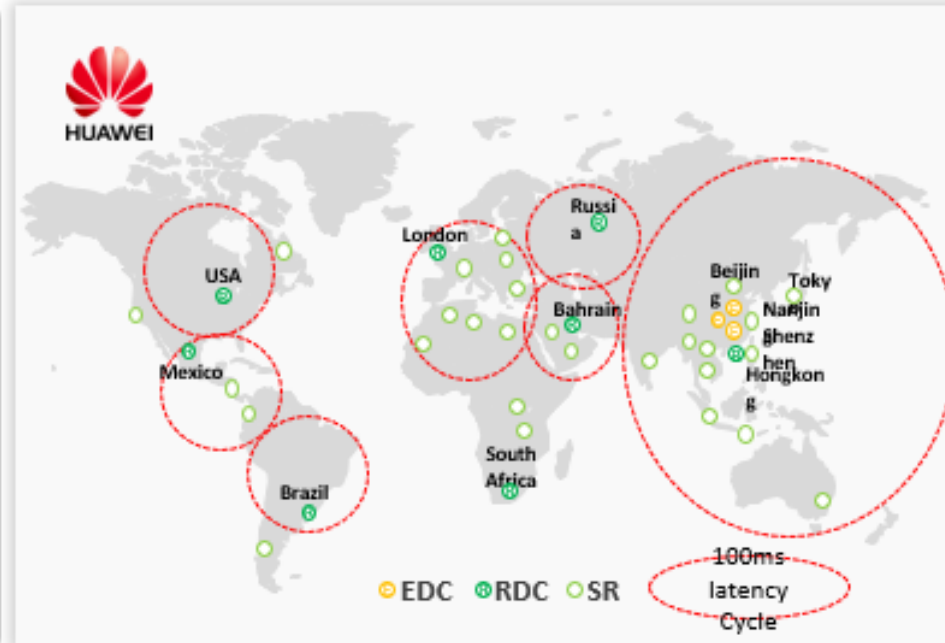
- Big Data, Parallel Processing, 3D Rendering, and Search Engine services requires the combined processing of clustered servers and generates high amount of horizontal flow of data within the network.
- Elastic scaling and online migration of virtual machines, and high amount of data transferred between these virtual machines also contributes to the increased horizontal flow of data traffic within the network.

Challenges of Traditional Data Center - Business Driven Growth



100million users in 1 month

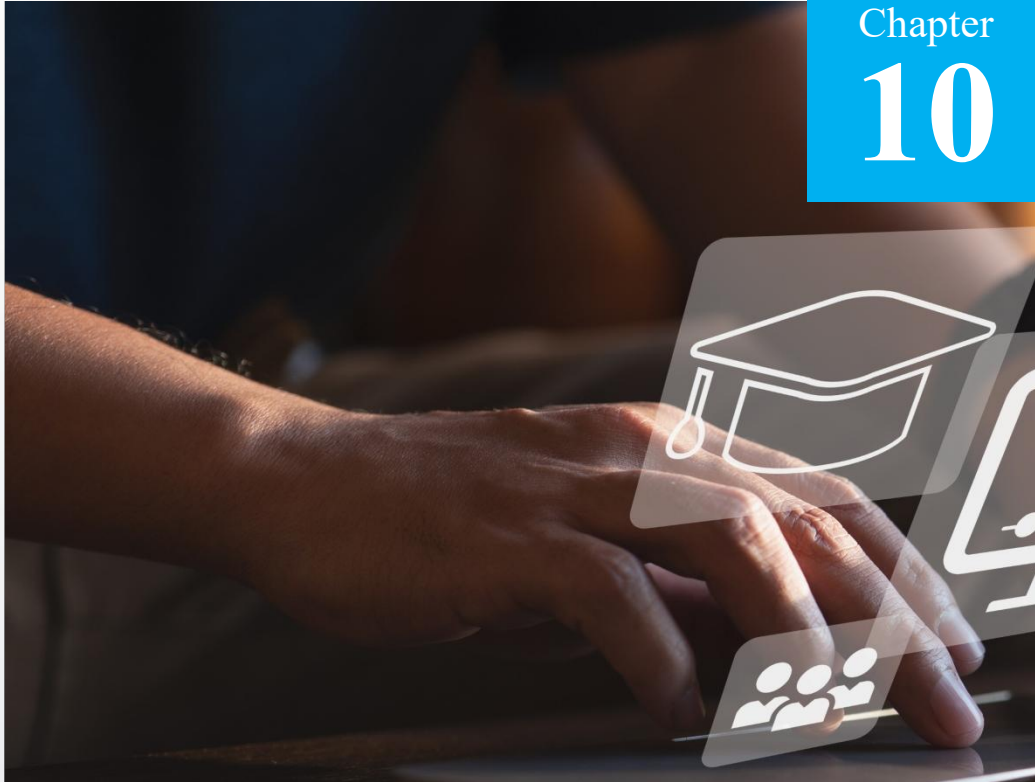
Quickly Satisfy Business Demand



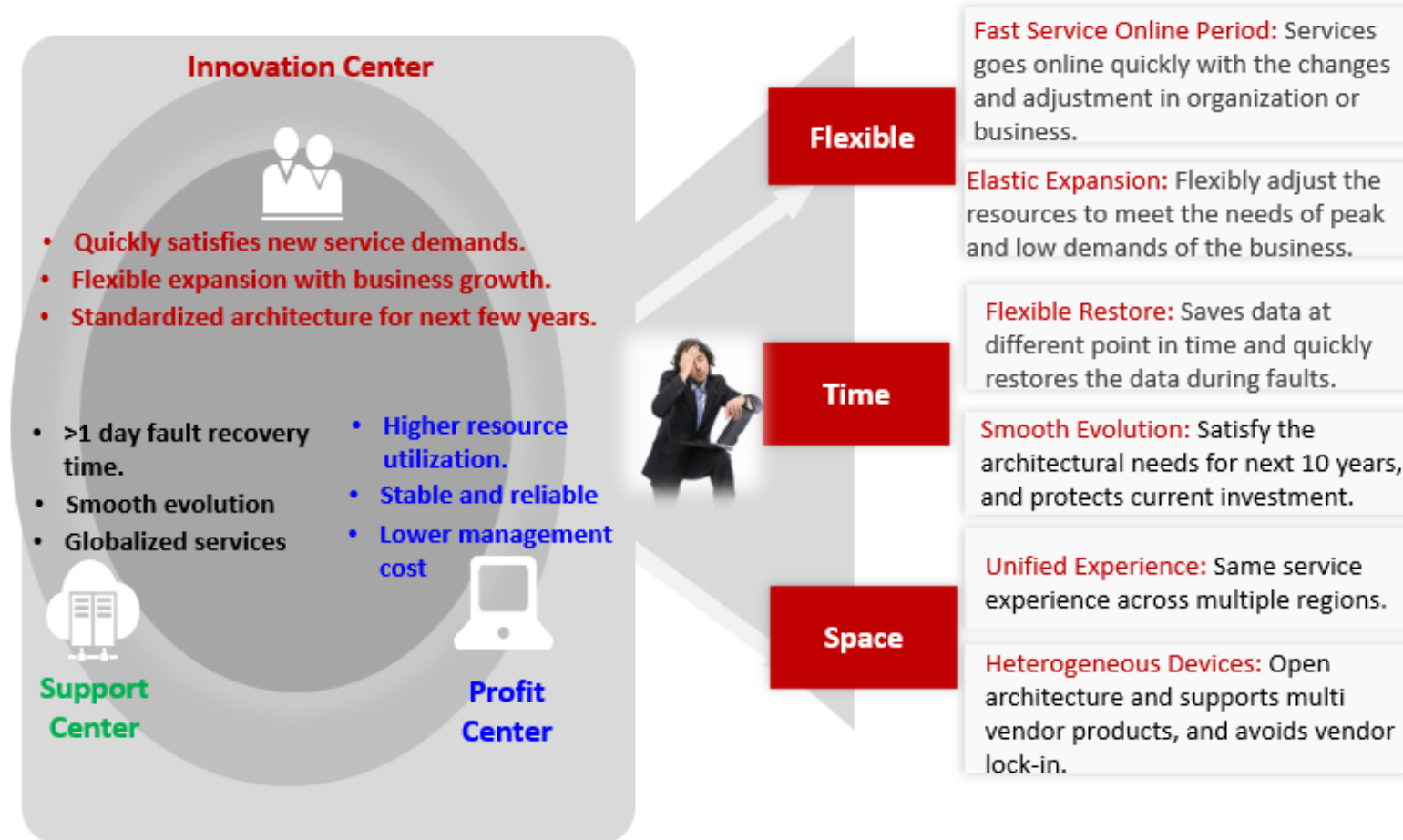
Multi Region Unified Service Experience

Chapter
10

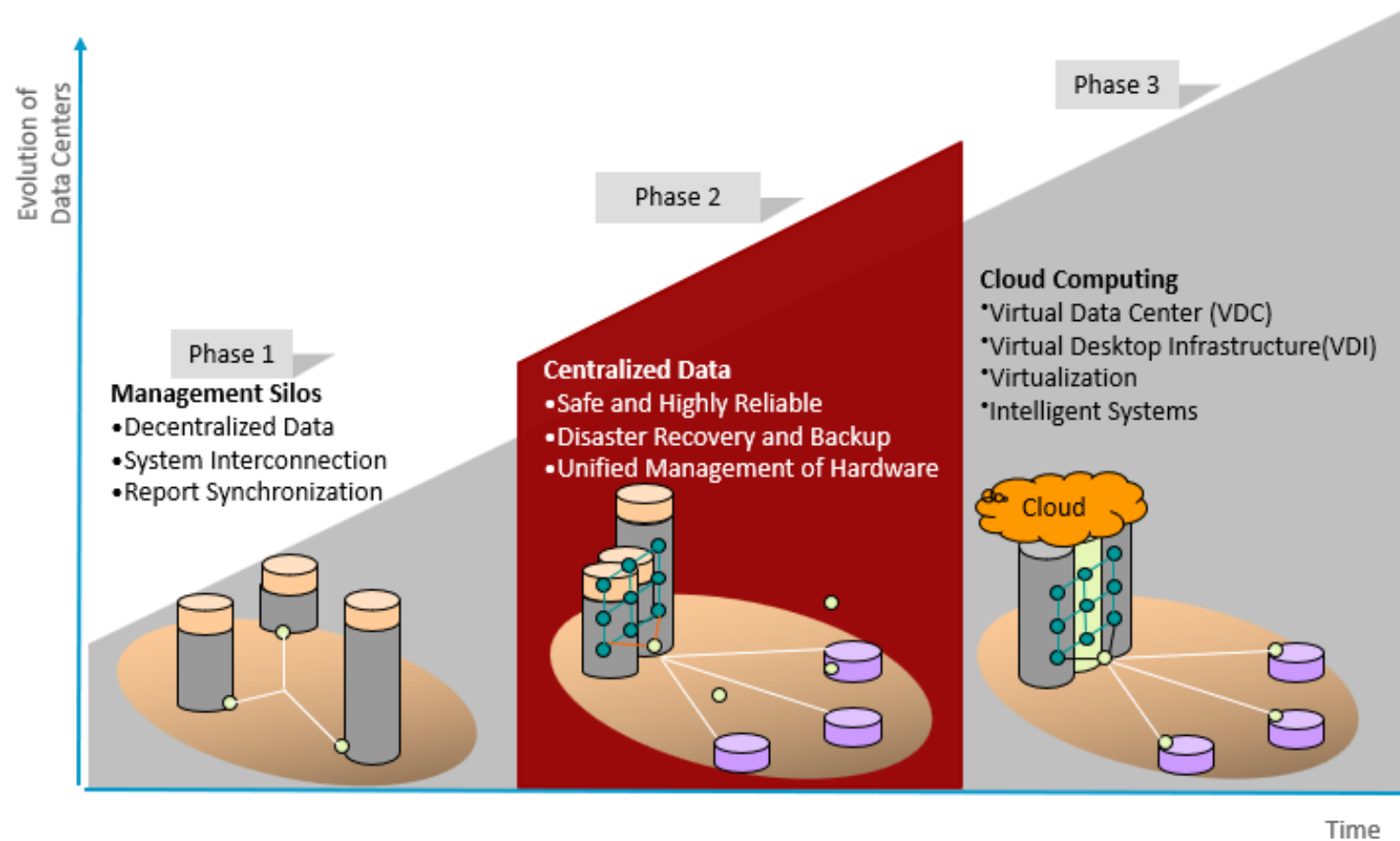
Innovation Data Center



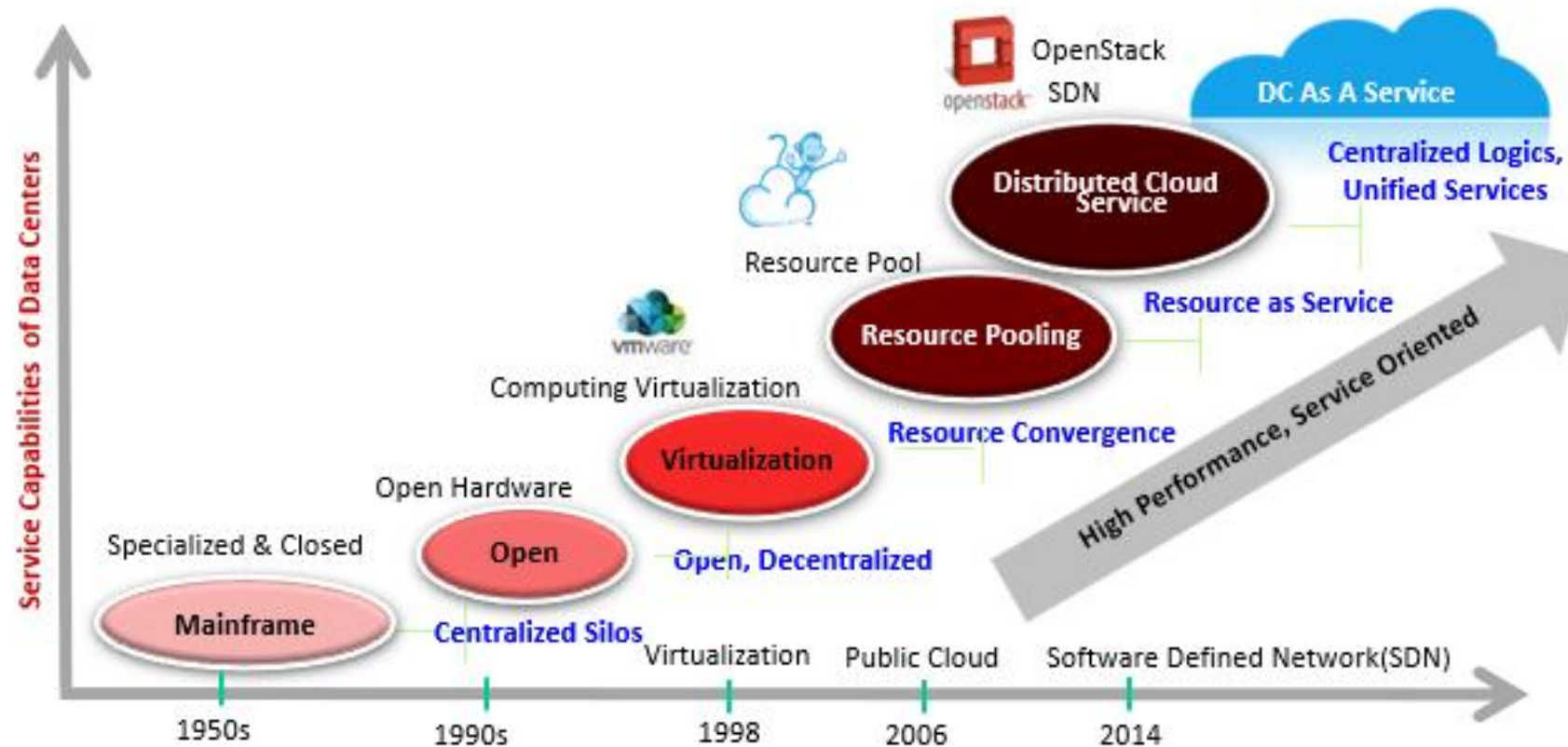
What Kind of Data Center is Needed by Enterprises ?



Data Center Development Stages



Service Oriented Cloud Data Center



Unique Features of Cloud Data Centers

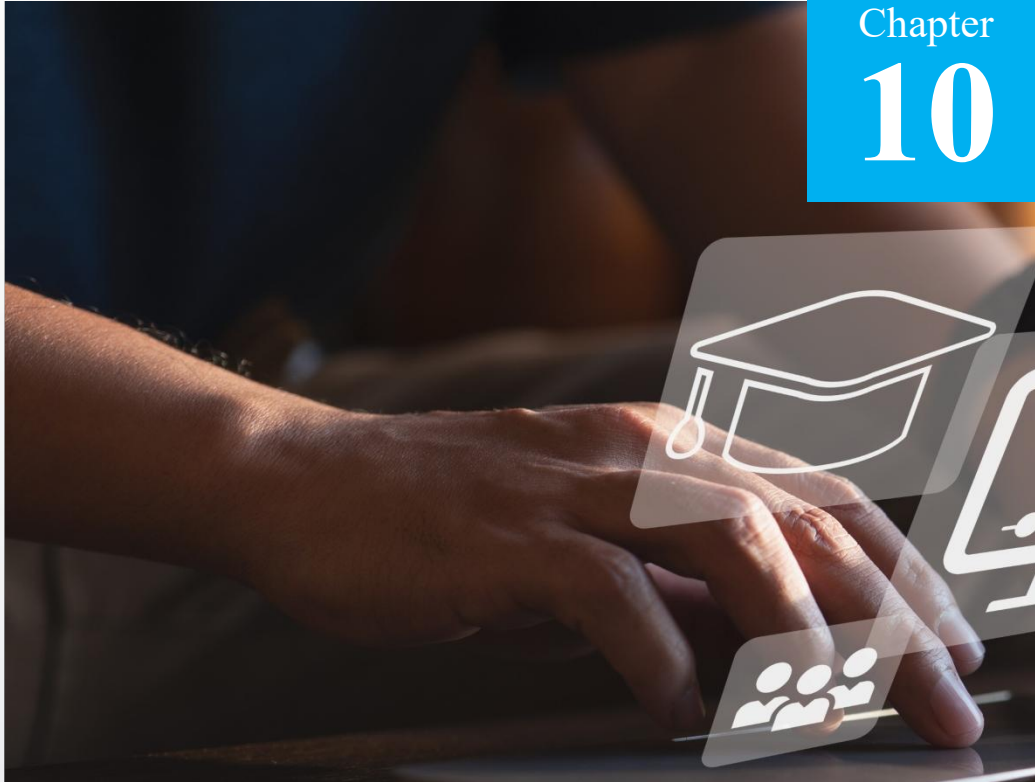
- Cloud Data Centers has the following advantages:
 - Increases the utilization rate of IT devices and hardware.
 - Simplifies management.
 - Fast deployment of services, more agile support on enterprise business growth.
 - Energy saving.



Chapter

10

Cloud Data Center Development Trend



Cloud Data Center Development Trend (1)

Service Silo

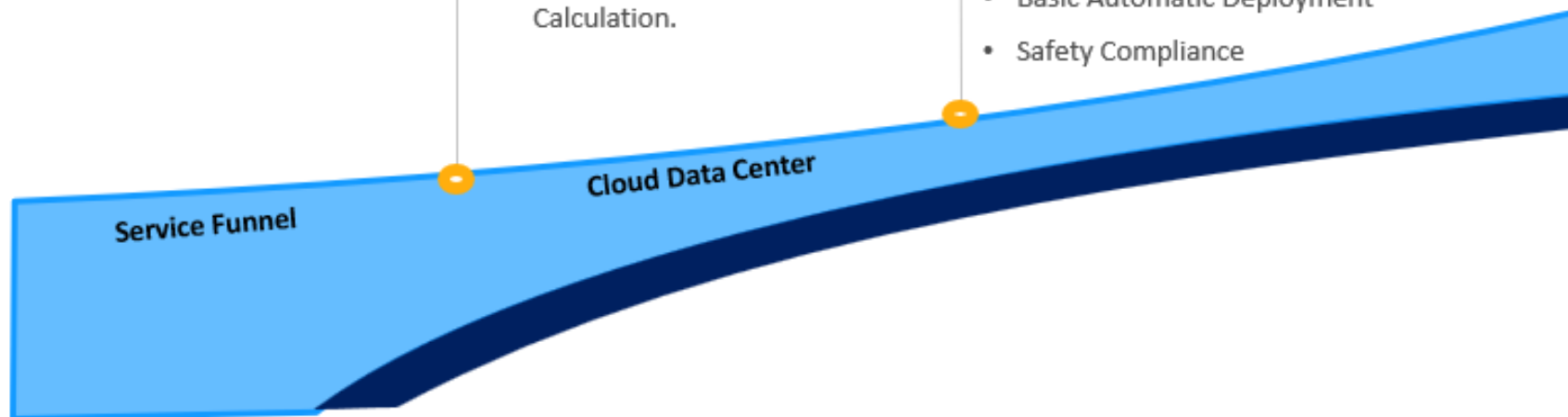
- Service Silos.
- Large amount of manual operation.
- No standardized tenant oriented services.
- No virtualization or manually deployed virtualization.
- No global capacity planning.

Basic IaaS

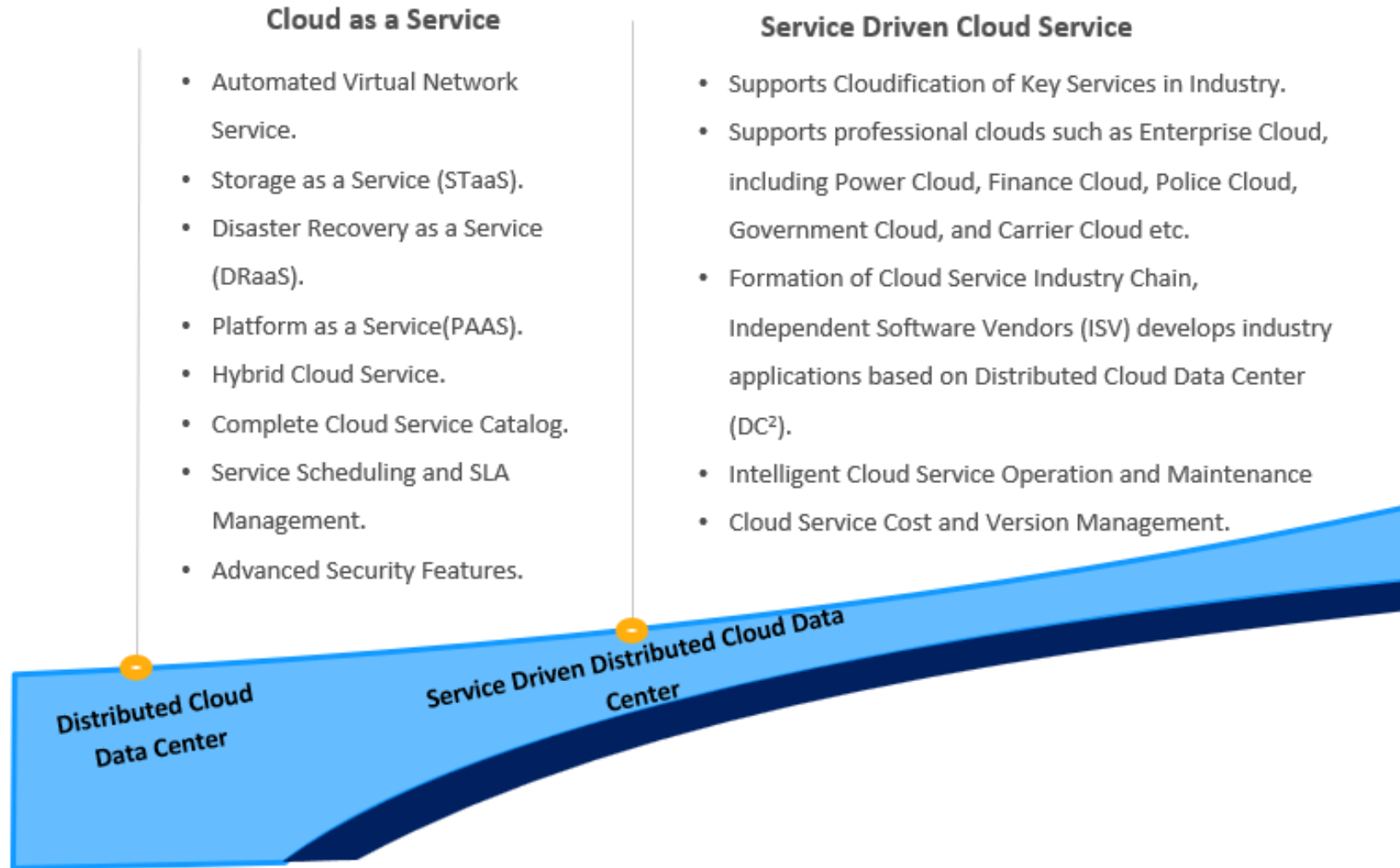
- Multiple services such as Automatic deployment of VM, Cloud Disk and Elastic IP.
- Virtual Resource Pools.
- Cloud Management Platform.
- Global Role and Authorization Management.
- Measured Service and Cost Calculation.

Cloud Management

- Unified Capacity Management
- Multi Tenant Self Service Virtual Data Center (VDC)
- Multi Resource Pools/ Multi Data Center, Heterogeneous Virtualization Management.
- Software Defined Networking Support.
- Basic Automatic Deployment
- Safety Compliance



Cloud Data Center Development Trend (2)





Thank You