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Cloud Computing Concepts and Technology

Lecture (1)

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Cloud Definitions

In 1969, Leonard Kleinrock, one of the chief scientists of the original Advanced Research Projects Agency Network (ARPANET), which seeded the Internet, said:

> *As of now, computer networks are still in their infancy, but as they grow up and become sophisticated, we will probably see the spread of* 'computer utilities' *which, like present electric and telephone utilities, will service individual homes and offices across the country.*

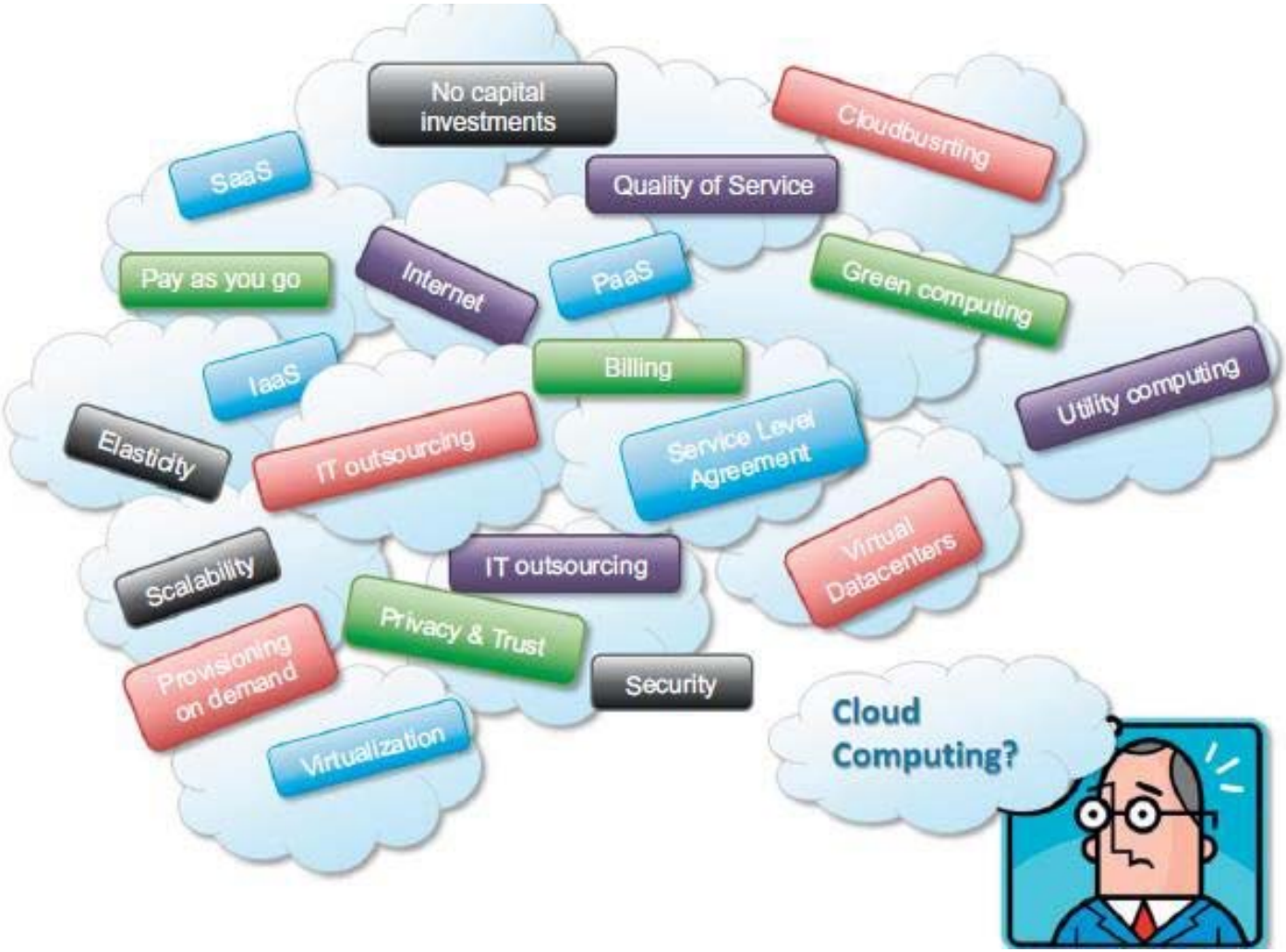
I don't care where my servers are, who manages them, where my documents are stored, or where my applications are hosted. I just want them always available and access them from any device connected through Internet. And I am willing to pay for this service for as a long as I need it.

Introduction

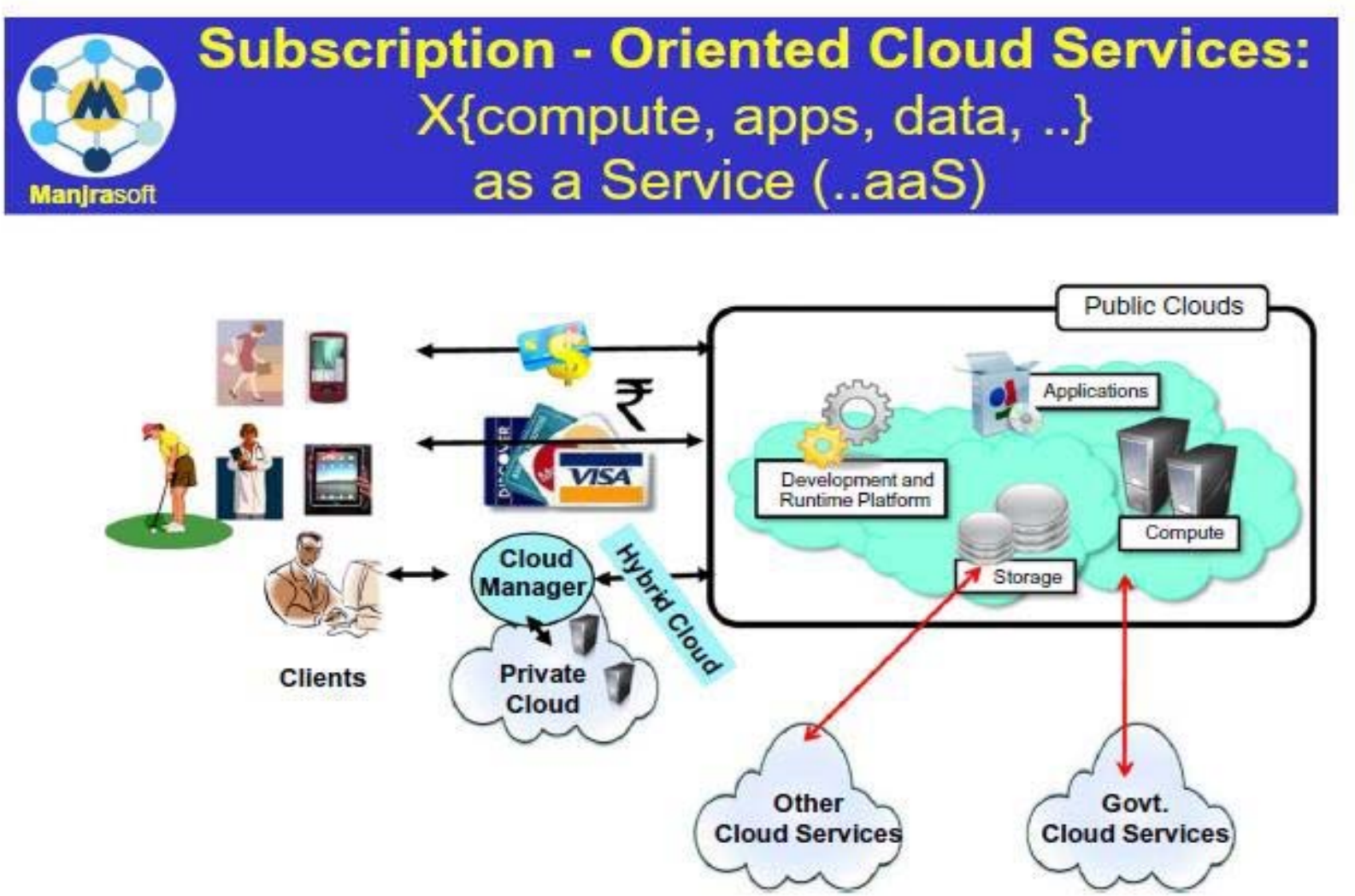
Cloud Definition (NIST)

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

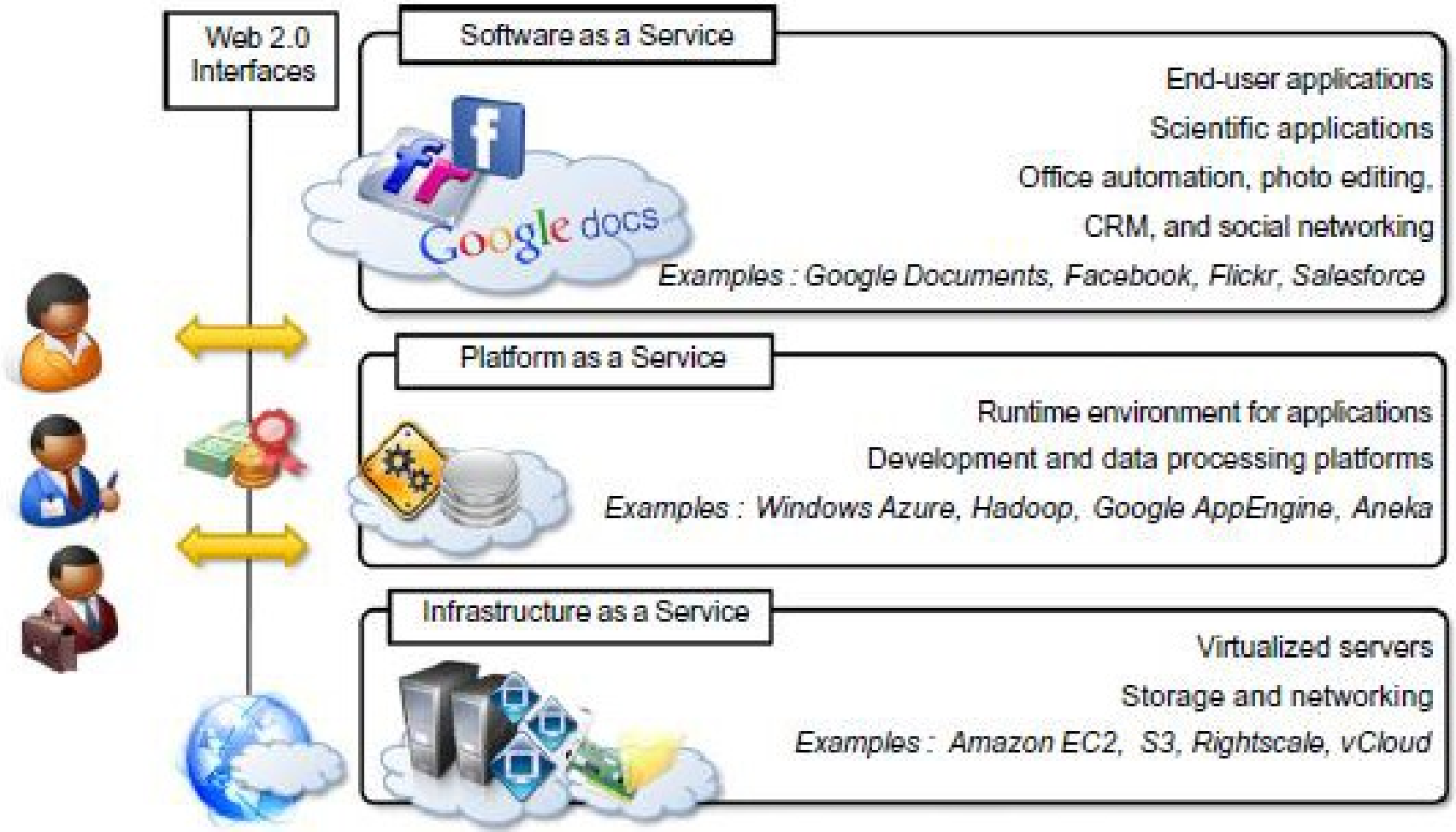
Cloud Computing Technologies



Cloud Deployment Model



Cloud Platforms



Cloud Benefits

- No up-front commitments
- On-demand access
- Nice pricing
- Simplified application acceleration and scalability
- Efficient resource allocation
- Energy efficiency • Seamless creation and use of third-party services

Cloud Challenges

- a new set of challenges concerning the dynamic provisioning of cloud computing services and resources arises. For example, in the Infrastructure-as-a-Service domain, how many resources need to be provisioned, and for how long should they be used, in order to maximize the benefit. Technical challenges also arise for cloud service providers for the management of large computing infrastructures and the use of virtualization technologies on top of them.
- Secuirty

Historical Development

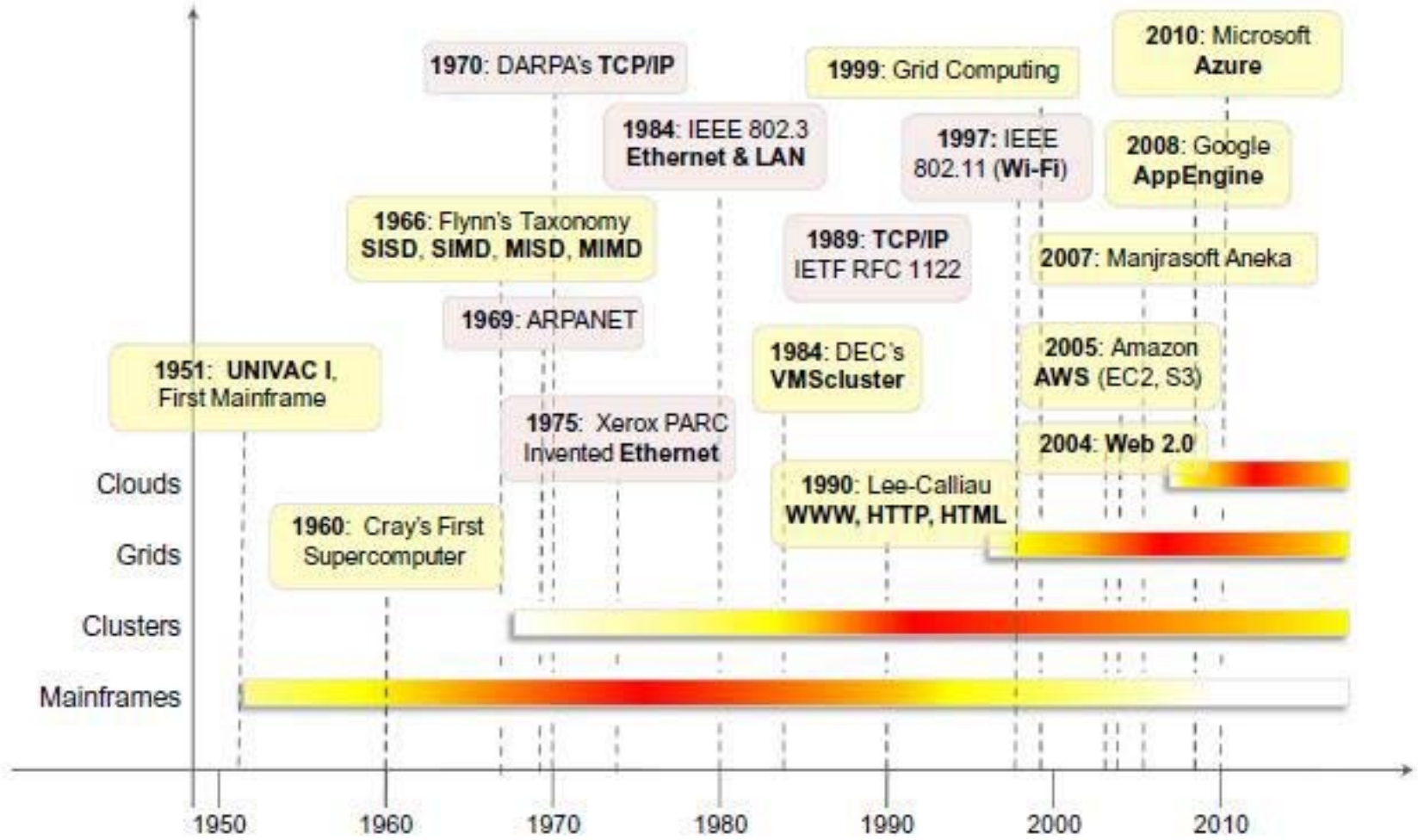
- **Distributed systems**

A distributed system is a collection of independent computers that appears to its users as a single coherent system.

Three major milestones have led to cloud computing: mainframe computing, cluster computing, and grid computing.

- **Mainframes.**
- **Clusters.**
- **Grids.**

Historical Development



Virtualization

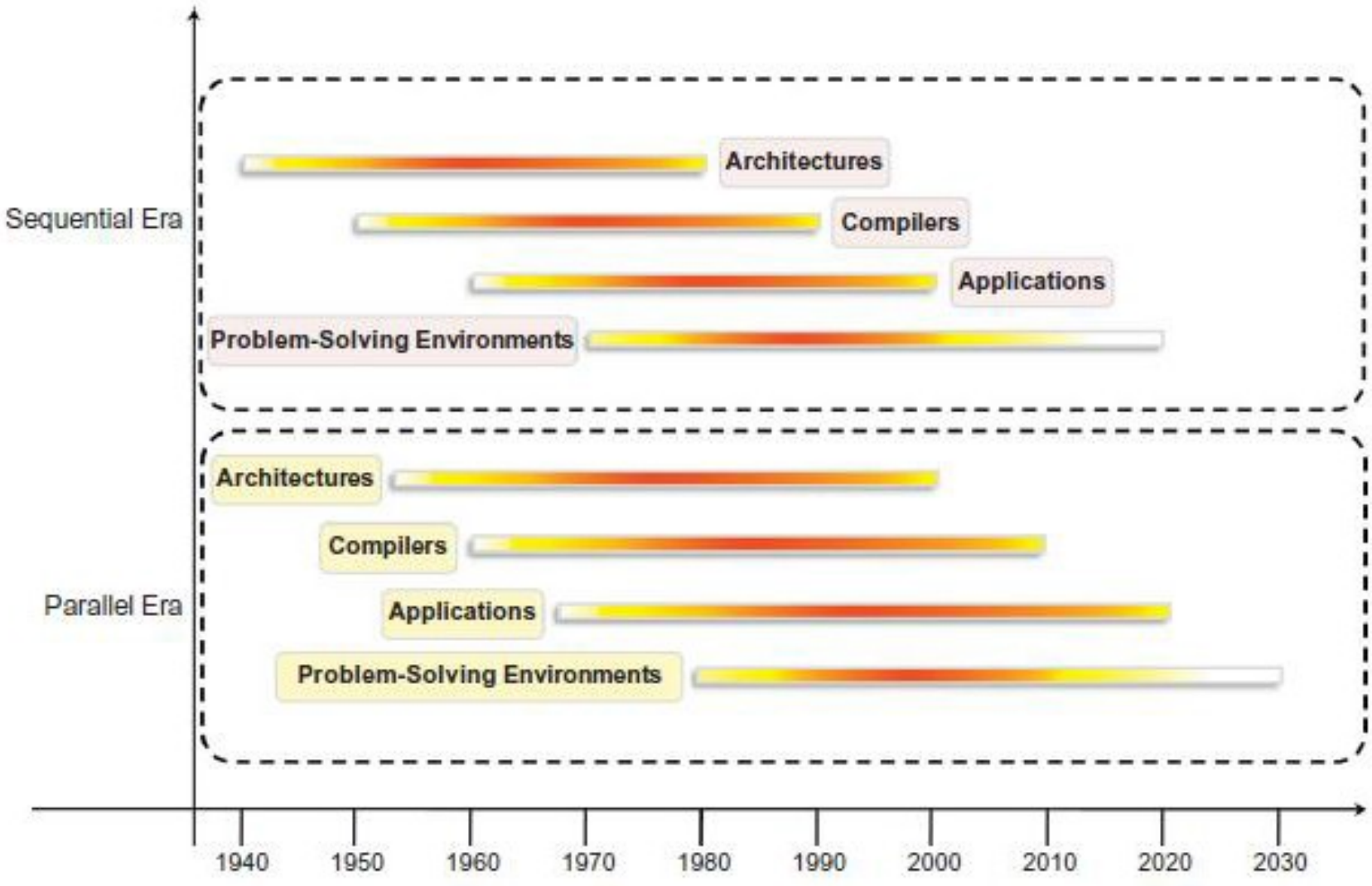
- ***Virtualization*** is another core technology for cloud computing. It encompasses acollection of solutions
- allowing theabstraction of some of the fundamental elements forcomputing ,suchashard- ware, runtime environments, storage,and networking. Virtualization has been around for more than 40 years, but its application has always been limited bytechnologies that did not allow an efficient use of virtualization solutions.

- **Web 2.0 (XML. SOAP, AJAX. WSDL) examples are facebook, google flicker, google maps, google documents , you tube, twitter**

Cloud Platform Examples

- Amazon web services (AWS)
- Google AppEngine
- microsoft Azure
- Hadoop
- Force.com and Salesforce.com
- Manjrasoft Aneka

Parallel v.s. Distributed

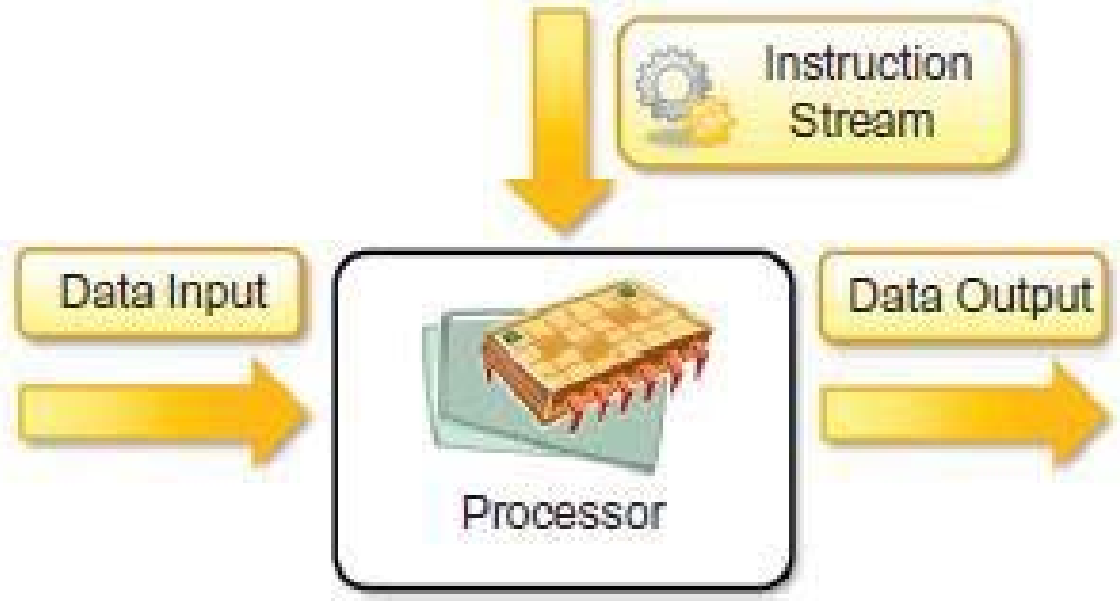


Parallel Processing

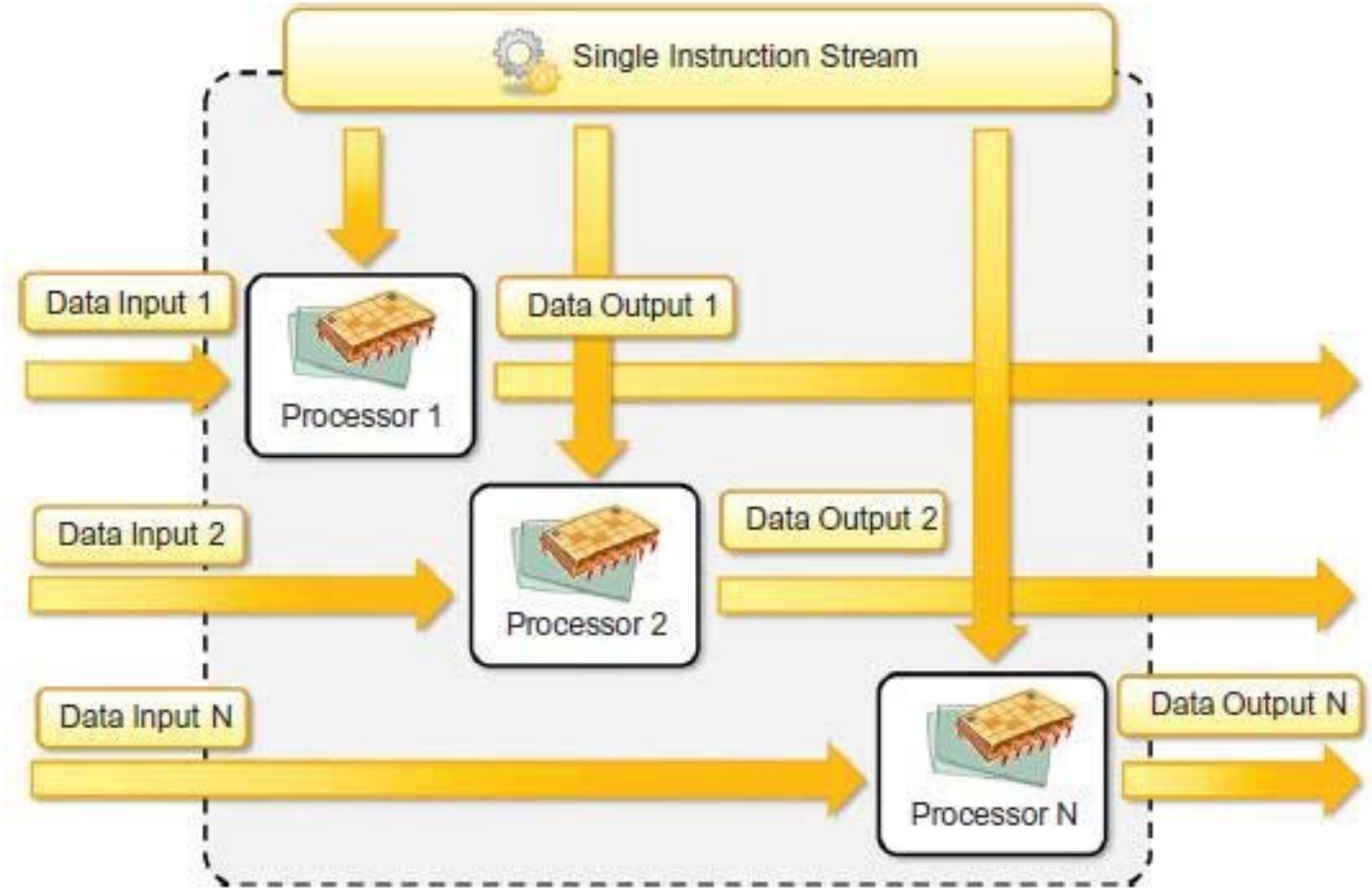
- Processing of multiple tasks simultaneously on multiple processors is called parallel processing

  - Single-instruction, single-data (SISD) systems
  - Single-instruction, multiple-data (SIMD) systems
  - Multiple-instruction, single-data (MISD) systems
  - Multiple-instruction, multiple-data (MIMD) systems

SISD

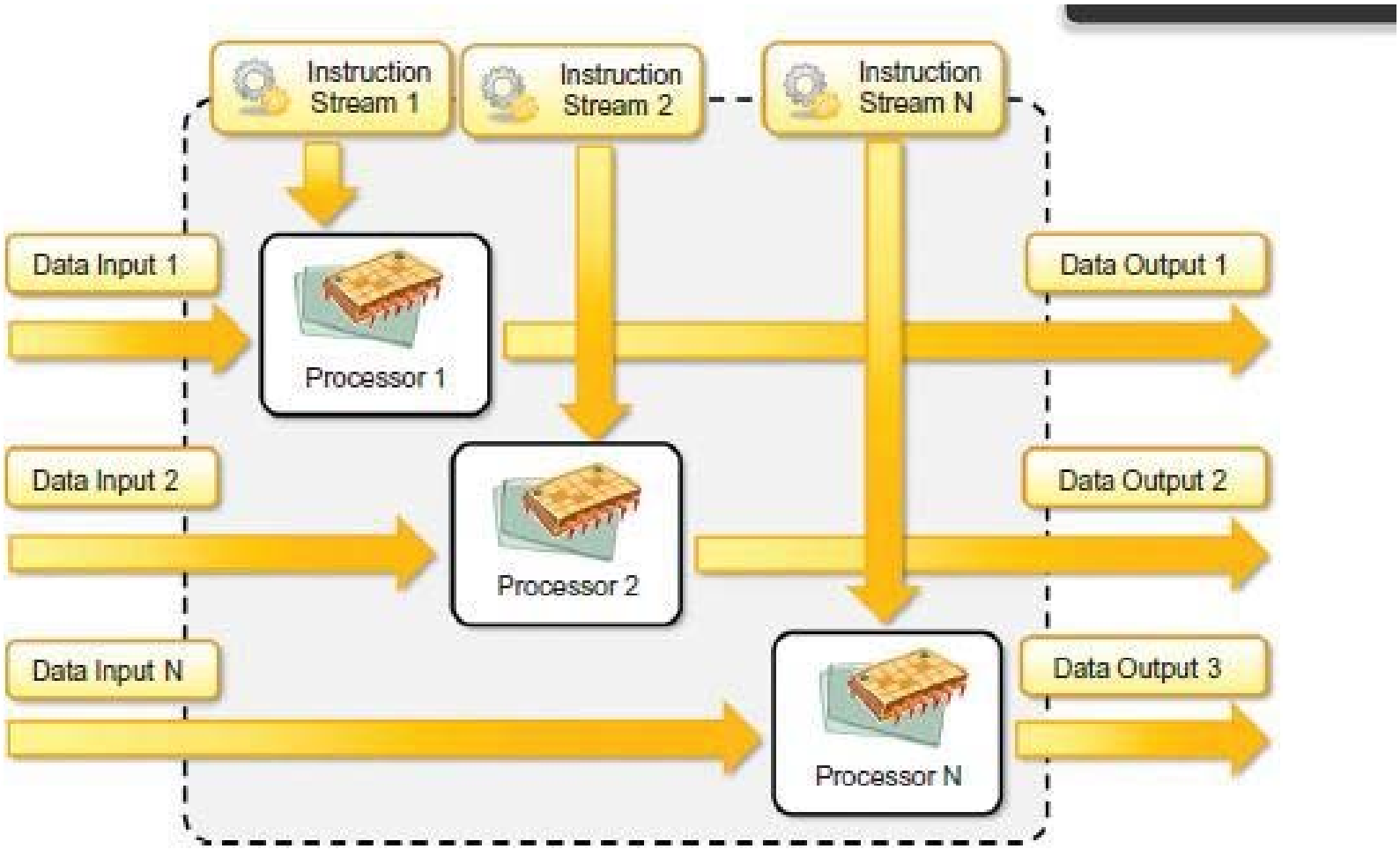


SIMD


Single Instruction Stream
Data Input 1
Processor 1
Data Output 1
Data Input 2
Processor 2
Data Output 2
Data Input N
Processor N
Data Output N

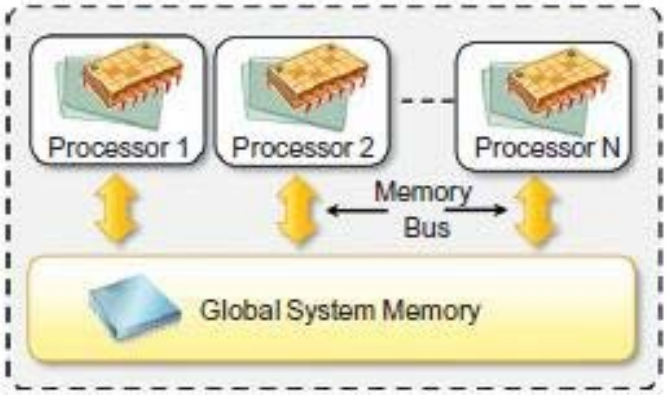
$$Ci = Ai * Bi$$

MISD

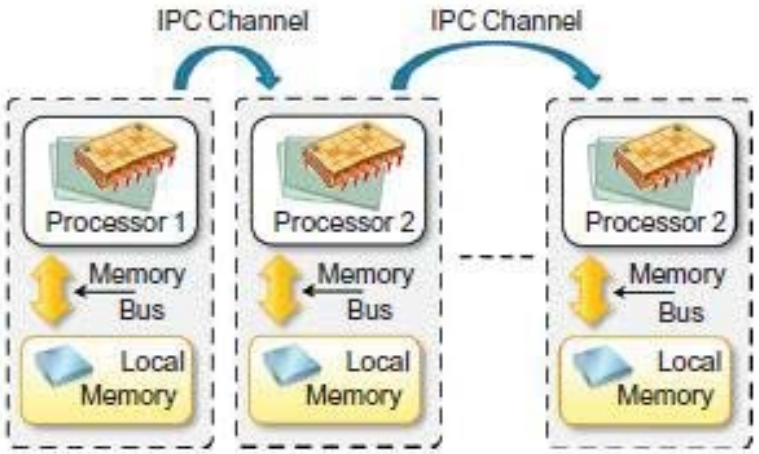


$y = \sin(x) + \cos(x) + \tan(x)$

MIMD



Shared memory MIMD machines



Distributed memory MIMD machines

Approaches to parallel programming

- **Data parallelism**
- **Process parallelism**
- **Farmer-and-worker model**

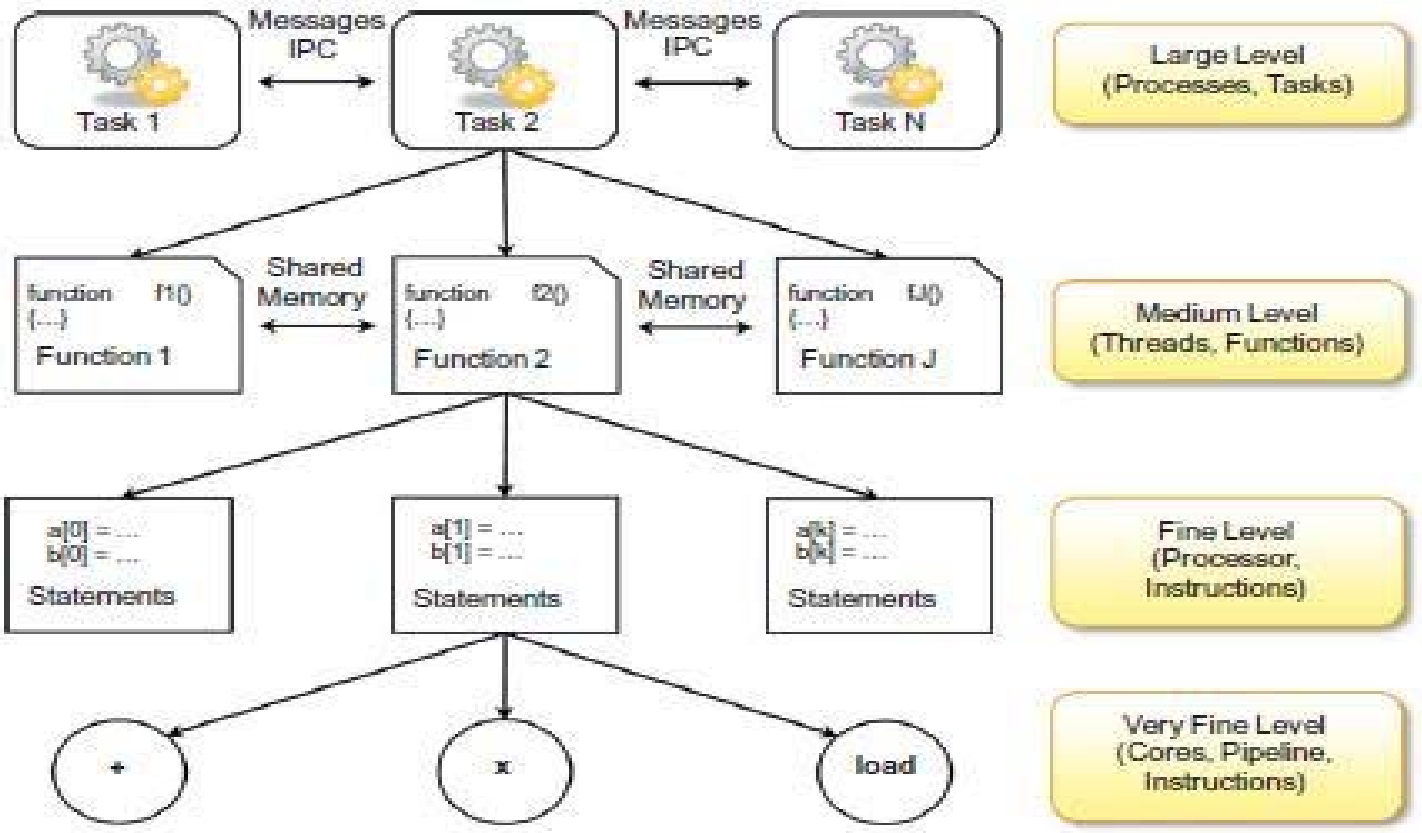
These three models are all suitable for task-level parallelism. In the case of **data parallelism, the divide-and-conquer technique is used to split data into multiple sets, and each data set is processed on different PEs using the same instruction**. This approach is highly suitable to processing on machines based on the SIMD model. In the case of process parallelism, a given operation **has multiple (but distinct) activities that can be processed on multiple processors**. In the case of the farmer- and-worker model, a job distribution approach is used: **one processor is configured as master and all other remaining PEs are designated as slaves; the master assigns jobs to slave PEs and, on completion**, they inform the master, which in turn collects results. These approaches can be utilized in different levels of parallelism.

Levels of parallelism

Table 2.1 Levels of Parallelism

Grain Size	Code Item	Parallelized By
Large	Separate and heavyweight process	Programmer
Medium	Function or procedure	Programmer
Fine	Loop or instruction block	Parallelizing compiler
Very fine	Instruction	Processor

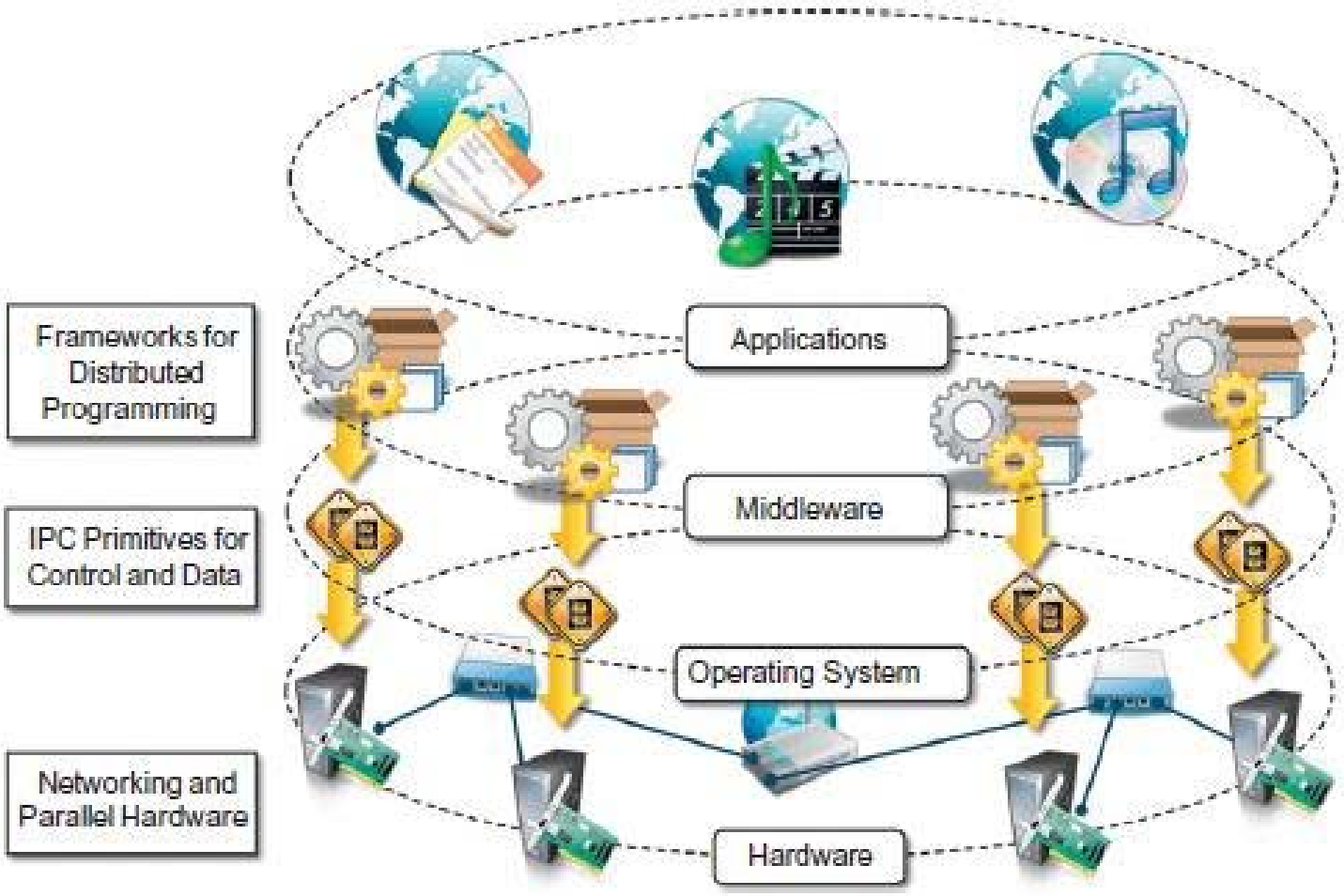
Levels of parallelism



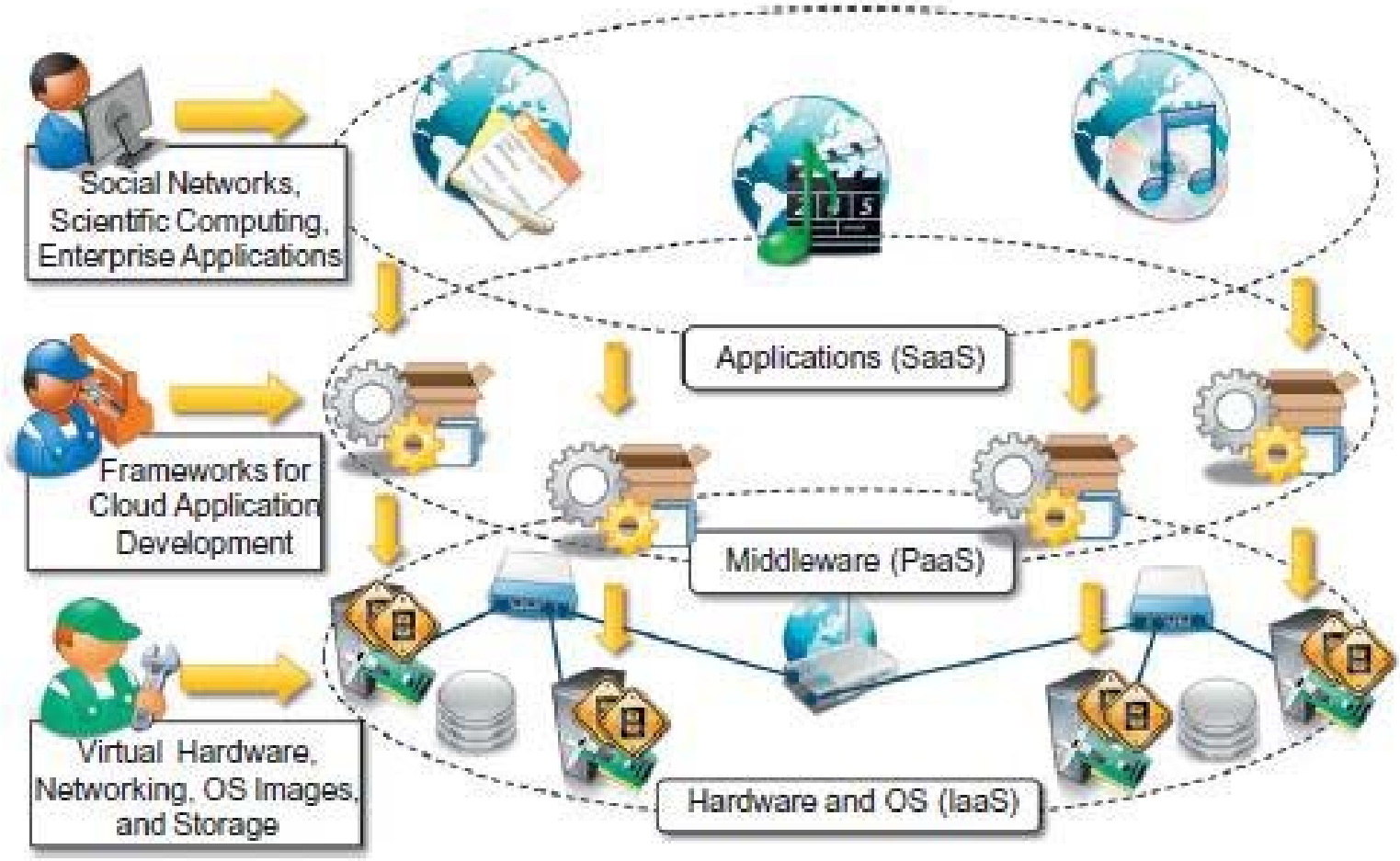
Distributed System Definitions

- A distributed system is a collection of independent computers **that appears to its users as a single coherent system**

Complements of Distributed System



Cloud Computing DS



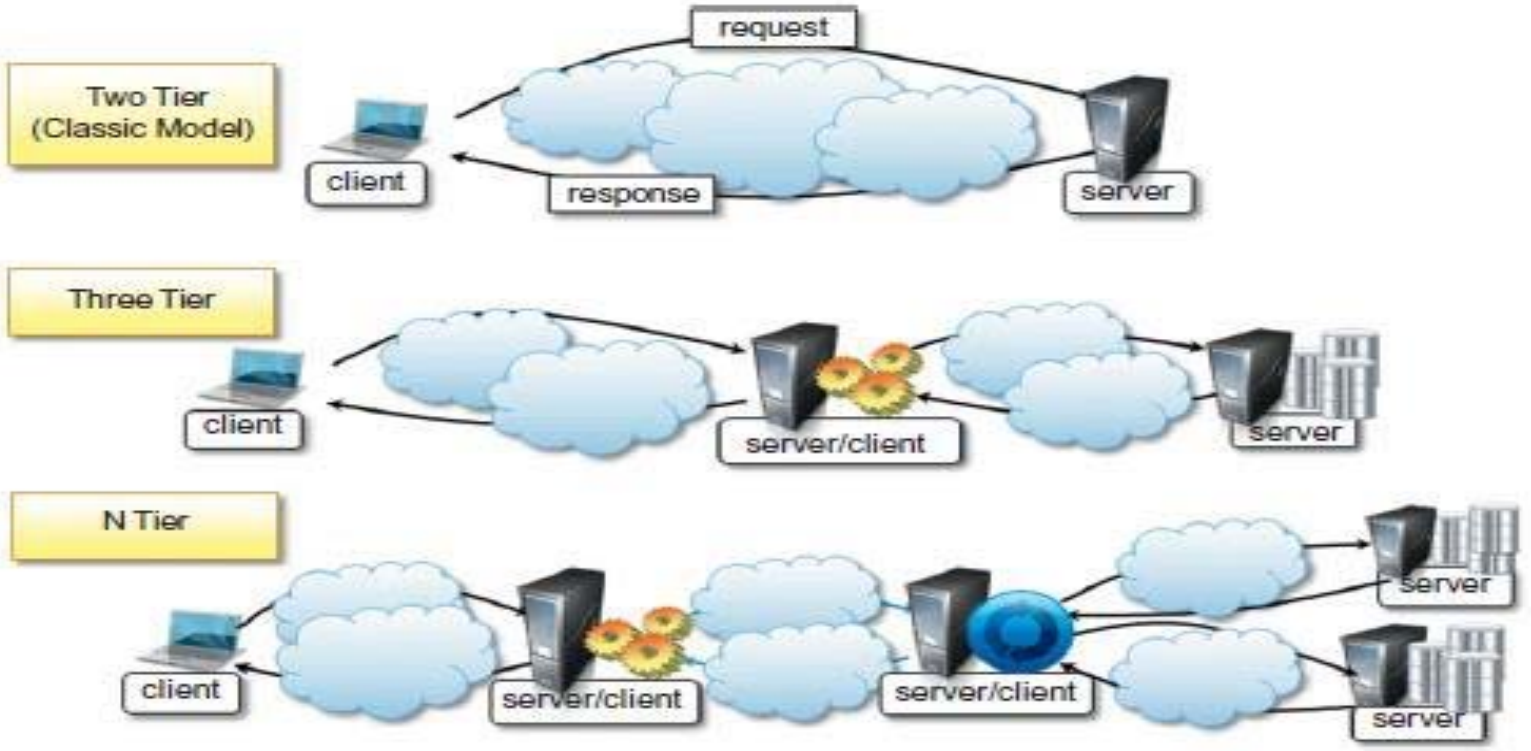
Software architectural styles

Table 2.2 Software Architectural Styles

Category	Most Common Architectural Styles
Data-centered	Repository Blackboard
Data flow	Pipe and filter Batch sequential
Virtual machine	Rule-based system Interpreter
Call and return	Main program and subroutine call/top-down systems Object-oriented systems Layered systems
Independent components	Communicating processes Event systems

System architectural styles

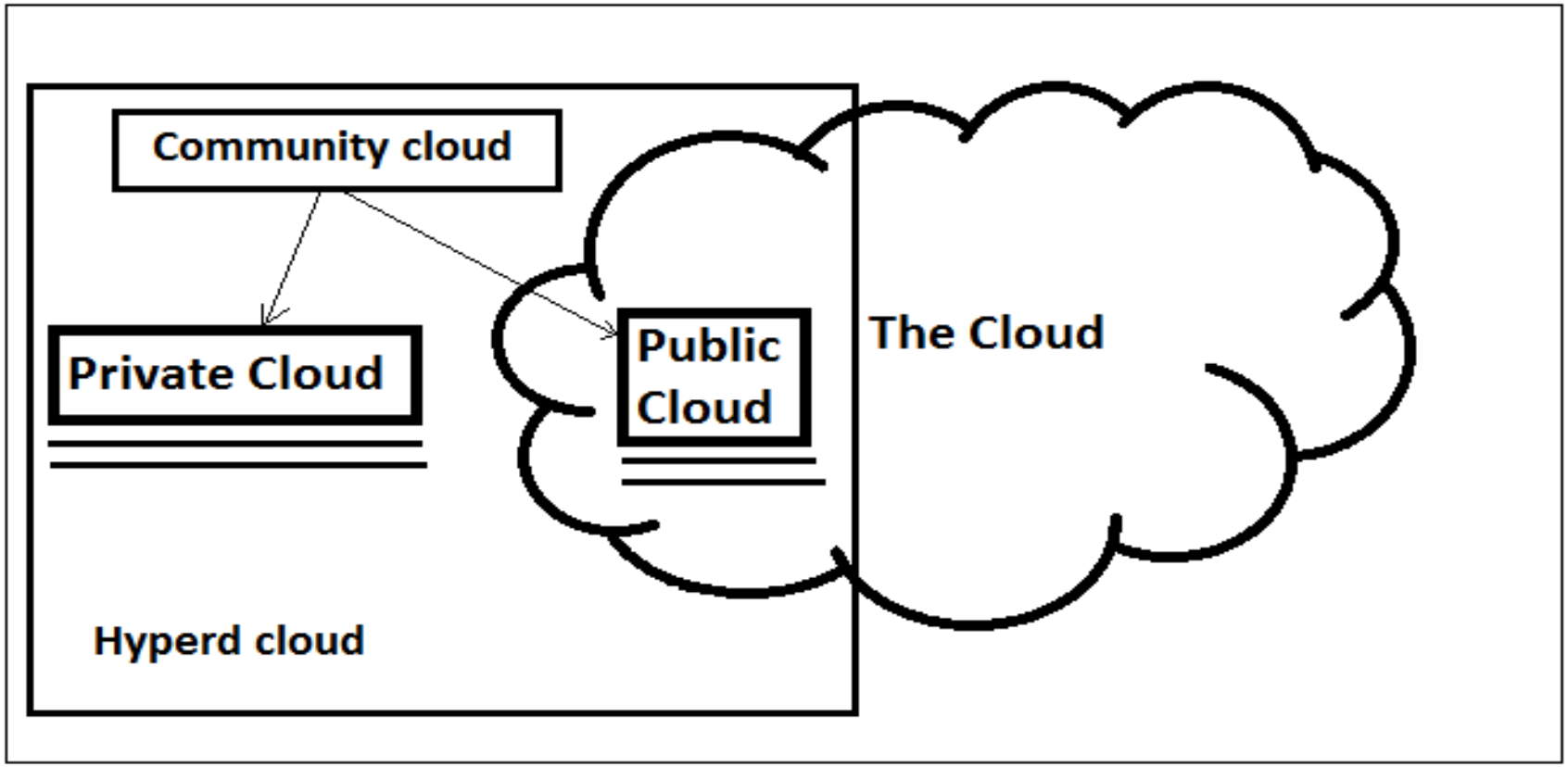
- **Client/server**
  - **Thin-client model.**
    - **Fat-client model.**



Peer to Peer

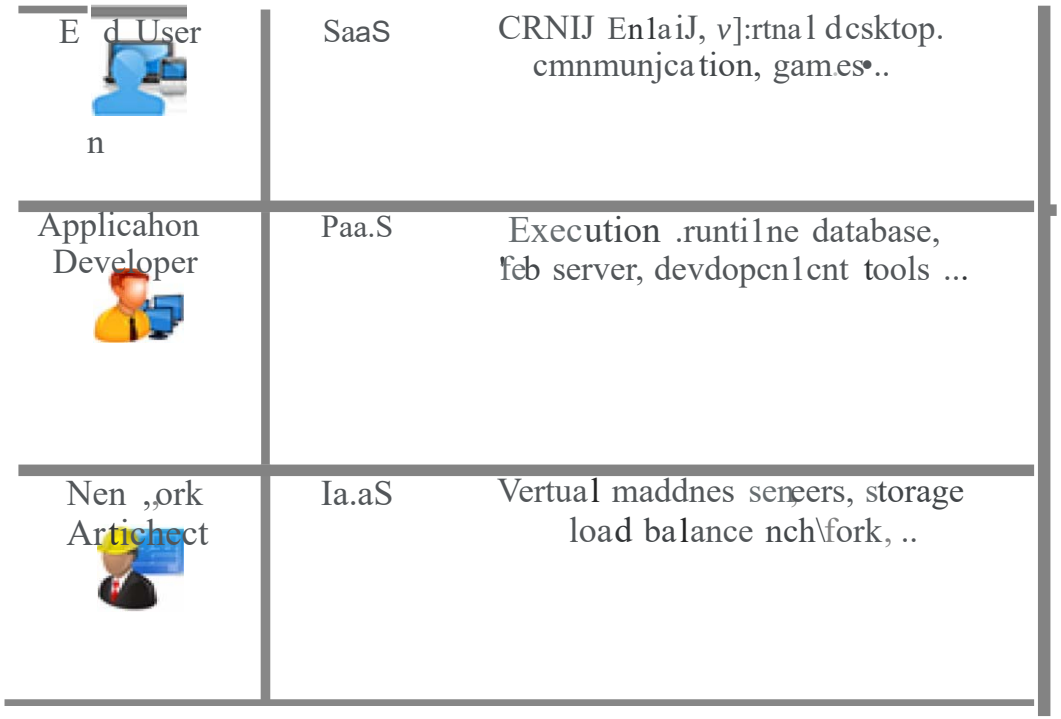
Part 5: Deployment Models

- Pay per use



Cloud Platforms

Cloud Client



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THANK YOU