Session 1

Computing paradigm and introduction to Cloud Computing

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Alliance with FPT Education

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

- 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.

- 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

- 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, . . .

- 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
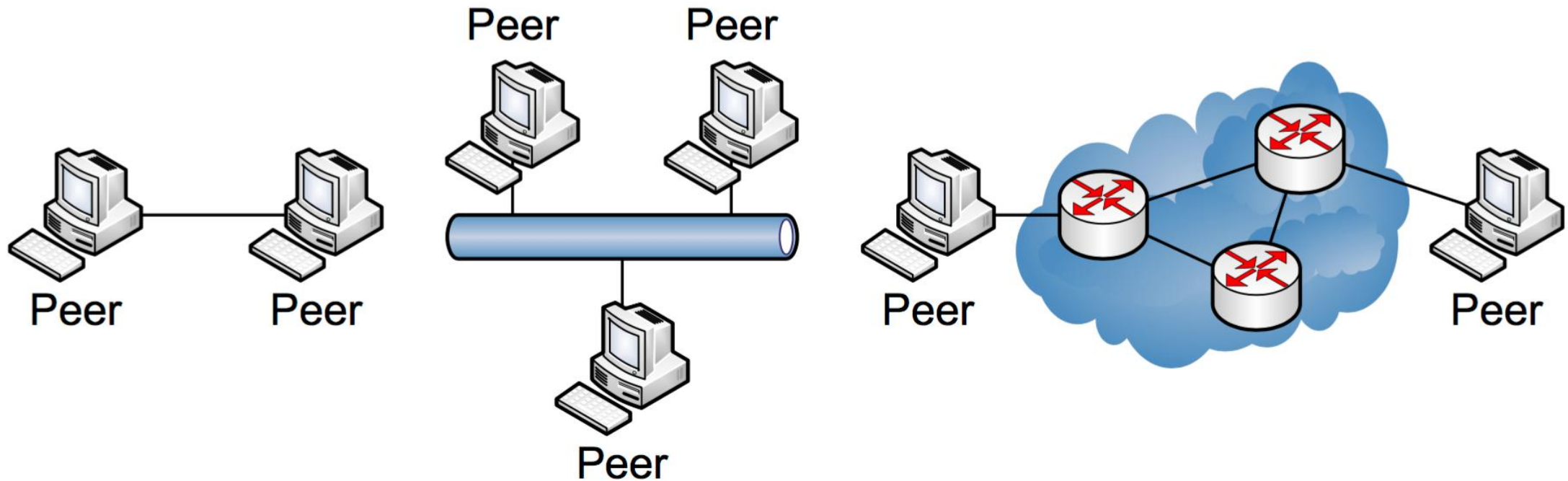
- Benefits of P2P:
  - No need for dedicated application and database servers
  - Improved scalability and reliability (no single point of failure)
- Shortcomings of P2P:
  - Poor security
  - Lack of centralized control
  - Computers with shared resources may suffer from sluggish performance
- P2P networking allows easily to share and download copyrighted files
  - Is it a benefit or a shortcoming? :-)

- 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 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.

- 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 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.
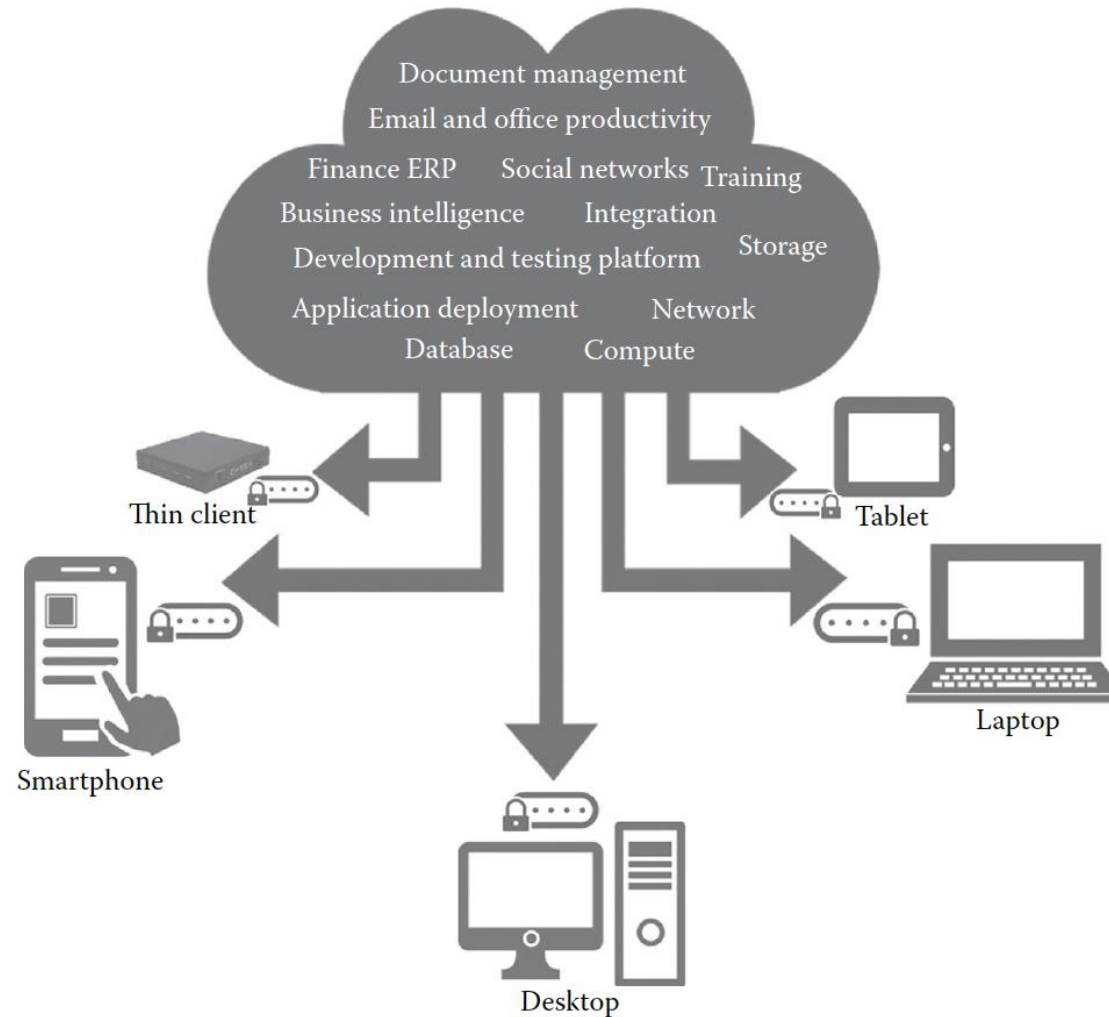
- *On-demand self-service:* A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service's provider.
- *Broad network access*: Capabilities are available over the network and accessed 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

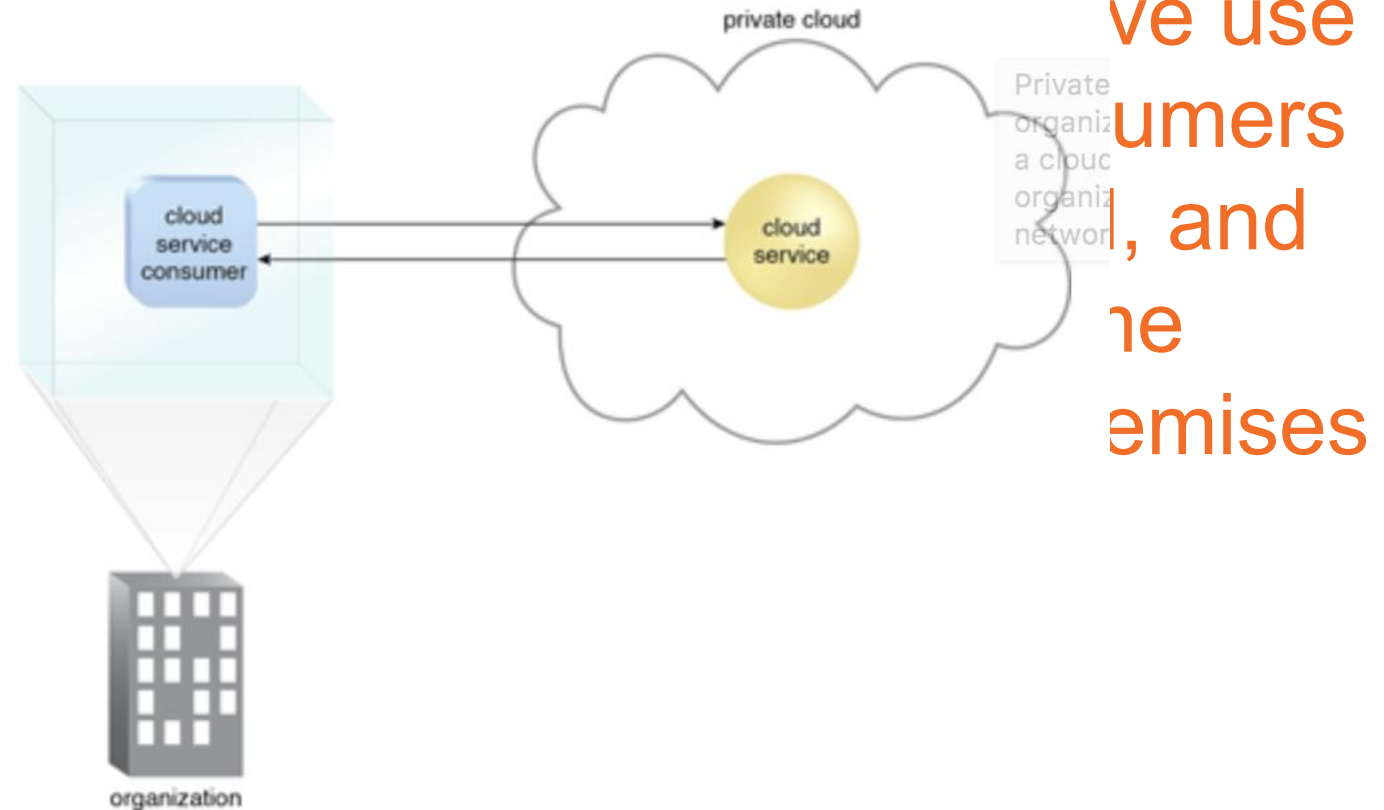# Five Essential Characteristics

- *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

- 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
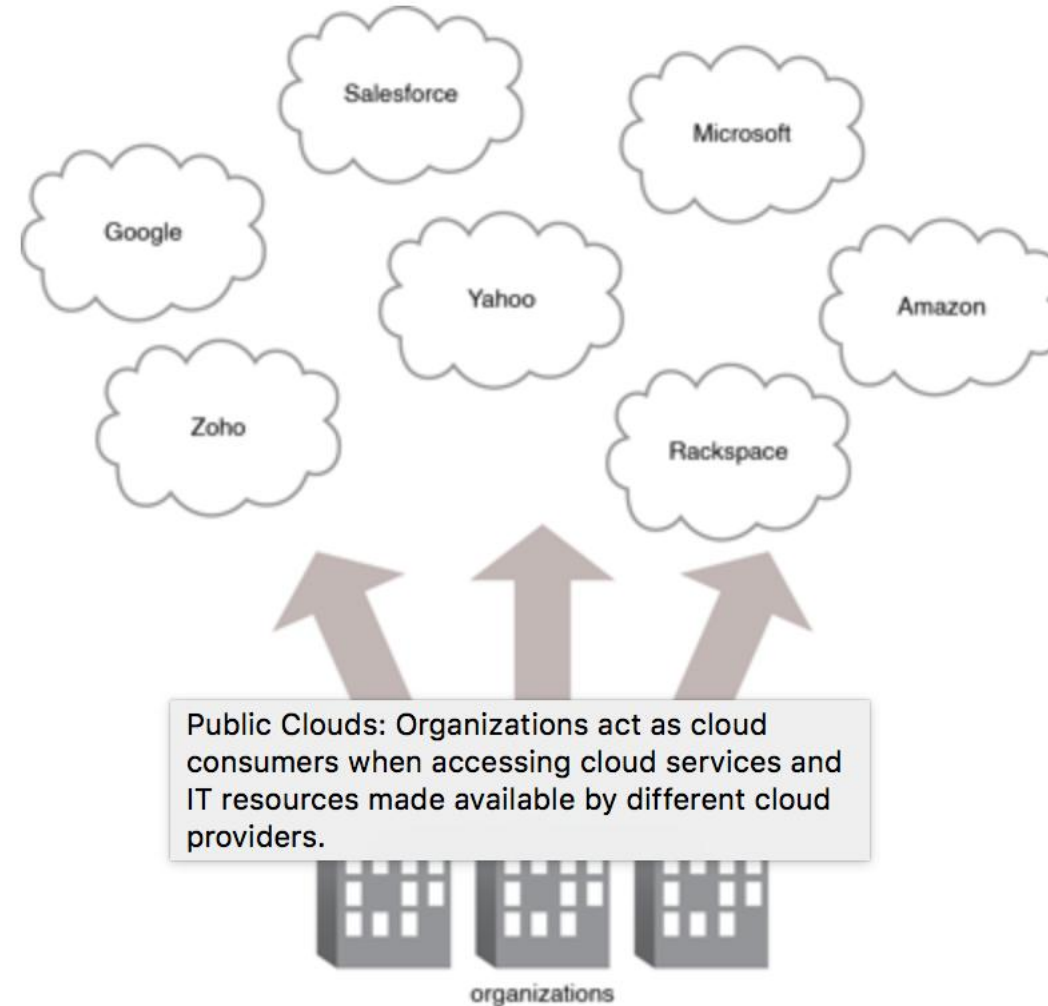
- The cloud infrastru   ve use
  by a single organiz   umers
  (e.g., business un   , and
  operated by the o   ne
  combination of the   emises

private cloud

cloud
service
consumer

cloud
service

Private
organiz
a clouc
organiz
networl

organization

- *Public cloud*: The cl   for
  open use by the ge
  managed, and oper   r
  government organiz   em. It
  exists on the premis

Public Clouds: Organizations act as cloud consumers when accessing cloud services and IT resources made available by different cloud providers.

organizations

- *Community cloud*: Th
  several organizations
  that has shared conc
  organizations or a thi
  off premise
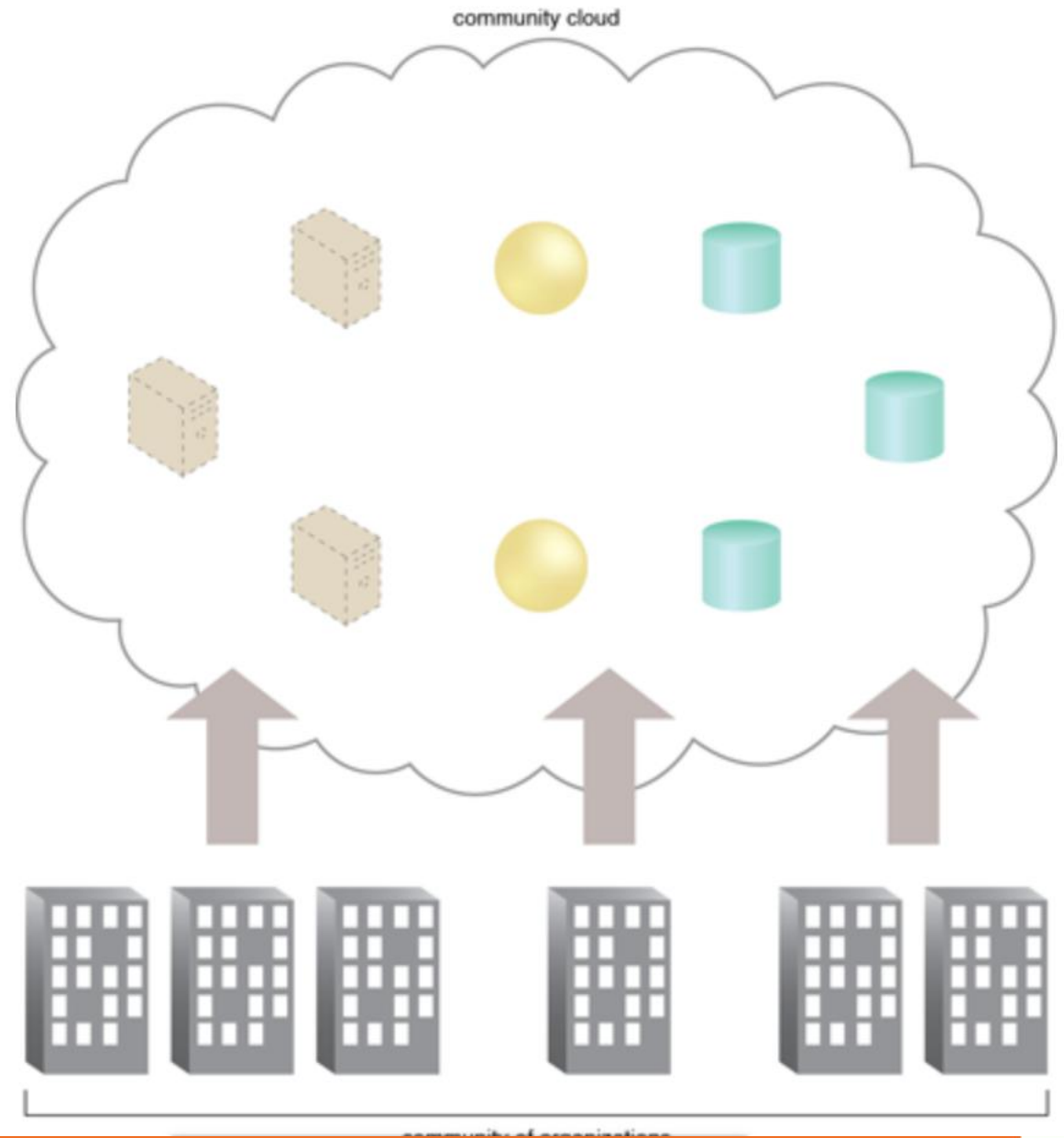
- The cloud infrast... ...re distinct cloud infr... ...public) that remai... ...her by standardized ... ... data and applicat...

public cloud

cloud service → public data

private cloud

cloud service consumer

cloud service → sensitive data

organization

- The three
  computin
  as follows
  - Softwar
  - Platform
  - Infrastru

- The provi... inclu... and ... poss... confi...
- Typi... er relati... analytics, and online accounting software.
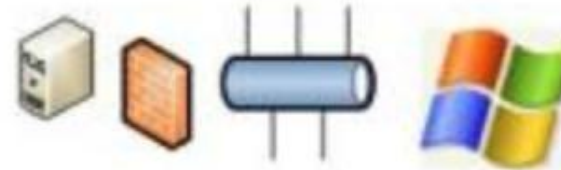
Examples of cloud based software:

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

- *Cloud PaaS*: T... s to deploy ont... ed or acquired a... languages, lib... he provider

- *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

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