Amirkabir University of Technology
(Tehran Polytechnic)

Cloud Computing

5-4-3 Principles of Cloud computing

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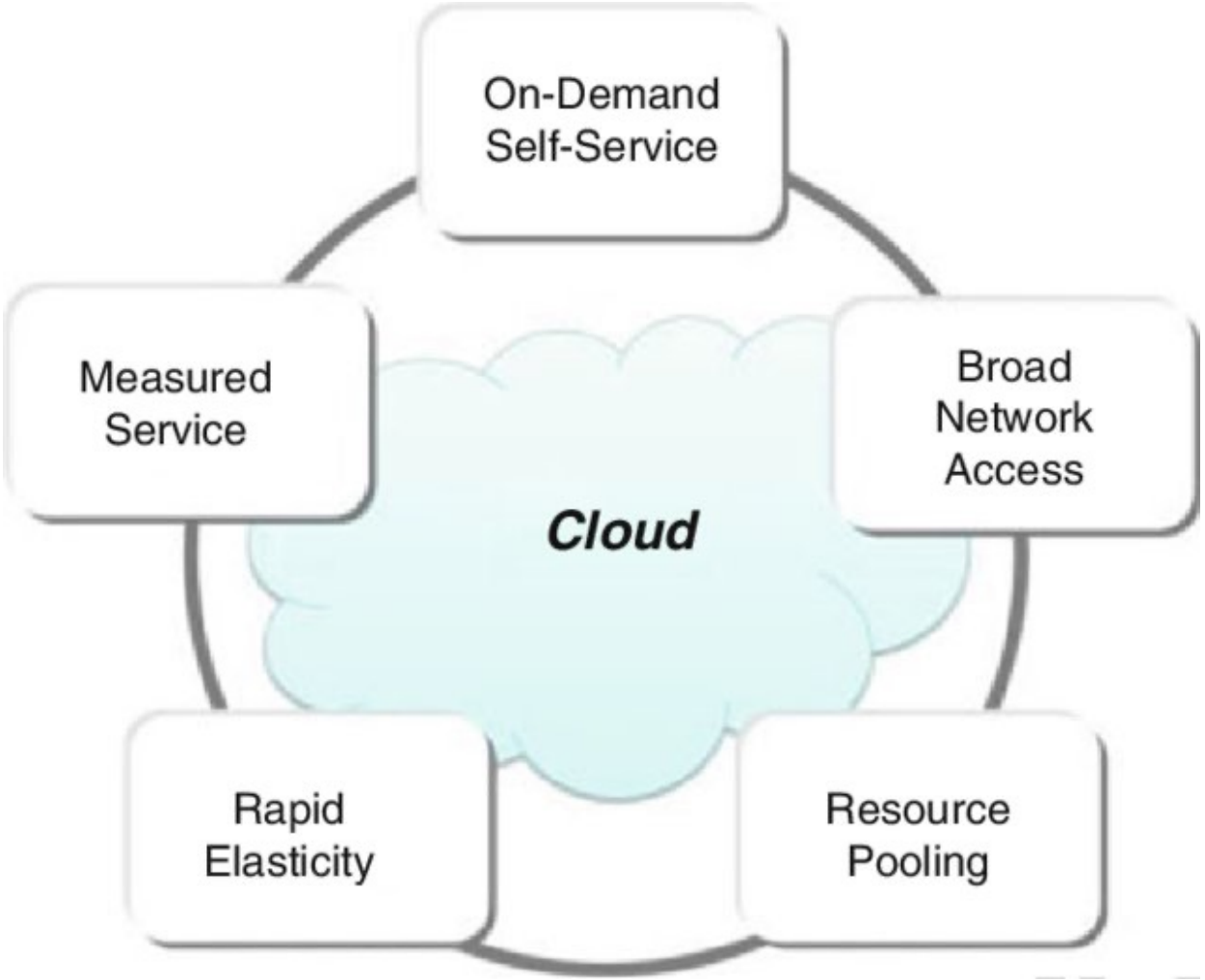
Spring 2023

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

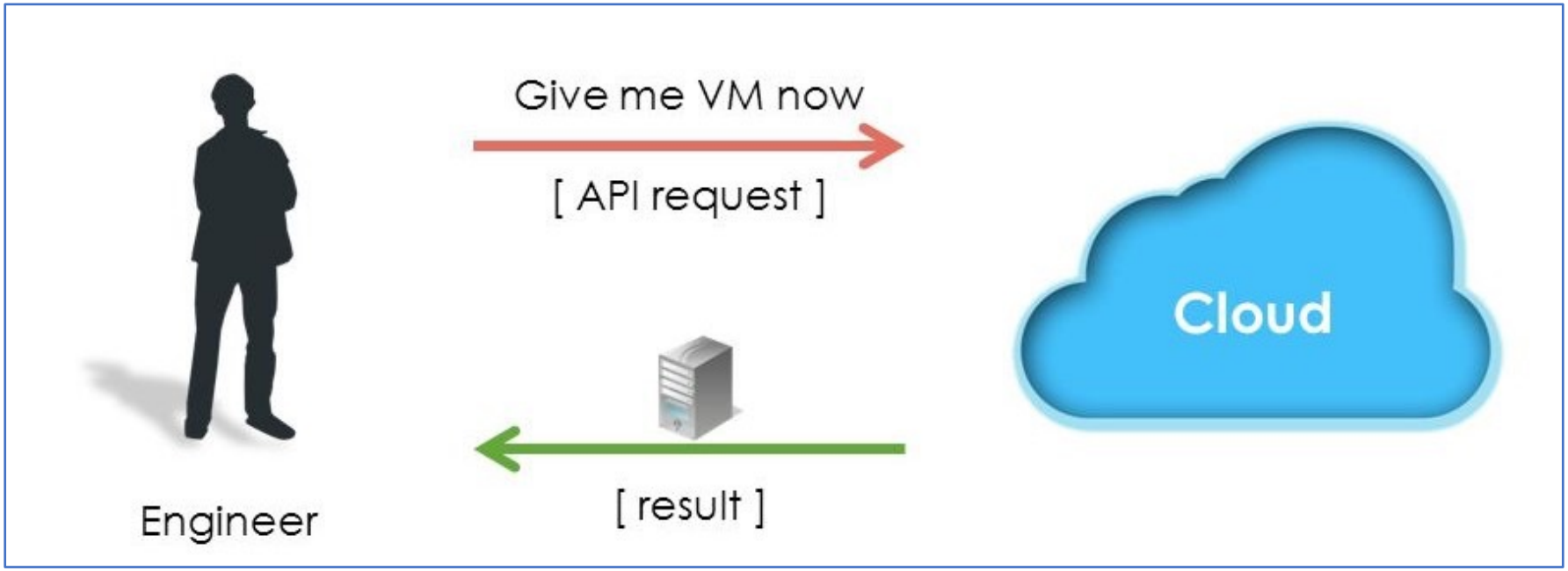
https://medium.com/@angelinmaryjohn/cloud-computing-what-exactly-is-it-ec218cb71a93

Five Essential Characteristics



On-demand self-service

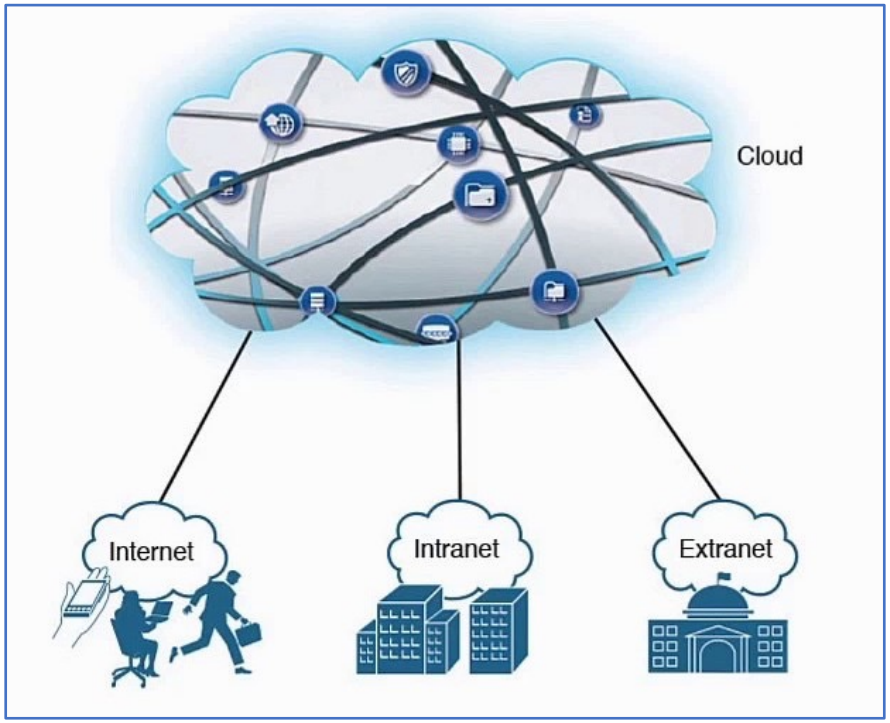
- Capabilities can be provisioned automatically without requiring human interaction with service providers.



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

Broad network access

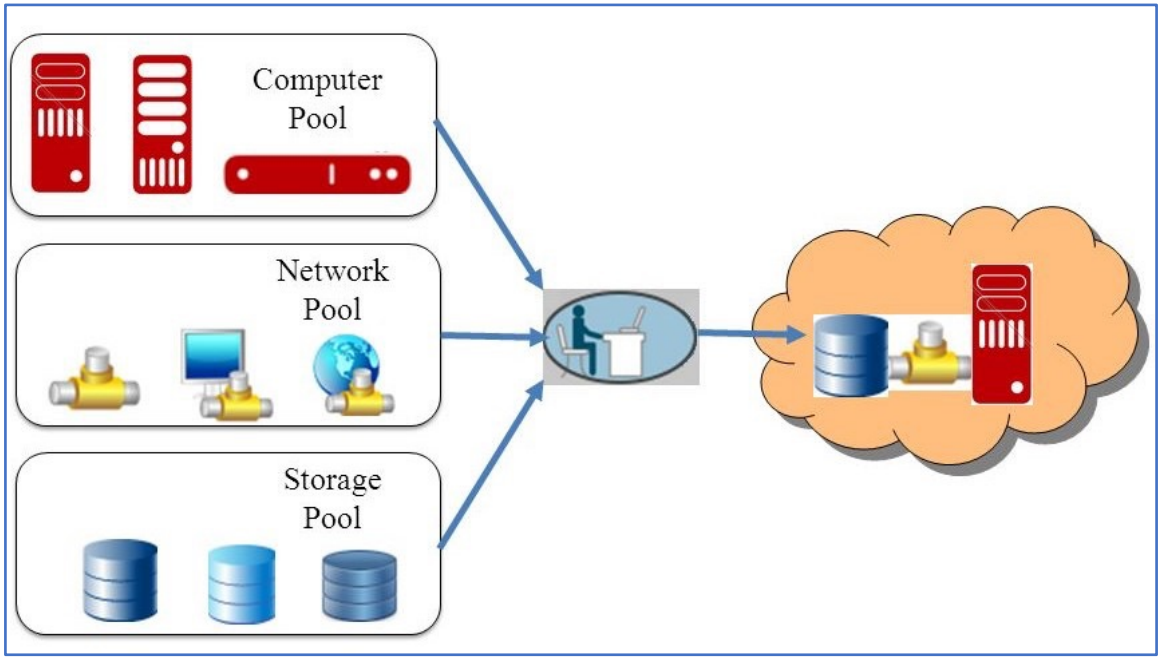
- Capabilities are available over the network and accessed through standard mechanisms.



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

Elastic resource pooling

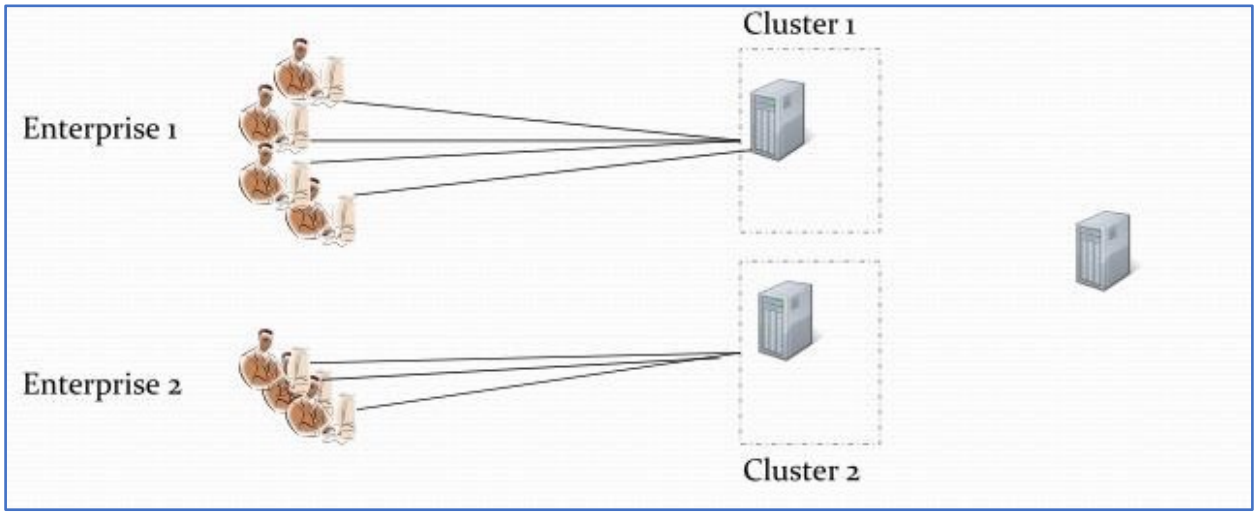
- The provider's computing resources are pooled to serve multiple consumers using a ***multitenant model***.



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

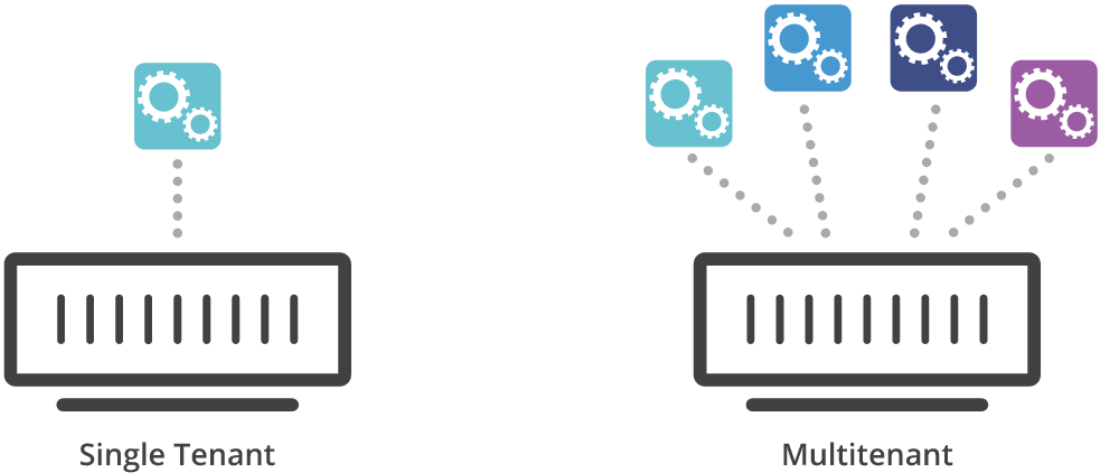
- Cloud systems automatically control and optimize resource use.
- Using metering capability at some level of abstraction appropriate to the type of service.
  - e.g., storage, processing, bandwidth, and active user accounts.

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

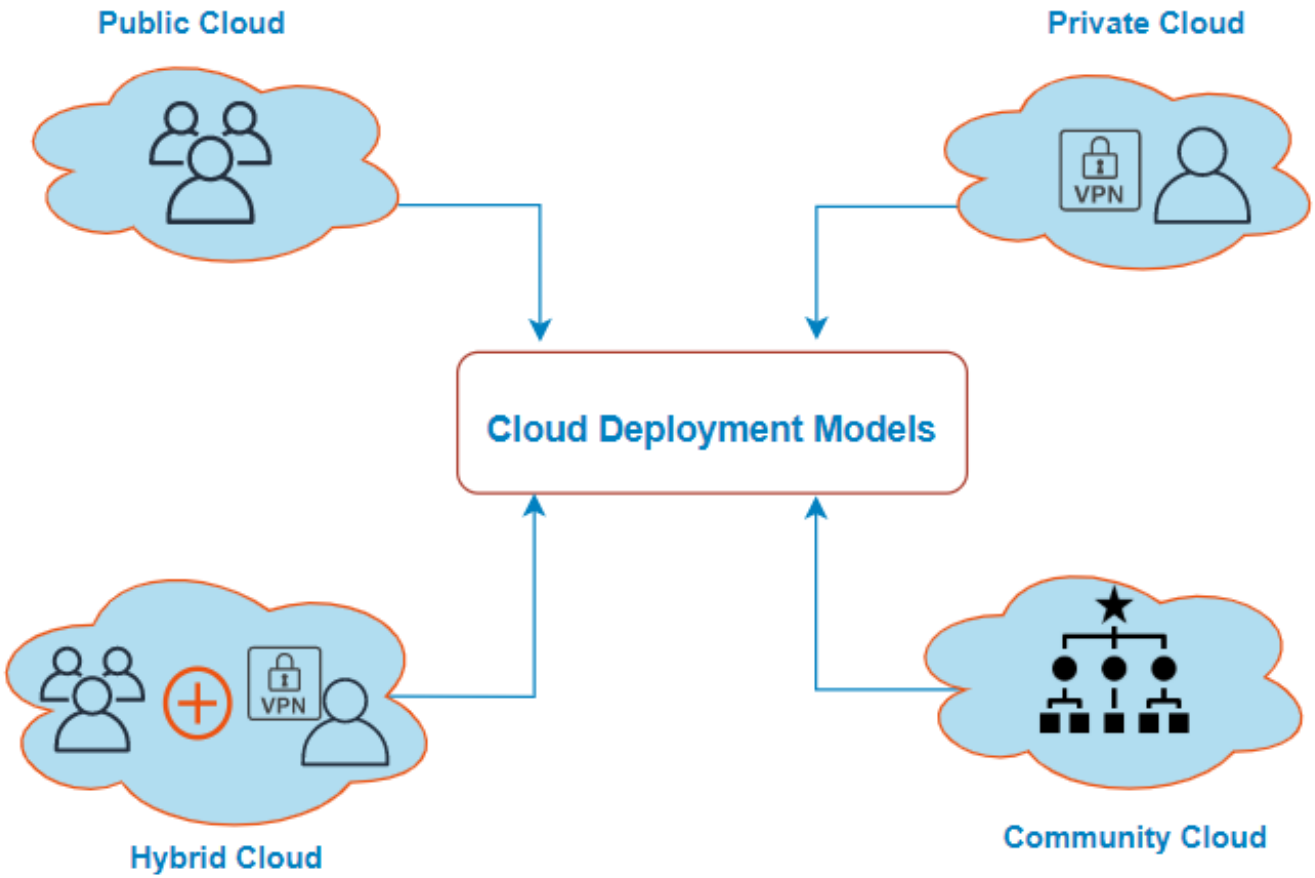
Another Important Characteristic

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*.



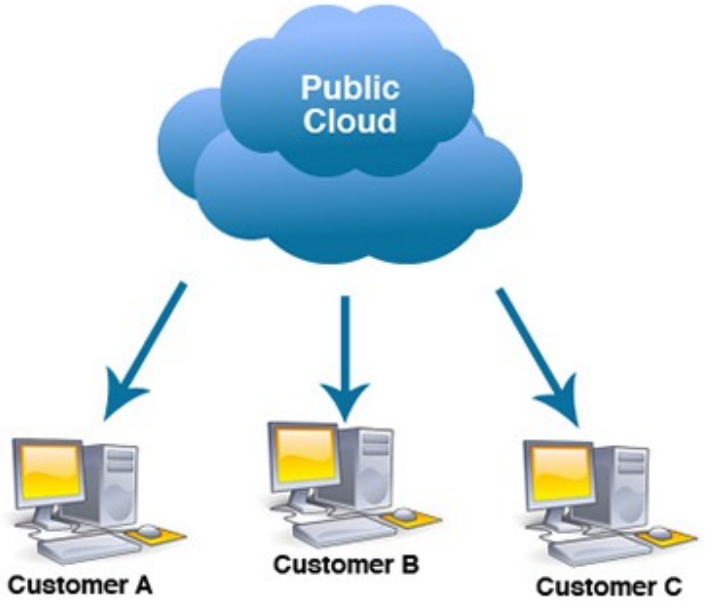
Four Cloud Deployment Models



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

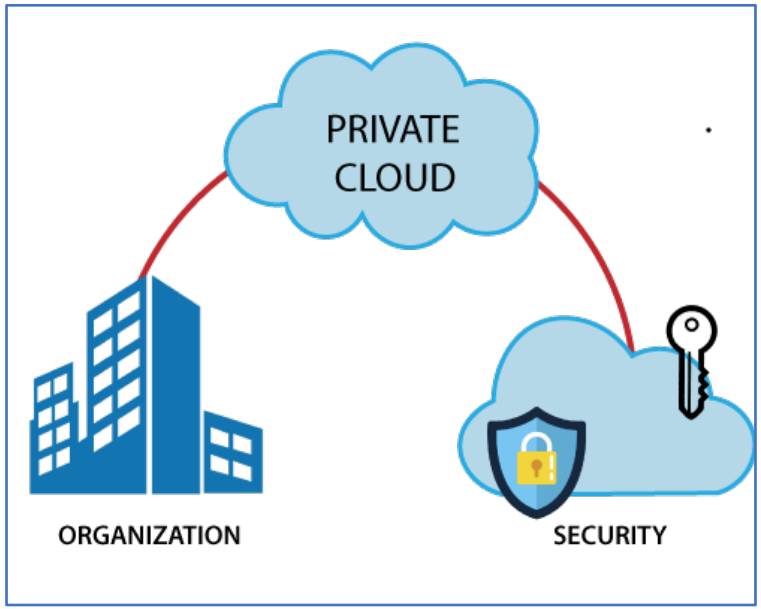
Public cloud

- 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

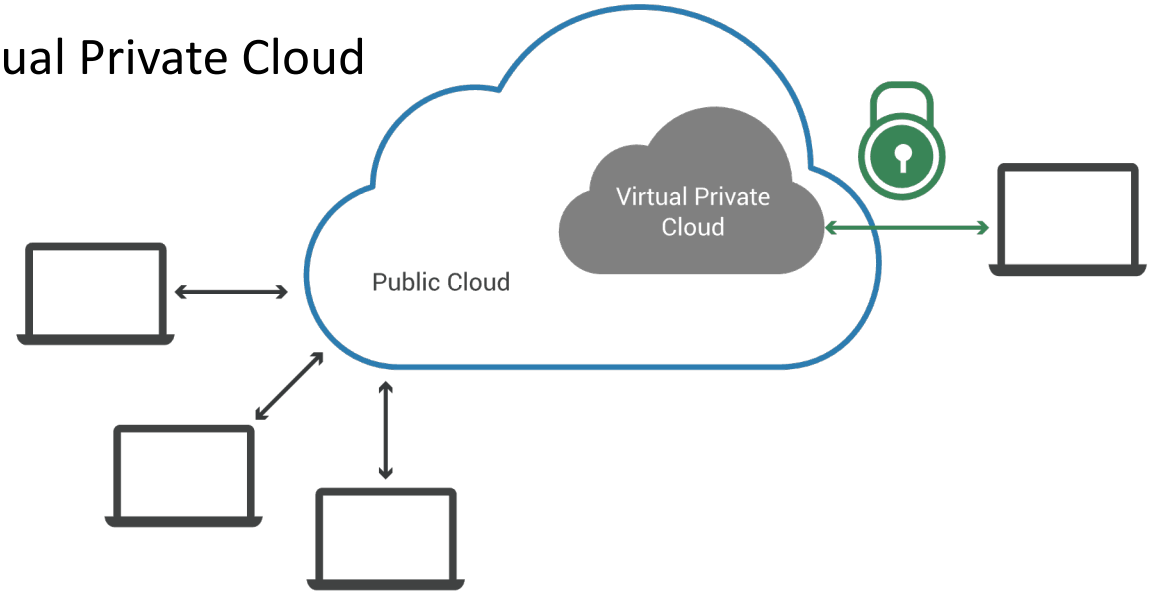
- The cloud infrastructure is provisioned for ***exclusive use by a single organization*** comprising multiple consumers.
- It may be owned, managed, and operated by the organization, a third party, or some combination of them.



Private cloud (cont.)

Virtual Private cloud

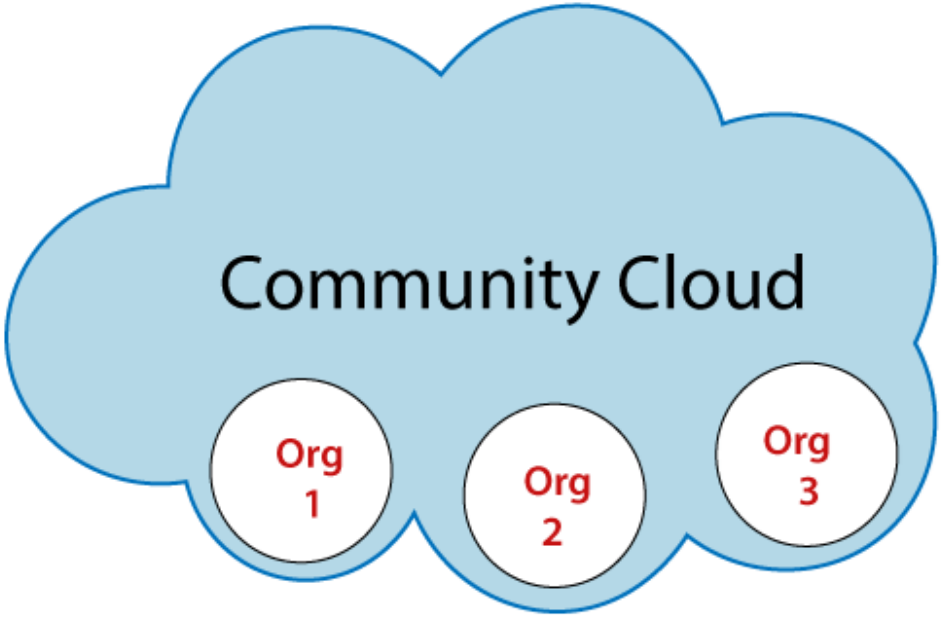
- IS a segment of a public cloud, designated for a user ***with additional provisions and features*** for meeting that user's specific security and compliance requirements.
- Example: Amazon's Virtual Private Cloud



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

Community cloud

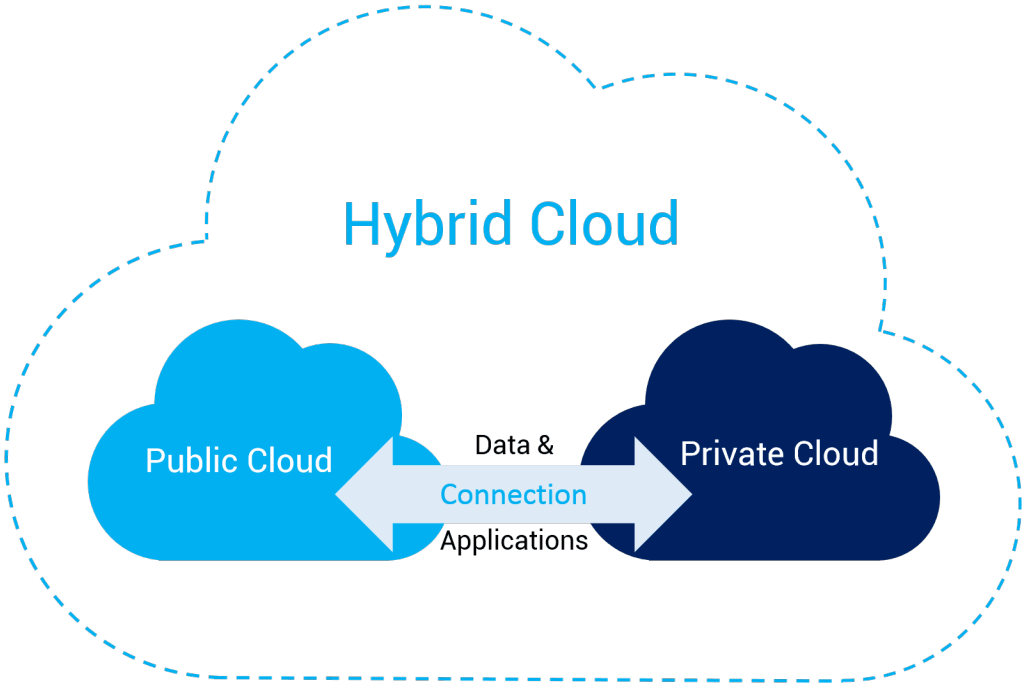
- The cloud infrastructure is shared by several organizations and supports a specific community ***that has shared concerns***.



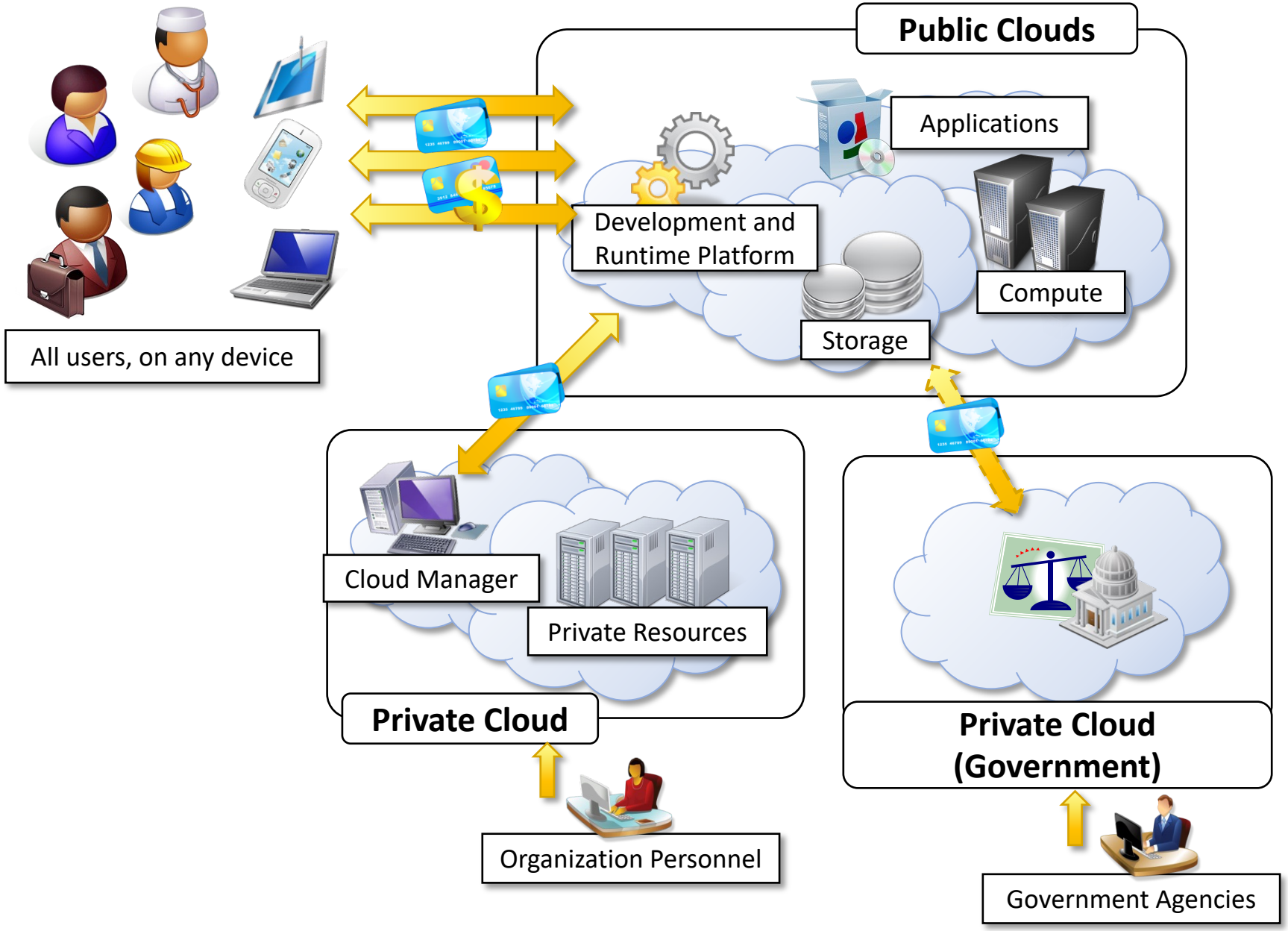
https://www.javatpoint.com/community-cloud

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

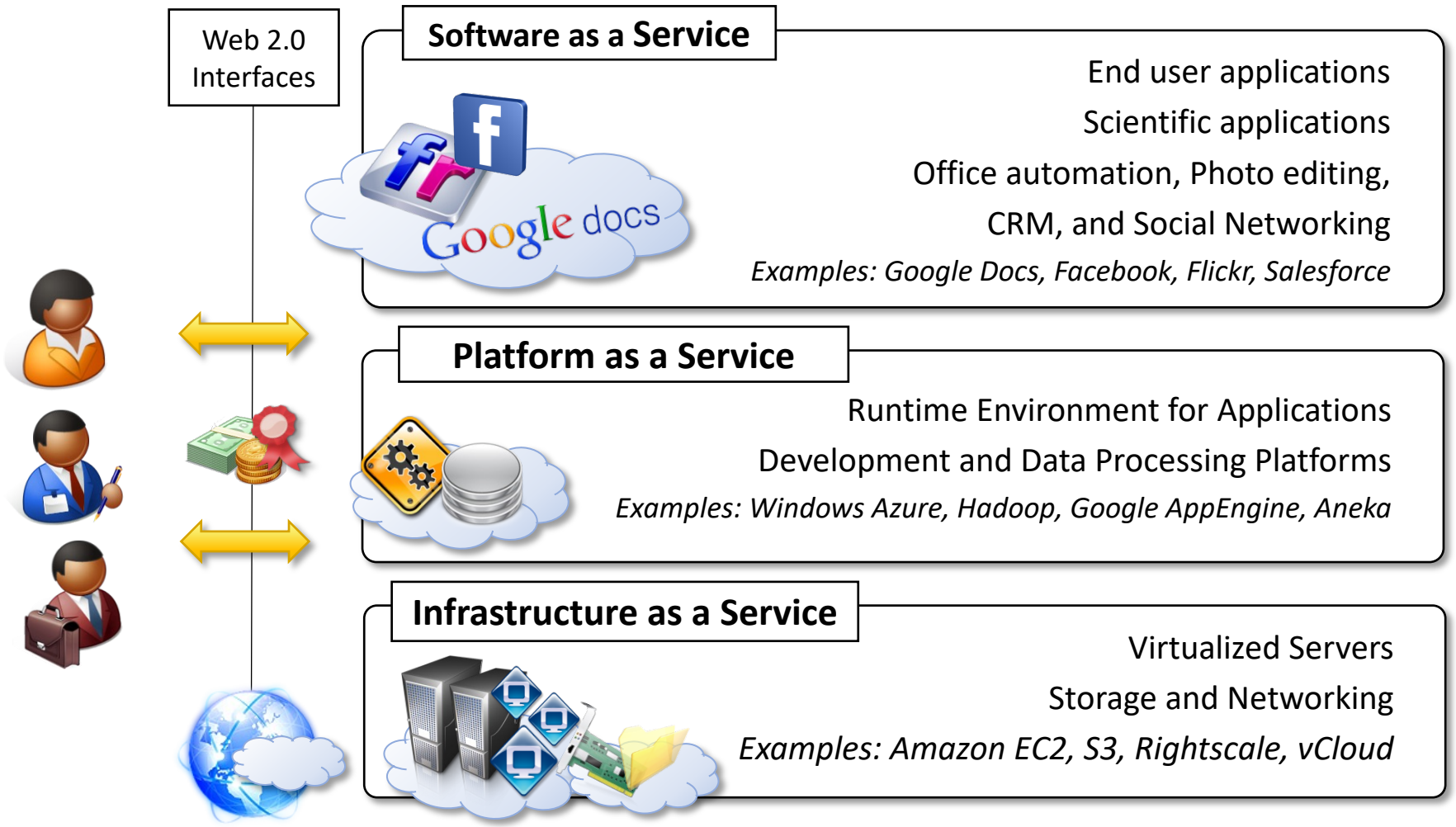

Public Clouds
Applications
Development and Runtime Platform
Compute
Storage
All users, on any device
Cloud Manager
Private Resources
Private Cloud
Private Cloud (Government)
Organization Personnel
Government Agencies

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.

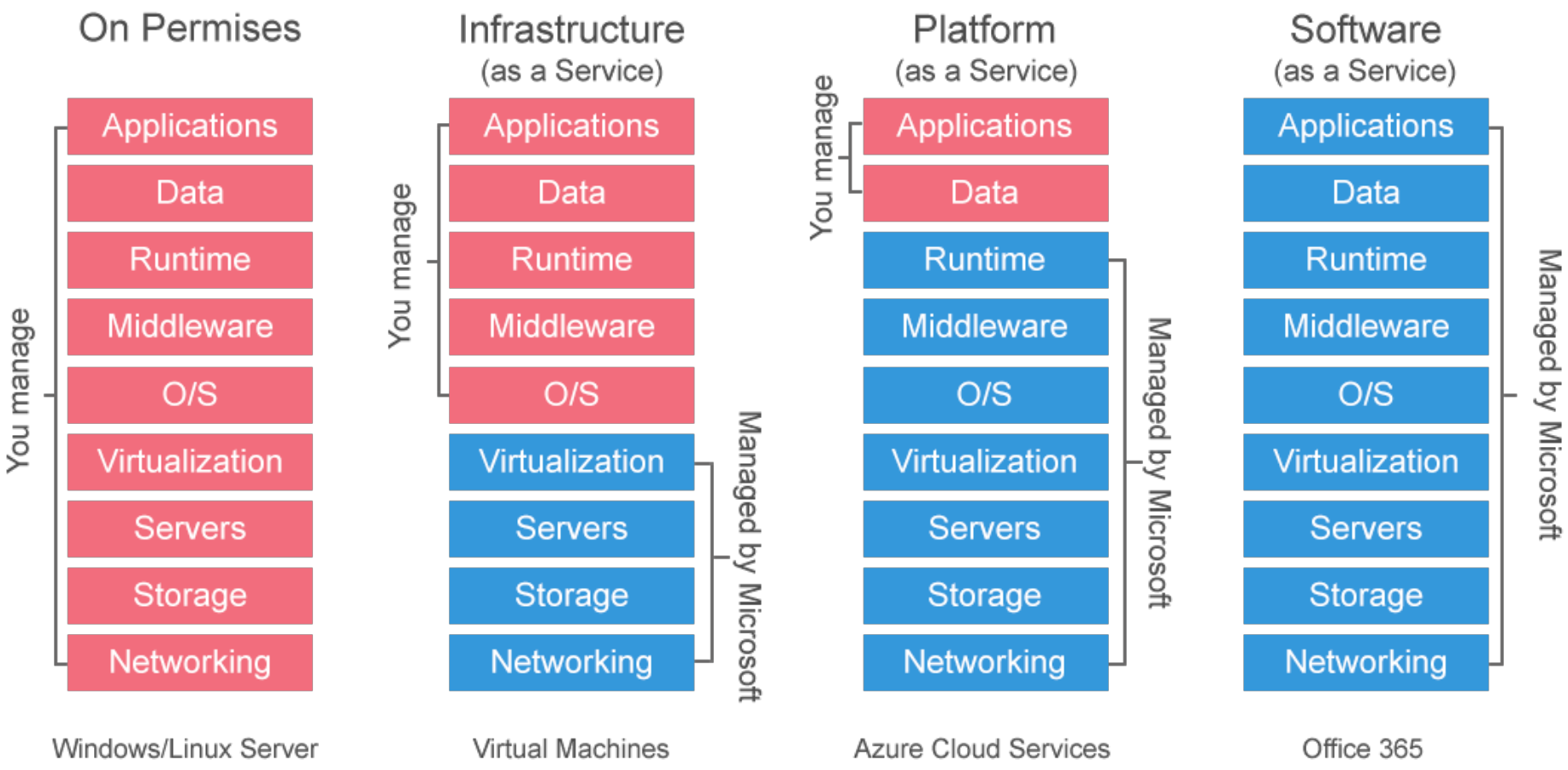
Infrastructure as a Service (IaaS)

- 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)**