

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?

2. Why cloud computing?

3. Categorizations of cloud computing

4. Cloud providers

1. What is cloud computing?

Celeste:
What is a
“cloud”
computing?

Types of networks (accessibility perspective):

Internet

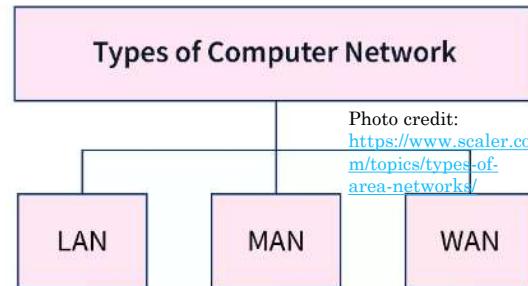
Extranet

Intranet

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 3rd 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



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	<p>Current plan</p> <p>Includes</p> <ul style="list-style-type: none">✓ 15 GB of storage
Basic 100 GB	<p>1-month trial</p> <p>NT\$65.00 \$0/month for 1 month</p> <p>NT\$65.00/month after</p> <p>Get Offer</p> <p>Cancel anytime. Terms apply.</p> <p>Google One includes</p> <ul style="list-style-type: none">✓ 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
Premium 2 TB	<p>1-month trial</p> <p>NT\$330.00 \$0/month</p>



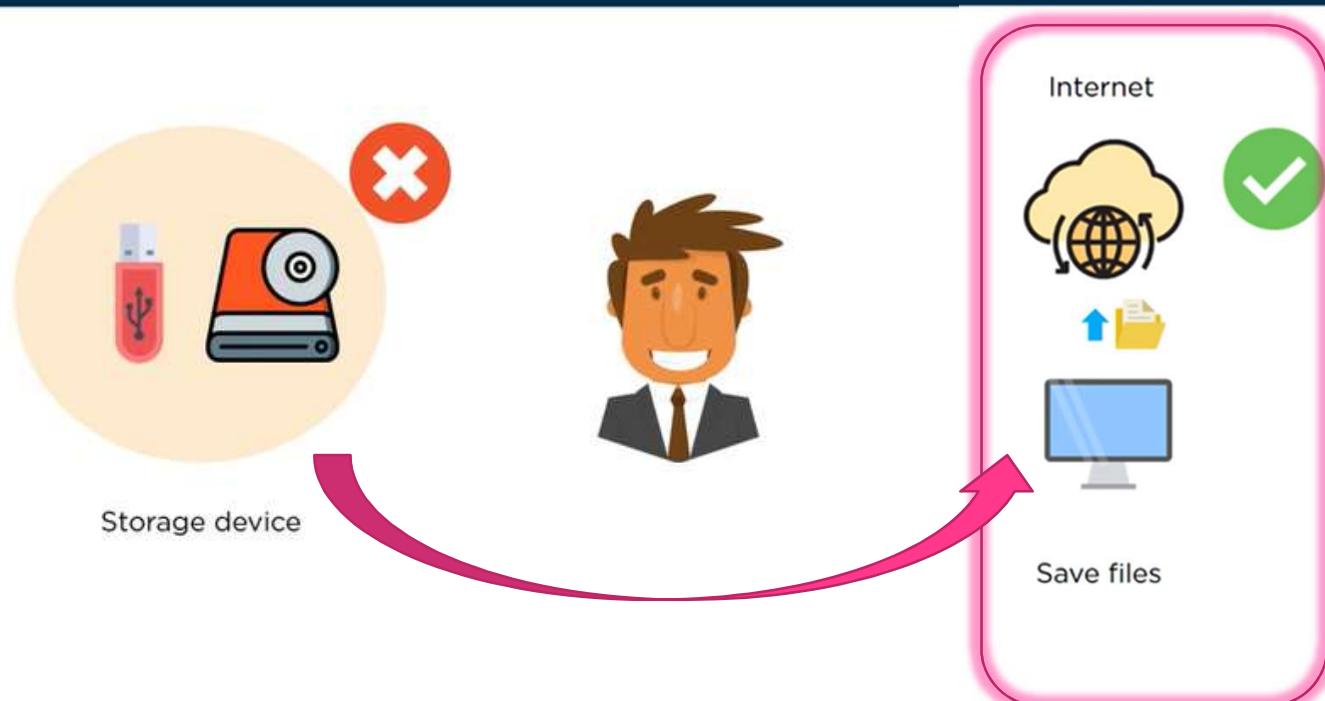
Google Drive Pricing

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/reviews/google-drive>
Google Drive Pricing 2023 - TrustRadius

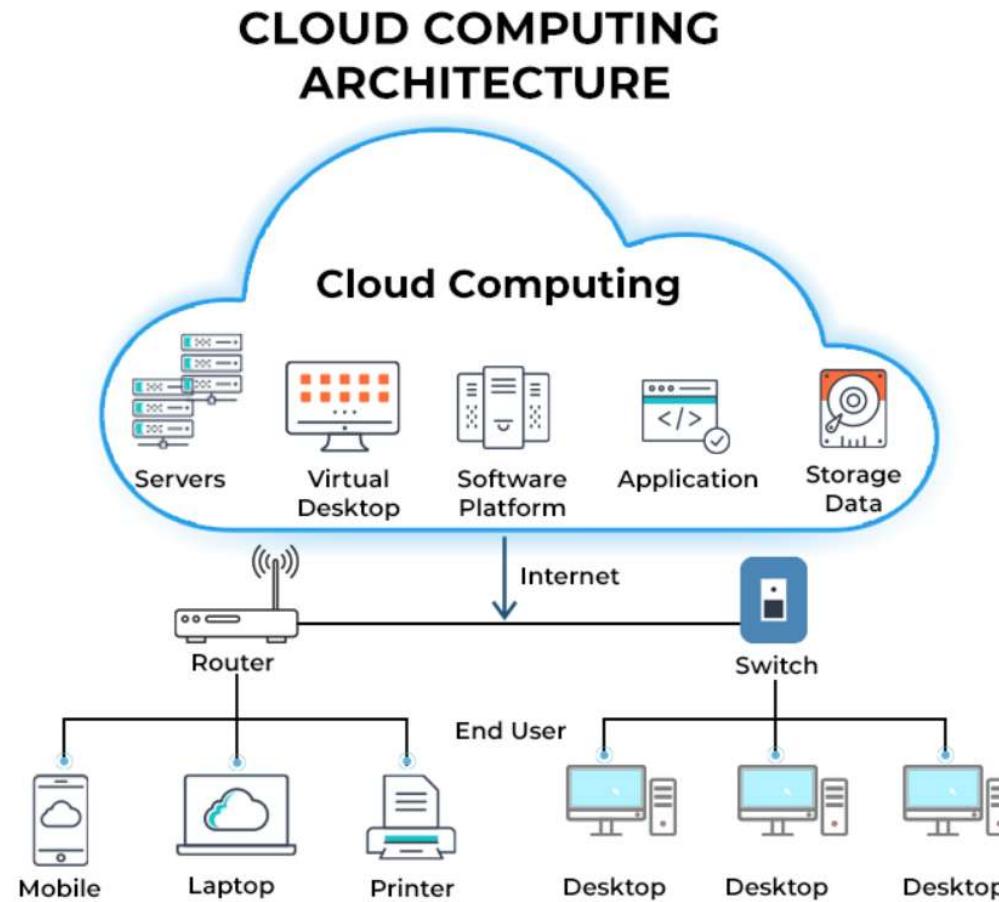
1. What is cloud computing? – example

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

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Ng, 2025



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

1. What is ...

Celeste:
What is “on-premise” computing?

@Celeste

- 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.



Palo Alto Firewalls Rated				
CATEGORY	BEST	VERY GOOD	GOOD	POOR
Security Performance	●	○	○	○
Value	●	○	○	○
Implementation	●	○	○	○
Management	●	○	○	○
Support	○	●	○	○
Cloud Features	○	●	○	○

X

SOURCE: eSecurityPlanet.com

Palo Alto Networks PA Series Review: NGFW Features & Cost

Visit

2. Why cloud computing?

本地(地端)數據中心

ON-PREMISE



On-premise vs Cloud Computing

雲端數據中心

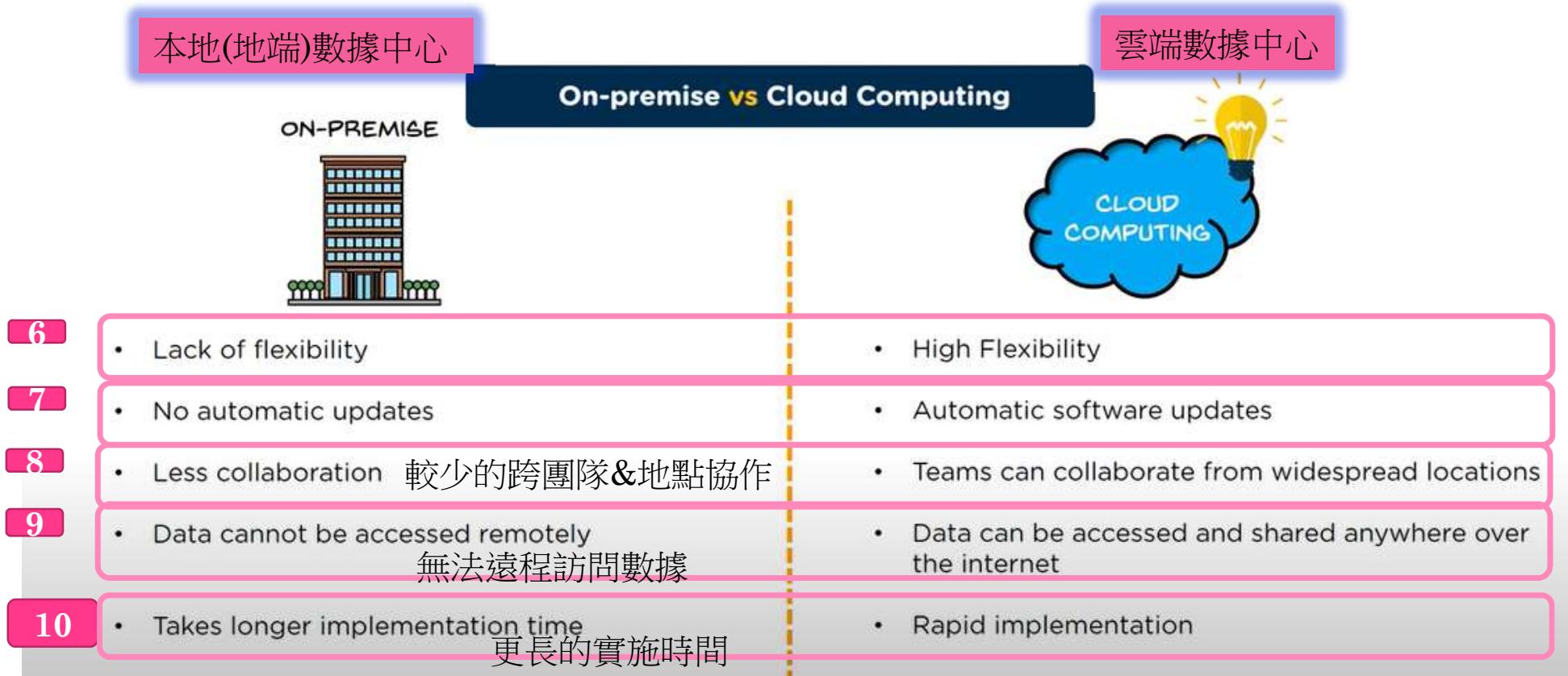


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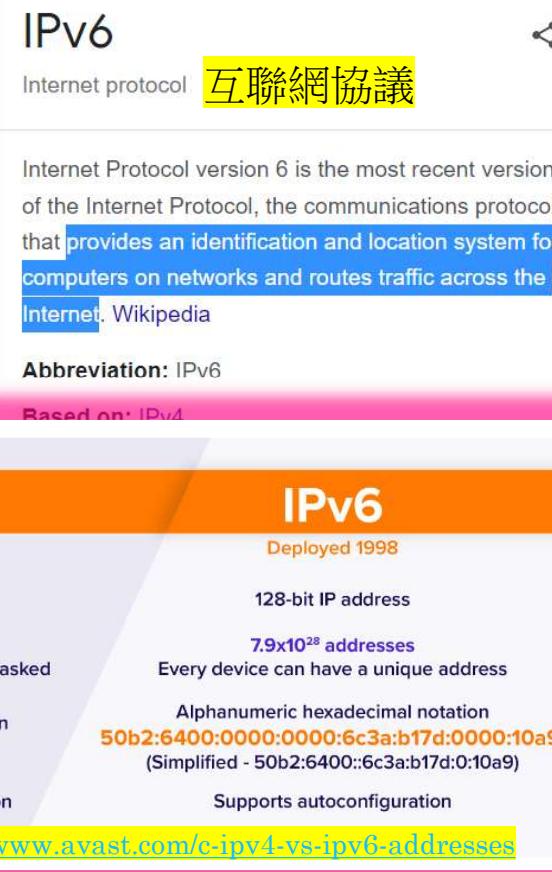
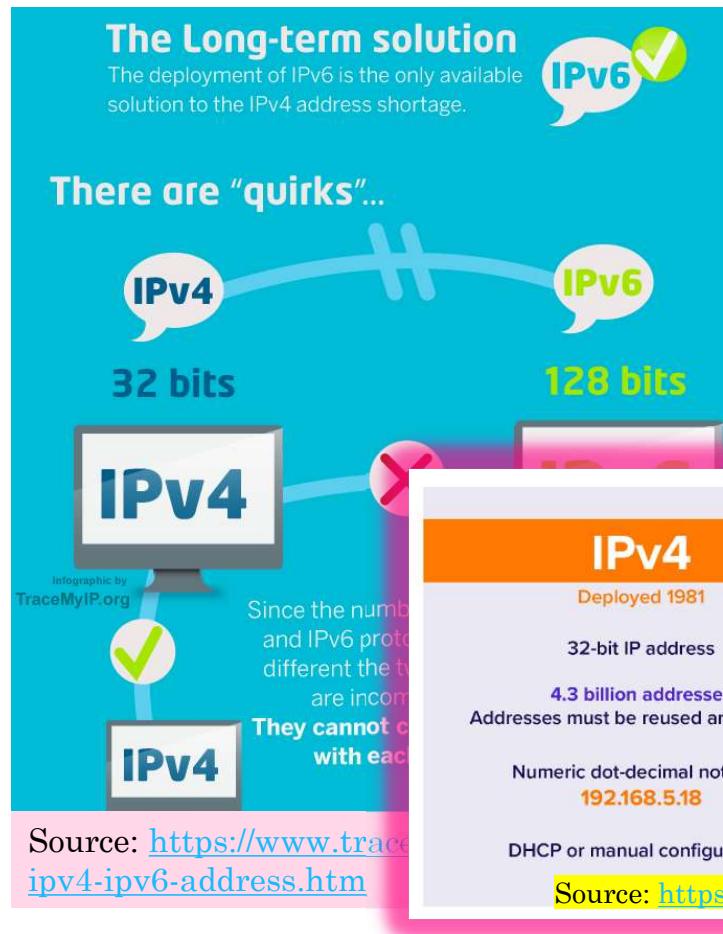
- Higher pay, less scalability 較少的可擴展性
- Allot huge space for servers 為服務器分配巨大的空間
- Appoint a team for hardware and software maintenance 任命一個團隊進行硬件和軟件維護
- Poor data security
- Less chance of data recovery 資料復原

- Pay for what you use
Scale up= pay more
Scale down= pay less
- No server space required
- No experts required for hardware and software maintenance
- Better data security
- Disaster recovery

2. Why cloud computing?



2. Why cloud computing? – Flexibility in IT infrastructure



- 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>

POWERS OF 2

avr-asm-tutorial.net

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							

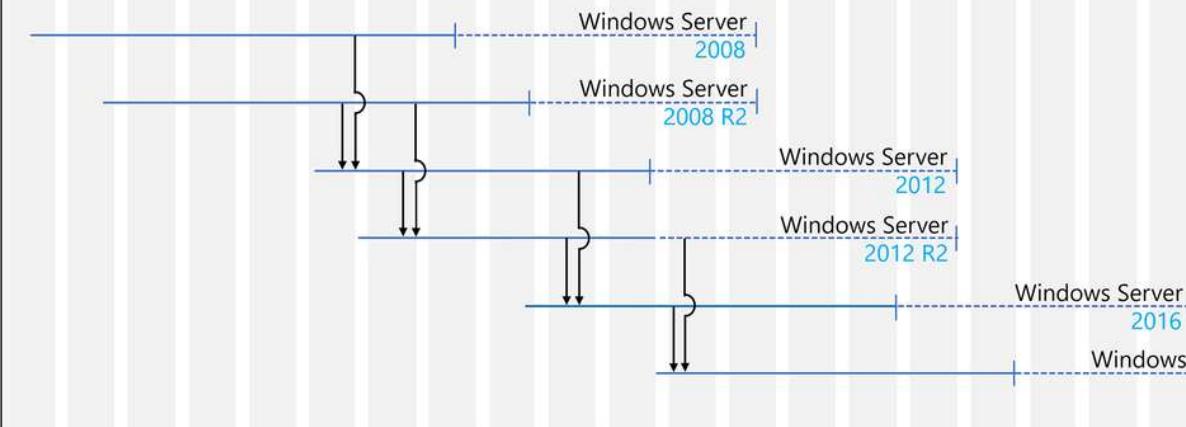
2. Why cloud computing? – Flexibility in IT infrastructure

Statista



Windows Server In-place Upgrade

Upgrade In-place to the current version from the previous two versions



Legend
Mainstream Support Period
Extended Support Period
Supported Upgrade Path

Windows Server Upgrade Paths Diagram

Source: <https://techcommunity.microsoft.com/t5/itops-talk-blog/how-to-in-place-upgrade-windows-server-2008r2-to-windows-server/ba-p/752330>

Cybercrime Expected To Skyrocket in the Coming Years

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

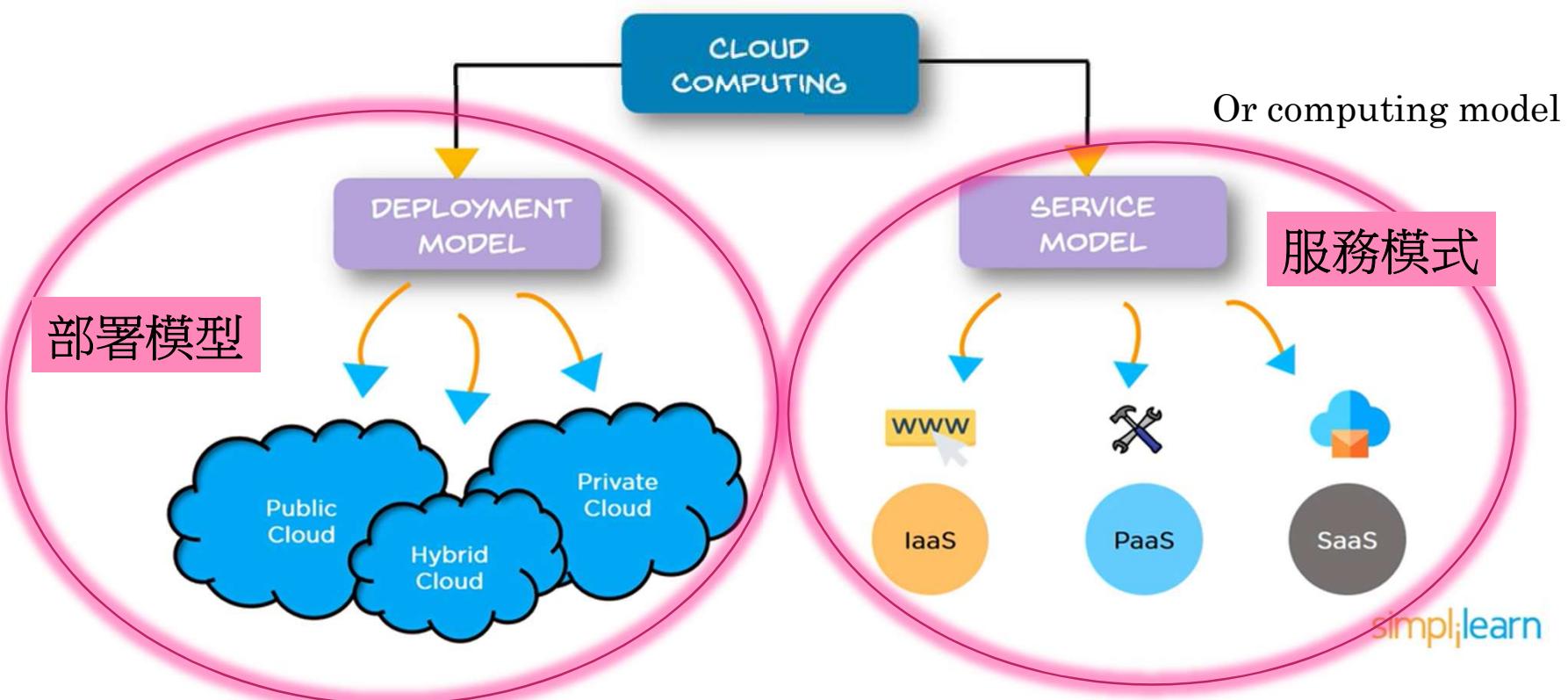


As of November 2022. Data shown is using current exchange rates.

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

Such as:
Dropbox,
Zoom, MS
Office 365,
Google
Workspace

Is over the Internet

PUBLIC CLOUD

BUS



Accessible to
everyone

... all the time

Can be on an intranet
or on-premise

PRIVATE CLOUD

OWN CAR



Owned by a
single person

... all the time

Utilizes both public
& private clouds

HYBRID CLOUD

TAXI



Rent a
private taxi

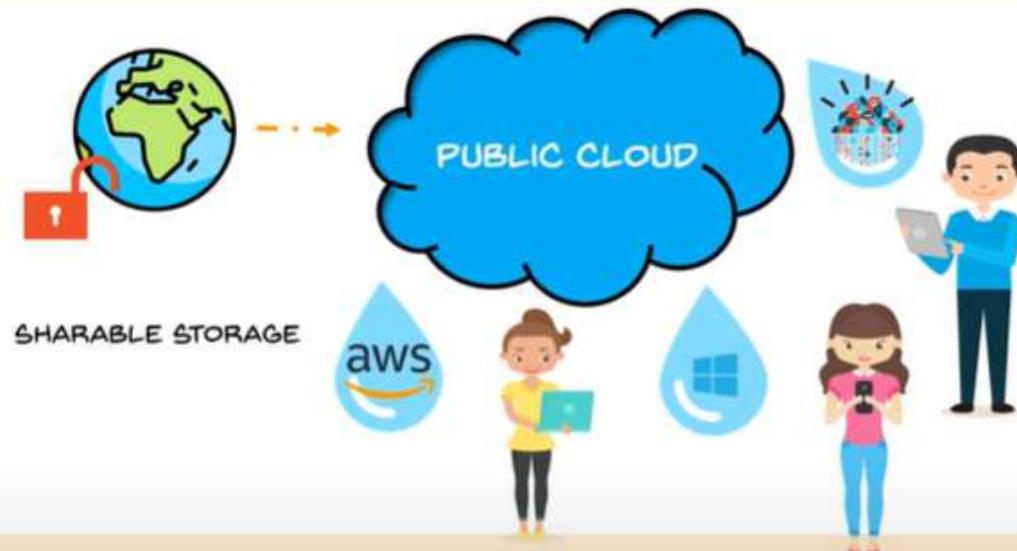
Such as:
IBM Cloud
Private, MS
Azure Stack,
VMware
Cloud on
AWS, Google
Anthos

There are

- Moments when it is owned by the passenger, and
- Moments when it is owned by the taxi driver

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

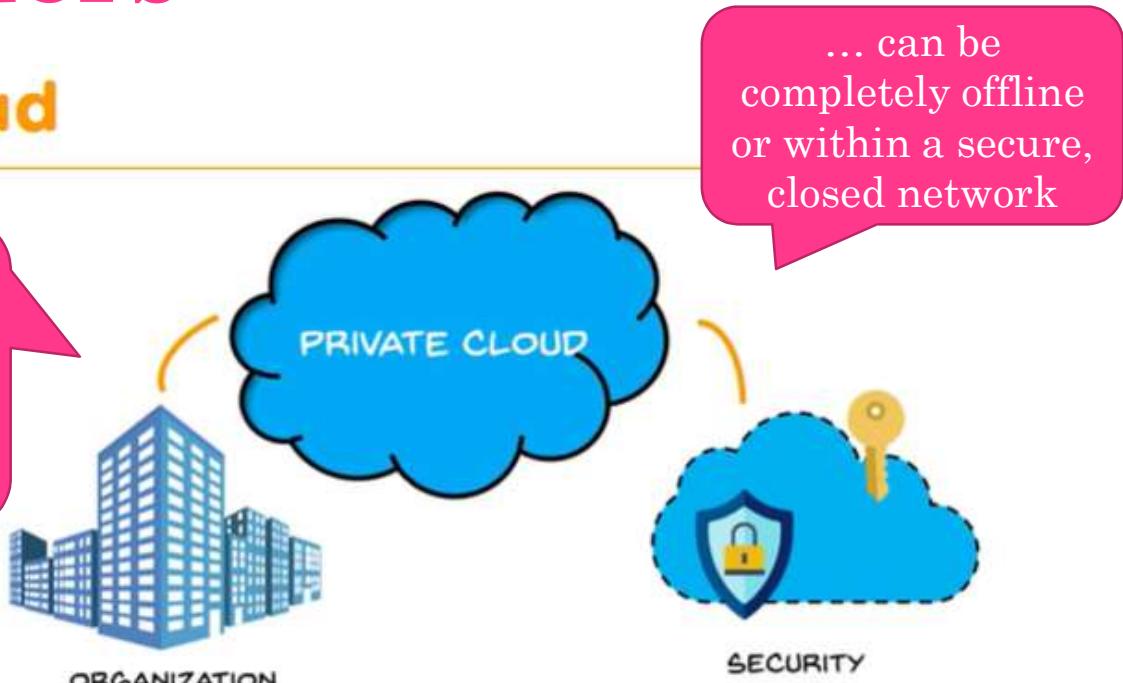
Celeste:

- Google Cloud Platform,
- Alibaba Cloud

3.1. Deployment models – cloud providers

Private Cloud

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



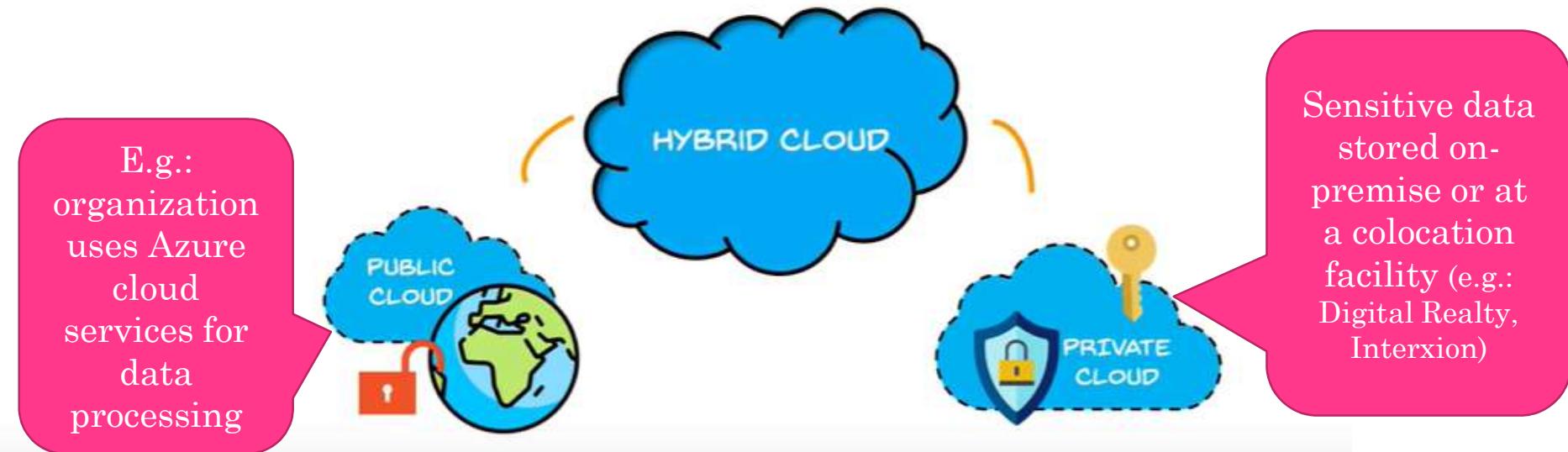
... operated by a single organization or for an organization

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

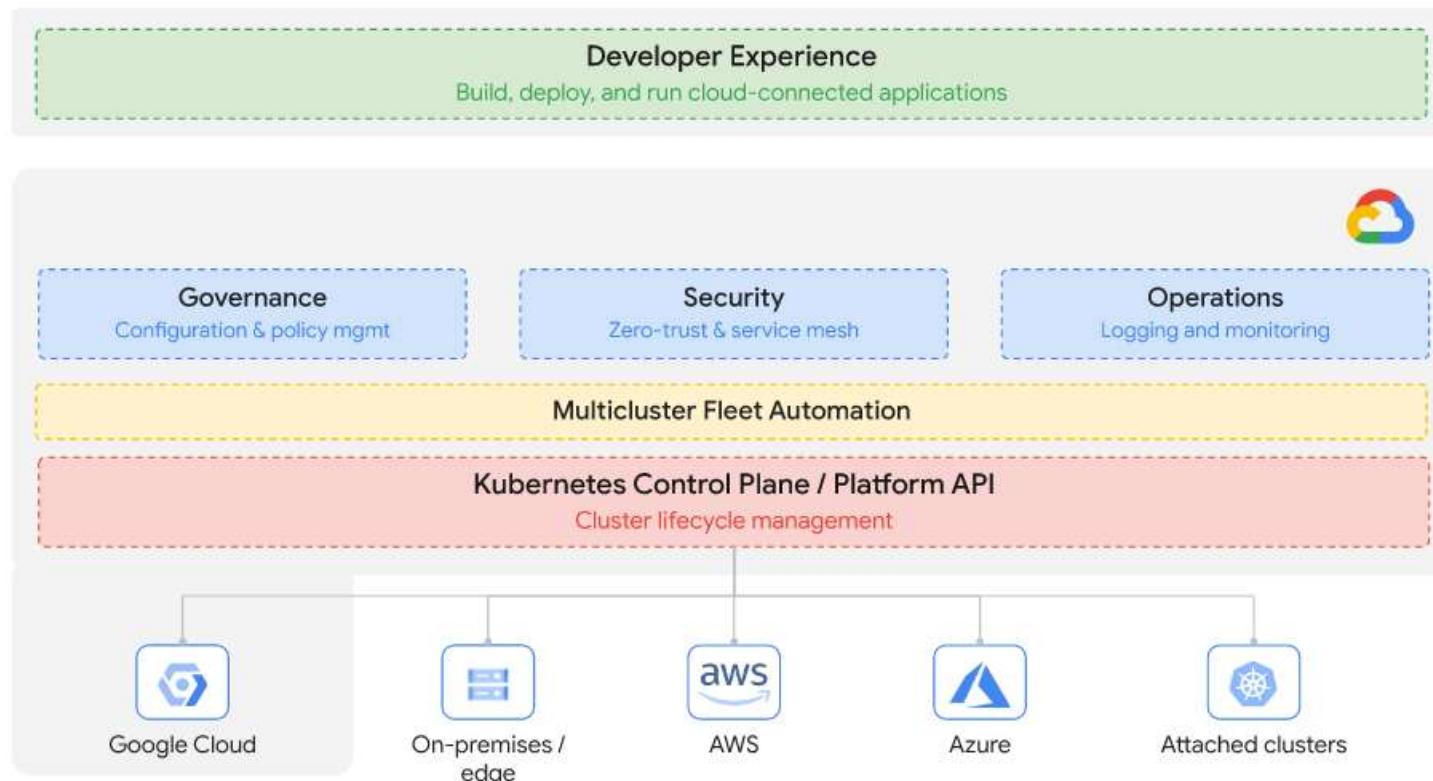


It consists the functionalities of both public and private cloud

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.

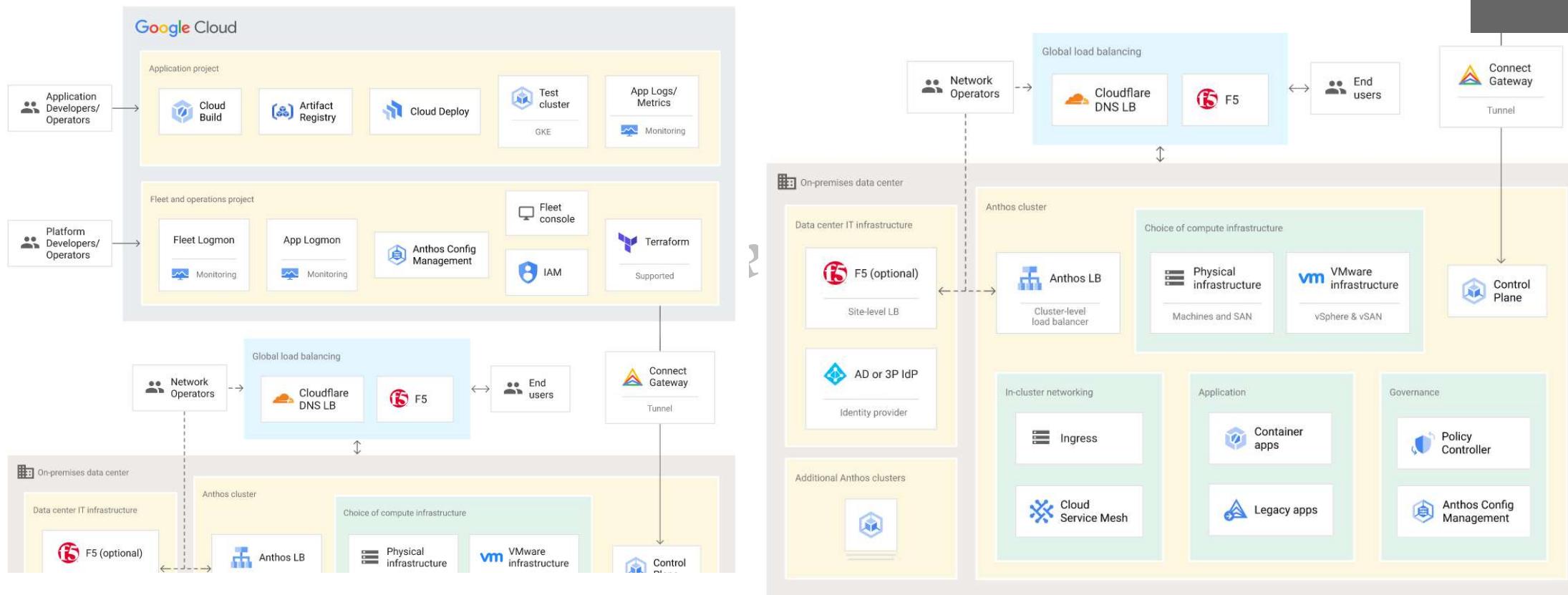
3.1. An example of a hybrid cloud: Google Anthos



- 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>

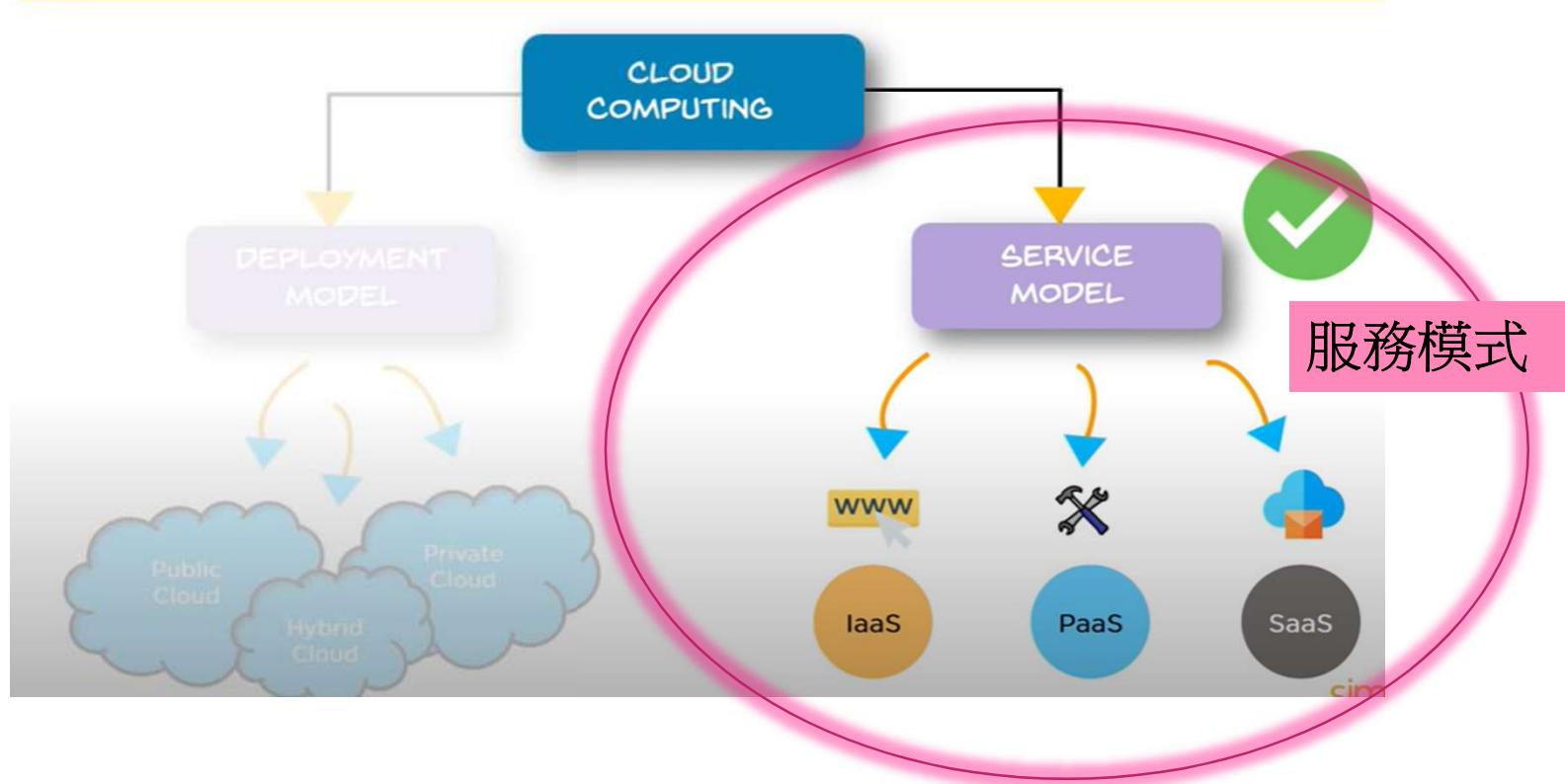
3.1. An example of a hybrid cloud: Google Anthos



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?



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 the Infrastructure as a Service (IaaS) model. On the left, a light blue rectangular box contains a yellow circle with the text "IaaS" and a blue "WWW" icon with a cursor pointing at it. Below this are four green checkmark icons with corresponding text: "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", and "Users: IT Administrators". A red rectangular box highlights the "Users: IT Administrators" text. On the right, a hand holds a black smartphone displaying a white screen with the text "IAAS PRODUCTS AND SERVICES" at the top. The screen shows logos for "amazon web services™ EC2", "Microsoft Azure", and "GOGRID".

- ✓ 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**

IAAS PRODUCTS AND SERVICES

amazon web services™ EC2

Microsoft Azure

GOGRID

3.2. Service models – cloud providers

PaaS



Celeste: is GitHub a 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

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.

Celeste: information
verified!

3.2. Service models – cloud providers

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 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

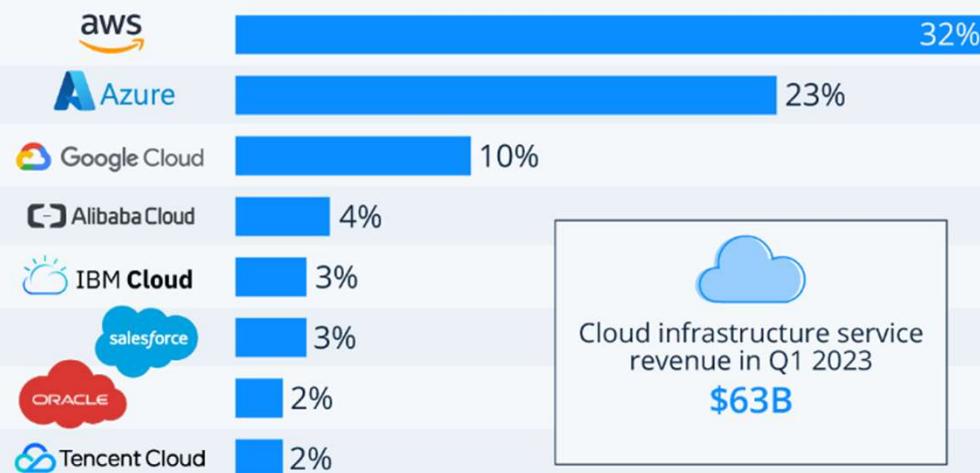
4. Cloud infrastructure service providers



4. Cloud infrastructure service providers

Big Three Dominate the Global Cloud Market

Worldwide market share of leading cloud infrastructure service providers in Q1 2023*



* includes platform as a service (PaaS) and infrastructure as a service (IaaS)
as well as hosted private cloud services

Source: Synergy Research Group





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Ng, 2025

THANK YOU!



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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/>