Lecture 15 Cloud Computing Architecture

- Computing Architecture
- Layered Software Model
- Cloud-based Architecture Design

云计算架构

What is Cloud Computing?

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction --- *NIST*

云计算是一种商业计算模型。它将计算任务分布在大量计算机构成的资源池上，使各种应用系统能够根据需要获取计算力、存储空间和各种软件服务 --- *刘鹏*

Cloud standards organizations

The Cloud Standards Customer Council (CSCC)

OpenStack

OASIS (TOSCA and IDCloud)

W3C (Linked Data)

Open Services for Lifecycle Collaboration

Distributed Management Task Force

The Storage Networking Industry Association

The Open Group (CCRA)

The Internet Engineering Task Force

International Organization for Standardization

What is Cloud Computing ?

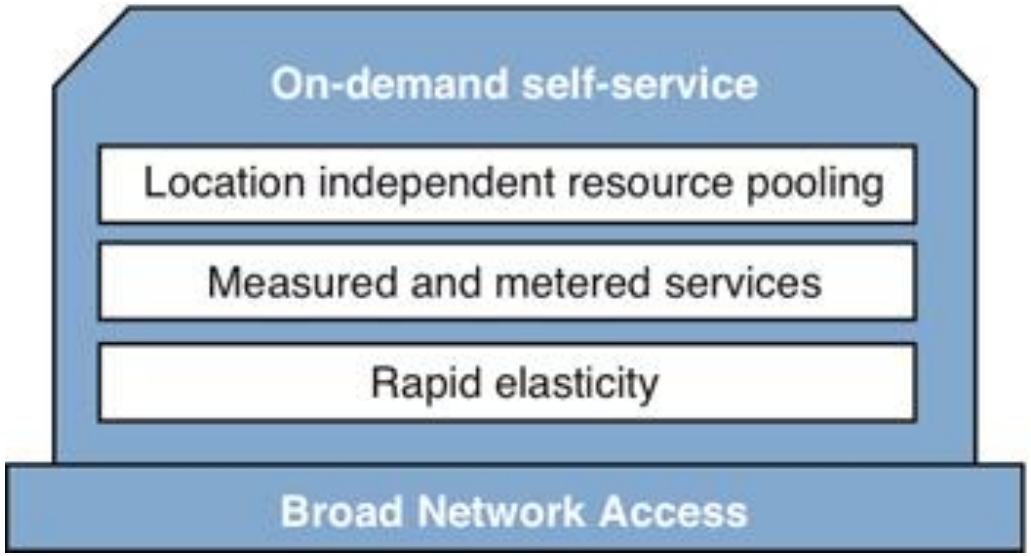
- Wiki： is a kind of Internet-based computing that provides shared processing resources and data to computers and other devices on demand. It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services), which can be rapidly provisioned and released with minimal management effort.
- **Google**： all computing resources and applications are located in the cloud and shared via Internet, without installing any applications at the end device.
- **Microsoft**： a computing model of Cloud + Terminal, in which the computing resources are distributed to the cloud, user ends and co-op parties, through which the user is able to determine the best way to use computing resources.
- **IDC**： a new mode for IT technology development, deployment and marketing, which may provide on-demand product, service and solution through Internet.

NIST's 5-4-3 Cloud Computing Model

- Five characters
- Four deployment patterns
- Three service models

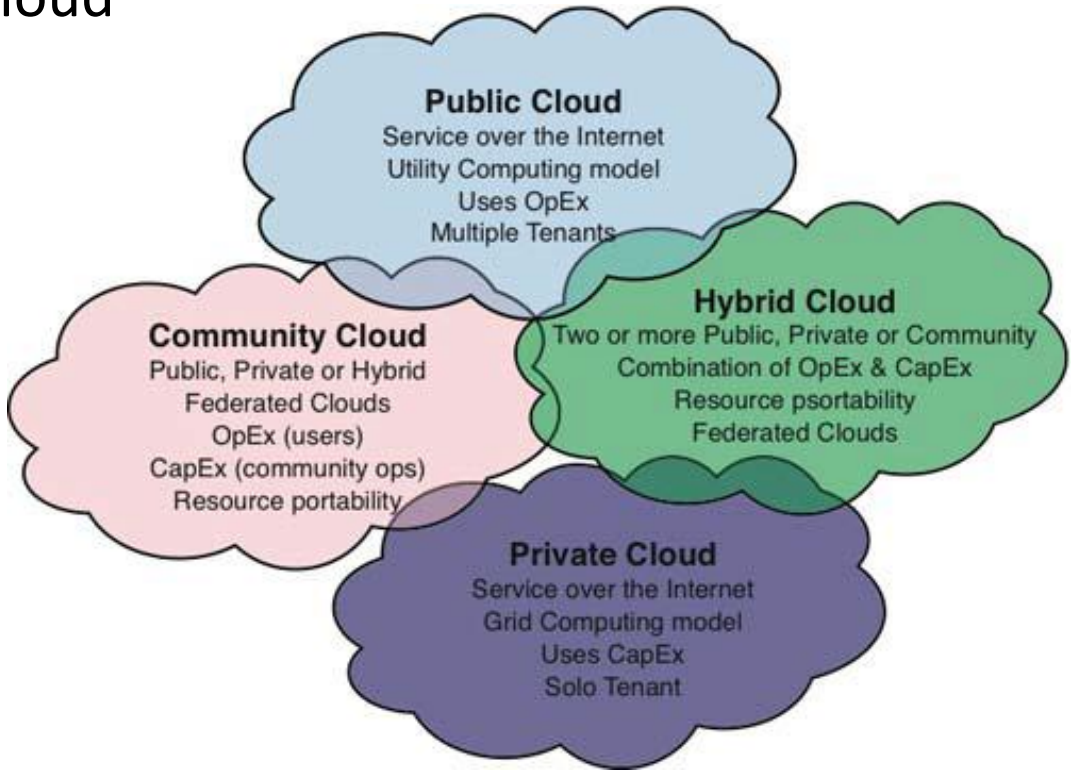
Five Characters for Cloud Computing

- On-demand service
- Abstract computing resource pool
- Pay-on-use
- Fast and elastic expansion
- a wide network access



Four Deployment Patterns for Cloud Computing

- Public Cloud
- Private Cloud
- Community Cloud
- Hybrid Cloud



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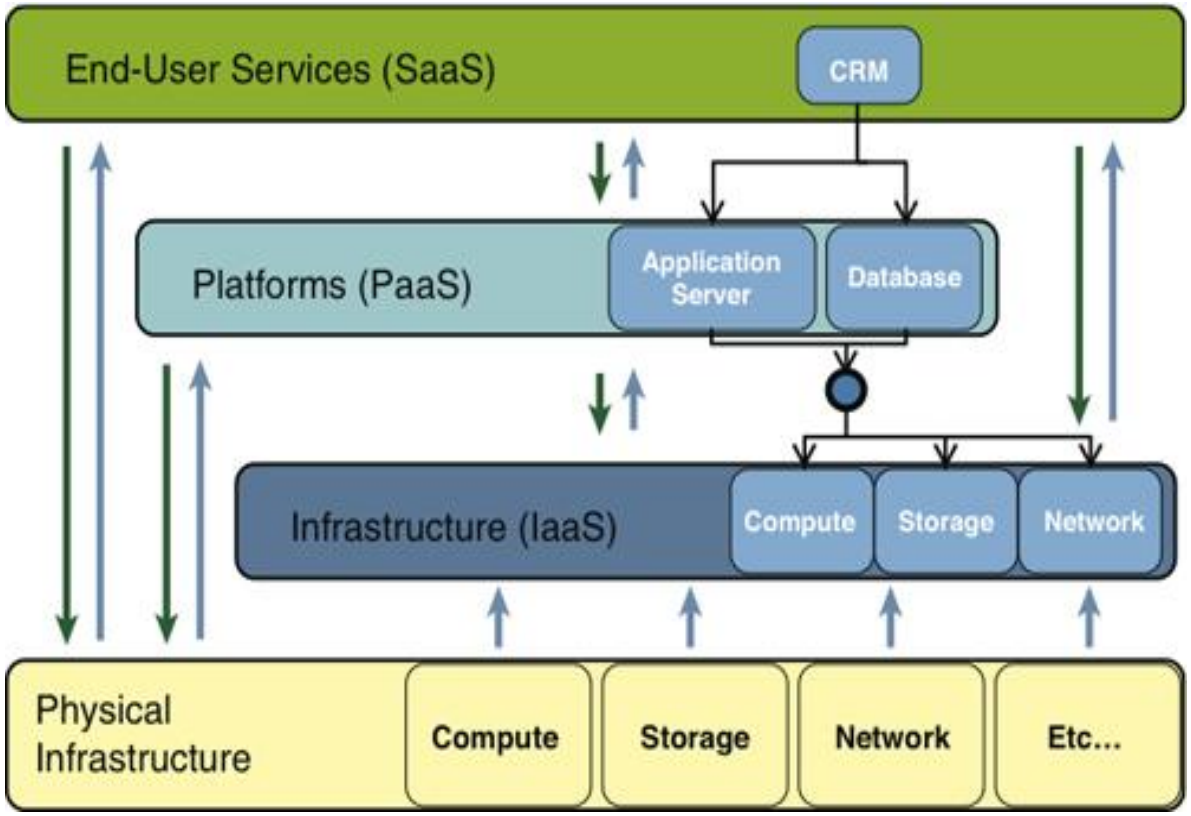
Three Service Models for Cloud Computing

- SaaS
- PaaS
- Iaas



Key Elements of Cloud Architecture

- Distributed file system and data storage architecture
- Abstraction of computing resources and scheduling
- Layered software architecture
- Decoupling of service interface and function implementation
- Virtual reality technology

Layered Model of Cloud Architecture

- Cloud applications
  Various user applications that run in the cloud and serve the users
- Cloud Platform
  The functional or service platforms that support the user applications
- Cloud Management
  The system tools to schedule tasks and manage resources in cloud
- Cloud Storage
  The distributed file system and database storage to manage the data
- Cloud Resources
  The abstraction of physical resources in the cloud

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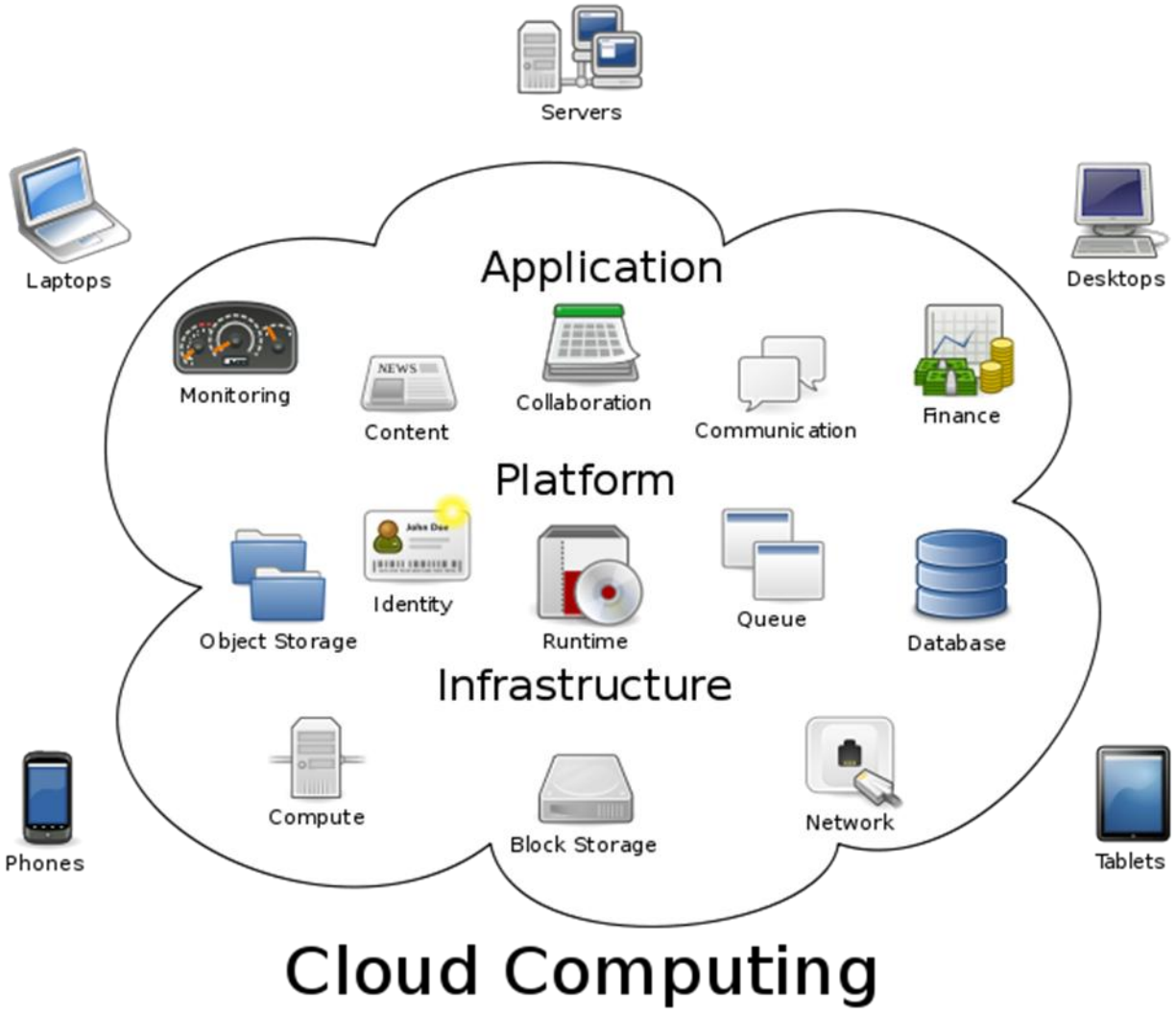
Servers
Laptops
Desktops
Application
Monitoring
Content
Collaboration
Communication
Finance
Platform
Identity
Object Storage
Runtime
Queue
Database
Infrastructure
Compute
Block Storage
Network
Phones
Tablets
Cloud Computing

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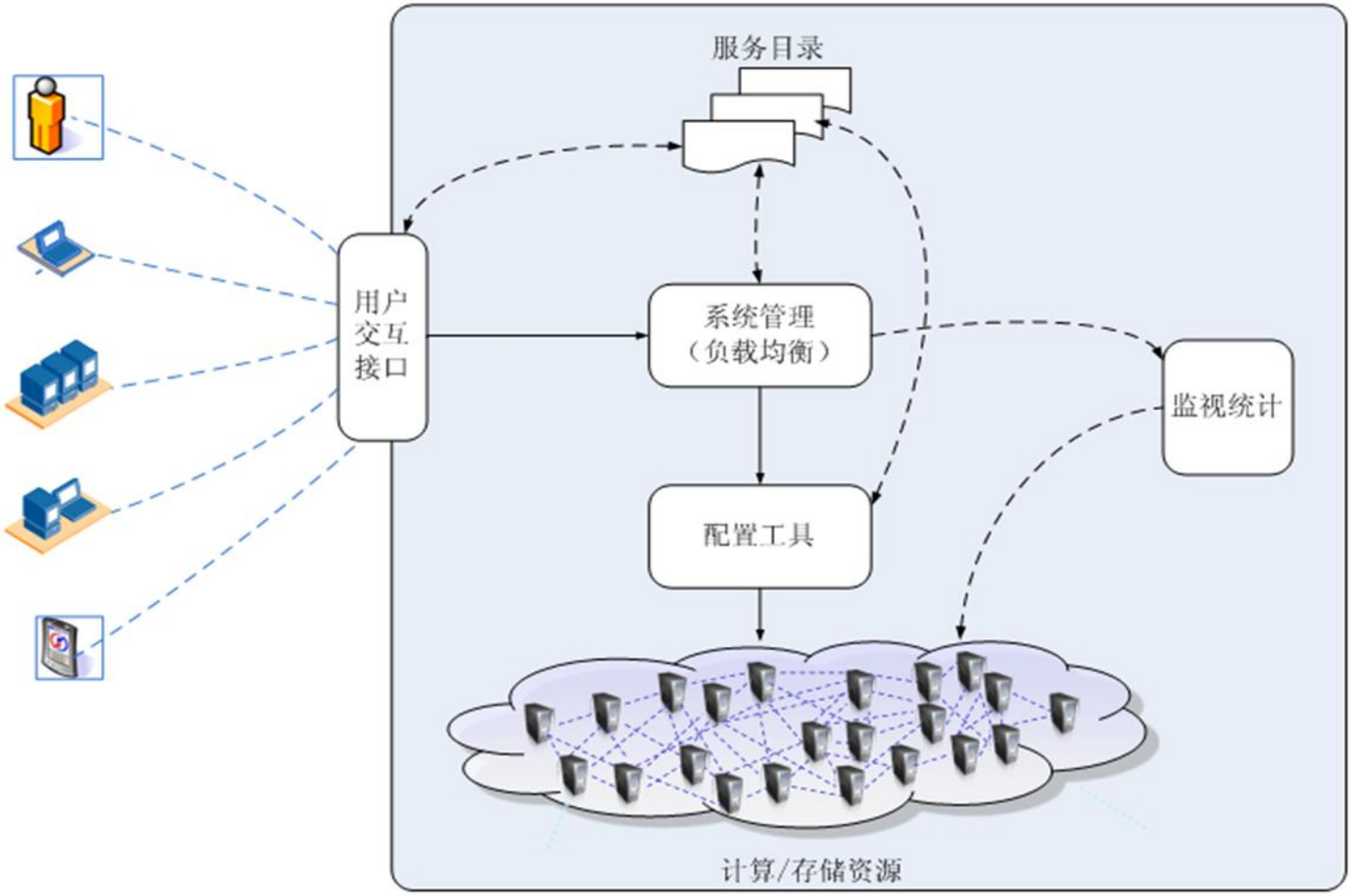

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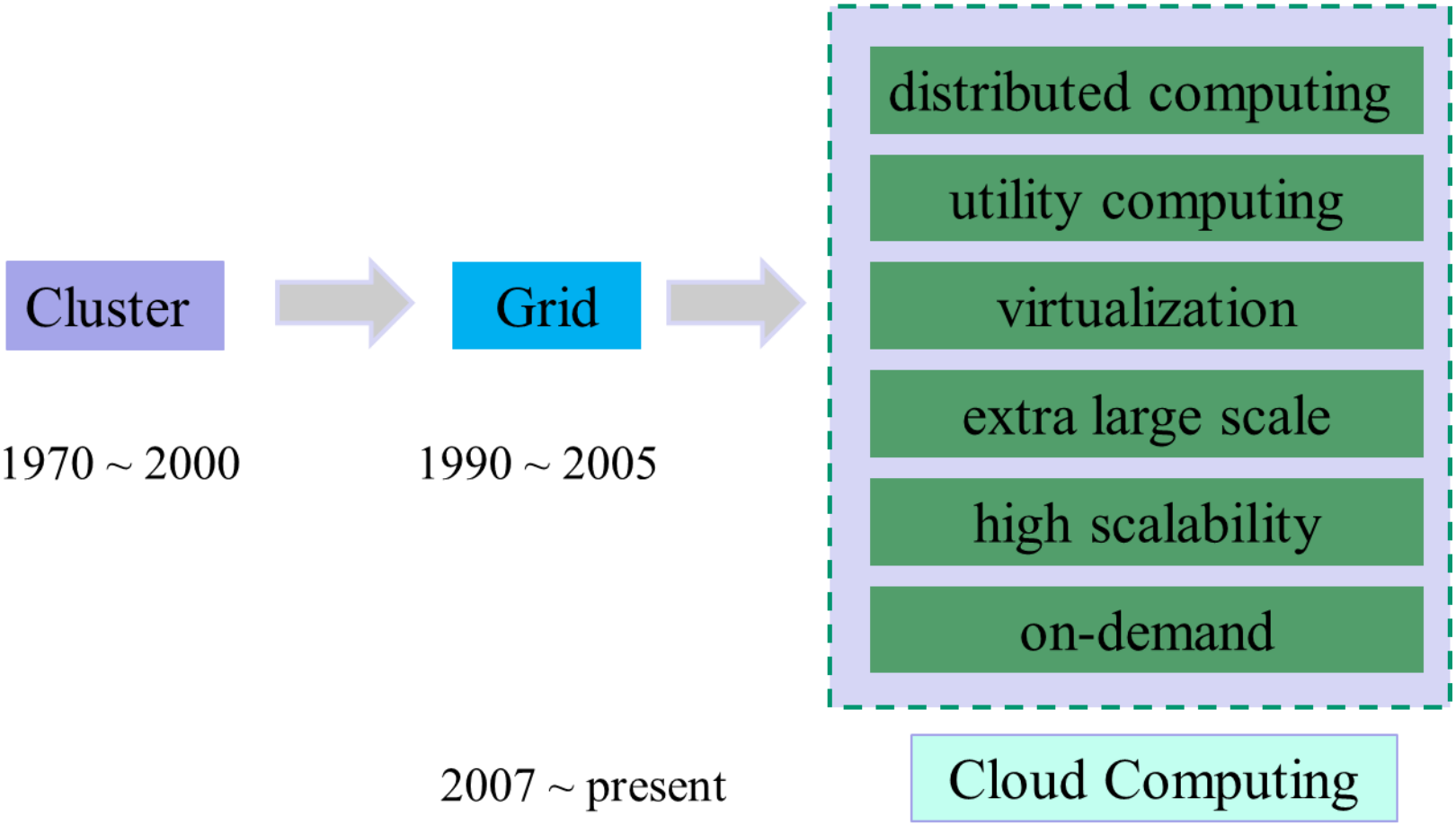
Cloud Computing Evolution



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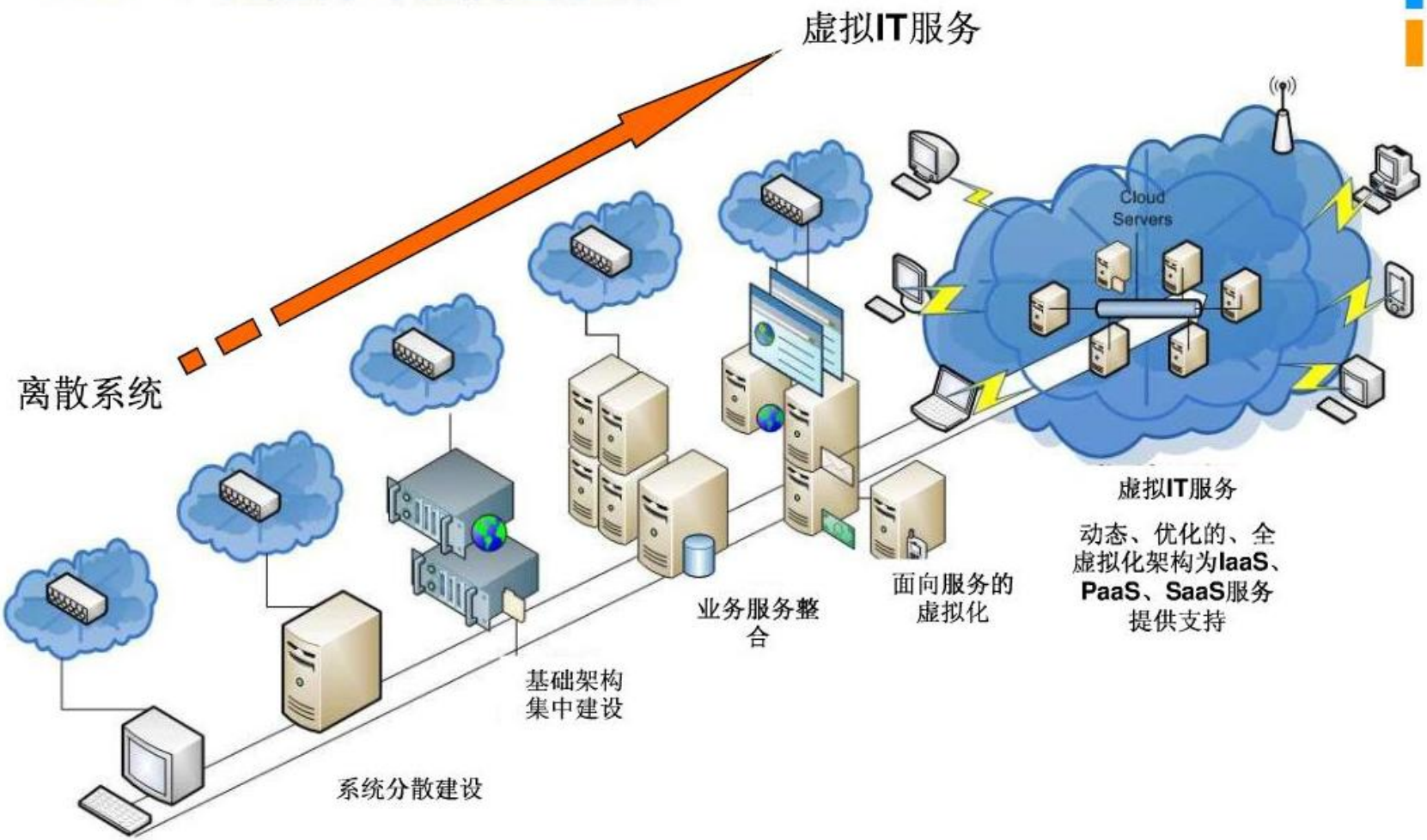
When ？ 云是何时发展起来的？



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Dual Innovation for Technology and Business

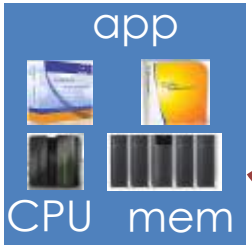
Electricity： power equipment to power service

Power plant

Electric Generator

Info： H/D & S/W to info service

Info provider



- Business change：from Buy computer/software to Buy information service
- Business think：cloud computing = information plant
- Technology view：cloud computing = virtualization + cluster management


Why Cloud?

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Advantages of Cloud Computing

- high availability
- high scalability – extra large-scale
- on-demand service
- economic
- high usability via visualization

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Cloud Computing Architecture

- distributed system
- layered software architecture
- computing resource abstraction
- service-based interface
- open architecture and open standard

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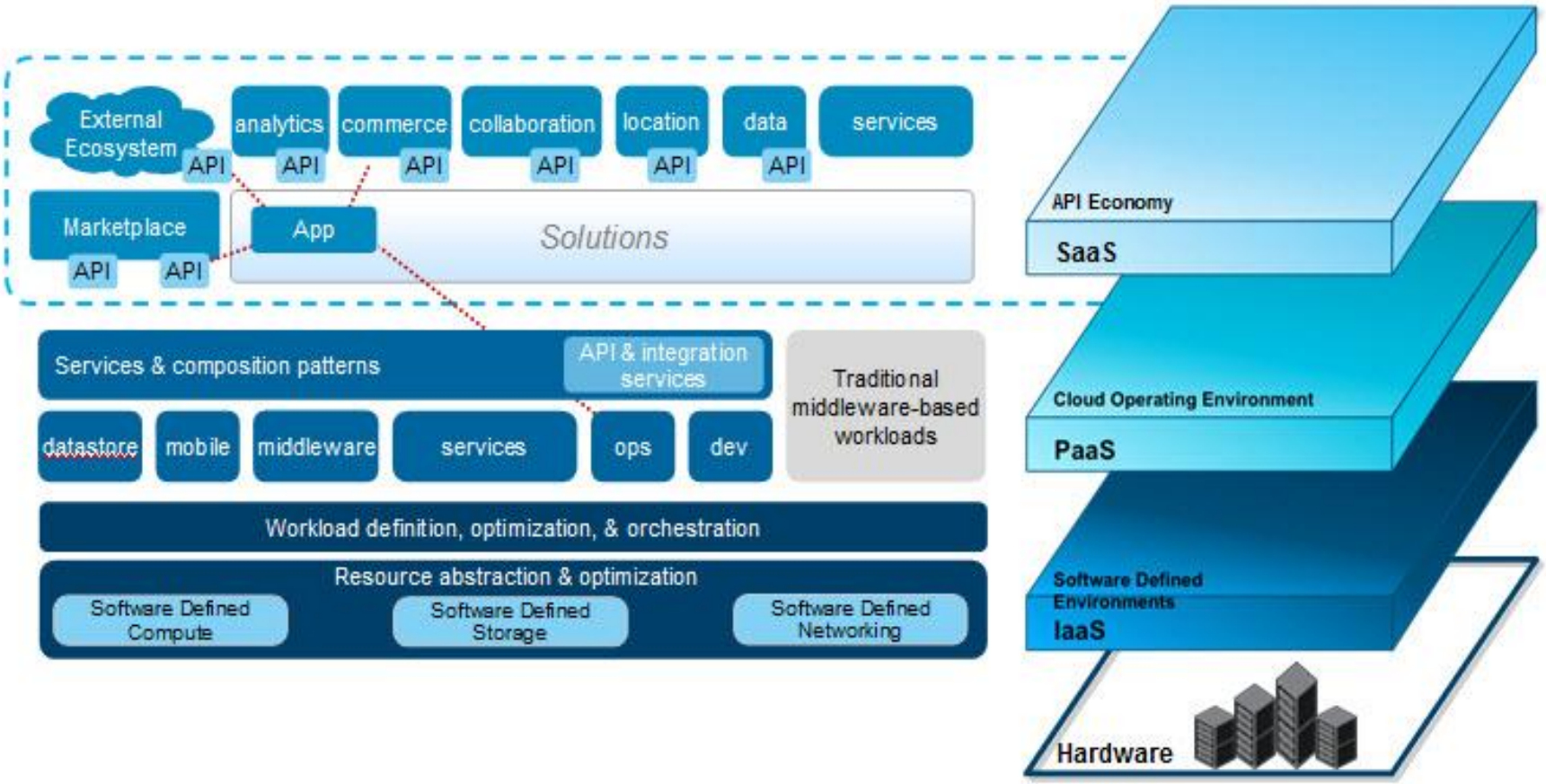
Layered Cloud Software Model

- cloud application layer
- virtualized execution environment
- integrated service/function layer
- computing resource scheduling layer
- data storage/management layer
- IT infrastructure layer (servers, storage, network, etc.)

IBM's Open Cloud Architecture



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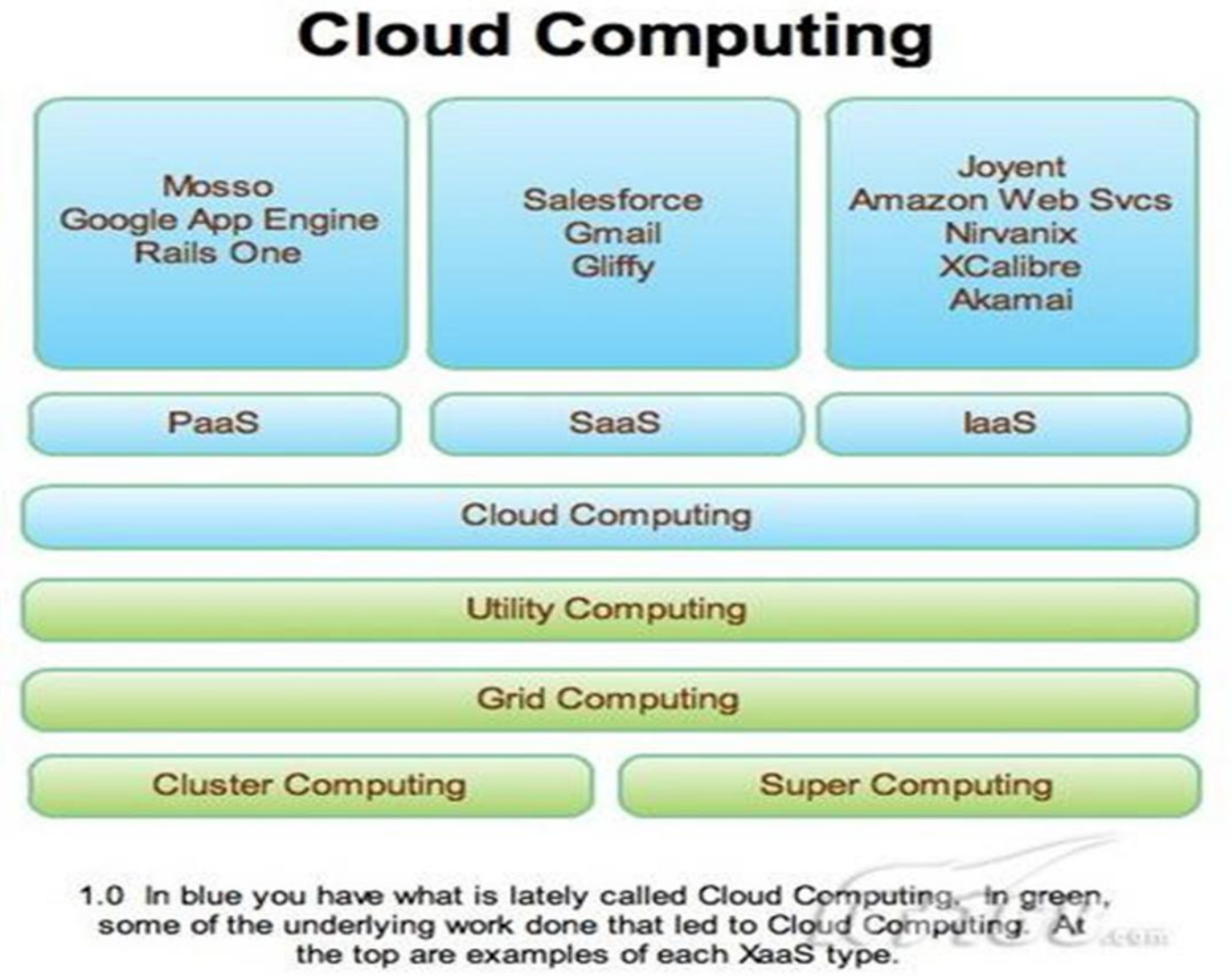


1.0 In blue you have what is lately called Cloud Computing. In green, some of the underlying work done that led to Cloud Computing. At the top are examples of each XaaS type.

云计算架构

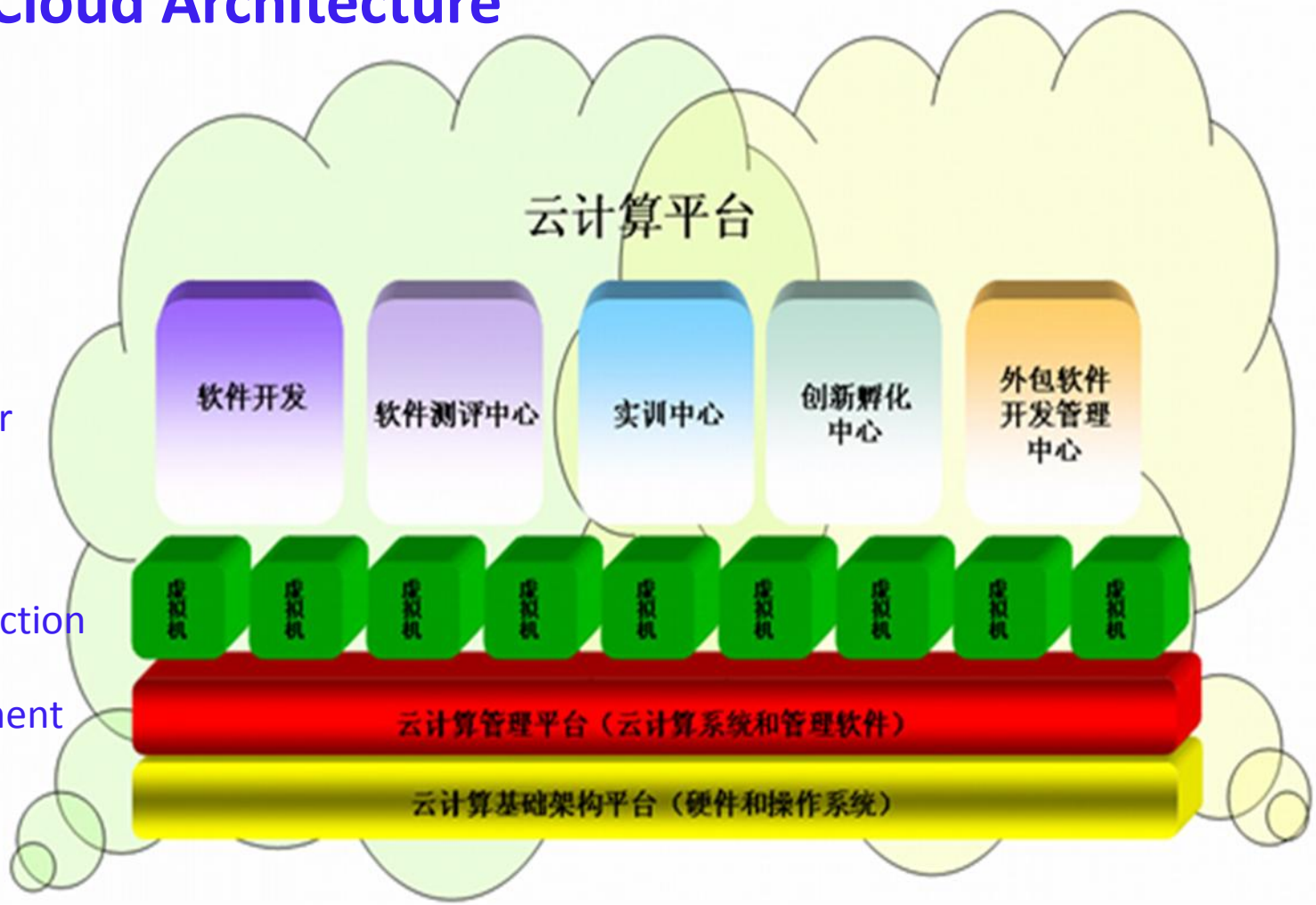
Sample: Cloud Architecture

Application layer

Resource abstraction

Cloud management

IT infrastructure



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Service-oriented Cloud Model

- SaaS (Software as a Service)

  Software is provided to customers as a kind of service via Internet rather than being sold to customers as a product

- PaaS (Platform as a Service)

  A computing platform (O/S + SDK + execution environment) is provided in a package as a service for user development

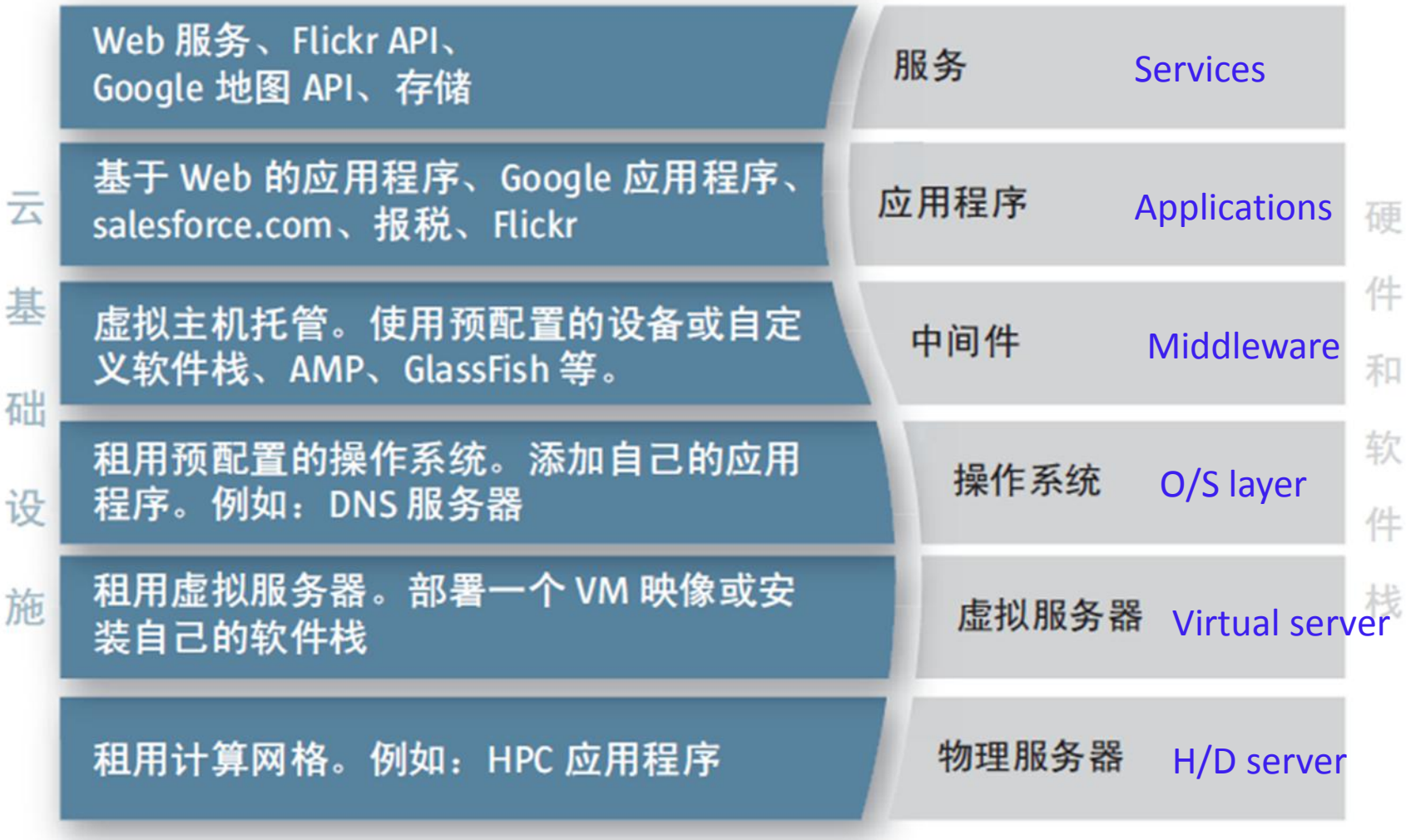
- IaaS (Infrastructure as a Service)

  An IT infrastructure including both hardware and software resources is provided as a service

云计算架构


专用
通用
将软件作为服务
SaaS (Software as a Service)
将平台作为服务
PaaS (Platform as a Service)
将基础设施作为服务
IaaS (Infrastructure as a Service)
如：Salesforce online CRM
如：Google App Engine
Microsoft Windows Azure
如：Amazon EC2/S3

云计算架构


云基础设施
Web 服务、Flickr API、Google 地图 API、存储
服务 Services
基于 Web 的应用程序、Google 应用程序、salesforce.com、报税、Flickr
应用程序 Applications
虚拟主机托管。使用预配置的设备或自定义软件栈、AMP、GlassFish 等。
中间件 Middleware
租用预配置的操作系统。添加自己的应用程序。例如：DNS 服务器
操作系统 O/S layer
租用虚拟服务器。部署一个 VM 映像或安装自己的软件栈
虚拟服务器 Virtual server
租用计算网格。例如：HPC 应用程序
物理服务器 H/D server
硬件和软件栈

云计算架构

应用云

Application cloud

服务云

Service cloud

资源云

Resource cloud

云计算架构

How? 打造自己的云？

用户层(应用)

中间件（用户、核心）

系统

SaaS

PaaS

IaaS

协作

CRM/ERP/HR

交易处理

企业级应用程序

Software as a Service

中间件

Web 2.0

Java

数据库

开发工具

Platform as a Service

主机

网络

Data Center Fabric

存储

虚拟化共享,动态供给

Infrastructure as a Service

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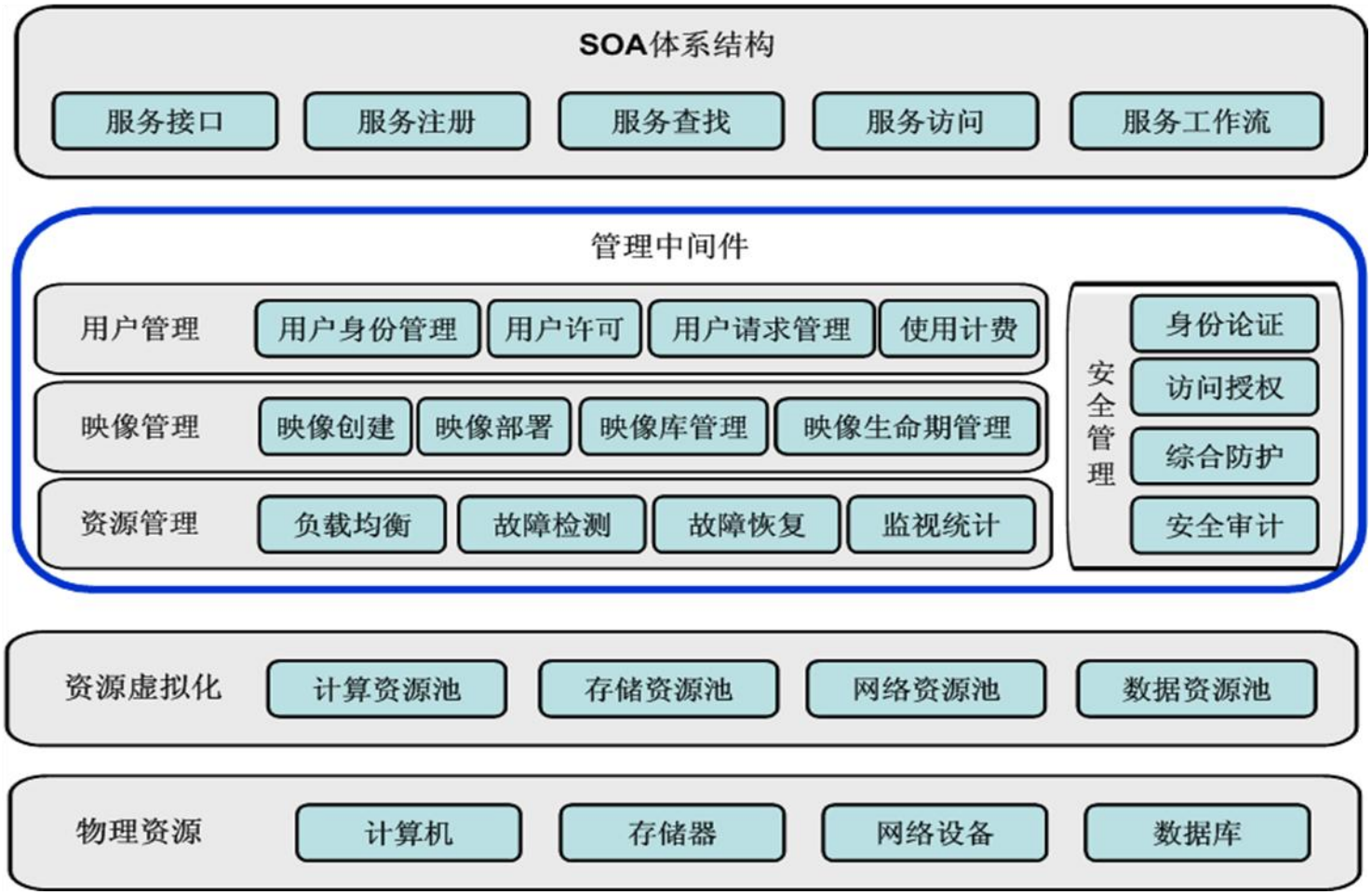
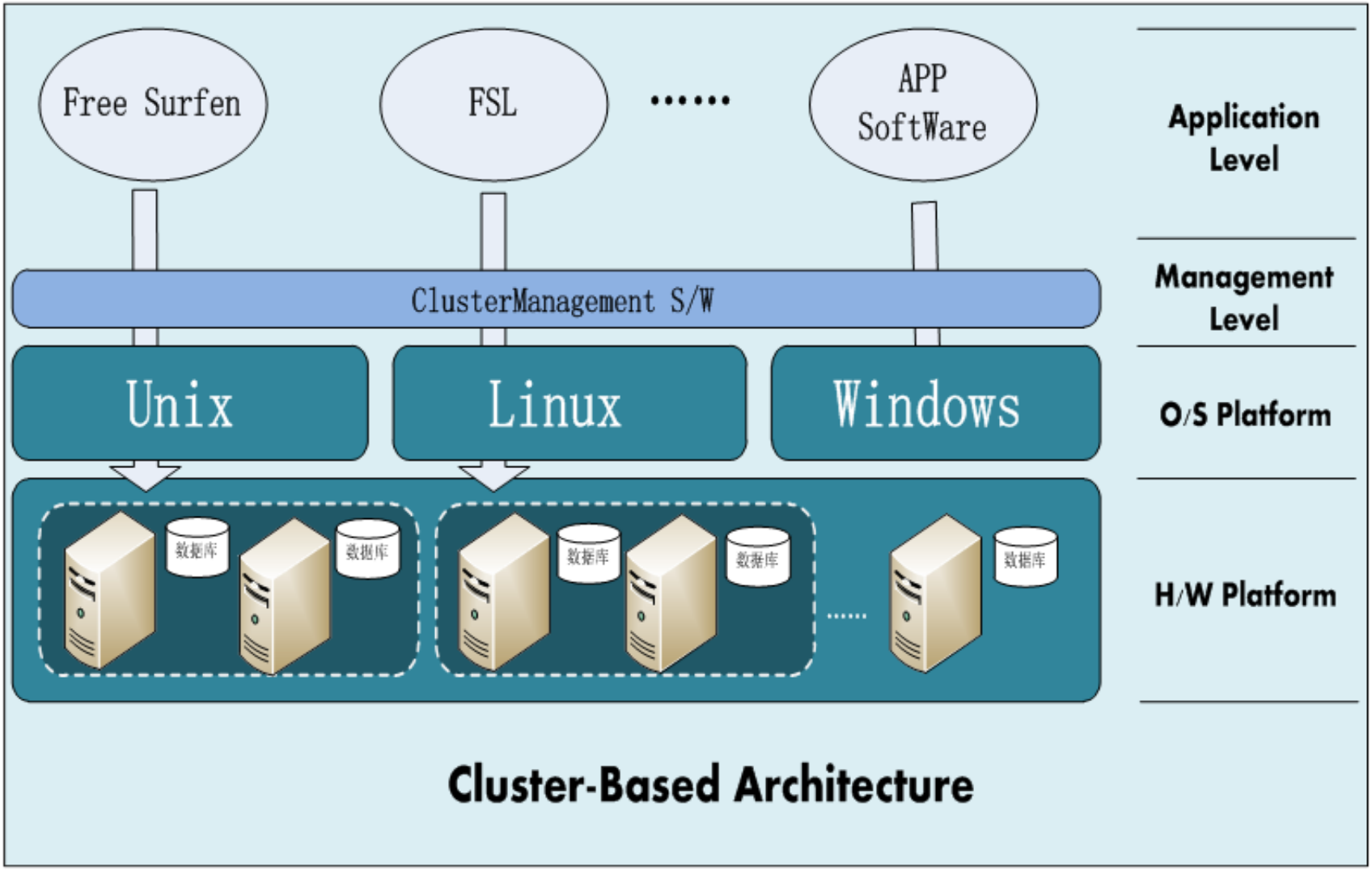
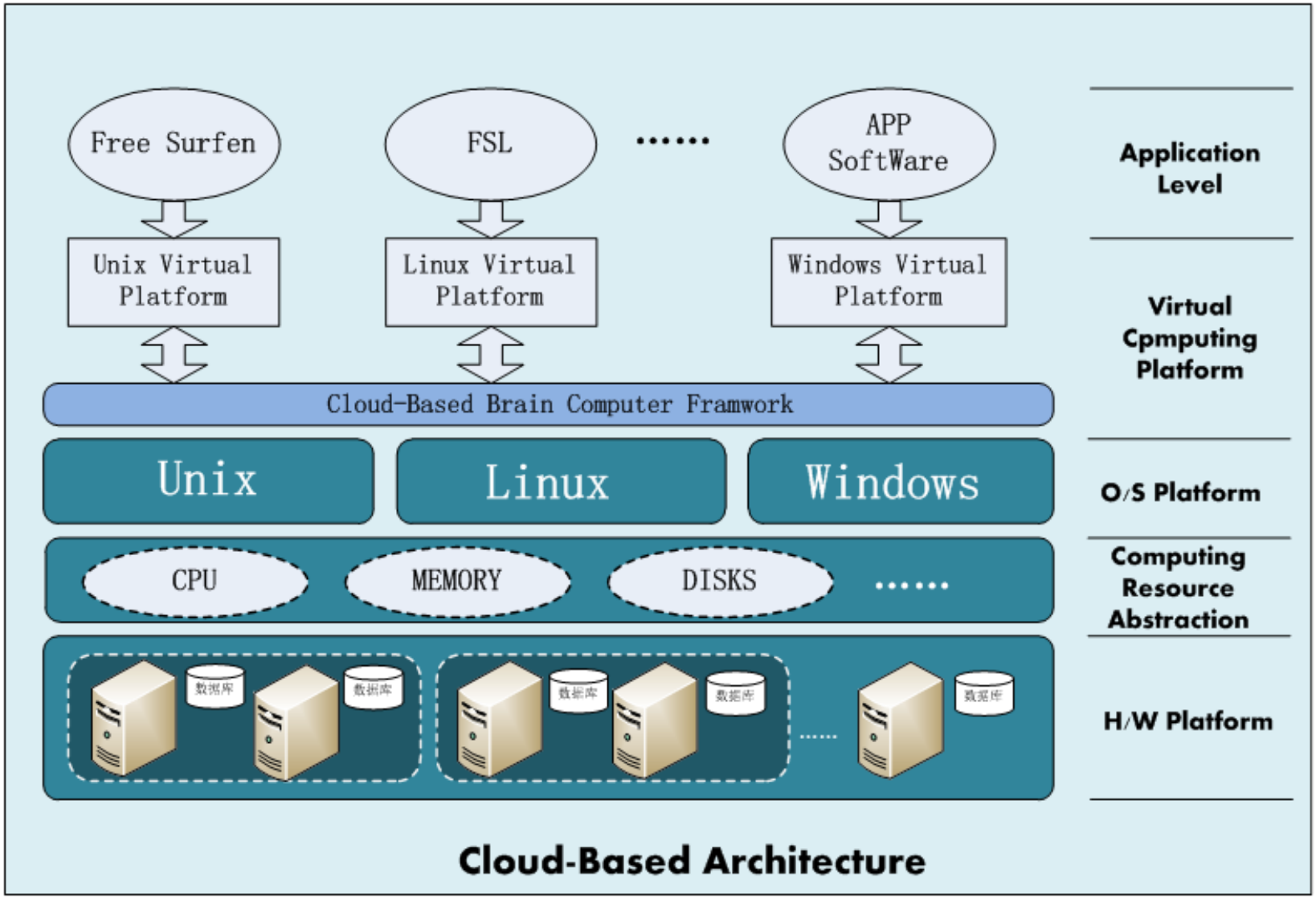
Cloud-based Software Architecture



云计算架构


Free Surfen
FSL
.....
APP SoftWare
Application Level
ClusterManagement S/W
Management Level
Unix
Linux
Windows
O/S Platform
数据库
数据库
数据库
数据库
.....
H/W Platform
Cluster-Based Architecture

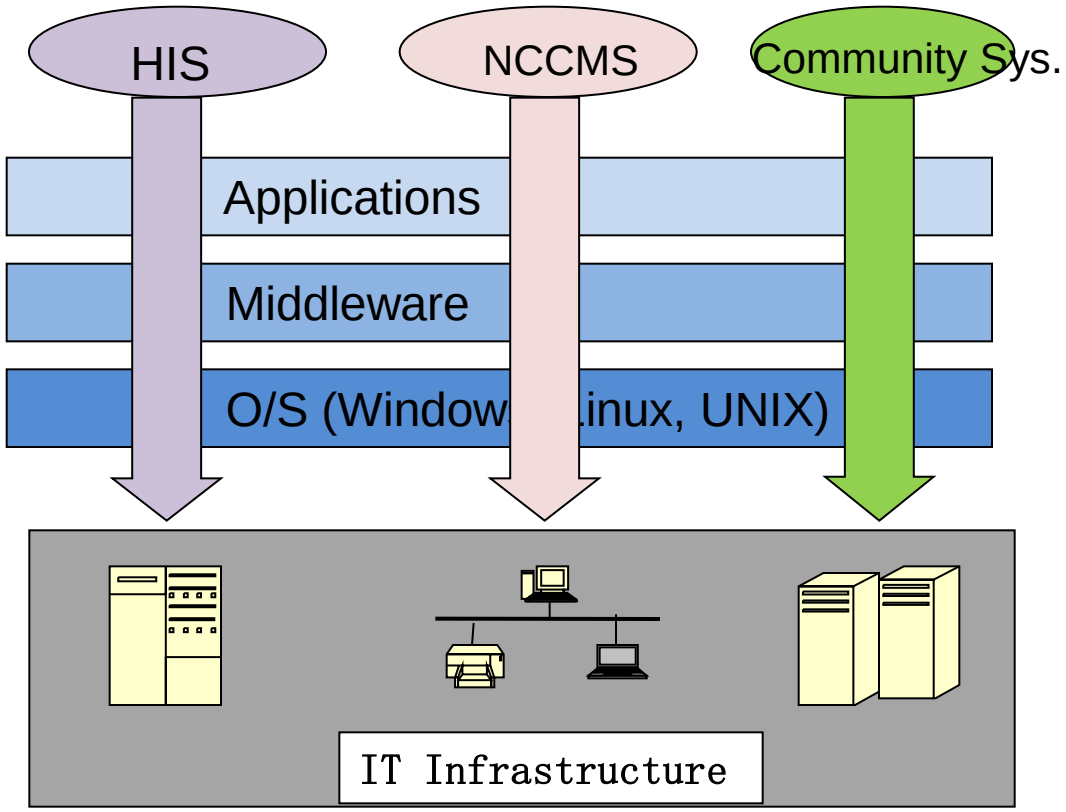
云计算架构


Free Surfen
FSL
.....
APP SoftWare
Application Level
Unix Virtual Platform
Linux Virtual Platform
Windows Virtual Platform
Virtual Cpmputing Platform
Cloud-Based Brain Computer Framwork
Unix
Linux
Windows
O/S Platform
CPU
MEMORY
DISKS
.....
Computing Resource Abstraction
数据库
H/W Platform
Cloud-Based Architecture

云计算架构

Isolated Island-style Legacy

- Each systems or application runs like an “island” without interchange with others
- Computing resources are owned by individual systems or applications, not shared
- More problematic, the upper applications are tightly bind to the underneath execution environment, making the upgrade on either applications or bottom hardware layer much difficult



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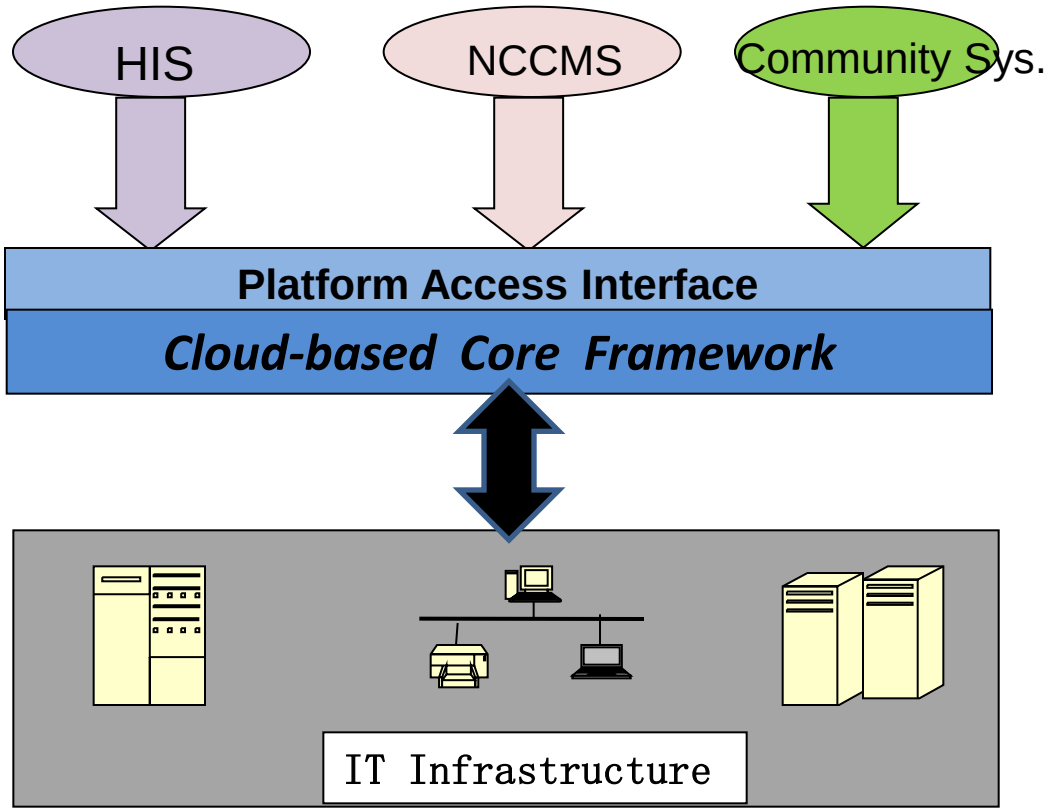
Cloud-based RHIN Architecture

- Upper applications are not dependent to the bottom infrastructure, which makes upgrade easier
- Computing resources can managed and scheduled by the platform
- Application development can use the software framework provided by the platform, can be standard and cost-effective



云计算架构

基于云架构的软件体系模型 Software Layer Model for Cloud Architecture

应用软件层

基于云架构的业务支撑层（核心框架库）

数据采集层

系统资源层

云计算架构

Open Source Cloud System　　Commercial Cloud Product

开源云计算系统	对应的商用云计算系统
Hadoop HDFS	Google GFS
Hadoop MapReduce	Google MapReduce
Hadoop HBase	Google Bigtable
Hadoop ZooKeeper	Google Chubby
Eucalyptus、Enomaly ECP、Nimbus	Amazon EC2
Eucalyptus	Amazon S3
Sector and Sphere	无直接对应系统
abiquo	无直接对应系统
MongoDB	无直接对应系统

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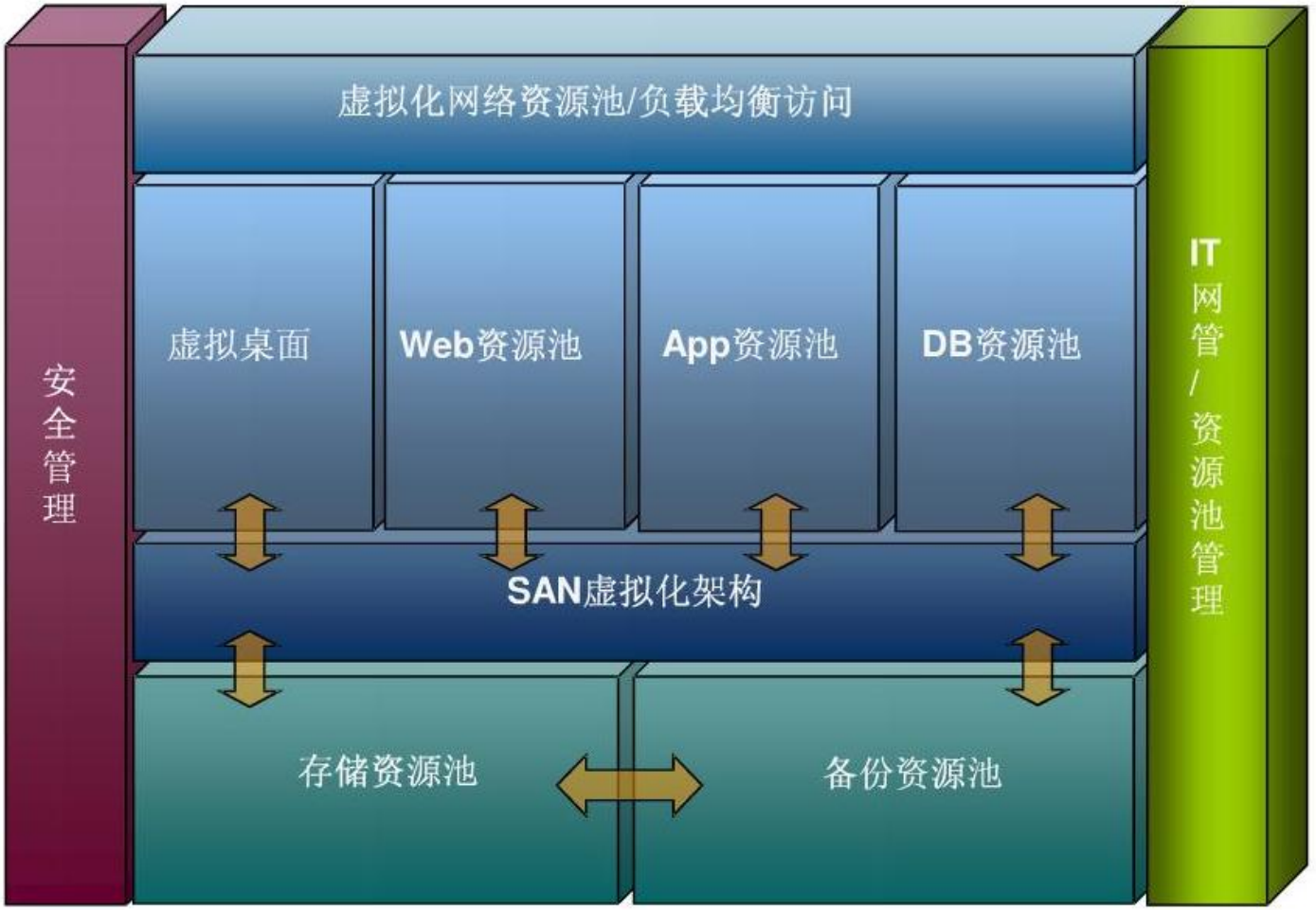
续：IaaS(Infrastructure as a Service)规划模型



云计算架构

Service Models of Cloud Computing

SaaS

– （Software as a Service）软件即服务
SaaS侧重于服务，通过网络提供软件程序服务

PaaS

– （Platform as a Service ）平台即服务
PaaS侧重于服务，以服务器平台或者开发环境提供服务

IaaS

– (Infrastructure as a Service)基础设施即服务
IaaS注重计算资源的共享， 消费者通过 Internet 可以从完善的计算机基础设施获得服务

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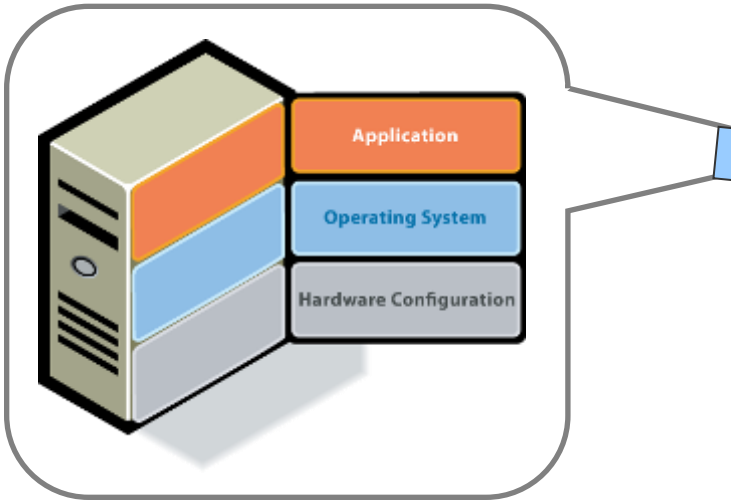
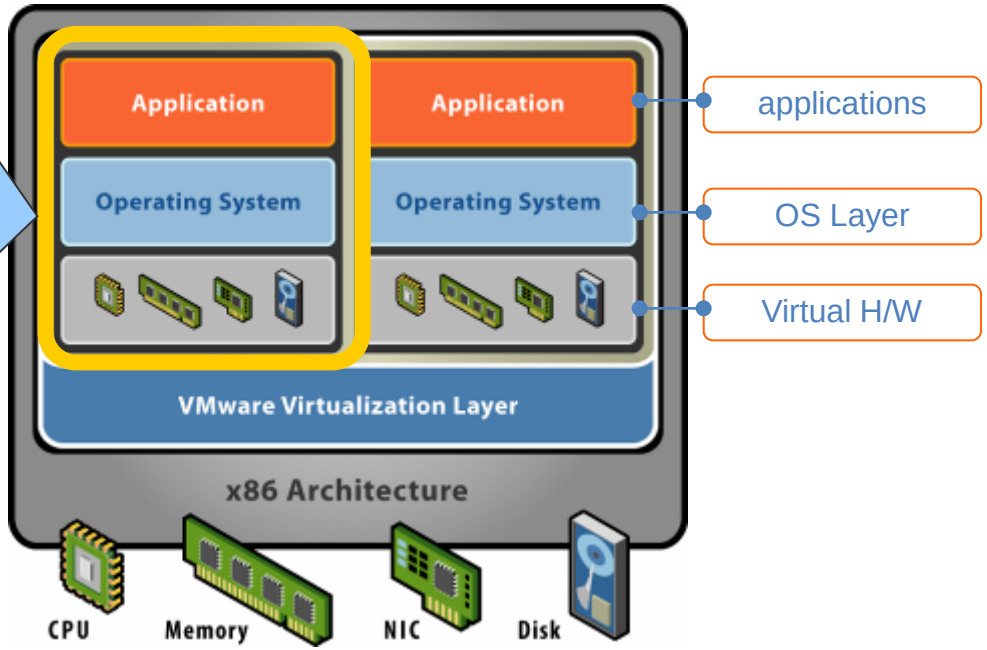
Virtualization: assembly hardware, O/S and application to a virtual machine and provide service rather than computing resource

before virtualization



after virtualization



- s/w is tightly bind to h/w
- each machine has only one O/S
- one machine runs one application

- s/w is independent to h/w platform
- each machine runs multiple applications
- service rather than resource is provided

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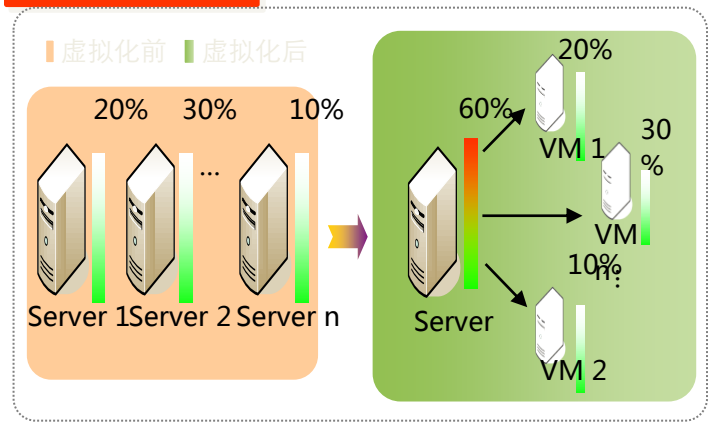
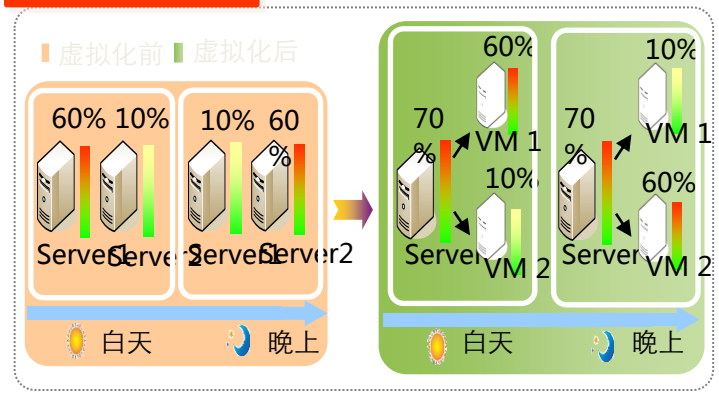
Virtualization lifts computing resource utilization

资源共享



- 虚拟化前
  - 服务器利用率通常仅5%~10%
- 虚拟化后
  - 虚拟服务器的整合比常为1:5~1:10
  - 服务器利用率提升到60%以上

分时共享



	峰值时间	谷底时间
Wap网关服务器	9时	22时
彩信服务器	18时	6时

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Core Technology for Virtualization on Cloud Platform

Virtualization	虚拟化实现资源“空分、时分”共享，提升利用率
Distributed storage and computing model	分布式的计算、存储提升系统整网可靠性，降低对单点硬件的可靠性依赖，降低采购成本
Cluster management	基于网络运维管理平台，提高整网的运维效率
Multi-domain resource management	基于的网络的业务部署支撑跨域业务，提升用户体验
Performance optimized h/w	高能效比、针对云计算优化的硬件降低整体TCO

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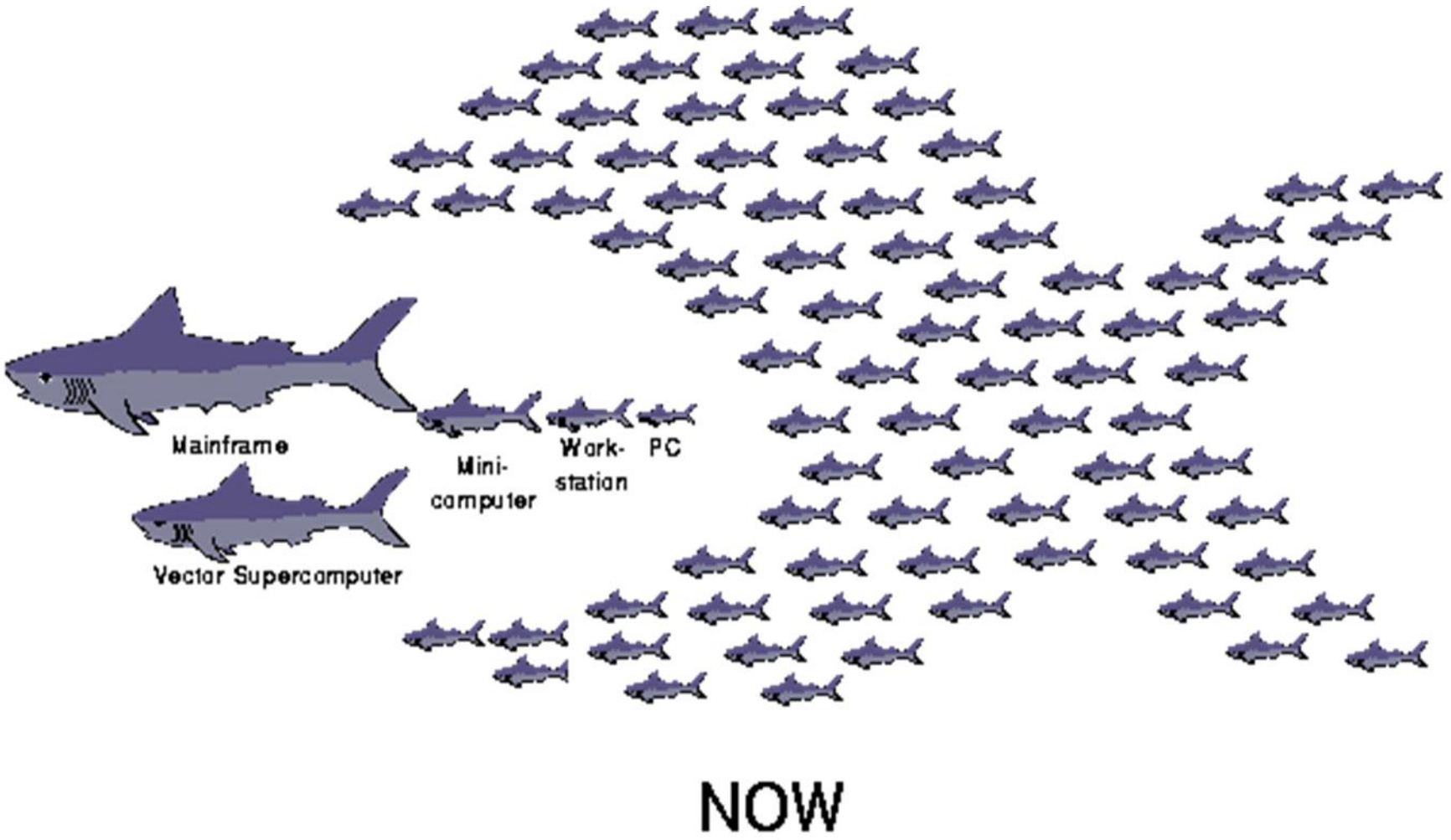
Mainframe
Vector Supercomputer
Mini-computer
Work-station
PC
NOW

End of Lecture

谢谢！