

# Cloud Computing: Overview

Direct quotes from source: Simplilearn, 2018, URL:  
<https://www.youtube.com/watch?v=RWgW-CgdIk0&feature=youtu.be>,

Otherwise, as specified.

Prepared by: Celeste Ng, May 2023

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# 1. What is cloud computing?

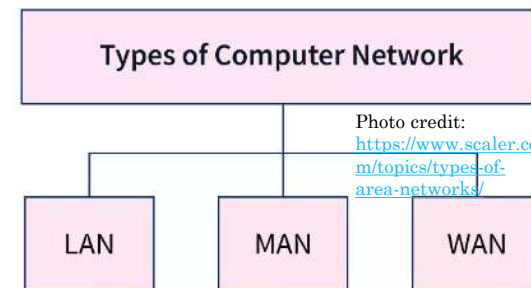
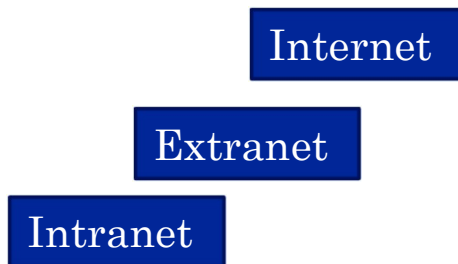
Celeste:  
What is a  
“cloud”  
computing?

互連計算基礎設施和 IT 資源  
網絡的“虛擬化”

- A “virtualization” of a network of “interconnected” computing infrastructures & IT resources (such as servers, computers, storage, printers, scanners, IoT devices, IT systems, ....) that are
  - Available remotely,
  - Accessible over the Internet
  - (typically,) Hosted by a 3<sup>rd</sup> party service provider

- 遠程可用，
- 可通過互聯網訪問
- 通常）由第三方服務提供商託管

Types of networks (accessibility perspective):



# 1. What is cloud computing?

## 按需計算服務

Cloud computing is the delivery of on-demand computing services over the internet on a pay-as-you-go basis

15 GB

Current plan

Includes

✓ 15 GB of storage

1-month trial

Basic

100 GB

NT\$65.00 \$0/month for 1 month

NT\$65.00/month after

Get Offer

Cancel anytime [Terms apply](#)

Google One includes

✓ 100 GB of storage

✓ Access to Google experts

✓ Share with up to 5 others

✓ More Google Photos editing features

✓ Extra member benefits

✓ VPN for multiple devices

1-month trial

Standard

200 GB

NT\$90.00 \$0/month for 1 month

NT\$90.00/month after

Get Offer

Cancel anytime [Terms apply](#)

Google One includes

✓ 200 GB of storage

✓ Access to Google experts

✓ Share with up to 5 others

✓ More Google Photos editing features

✓ Extra member benefits

✓ VPN for multiple devices

1-month trial

Premium

2 TB

NT\$330.00 \$0/month



### Google Drive Pricing

Plan	Cost	Cloud Storage Per User
Business Starter	\$6/user/month	30 GB
Business Standard	\$12/user/month	2 TB
Business Plus	\$18/user/month	5 TB
Enterprise	Custom Quote	As Much as You Need

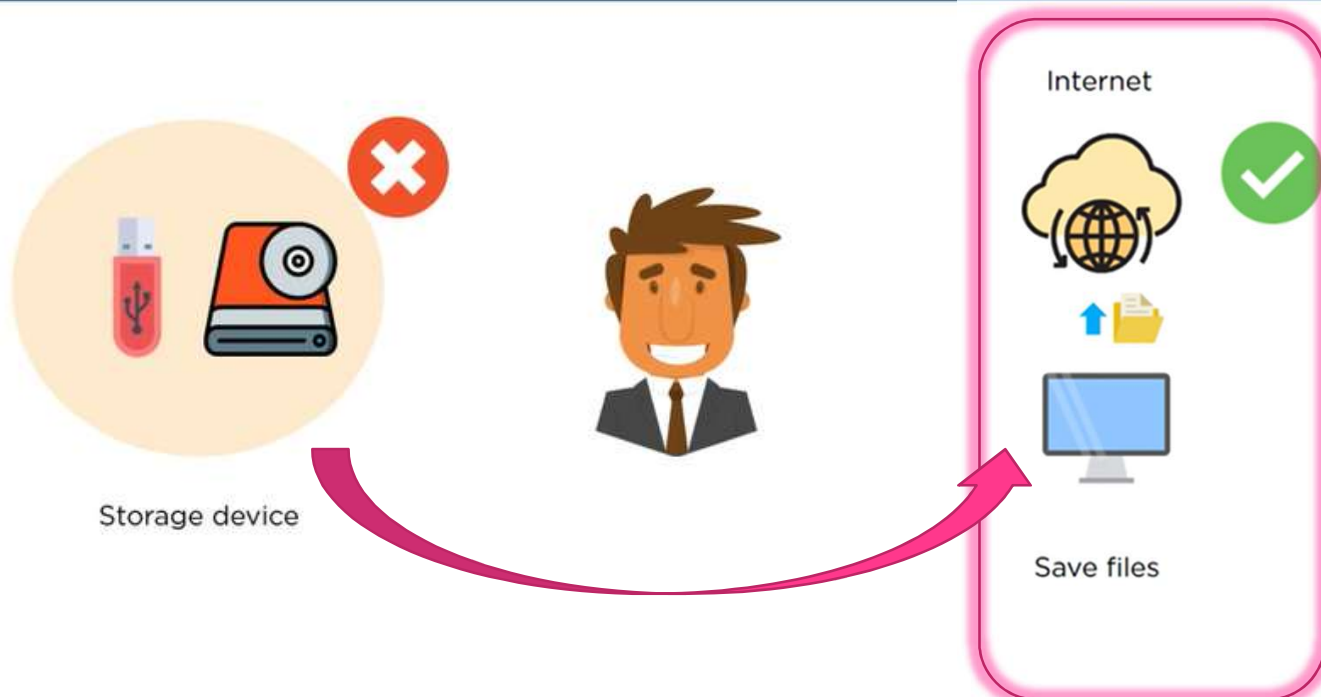
TrustRadius  
<https://www.trustradius.com> > ... > Google Drive

Google Drive Pricing 2023 - TrustRadius

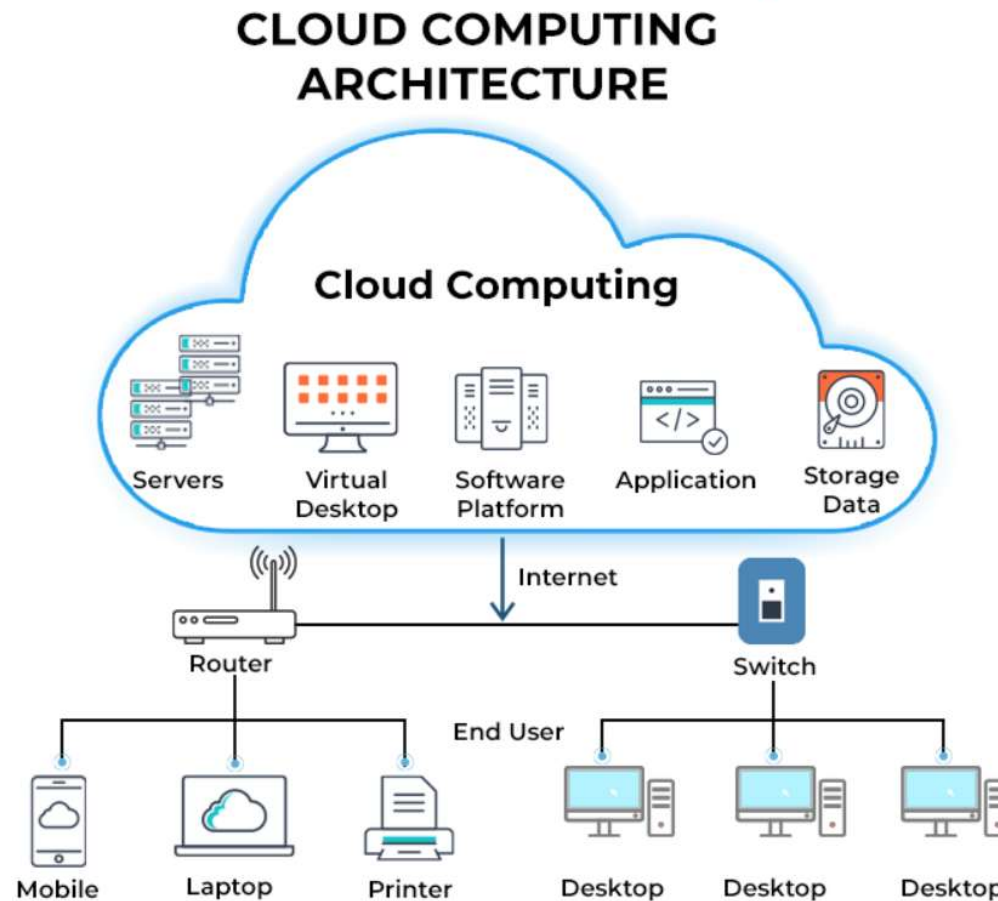
simplylearn

# 1. What is cloud computing? – example

Rather than managing files on a local storage device, cloud computing makes it possible to save them over internet



# 1. What is cloud computing? – Architecture



Source:

<https://www.spiceworks.com/tech/cloud/articles/what-is-cloud-computing/>

# 1. What is ...

Celeste:  
What is “on-  
premise”  
computing?

- A “physicalization” of a network of “interconnected” computing infrastructures & IT resources (such as servers, computers, storage, printers, scanners, IoT devices, IT systems, ....) that are
  - Installed and available in-house,
  - Operated from the user or business owner’s own data center

The average enterprise data center costs between \$10 million and \$12 million per build, with costs typically front-loaded onto the first few megawatts of deployment. The typical edge data center costs between \$8 million and \$9 million.

Source: <https://www.datacenterdynamics.com/en/marketwatch/cutting-data-center-construction-costs-use-supporting-infrastructure-ptss-peter-sacco/>

Pricing. Palo Alto Networks offers a wide range of NGFW options. The company's most recently released appliances, the PA-220R (ruggedized), PA-3200 Series and PA-5280, range in price from \$2,900 to \$200,000, while the base PA-220 lists at \$1,000.

eSecurity Planet  
<https://www.esecurityplanet.com/products/palo-alto-n...>



Palo Alto Firewalls Rated				
CATEGORY	BEST	VERY GOOD	GOOD	
Security Performance	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Value	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	
Implementation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Support	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	
Cloud Features	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	

Palo Alto Networks PA Series Review: NGFW Features & Cost

## 2. Why cloud computing?

本地(地端)數據中心

雲端數據中心

### On-premise vs Cloud Computing

ON-PREMISE



1

Higher pay, less scalability 較少的可擴展性

Pay for what you use  
Scale up= pay more  
Scale down= pay less

2

Allot huge space for servers 為服務器分配巨大的空間

No server space required

3

Appoint a team for hardware and software maintenance 任命一個團隊進行硬件和軟件維護

No experts required for hardware and software maintenance

4

Poor data security

Better data security

5

Less chance of data recovery 資料復原

Disaster recovery



## 2. Why cloud computing?

本地(地端)數據中心

雲端數據中心

### On-premise vs Cloud Computing

ON-PREMISE



6

- Lack of flexibility

- High Flexibility

7

- No automatic updates

- Automatic software updates

8

- Less collaboration 較少的跨團隊&地點協作

- Teams can collaborate from widespread locations

9

- Data cannot be accessed remotely  
無法遠程訪問數據

- Data can be accessed and shared anywhere over the internet

10

- Takes longer implementation time  
更長的實施時間

- Rapid implementation

# 2. Why cloud computing? – Flexibility in IT infrastructure

**The Long-term solution**  
The deployment of IPv6 is the only available solution to the IPv4 address shortage.

**There are "quirks"...**

IPv4 32 bits

IPv6 128 bits

Since the number of IPv4 addresses is running out, and IPv6 protocols are different, the two are incompatible. They cannot coexist with each other.

Source: <https://www.traceip.org/ipv4-ipv6-address.htm>

## IPv6

Internet protocol 互聯網協議

Internet Protocol version 6 is the most recent version of the Internet Protocol, the communications protocol that provides an identification and location system for computers on networks and routes traffic across the Internet. Wikipedia

Abbreviation: IPv6

Based on: IPv4

IPv4	IPv6
Deployed 1981	Deployed 1998
32-bit IP address	128-bit IP address
4.3 billion addresses Addresses must be reused and masked	$7.9 \times 10^{28}$ addresses Every device can have a unique address
Numeric dot-decimal notation 192.168.5.18	Alphanumeric hexadecimal notation 50b2:6400:0000:0000:6c3a:b17d:0000:10a9 (Simplified - 50b2:6400::6c3a:b17d:0:10a9)
DHCP or manual configuration	Supports autoconfiguration

Source: <https://www.avast.com/c-ipv4-vs-ipv6-addresses>

8 binary digits

## IPv4

- Comprise 4 sets of numbers, each ranging from 0 to 255 ...
- E.g.: 104.103.88.45
- Has a theoretical limit of 4.3 billion addresses
- Replacing old IPv4 equipment would be prohibitively expensive and disruptive, and so IPv6 is being slowly rolled out

## IPv6

- Introduced in the late 1990s as a replacement for IPv4.
- Uses 128-bit addresses formatted as 8 groups of 4 hexadecimal numbers separated by colons [Hex numbers are represented by: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E and F.]
- IPv6 allows for a theoretical 340,282,366,920,938,463,463,374,607,431,768,211,456, or 340 undecillion addresses.
- This means that every device on the internet can have a unique IPv6 address.
- E.g.: IPv6 address looks like this — 2002:0de6:0001:0042:0100:8c2e:0370:7234

Source: <https://www.avast.com/c-ipv4-vs-ipv6-addresses>

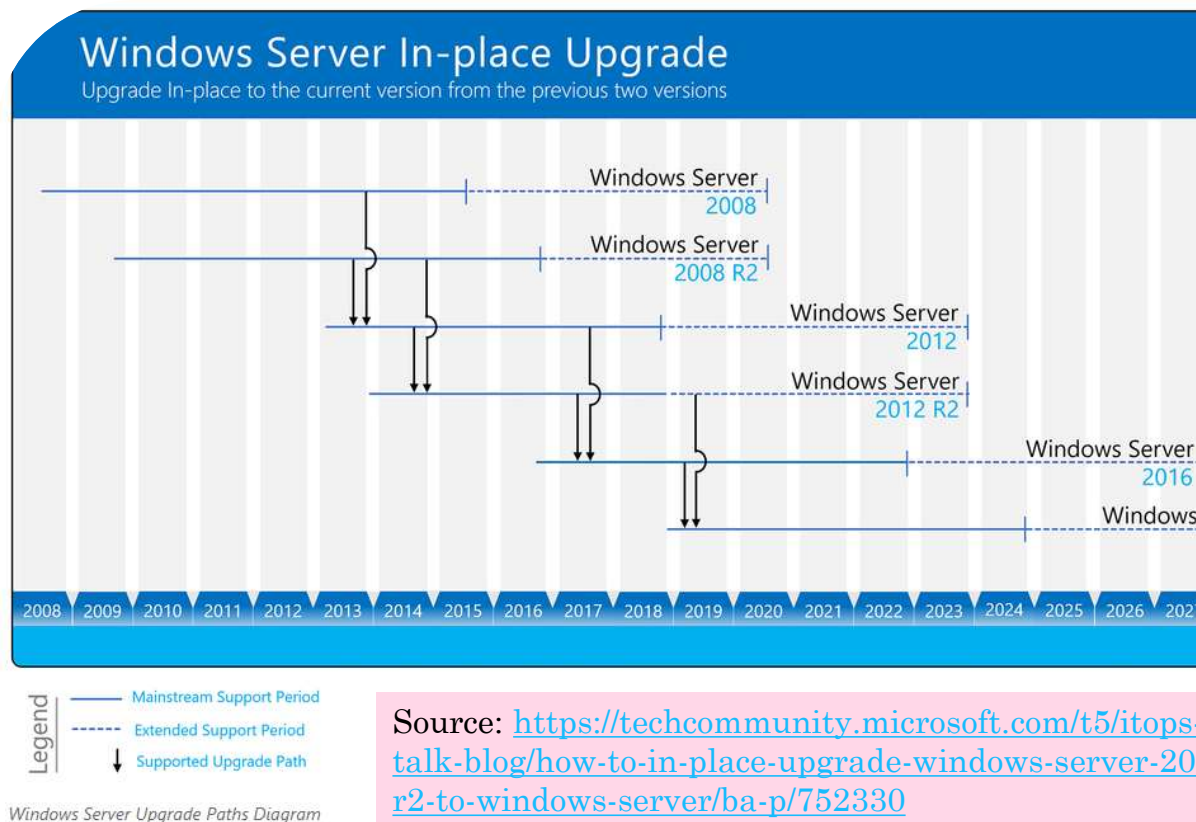
Math = Love

avr-asm-tutorial.net

# POWERS OF 2

Binary	1	0	1	0	1	0	1	0
Decimal value	128	64	32	16	8	4	2	1
$2^6$	=	64						
$2^7$	=	128						
$2^8$	=	256						
$2^9$	=	512						
$2^{10}$	=	1024						

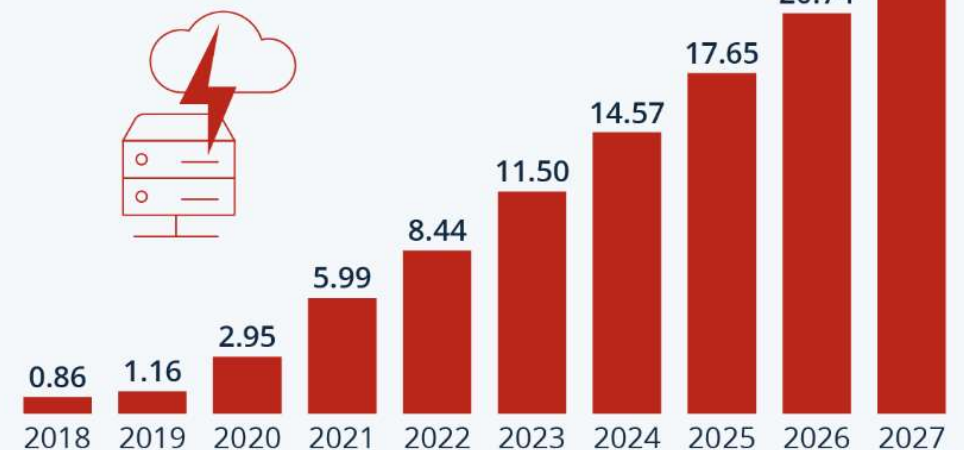
## 2. Why cloud computing? – Flexibility in IT infrastructure



Statista

### Cybercrime Expected To Skyrocket in the Coming Years

Estimated cost of cybercrime worldwide (in trillion U.S. dollars)

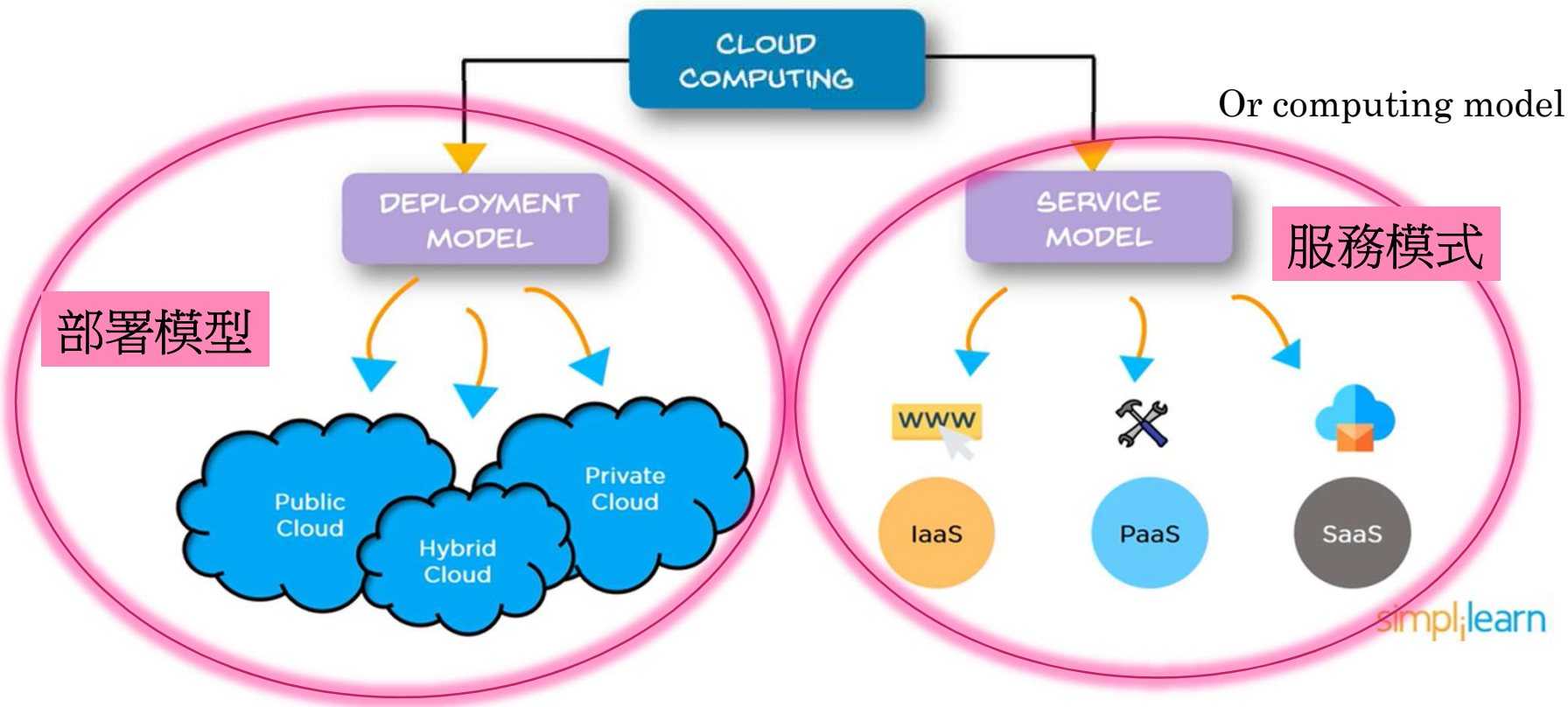


As of November 2022. Data shown is using current exchange rates.

Sources: Statista Technology Market Outlook, National Cyber Security Organizations, FBI, IMF

# 3. Categorizations of cloud computing

## Two Categorizations

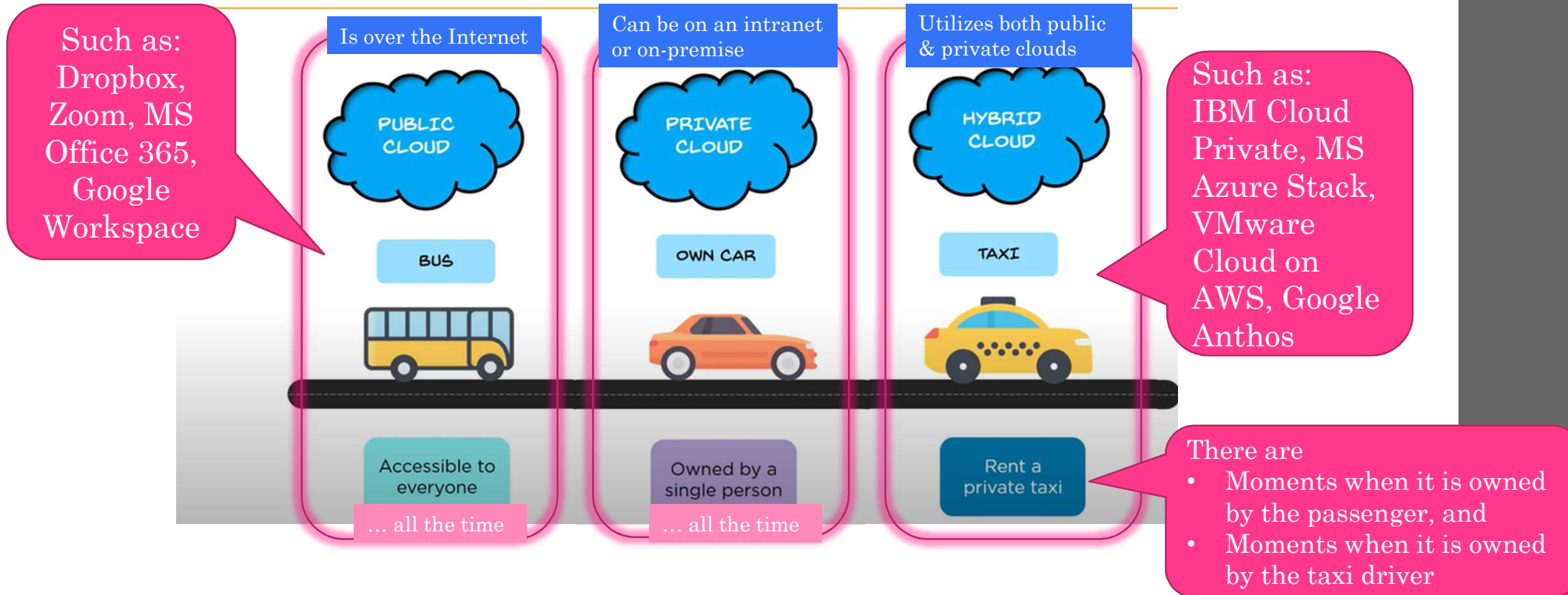




# 3.1. Deployment models

Celeste: They are based on the perspective of “the ownership” of the cloud

## Types of Deployment Models - A comparison



# 3.1. Deployment models – cloud providers

## Public Cloud



The cloud infrastructure is made available to the general public over the internet and is owned by a cloud provider

Example: AWS, Microsoft Azure, IBM's Blue Cloud and Sun Cloud

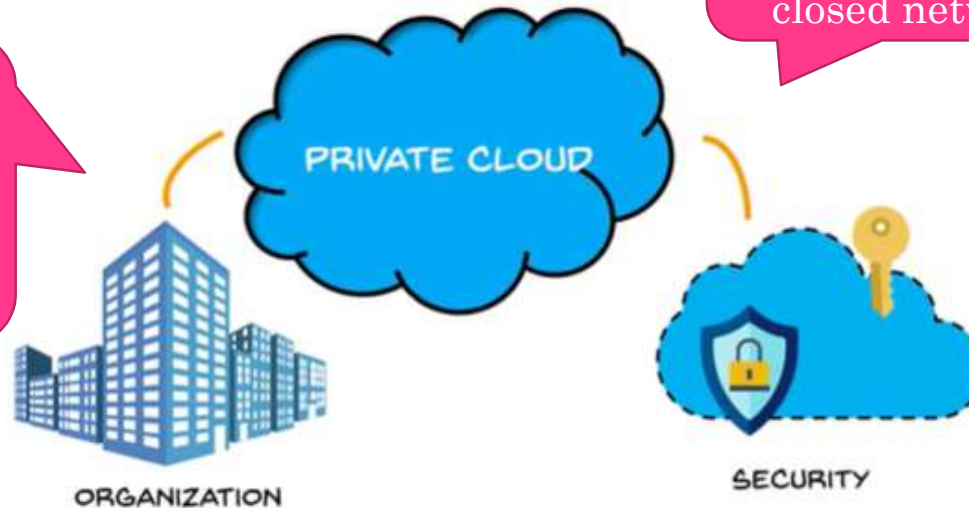
Celeste:

- Google Cloud Platform,
- Alibaba Cloud

# 3.1. Deployment models – cloud providers

## Private Cloud

Celeste: it could simply be your own intranet (internal network)



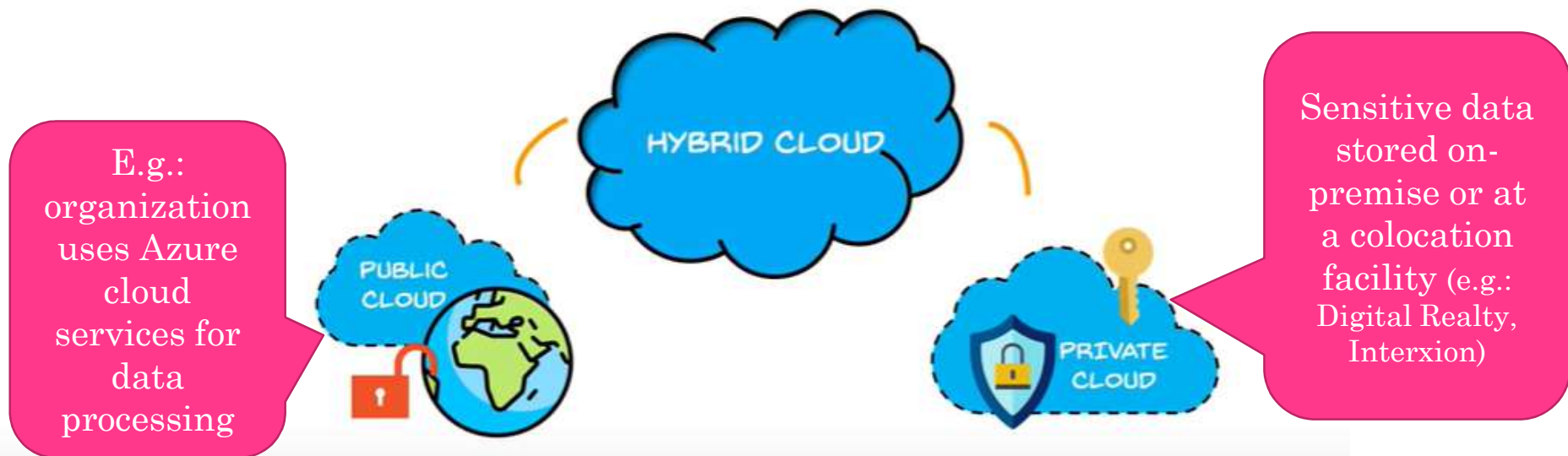
... operated by a single organization or for an organization

The cloud infrastructure is exclusively operated by a single organization. It can be managed by the organization or a third party and may exist on-premise or off-premise

Example: AWS, VMware

# 3.1. Deployment models – cloud providers

## Hybrid Cloud

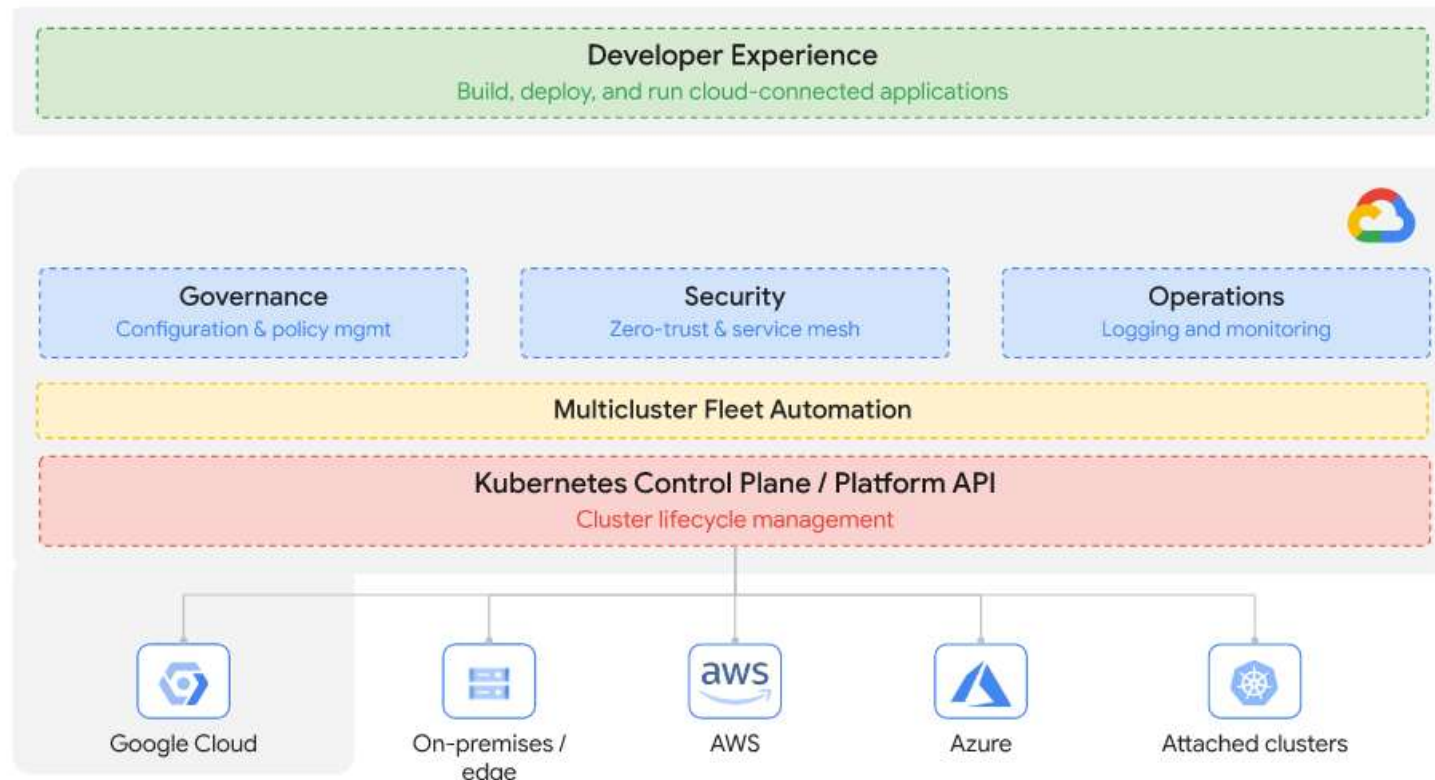


It consists the functionalities of both public and private cloud

For example: 政府/聯邦機構  
Federal agencies opt for private clouds when sensitive information is involved  
Also, they use the public cloud to share datasets with general public or other government departments



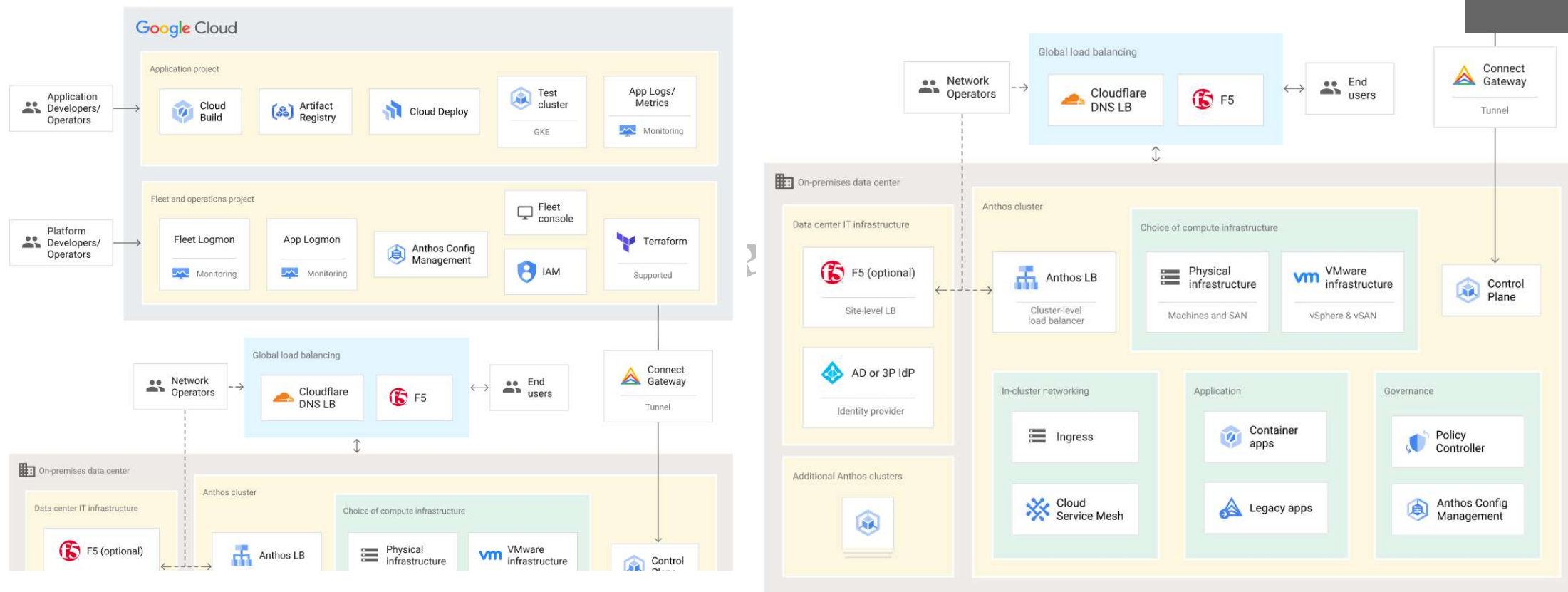
## 3.1. An example of a hybrid cloud: Google Anthos



- Anthos works across multiple clusters and infrastructure providers
- You can enable the entire Anthos platform to use all available features, including multi-cloud and hybrid cloud capabilities

Source: <https://cloud.google.com/anthos/docs/concepts/overview>

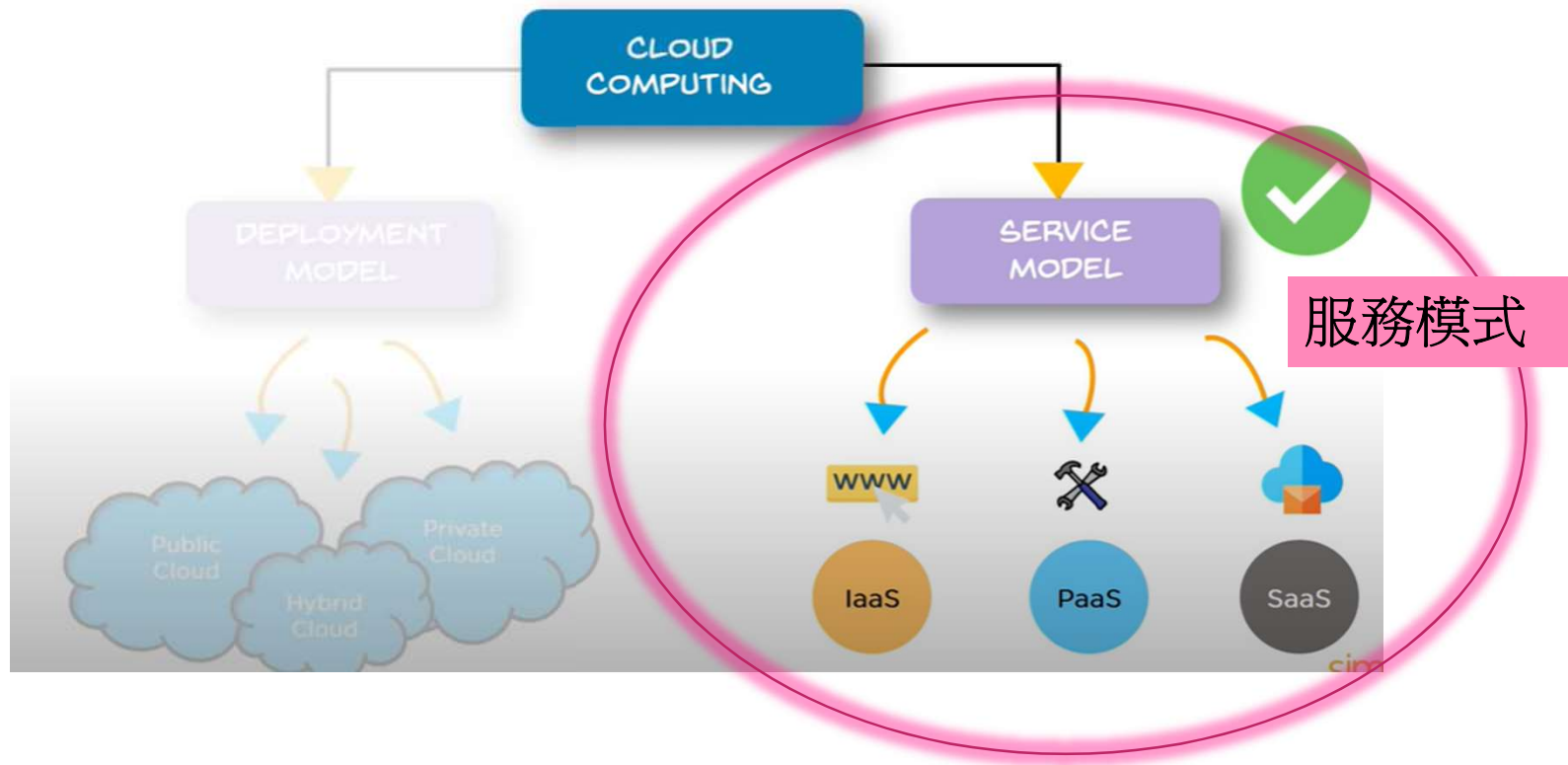
# 3.1. An example of a hybrid cloud: Google Anthos



Source: <https://cloud.google.com/anthos/docs/architecture/anthos-hybrid-environment>

## 3.2. Service models

### Types of Service Models



## 3.2. Service models

Which cloud service is suitable for you?

WWW

**IAAS**

If your business needs a virtual machine, opt for Infrastructure as a Service



**PAAS**

If your company requires a platform for building software products, pick Platform as a Service



**SAAS**

If your business doesn't want to maintain any IT equipment, then choose Software as a Service



## 3.2. Service models – cloud providers

### IaaS

The diagram illustrates IaaS (Infrastructure as a Service) products and services. It features a central light blue box with a list of characteristics and a list of providers. To the right, a smartphone displays the logos for Amazon EC2, Microsoft Azure, and Google Cloud Platform (GCP). A hand is shown pointing at the smartphone screen. Above the smartphone, a box contains the text 'IAAS PRODUCTS AND SERVICES'. The central box also includes a 'WWW' icon and a cursor pointing to it.

**IAAS PRODUCTS AND SERVICES**

**IaaS**

- ✓ IaaS is a cloud service that provides basic computing infrastructure
- ✓ Services are available on **PAY-FOR-WHAT-YOU-USE** model
- ✓ IaaS providers include Amazon Web Services, Microsoft Azure and Google Compute Engine
- ✓ **Users: IT Administrators**

**amazon web services | EC2**

**Microsoft Azure**

**GOGRID**

## 3.2. Service models – cloud providers

### PaaS



- ✓ PaaS provides cloud platforms and runtime environments for developing, testing, and managing applications
- ✓ It allows software developers to deploy applications without requiring all the related infrastructure
- ✓ Users: Software Developers

Celeste: is  
GitHub a  
PaaS?

#### PAAS PRODUCTS AND SERVICES





## 3.2. Service models – cloud providers: PaaS

- PaaS (Platform as a Service) is a cloud computing model in which a cloud provider offers a platform to users for developing, deploying, and managing applications. Here are some examples of PaaS:
  1. **Heroku**: A cloud-based platform for building, deploying, and managing web applications in multiple programming languages, such as Ruby, Python, and Node.js.
  2. **Microsoft Azure**: A cloud computing platform that offers PaaS services, including Azure App Service for building and deploying web applications and Azure Functions for serverless computing.
  3. **Google App Engine**: A fully managed serverless platform for developing and deploying web applications in multiple programming languages, such as Python, Java, and Go.
  4. **AWS Elastic Beanstalk**: A fully managed PaaS service that enables developers to deploy and scale web applications quickly and easily using popular languages and frameworks, such as Java, .NET, and Python.
  5. **Salesforce Platform**: A cloud-based platform that offers PaaS services, including
    1. Force.com for building and deploying business applications and
    2. Heroku for developing and deploying web applications.

Source: ChatGPT-3.5, 30<sup>th</sup> April, 2023

Celeste: information  
verified!

## 3.2. Service models – cloud providers

### SaaS

SaaS

- ✓ In SaaS, cloud providers host and manage the software application on a pay-as-you-go pricing model
- ✓ All software and hardware are provided and managed by a vendor so you don't have to maintain anything
- ✓ Users: End Customers

Celeste:

- Have you heard of eBay? Shopify? 1shop?
- → are “web-based retail” services providers
- Are selling SaaS to you
- Amazon Marketplace (for third-party sellers) & Amazon Prime (for streaming video and music)



1shop.tw

<https://1shop.tw>

1shop 一頁購物

SAAS PRODUCTS AND SERVICES





Office 365 Google Apps



## 3.3. Service models – differences

### Differences between IaaS, PaaS and SaaS

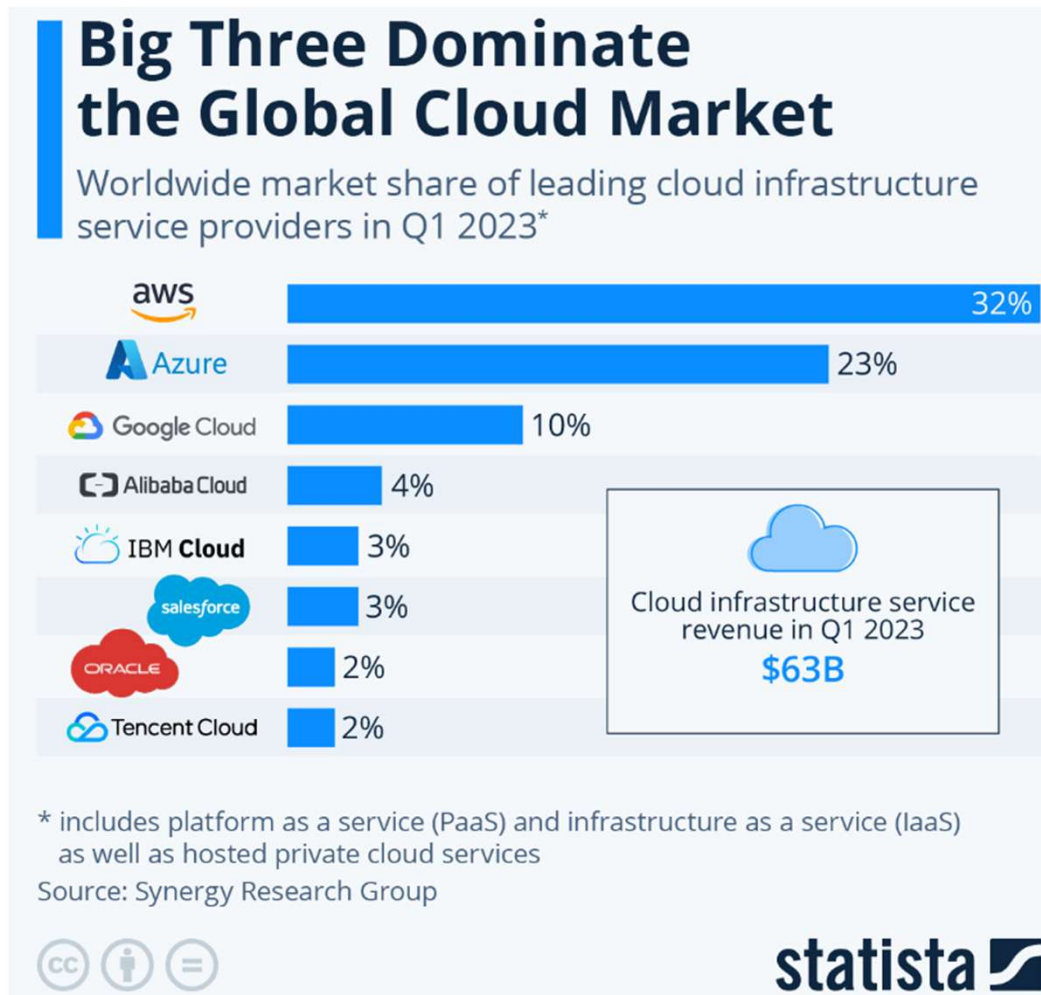
On-Premises	IaaS	PaaS	SaaS
Applications	Applications	Applications	Applications
Data	Data	Data	Data
Runtime	Runtime	Runtime	Runtime
Middleware	Middleware	Middleware	Middleware
O/S	O/S	O/S	O/S
Virtualization	Virtualization	Virtualization	Virtualization
Servers	Servers	Servers	Servers
Storage	Storage	Storage	Storage
Networking	Networking	Networking	Networking

 Managed by you  Managed by Vendor

## 4. Cloud infrastructure service providers



## 4. Cloud infrastructure service providers





# THANK YOU!

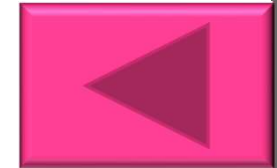
 Celeste SP Ng

 Email: celeste@saturn.yzu.edu.tw

 Phone: 2614

 Website: <http://celesteng.mis.yzu.edu.tw/>

# Hexadecimal number system



Byju's



HEXADECIMAL NUMBER SYSTEM TABLE

BYJU'S  
The Learning App

Decimal Numbers	4-bit Binary Number	Hexadecimal Number
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

2002:0de6:0001:0042:0100:8c2e:0370:7234

Celeste:  
IPv6 ()

- Given: 128 bits IP address, 8 groups of 4 hexadecimal number
- → each group ( $= 128/8$ ) = 16 bits
- → 16 bits = 4 hexadecimal number
- → each hexadecimal number ( $= 16/4$ ) = 4 bits
- →  $2^4 = 16$  (numbers + symbols)



# Cloud Computing Prediction

- With the public cloud market—cloud apps (SaaS), cloud development and data platforms (PaaS), and cloud infrastructure (IaaS)—expected to reach \$411 billion by 2022,
- [For more detailed report, please refer to Forrester's Predictions 2020: Cloud Computing report.]
- According to Forrester's, the major cloud vendors:
  - AWS,
  - Google,
  - Microsoft, and
  - Alibaba
- IBM and Oracle have attempted to play the field too

Source: Bayern, M., 2019, Forrester: The 5 ways cloud computing will change in 2020, URL: <https://www.techrepublic.com/article/forrester-the-5-ways-cloud-computing-will-change-in-2020/>