Cloud Computing Basics

Enterprises in the fast-growing ICT industry are posing higher requirements on compute, storage, and networking resources. Within this context, cloud computing, has emerged to meet the need for on-demand resources and accelerate business innovation.

Background of Cloud Computing

With the prevalence of the mobile Internet and a fully connected era, more terminal devices are being used and data is exploding every day, posing unprecedented challenges to conventional ICT.

- The PC era is essentially in which computers are networked, and personal computers are connected through servers. Now, in the mobile era, we can assess the Internet through mobile phones. With the advent of 5G, all computers, mobile phones, and intelligent terminals can be connected, and we can enter an era of Internet of Everything (IoE).
- In the IoE era, the entire industry will compete for ecosystem. From the PC era to the mobile era, and to the IoE era, the ecosystem experiences fast changes at the beginning, then tends to be relatively stable, and rarely changes when it is stable. In the PC era, a large number of applications run on Windows, Intel chips, and x86 architecture. Then, browsers come with the Internet. In the mobile era, applications run on iOS and Android systems that use the ARM architecture.
- Compared with the previous generation, the number of devices and the market scale of each generation increase greatly, presenting a future opportunity. As Intel and Microsoft in the PC era and ARM and Google in the mobile era, each Internet generation has its leading enterprises which master the industry chain. In the future, those who have a good command of core chips and operating systems will dominate the industry.

Challenges Faced by Conventional IT Architecture: The Internet brings a large amount of traffic, users, and data, so enterprises need to continually purchase traditional IT devices to keep pace with their rapid development. Therefore, the disadvantages of traditional IT devices gradually emerge.

- Long procurement period causes slow rollout of new business systems.
- The centralized architecture has poor scalability and can only increase the processing performance of a single node.
- Traditional hardware devices exist independently, and their reliability depends only on software.
- Devices and vendors are heterogeneous and hard to manage.
- The performance of a single device is limited.
- The utilization of devices is low, while the total cost remains high.

Enterprises Are Migrating to the Cloud Architecture
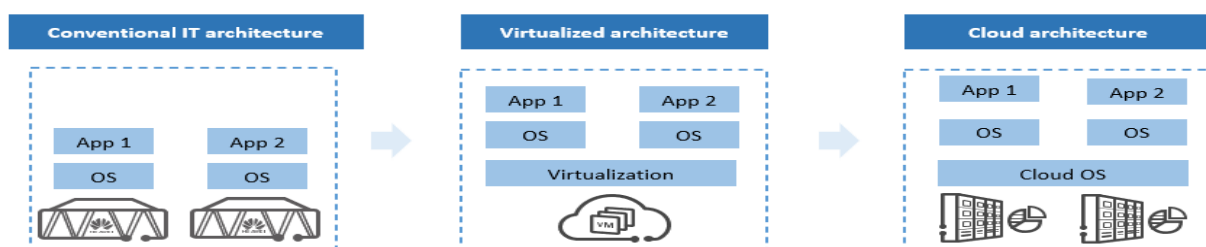
- The traditional IT architecture consists of hardware and software, including infrastructure, data centers, servers, network hardware, desktop computers, and enterprise application software solutions. This architecture requires more power, physical space, and capital, and is usually installed locally for enterprises or private use.
- With virtualization technology, computer components run on the virtualization environment, not on the physical environment. Virtualization enables maximum utilization of the physical hardware and simplifies software reconfiguration.
- With cloud transformation, enterprise data centers are transformed from resource silos to resource pooling, from centralized architecture to distributed architecture, from dedicated hardware to software-defined storage (SDS) mode, from manual handling to self-service and automatic service, and from distributed statistics to unified metering.

Definition of Cloud Computing

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction (National Institute of Standards and Technology (NIST)).

Simply put, the term "cloud" is a metaphor for networks and the Internet, and refers to an abstraction of the Internet and the infrastructure that underpins it. Computing refers to computing services provided by a powerful computer with a range of functionalities, resources, and storage. As such, cloud computing can be viewed as the delivery of on-demand, measured computing services over the Internet.
Cloud computing has the following characteristics:

- Broad network access
- Fast and elastic scaling
- On-demand self-service
- Resource pooling
- Metered services

Cloud Computing Is Around Us

The following are data sources of cloud computing in daily life. These apps are based on cloud computing, making our lives more convenient. Cloud computing allows enterprises to provide better products to attract more users.

- Cloud album, such as Baidu Cloud and iCloud Shared Album
- Cloud music, such as NetEase Cloud Music, Kugou Music, Kuwo Music, and Xiami Music
- Cloud video, such as Baidu Cloud and Tencent Cloud Video
- Cloud documents, such as Youdao Note, and Shimo document

Cloud Services and Applications Around Us (Enterprises)

- HUAWEI CLOUD Meeting allows interactive video and voice communications between people in two or more locations.
- Driven by the requirements of the government, transportation, electric power, medical care, education, finance, and military industries and enterprises, the video conferencing market in China has an average annual growth beyond 20%. Currently, only less than 5% of enterprises in China have video conference rooms, and more and more enterprises are aware of the importance

of efficient collaboration. Therefore, the video conferencing system has become indispensable for efficient office work.
- HUAWEI CLOUD Meeting can be used by enterprise offices, telemedicine, smart education, and enterprise organization construction.

E-Gov Cloud Online Services: The e-Government cloud enables access to comprehensive public services through the Internet and serves as an extensive service platform with software, application, and information resources provisioned for governmental bodies. It utilizes the compute, storage, network, security, and application resources in existing equipment rooms and leverages cloud computing to offer high reliability, availability, and elasticity.

Online services are the most typical application of e-Gov and are used in multiple cities. With online services, applicants fill in the application information and submit supporting documents. The administrative approval center approves applications by streamlining cross-department data. By moving services to the cloud, governments can greatly reduce expenditure, cloud service providers can gain new development benefits, and citizens can acquire services more and more conveniently.
- Guidance: All policies, bulletins, and processes are released through information guidance, making service handling processes clear for citizens and enterprises. Intelligent Process Automation (IPA) robots are provided to guide users.
- Handling: Based on big data and AI technologies, fields in documents can be auto-populated.
- Review: AI technologies pre-review documents, improve review efficiency and quality, and reduce pressure on staff. Real-Time Communication (RTC) audio and video technologies can implement contactless online pre-review.
- Collaboration: RPA technology handles all work items through the workbench, effectively collaborating with functional agencies. All application and service entries can be managed in a unified manner.

Public cloud is the main form of cloud computing, which is developing considerably in China. Public cloud vendors can be classified as follows:
- Traditional telecom infrastructure carriers, including China Mobile, China Unicom, and China Telecom
- Local government cloud computing platforms
- Public cloud platforms built by Internet giants, such as Alibaba Cloud and Tencent Cloud
- Some IDC carriers, such as 21Vianet Group
- Enterprises with foreign technical background or introducing foreign cloud computing technologies, such as Fengqi.Asian Cloud

Cloud Computing Models

Deployment Models for Cloud Computing
- **Private cloud** is a cloud infrastructure operated solely for a single organization. All data of the private cloud is kept within the organization's data center. Attempts to access such data will be controlled by ingress firewalls deployed for the data center, offering maximum data protection.
- **Public cloud** service provider owns and operates the cloud infrastructure and provides cloud services open to the public or enterprise customers. This model gives users access to convenient, on-demand IT services, comparable to how they would access utilities like water and electricity.

- A **hybrid cloud** is a combination of a public cloud and a private cloud or on-premises resources, that remain distinct entities but are bound together, offering the benefits of multiple deployment models. Users can migrate workloads across these cloud environments as needed.

Service Model for Cloud Computing
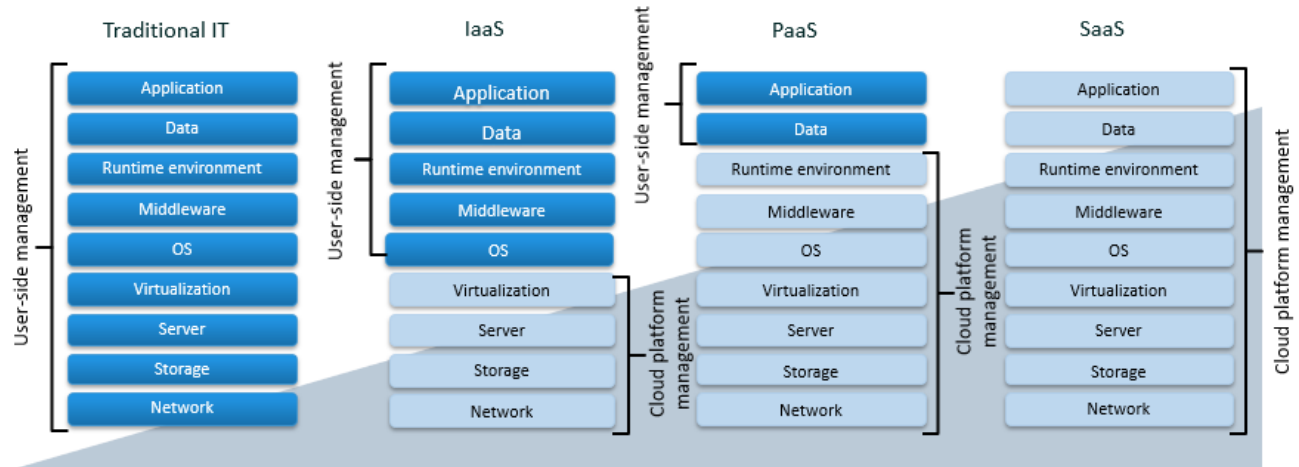
- Infrastructure as a Service (IaaS): The cloud platform provides infrastructure (such as servers, storage devices, networks, and virtual resources) and maintains related resources. Users only need to pay attention to the system and application layers.
- Platform as a Service (PaaS): The cloud platform provides infrastructure (such as servers, storage devices, networks, and virtual resources) and application deployment environment (such as the operating system, middleware, and software running environment) and maintains related resources. Users only need to focus on applications and data.
- Software as a Service (SaaS): The cloud platform provides all resources, services, and maintenance. Users only need to use applications.
- Compared with the conventional IT entire-process and all-device procurement mode, the cloud service-oriented mode provides IT devices as services that allow customers to select on demand, which has more advantages in flexibility, and low cost.

Benefits of Cloud Computing

Cloud computing integrates hardware resources into one in software, and dynamically allocates the resources to applications in software, which greatly improves resource usage. Cloud computing also supports auto scaling, and optimizes work efficiency. By building high-specification cloud data centers and introducing automatic scheduling technology, data storage is more centralized, and data assets are more effectively used, achieving energy saving, emission reduction, and easier maintenance. In this way, lower costs and higher efficiency are achieved in each dimension.

Cloud computing has five (5) main benefits:
- **On-demand self-service**: Customers can deploy processing services based on actual requirements on the server running time, network, and storage, and do not need to communicate with each service provider.
- **Broad network access**: Various capabilities can be obtained over the Internet, and the Internet can be accessed in standard mode from various clients, such as mobile phones, laptops, and PADs.

- **Resource pooling**: Computing resources of the service provider are centralized so that customers can rent services. In addition, different physical and virtual resources can be dynamically allocated and reallocated based on customer requirements. Customers generally cannot control or know the exact location of the resources. The resources include storage devices, processors, memory, network bandwidth, and virtual machines.
- **Quick deployment and auto scaling**: Cloud computing can rapidly and elastically provide computing capabilities. A customer can rent unlimited resources and purchase required resources at any time.
- **Metered services**: Cloud services are billed based on the actual resource usage, such as the CPU, memory, storage capacity, and bandwidth consumption of cloud servers. Cloud services provide two billing modes: pay-per-use and yearly/monthly.

Eight Common Characteristics of Cloud Computing
- **Massive scale**: Cloud computing service is on a large scale as it centralizes IT resource supply. This makes cloud computing different from conventional IT.
- **Homogeneity**: Homogeneity can also be understood as standardization, which is similar to power utilization. The voltage and socket interface should be the same for various electrical appliances and devices.
- **Virtualization**: Virtualization has two meanings. One is accurate computing units. If a cake is too large for one person, it is better to divide it into small pieces to share. That is, with smaller computing units, IT resources can be fully used. The other meaning is the separation of software and hardware. Before virtualization, software and specified hardware are bound together, and after virtualization, software can be freely migrated on all hardware, which is like renting a house instead of buying one.
- **Elastic computing**: Elastic computing means that IT resources can be elastically provided.
- **Low-cost software**: Low-cost software is provided to meet the market competition and requirements. Cloud computing, with low individual technical skill and financial requirements, makes IT easy to use. Small and micro startups are always willing to enjoy more IT services at the lowest cost. Based on this situation, low-cost software is required to earn money at small profits but quick turnover.
- **Geographic distribution**: As the broad access mentioned above, IT services can be provided anytime and anywhere. From the perspective of users, cloud computing data centers are geographically distributed and the performance of network bandwidth varies by region. Large public cloud service providers have dozens or even hundreds of data centers or service nodes to provide cloud computing services to global customers.
- **Service orientation**: Cloud computing is a service model, and the overall design is service-oriented.
- **Advanced security technology**: Public cloud has a large number of users with different requirements. Therefore, advanced security technologies must be adopted to protect cloud computing.