



# SESSION 1

COMPUTING PARADIGM AND INTRODUCTION TO CLOUD COMPUTING

# OBJECTIVES

- Computing Paradigms
- Cloud computing definition
- Cloud computing essential characteristics
- Cloud computing deployment models
- Cloud computing service models

# PREAMBLE

- The term paradigm conveys that there is a set of practices to be followed to accomplish a task
- In the domain of computing, there are many different standard practices being followed based on inventions and technological advancements.

# CLIENT/SERVER MODEL

- In the client/server model, all end systems are divided into clients and servers each designed for specific purposes
- Clients have an active role and initiate a communication session by sending requests to servers
  - Clients must have knowledge of the available servers and the services they provide
  - Clients can communicate with servers only; they cannot see each other
- Servers have a passive role and respond to their clients by acting on each request and returning results



# CLIENT/SERVER MODEL (CONT'D)



# CLIENT/SERVER MODEL (CONT'D)

## ➤ Software roles

- TCP/IP uses different pieces of software for many protocols to implement "client" and "server" roles
- Client software is usually found on client hardware and server software on server hardware, but not always
- Some devices may run both client and server software

## ➤ Web clients:

- Mozilla Firefox, Internet Explorer, Google Chrome, . . .

## ➤ Web servers:

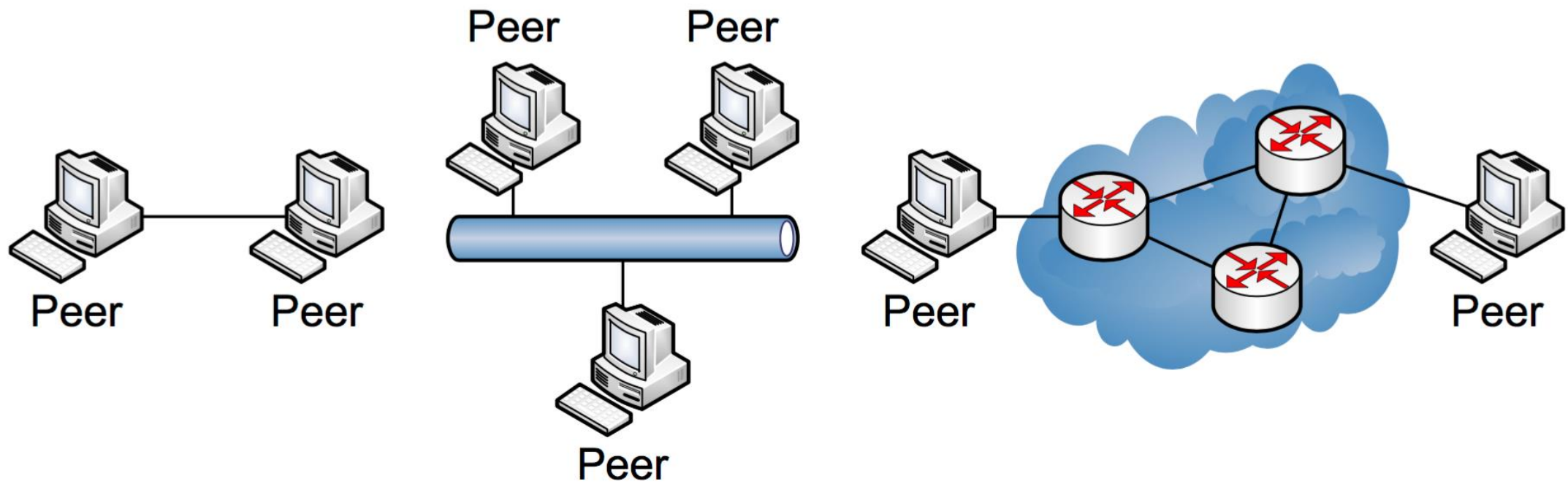
- Apache, Microsoft IIS, GWS, . . .

# P2P MODEL

- In the P2P model, all end systems have equivalent capabilities and responsibilities and either party can initiate a communication session
- The participants share a part of their own hardware resources
- Thus, the participants are both resource providers and resource requestors and use similar networking programs to connect with each other



## P2P MODEL (CONT'D)





# P2P MODEL (CONT'D)

## ➤ Benefits of P2P:

- No need for dedicated application and database servers
- Improved scalability and reliability (no single point of failure)

## ➤ Shortcomings of P2P:

- Poor security
- Lack of centralized control
- Computers with shared resources may suffer from sluggish performance

## ➤ P2P networking allows easily to share and download copyrighted files

- Is it a benefit or a shortcoming? :-)

# HIGH-PERFORMANCE COMPUTING

- In high-performance computing systems, a pool of processors (processor machines or central processing units [CPUs]) connected (networked) with other resources like memory, storage, and input and output devices, and the deployed software is enabled to run in the entire system of connected components.
- The processor machines can be of homogeneous or heterogeneous type.
- HPC systems are normally found in those applications where it is required to use or solve scientific problems.

# PARALLEL COMPUTING

- Parallel computing is also one of the facets of HPC
- It is run using multiple processors (multiple CPUs)
- A problem is broken down into discrete parts that can be solved concurrently
- Each part is further broken down into a series of instructions
- Instructions from each part are executed simultaneously on different processors
- An overall control/coordination mechanism is employed



# DISTRIBUTED COMPUTING

- Distributed computing is also a computing system that consists of multiple computers or processor machines connected through a network, which can be homogeneous or heterogeneous, but run as a single system
- The goal of distributed computing is to make such a network work as a single computer
- There is a support for the following characteristic features
  - Scalability: It is the ability of the system to be easily expanded by adding more machines as needed, and vice versa, without affecting the existing setup
  - Redundancy or replication: Here, several machines can provide the same services, so that even if one is unavailable (or failed), work does not stop because other similar computing supports will be available.



# CLUSTER COMPUTING

- A cluster computing system consists of a set of the same or similar type of processor machines connected using a dedicated network infrastructure.
- This is also a kind of HPC category.
- The individual nodes can work together to solve a problem larger than any computer can easily solve

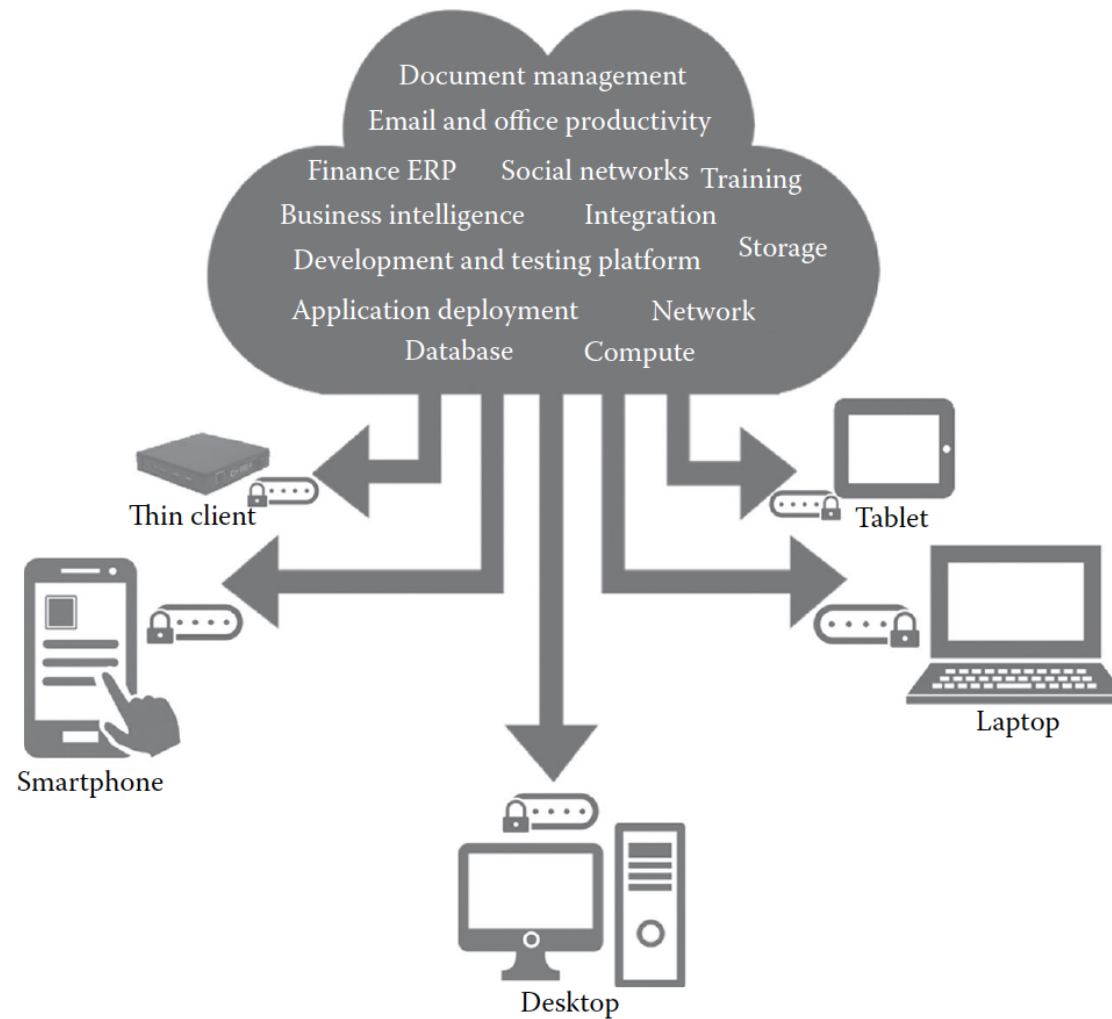
# GRID COMPUTING

- Grid computing is a network of computing or processor machines managed with a kind of software such as middleware, in order to access and use the resources remotely.
- The managing activity of grid resources through the middleware is called *grid services*
- Grid services provide access control, security, access to data including digital libraries and databases, and access to large-scale interactive and long-term storage facilities

# CLOUD COMPUTING

- In the simplest terms, cloud computing means storing and accessing data and programs over the Internet from a remote location or computer instead of our computer's hard drive.
- The cloud is just a metaphor for the Internet
- With an online connection, cloud computing can be done anywhere, anytime, and by any device.

# CLOUD COMPUTING (CONTINUE)





## FIVE ESSENTIAL CHARACTERISTICS

- *On-demand self-service*: A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service's provider.
- *Broad network access*: Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms
- *Elastic resource pooling*: The provider's computing resources are pooled to serve multiple consumers using a multitenant model

# FIVE ESSENTIAL CHARACTERISTICS

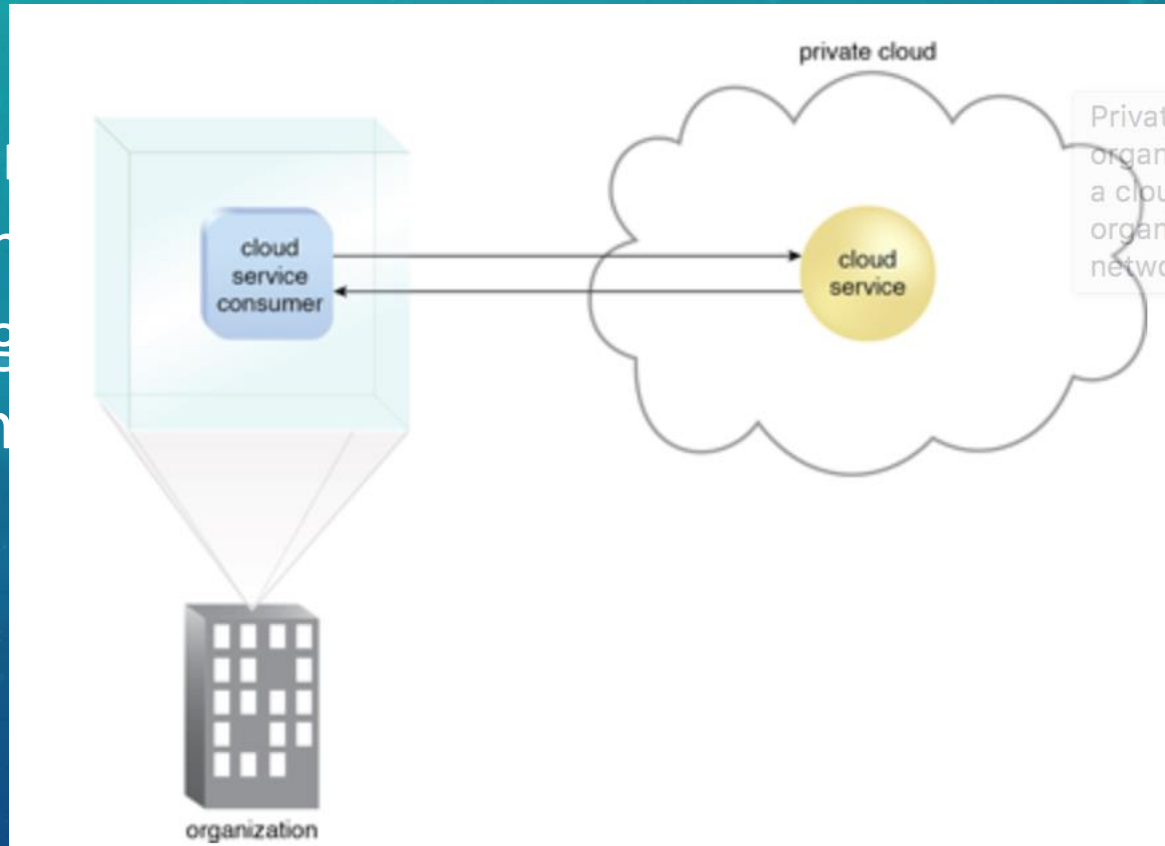
- *Rapid elasticity*: Capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in
- *Measured service*: Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service

# FOUR CLOUD DEPLOYMENT MODELS

- Deployment models describe the ways with which the cloud services can be deployed or made available to its customers, depending on the organization structure and the provisioning location.
- Four deployment models are usually distinguished, namely, **public**, **private**, **community**, and **hybrid** cloud service usage

# PRIVATE CLOUD

- The cloud infrastructure is dedicated to a single organization comprising multiple users (e.g., departments). It may be owned, managed and operated by the organization, a third party, or some combination thereof.



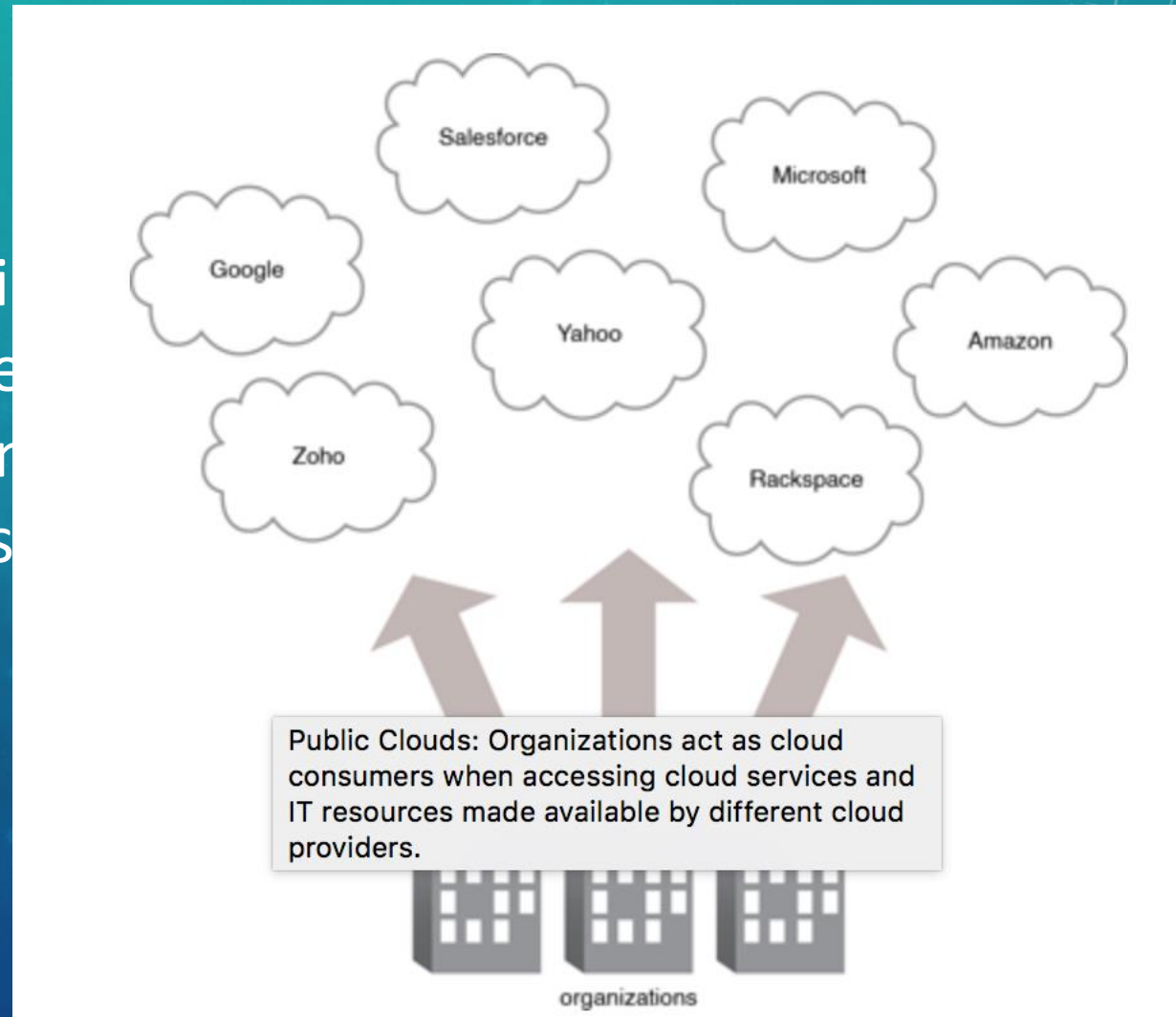
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# PUBLIC CLOUD

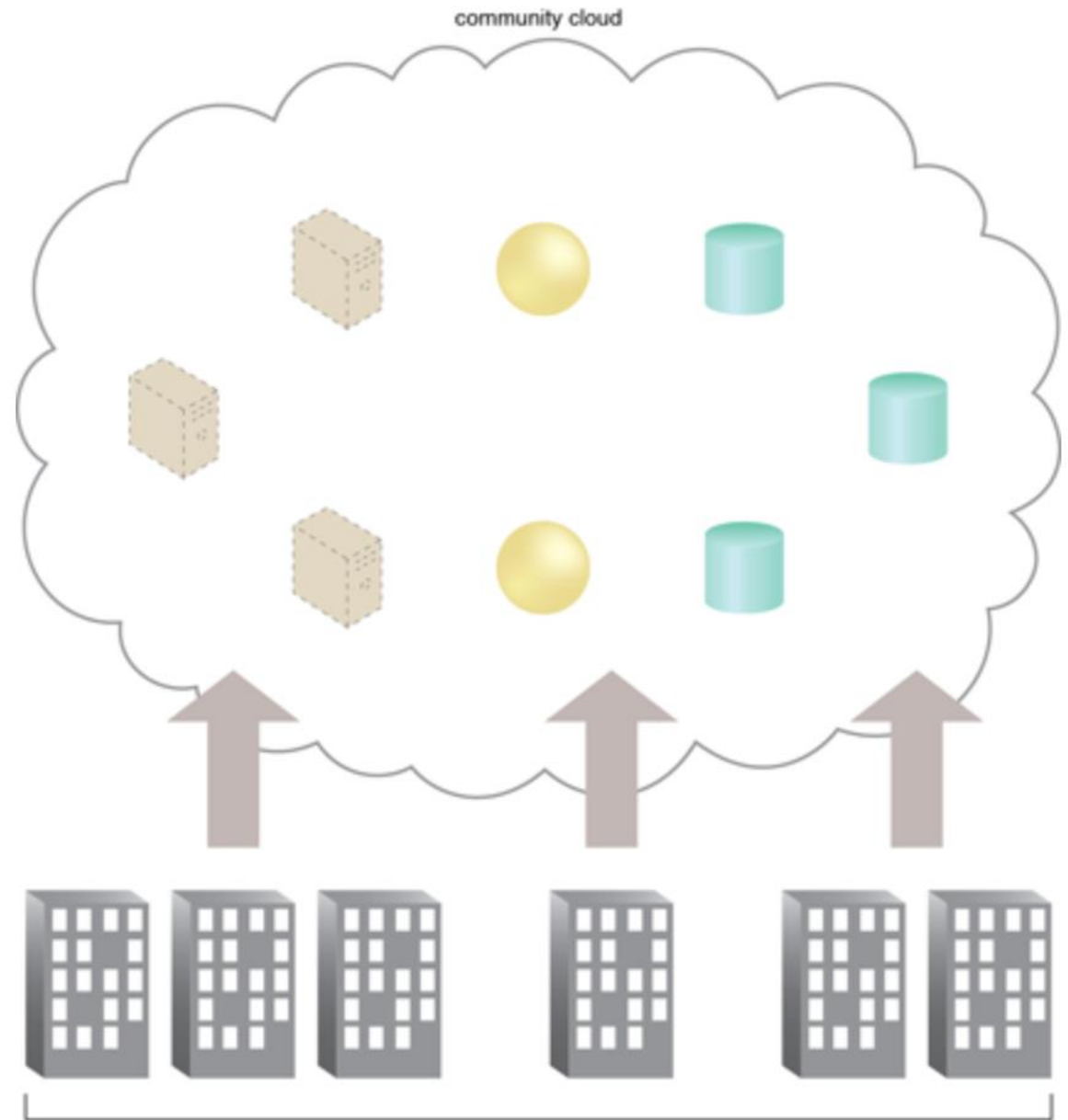
- *Public cloud:* The cloud is available to the general public. It may be used by business, academic, or government organizations. It exists on the premises

by the  
business,  
them.



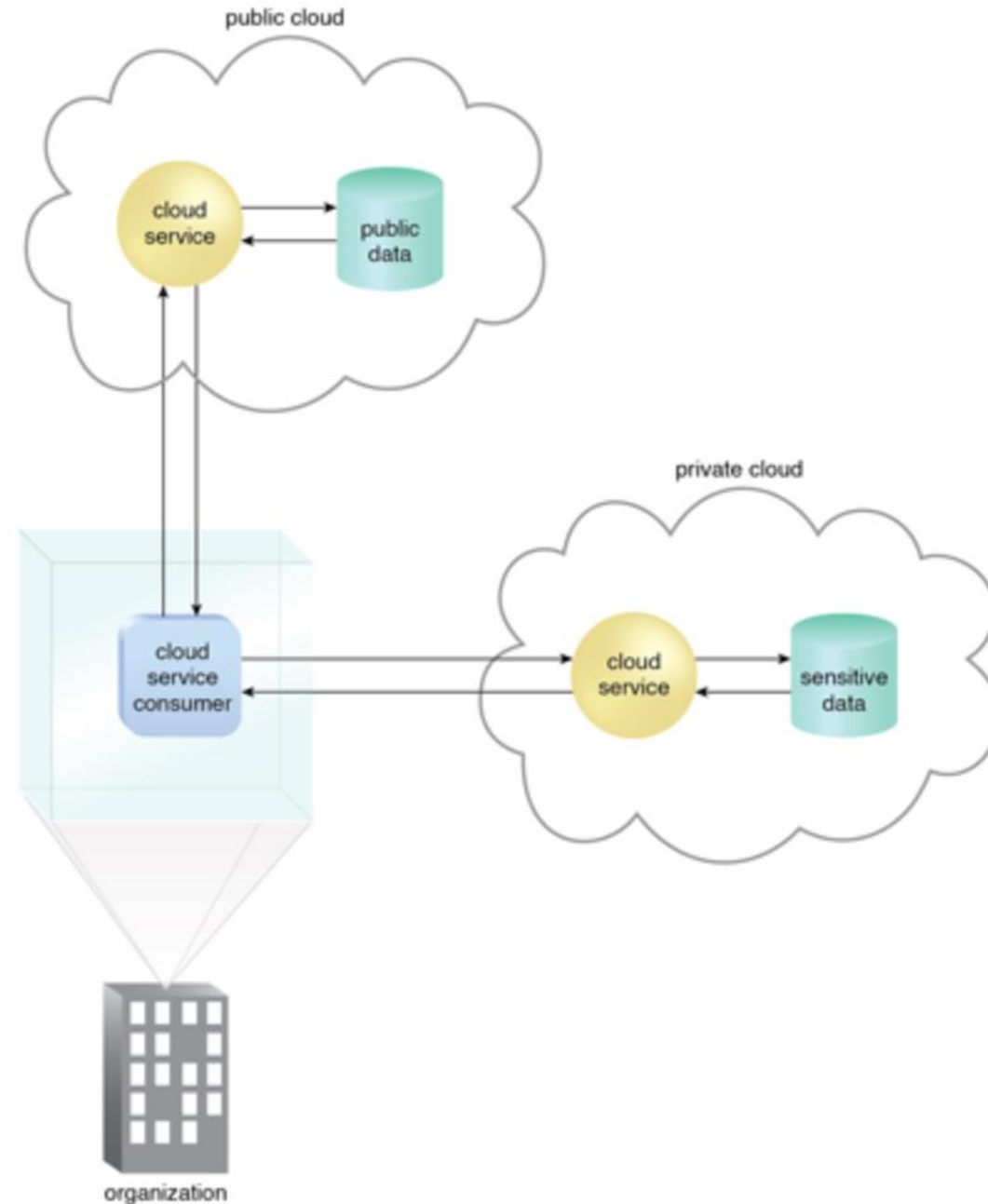
# COMMUNITY CLOUD

- *Community cloud*: The cloud for a specific community of organizations and support concerns. It may be managed by the community or a third party. It may exist on premise or off premise.



# HYBRID CLOUD

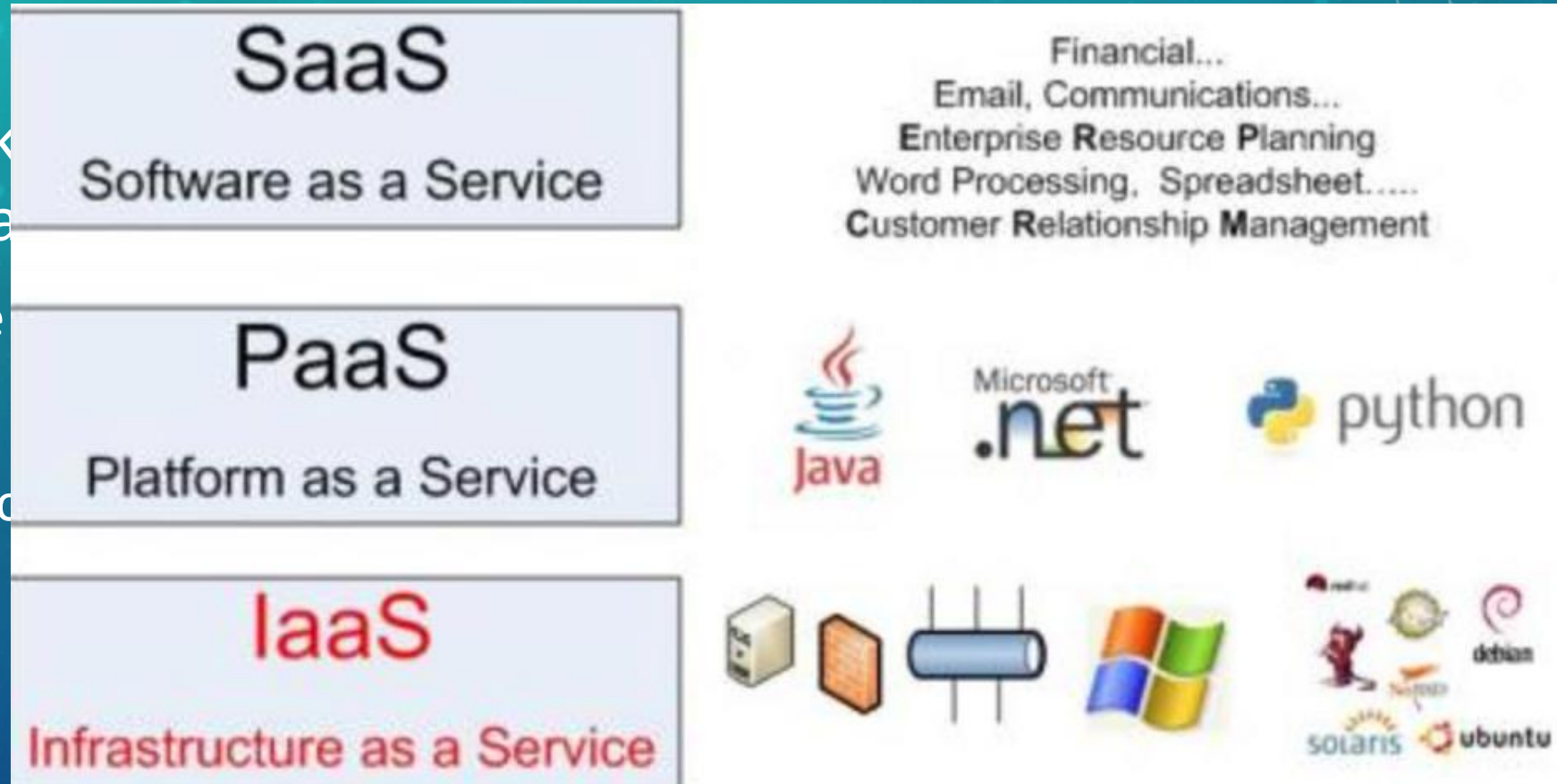
- The cloud infrastructure consists of public and private infrastructures (private for internal entities but are bound to public technology that enable



# THREE SERVICE OFFERING MODELS

➤ The three key resources are:

- Software
- Platform
- Infrastructure





# CLOUD SAAS

- The cloud application server capabilities of applications
- Typical management accounting software.

Examples of cloud based software:

- Financial Accounting Software
- Sales Software
- HR & Payroll Software
- Storage Software
- Email Software
- Instant Messaging



## CLOUD PAAS

- *Cloud PaaS*: The cloud infrastructure created using products supported by the



to

# CLOUD IAAS

- *Cloud IaaS*: The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources on a pay-per-use basis where he or she is able to deploy and run arbitrary software, which can include operating systems and applications.
- The consumer does not manage or control the underlying cloud infrastructure but has control over the operating systems, storage, and deployed applications and possibly limited control of select networking components



# RECAPS

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# REFERENCES

- Client/server and peer-to-peer models: basic concepts (Dmitri Moltchanov September 04, 2013)