Amirkabir University of Technology
(Tehran Polytechnic)


# Cloud Computing

# 5-4-3 Principles of Cloud computing

Seyyed Ahmad Javadi

sajavadi@aut.ac.ir

Fall 2022

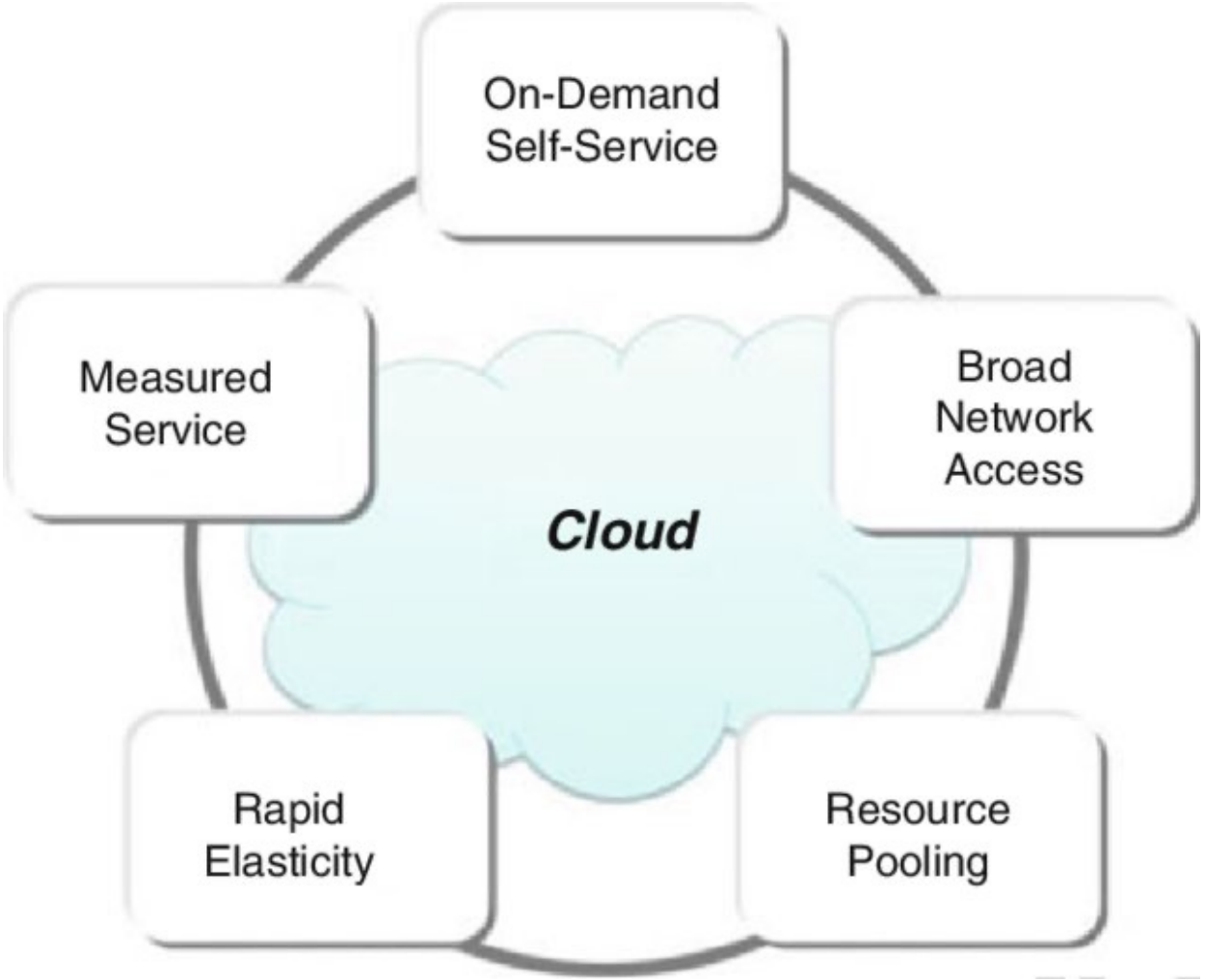


# 5-4-3 Principles of Cloud computing

- The 5-4-3 principles put forth by NIST describe:
  - The five essential characteristic features
  - The four deployment models
  - The three important and basic service offering models

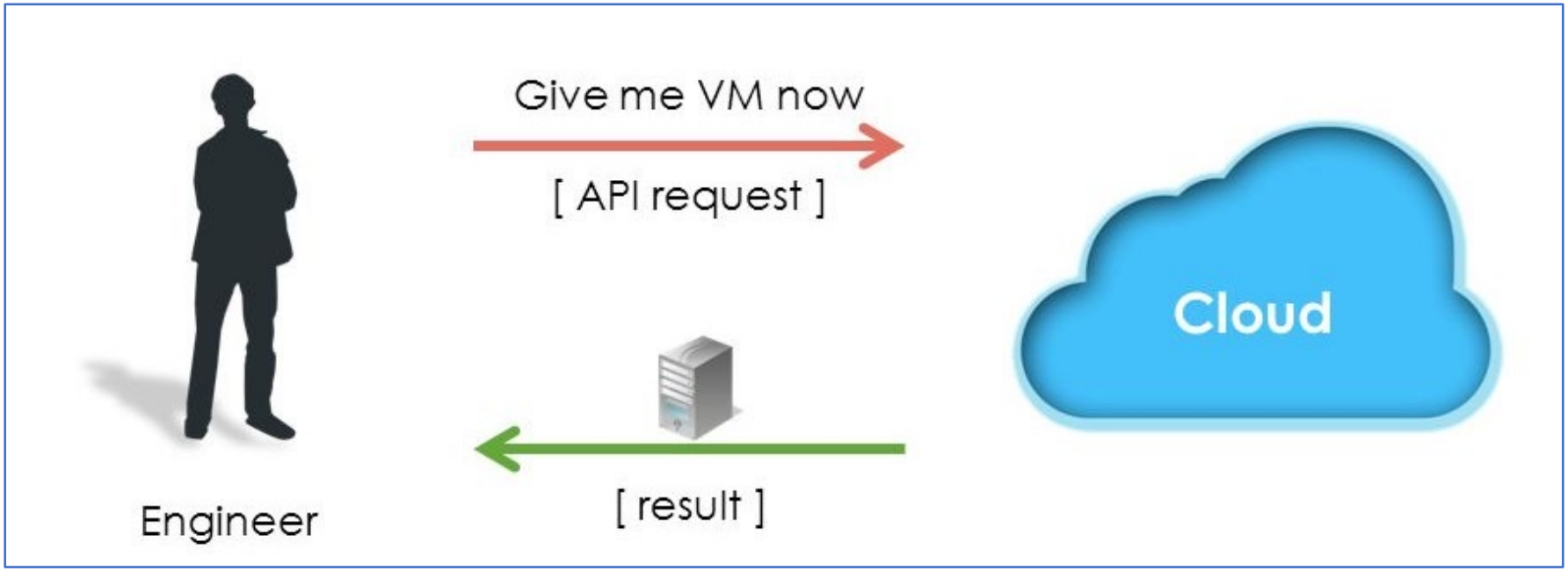
https://medium.com/@angelinmaryjohn/cloud-computing-what-exactly-is-it-ec218cb71a93

# Five Essential Characteristics



# On-demand self-service

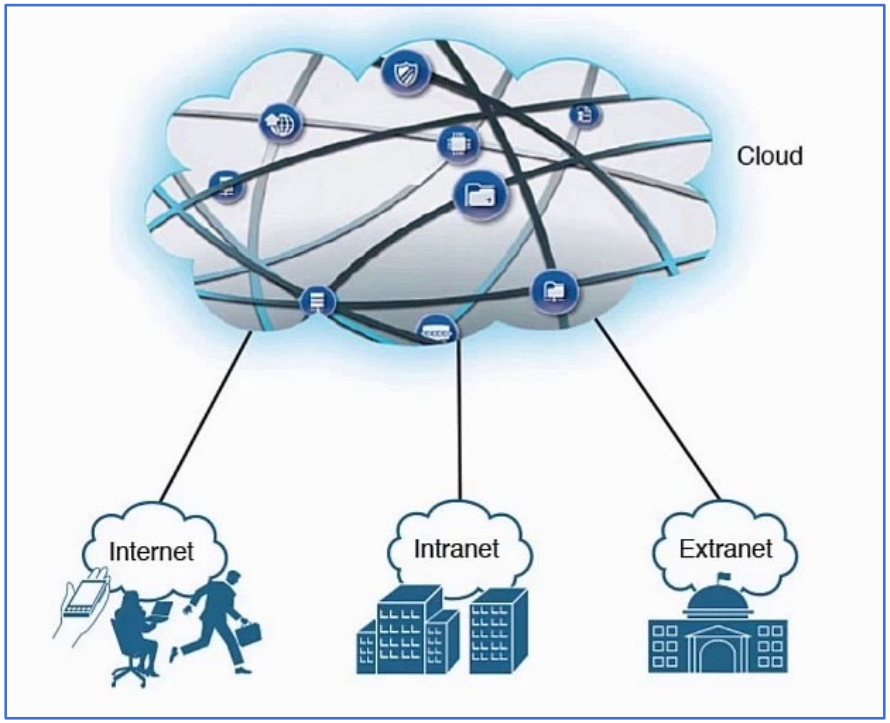
- Capabilities can be provisioned automatically without requiring human interaction with service providers.




https://www.hitechmv.com/cloud-computing-the-characteristics-part-2/

# Broad network access

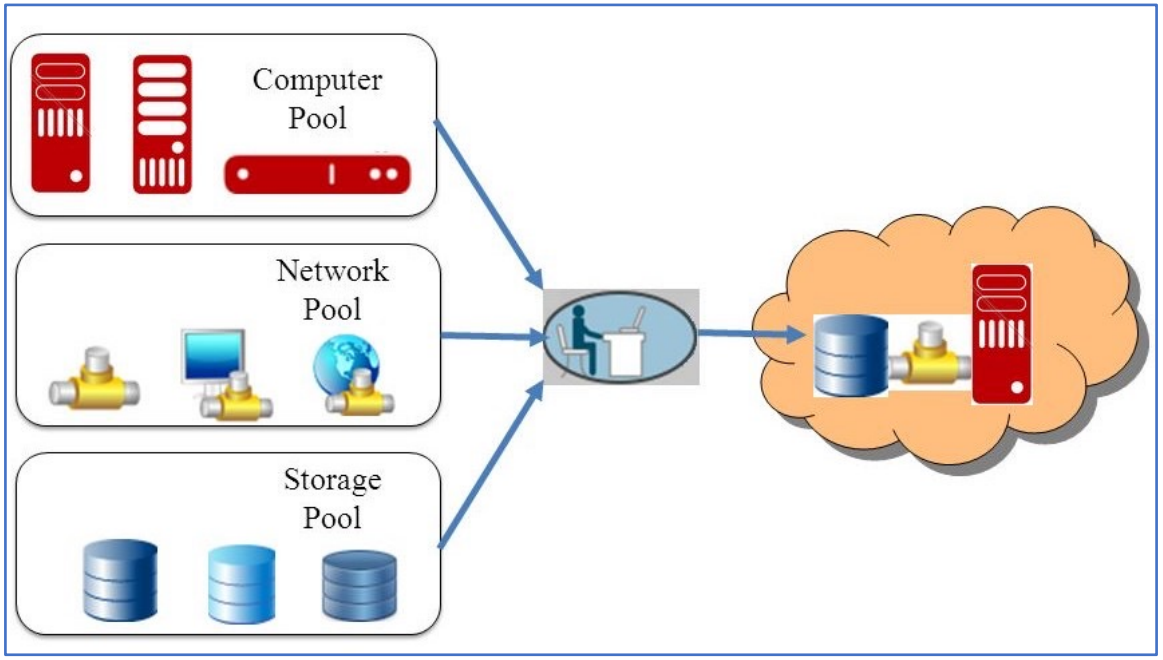
- Capabilities are available over the network and accessed through standard mechanisms.




https://www.hitechmv.com/cloud-computing-the-characteristics-part-2/

# Elastic resource pooling

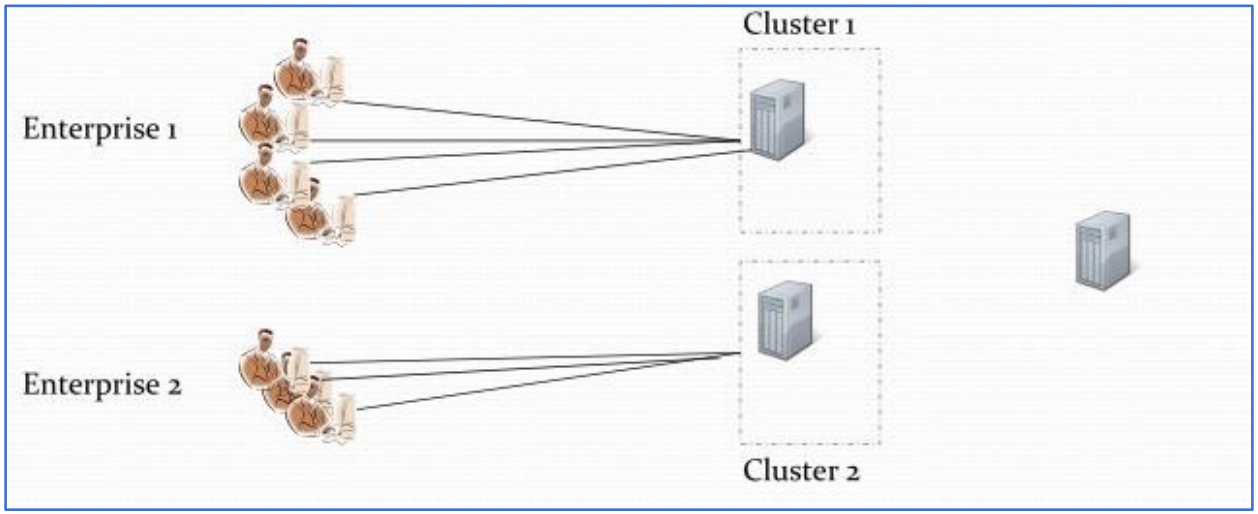
- The provider's computing resources are pooled to serve multiple consumers using a ***multitenant model***.




https://www.hitechmv.com/cloud-computing-the-characteristics-part-2/

# Rapid elasticity

- Capabilities can be rapidly and elastically provisioned to *quickly* ***scale out*** and rapidly released to quickly ***scale in***.
- To consumers, the capabilities often appear to be ***unlimited*** and can be purchased in any quantity at any time.




https://www.hitechmv.com/cloud-computing-the-characteristics-part-2/

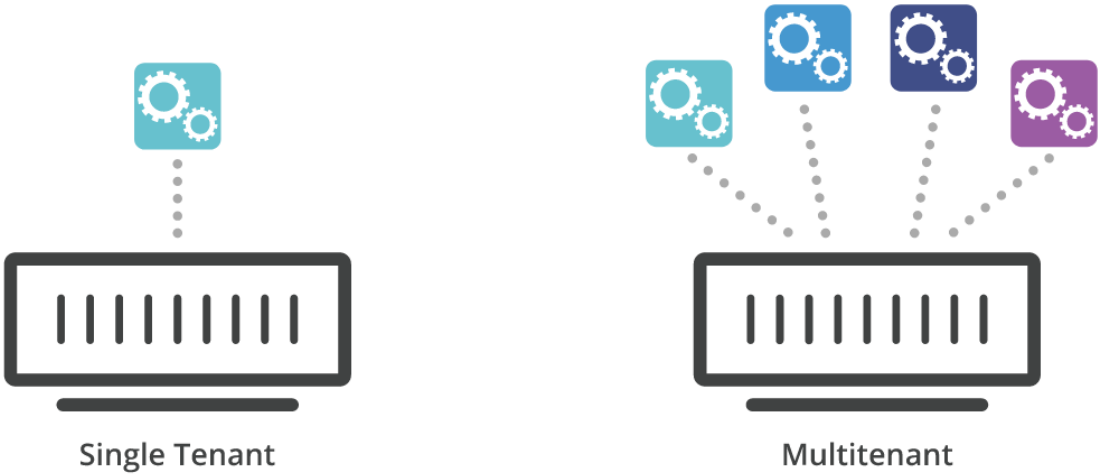
# Measured service

- Cloud systems automatically control and optimize resource use.
- Using metering capability at some level of abstraction appropriate to the type of service.
  - e.g., storage, processing, bandwidth, and active user accounts.

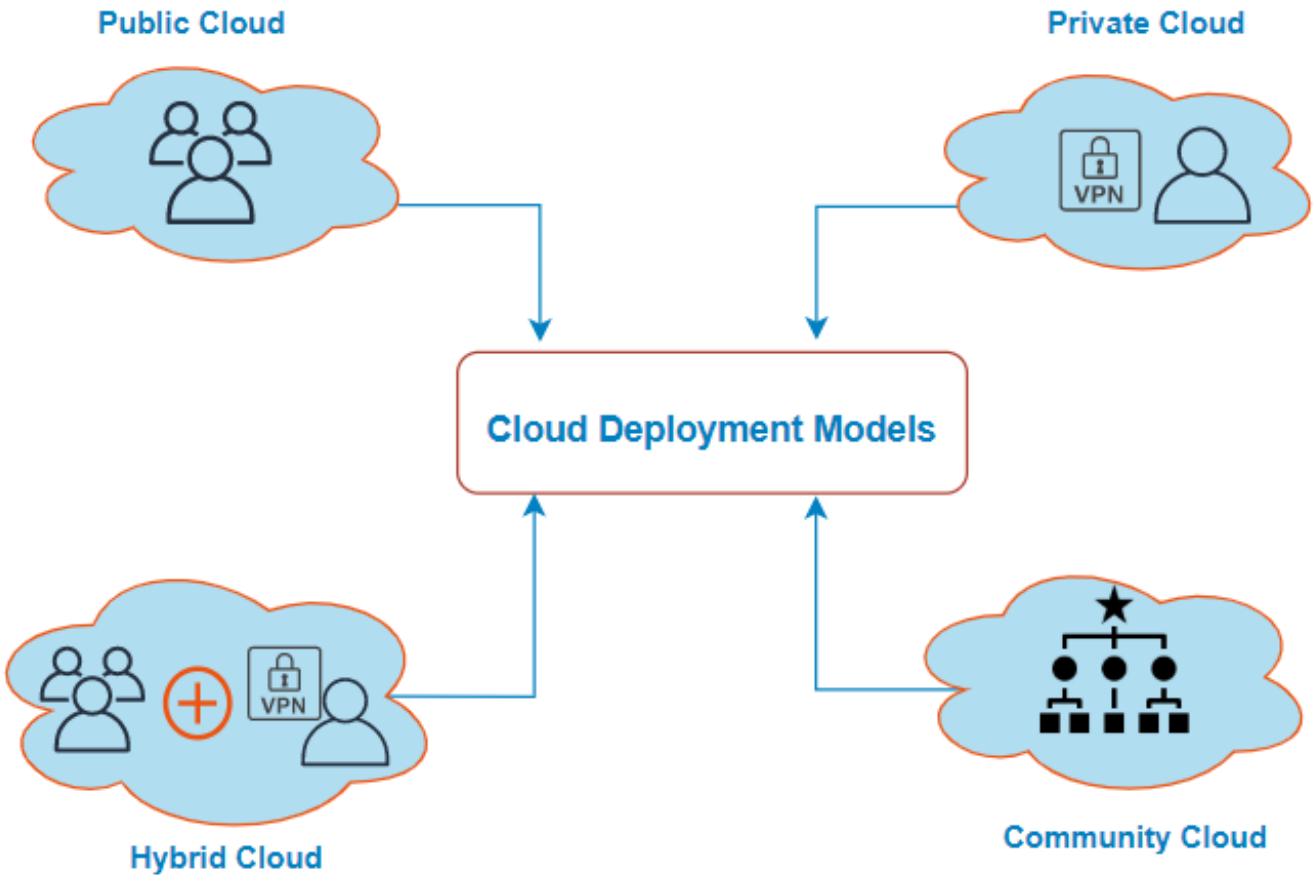
https://www.hitechmv.com/cloud-computing-the-characteristics-part-2/

# Another Important Characteristic

- **Multitenancy**
  - Cloud computing is ***a shared resource*** that draws on *resource pooling* as an important feature.
  - Use of same resources ***by multiple consumers***, so called *tenants*.



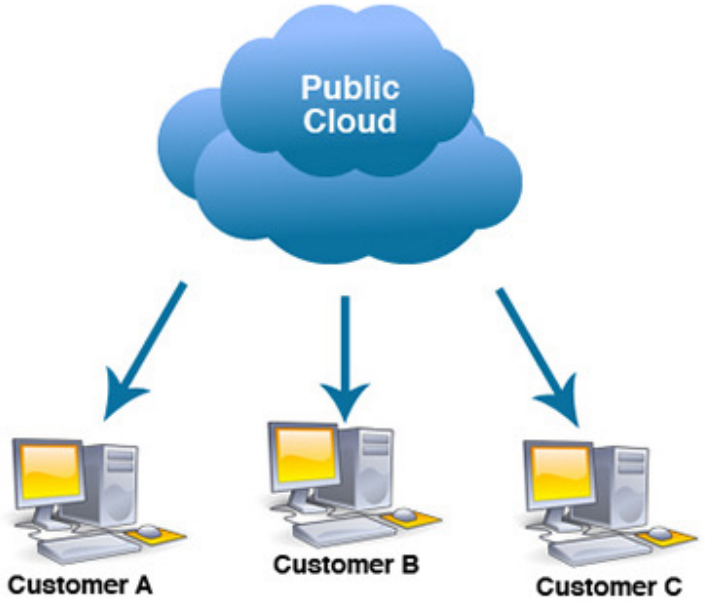
# Four Cloud Deployment Models




https://cloudiofy.com/types-of-cloud-computing/

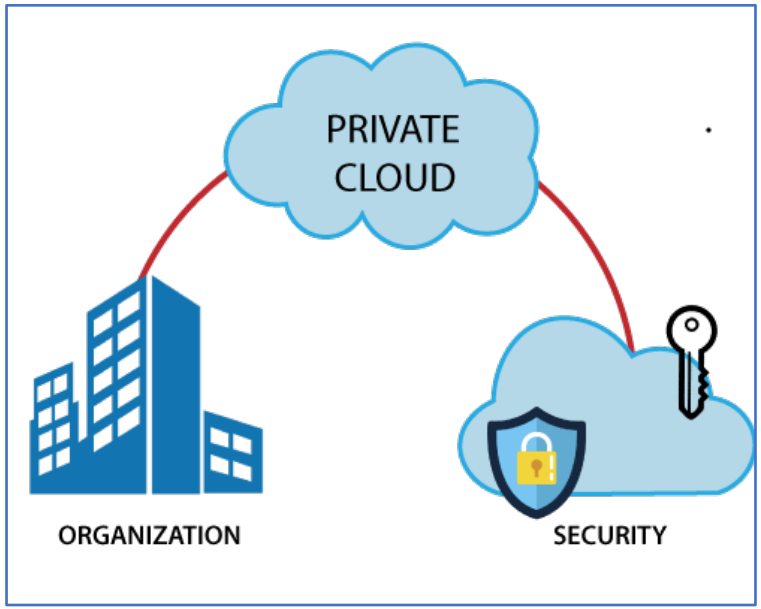
# Public cloud

- Cloud infrastructure is provisioned for **open use by the general public**.
- It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them.



# Private cloud

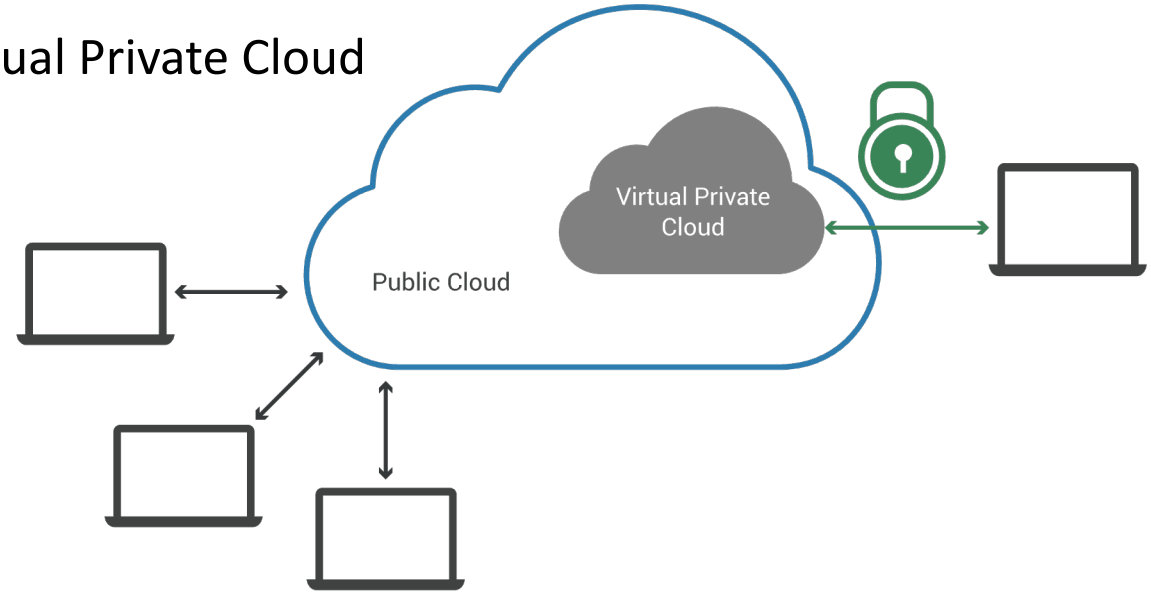
- The cloud infrastructure is provisioned for ***exclusive use by a single organization*** comprising multiple consumers.
- It may be owned, managed, and operated by the organization, a third party, or some combination of them.



# Private cloud (cont.)

## Virtual Private cloud

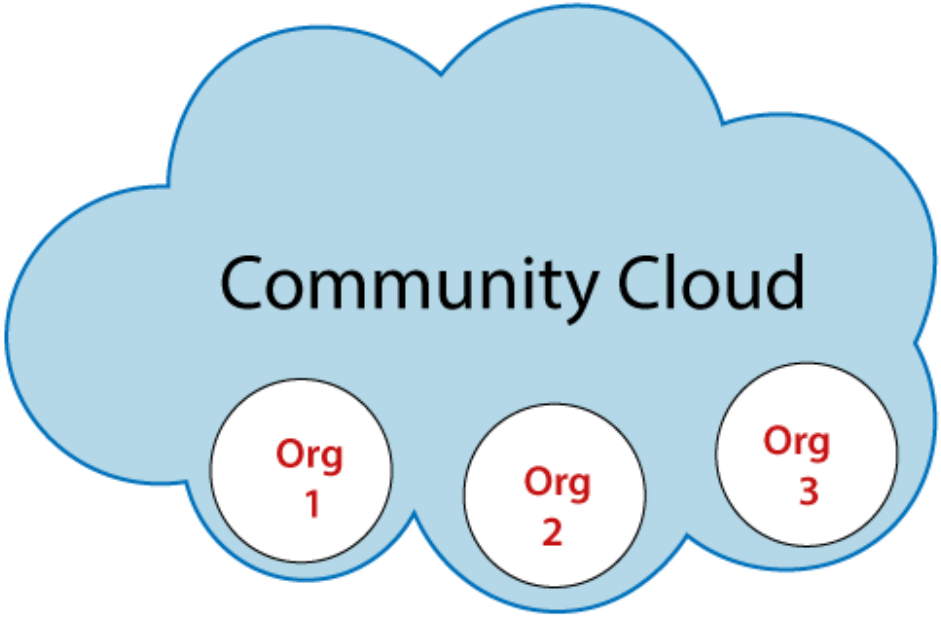
- IS a segment of a public cloud, designated for a user ***with additional provisions and features*** for meeting that user's specific security and compliance requirements.
- Example: Amazon's Virtual Private Cloud




https://www.cloudflare.com/fr-fr/learning/cloud/what-is-a-virtual-private-cloud/

# Community cloud

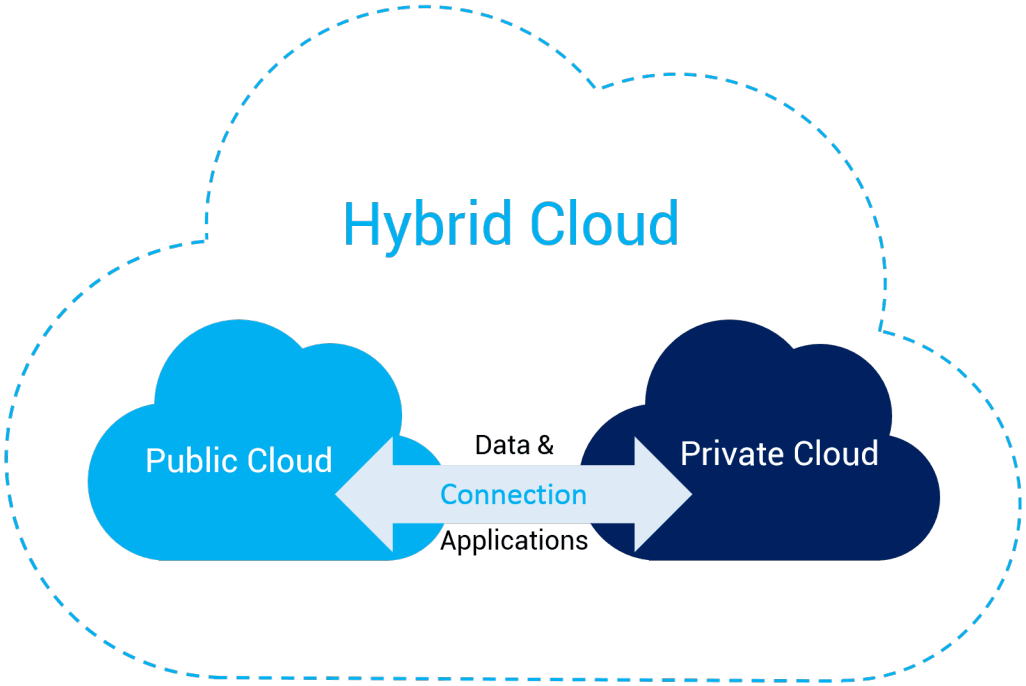
- The cloud infrastructure is shared by several organizations and supports a specific community ***that has shared concerns***.



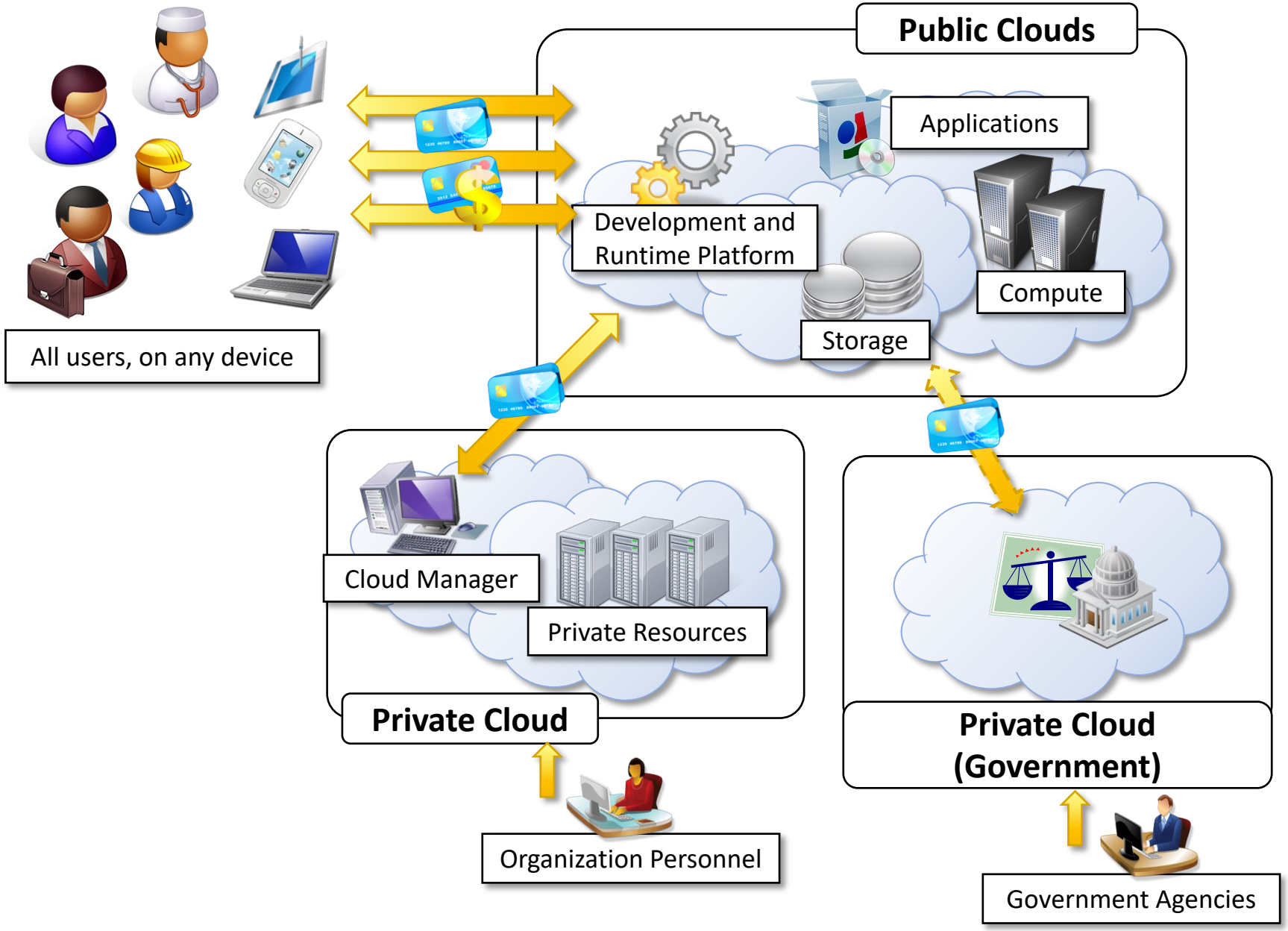

https://www.javatpoint.com/community-cloud

# Hybrid cloud

- The cloud infrastructure is a composition ***of two or more distinct cloud infrastructures*** (private, community, or public).




https://www.alibabacloud.com/knowledge/what-is-hybrid-cloud

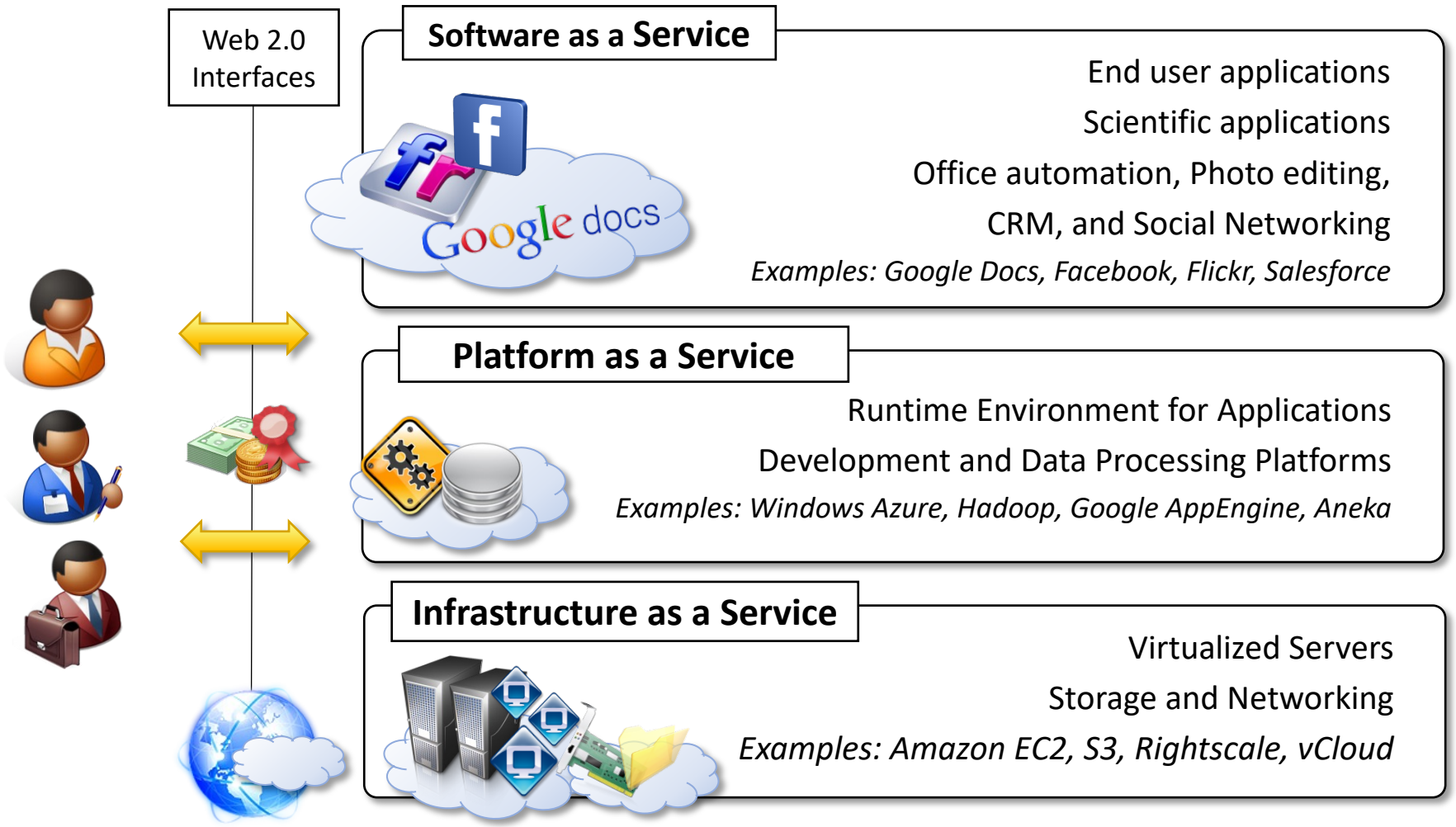

Public Clouds
Applications
Development and Runtime Platform
Compute
Storage
All users, on any device
Cloud Manager
Private Resources
Private Cloud
Private Cloud (Government)
Organization Personnel
Government Agencies

# Three Service Offering Models

- A fundamental characteristic of cloud computing is the capability to deliver, ***on demand***, a variety of IT services that are ***quite diverse*** from each other.
- Cloud computing services categorize into three major categories:


https://edge.siriuscom.com/cloud/the-top-3-cloud-computing-service-models

# Three Service Offering Models (cont.)



# Software as a Service (SaaS)

- An application is hosted by a cloud vendor and delivered as a service to users, primarily via the Internet.

# Software as a Service (SaaS)

- It eliminates the need to install and run the application locally.
  - No need for hardware and software maintenance and upgrades.

- Typical applications: Customer Relationship Management (CRM), business intelligence analytics, and online accounting software.

- Examples: SalesForce, Office 365, Google Apps

# Platform as a Service (PaaS)

- The platform and tools for application development and middleware systems are hosted by a vendor and offered to application developers.

# Platform as a Service (PaaS)

- Developers simply code and deploy without directly interacting with the underlying infrastructure .

- Service provider are responsible to provide *scalability and to manage fault tolerance.*
  - Users instead ***focus on the logic of the application*** while leveraging the provider's APIs and libraries.

- Examples: Google App Engine, Microsoft Azure Services.

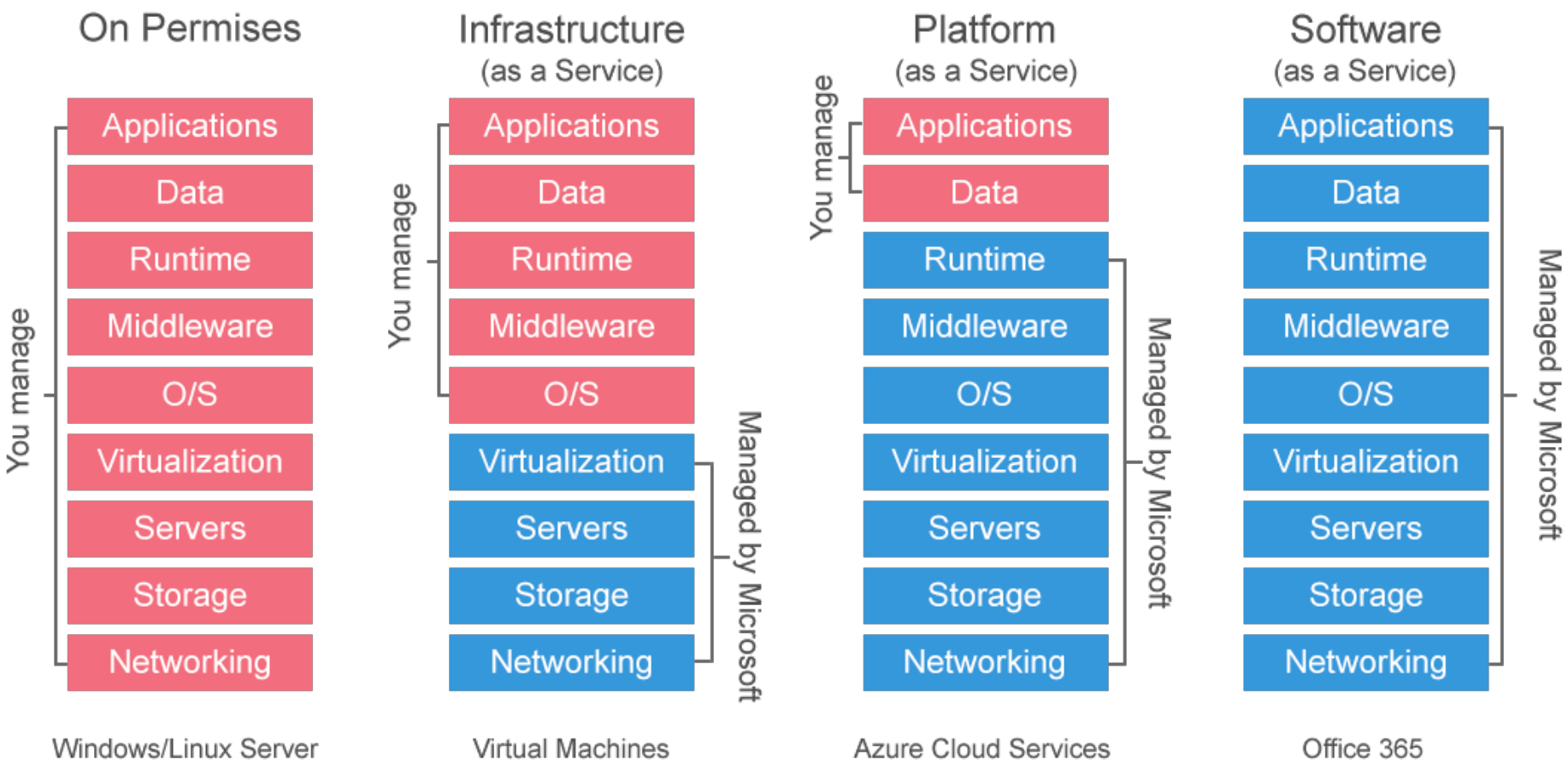
# Infrastructure as a Service (IaaS)

- Provisioning processing, storage, networks (and etc.) on a pay-per-use basis enabling users to deploy and run arbitrary software, which can *include operating systems and applications*.

# Infrastructure as a Service (IaaS)

- Virtual hardware is utilized to provide compute on demand in the form of virtual machine instances.
- Virtual storage is delivered in the form of raw disk space or object store.
- Example: Amazon Elastic Compute Cloud (EC2), GoGrid, and FlexiScale.

# The Three Delivery Models of Cloud Computing



# Anything as a Service (XaaS)

- Anything as a service, or XaaS, refers to the growing diversity of services available over the Internet via cloud computing.
- There are many services like
  - Desktop as a Service or Data as a Service (DaaS)
  - Communication as a Service (CaaS)
  - Monitoring as a Service (MaaS)
  - Testing as a Service (TaaS)
  - Security as a Service (SecaaS)
  - Analytics as a Service (AaaS)
  - **Function as a Service (FaaS)**
  - **Artificial Intelligence as a Service (AIaaS)**