Cloud Computing

Course Content

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Module 1

Introduction to Cloud Computing and its Enabling Technologies

What is Computing?

- Computing is the process of using computer technology to complete a given goal-oriented task.

- Computing may encompass the design and development of software and hardware systems for a broad range of purposes - often structuring, processing and managing any kind of information.

- Computing consists of three things:
  - *Managing,*
  - *Processing, and*
  - *Communicating information*

Contd…

- Over the years, computing has evolved – passing through a number of computational paradigms
    - More computational capacity
    - More efficiency
    - Less cost
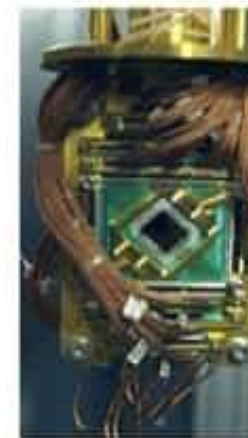   - Less size

Vacuum Tube

Transistors

Integrated Circuit

Microprocessor

Quantum Computer

1st Generation Computer

2nd Generation Computer

3rd Generation Computer

4th Generation Computer

5th Generation Computer

Generation of Computers

Generations	Period	Technology
First Generation	1946-1955	Vacuums Tube
Second Generation	1955-1965	Transistors
Third Generation	1965-1975	Integrated Circuits (ICs)
Forth Generation	1976-1988	Microprocessor/Large Scale Integration
Fifth Generation	Since 1988	Artificial Intelligence

Data Processing Methods

- Single user processing
- Time sharing processing
- Multiple processing
- Distributed processing

Mainframe Computing

- Sophisticated machines based on vacuum tube technology

- Incredibly bulky - some models would fit an entire room!!

- Users would connect to mainframes using terminals

- Designed and used for scientific tasks, not for personal use

Mainframe Computers

Size of an IBM 702, one of the mainframe systems used in the 1970s

Types of Computing Environments

- A computer system uses many devices, arranged in different ways to solve many problems. This constitutes a computing environment where many computers are used to process and exchange information to handle multiple issues.
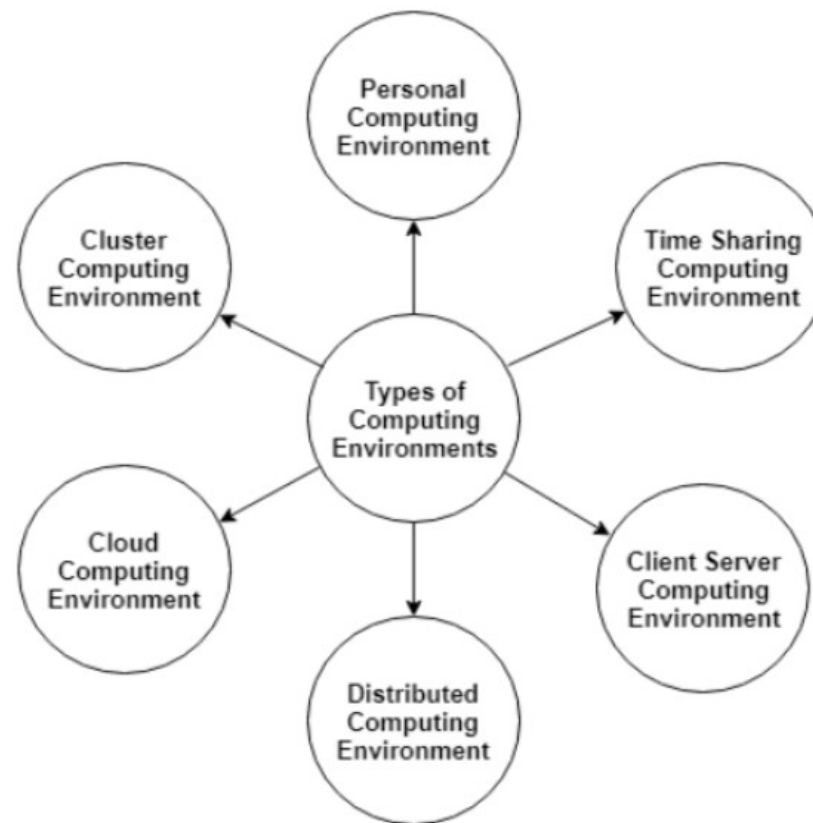
Personal Computing Environment

- In the personal computing environment, there is a single computer system. All the system processes are available on the computer and executed there.

- Smaller size machines – semiconductor technology.

- Designed for personal use.

- Every system now had dedicated computing power, memory and storage – available locally.

- The size of PCs has reduced considerably since their inception, along with an increase in computational power and storage capacity.

Time Sharing Computing Environment

- The time sharing computing environment allows multiple users to share the system simultaneously.

- Each user is provided a time slice and the processor switches rapidly among the users according to it.

- Because of this, each user believes that they are the only ones using the system.
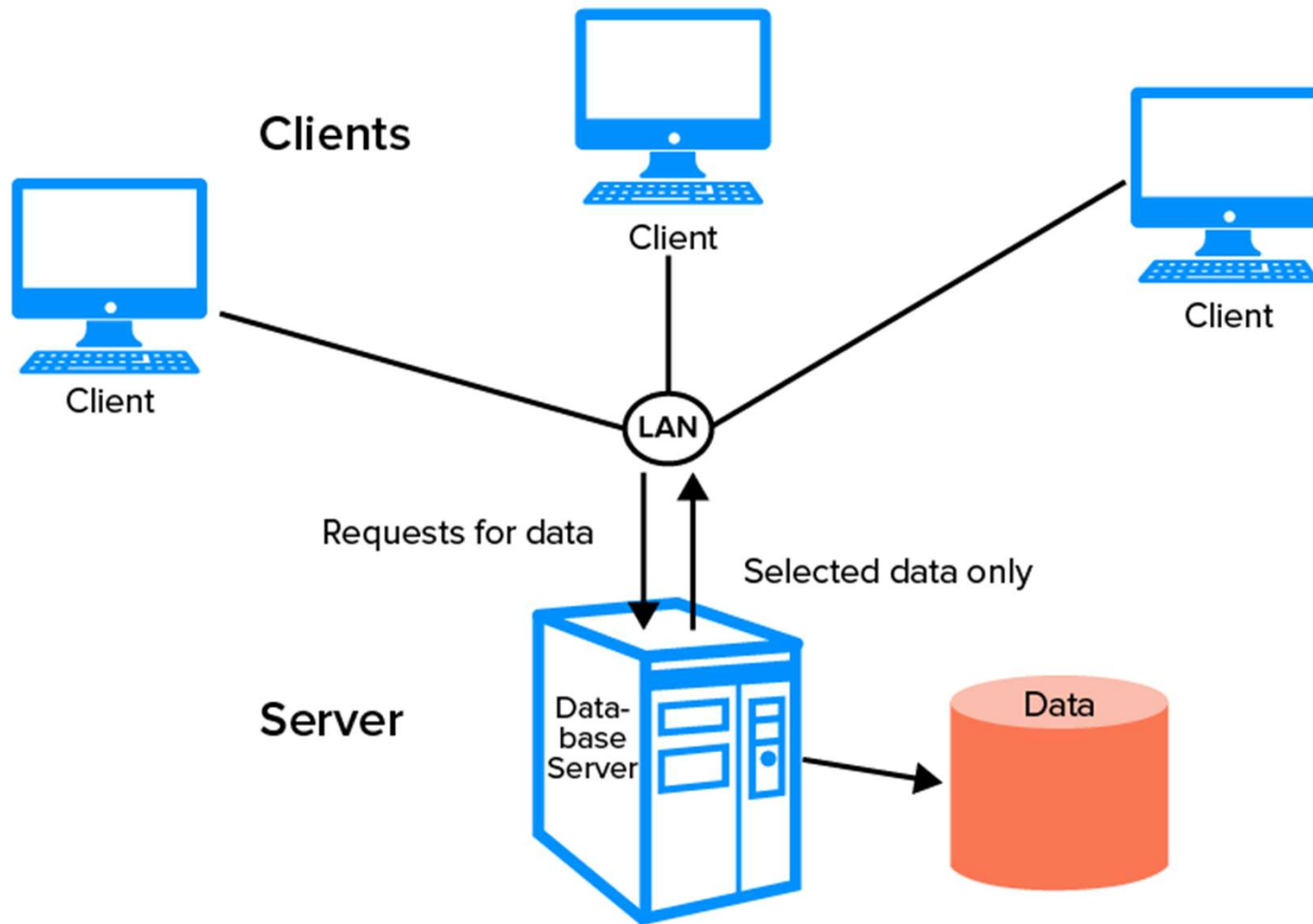
Networked Computing

- Need for networked computing:
    - Better communication between systems
    - Resource sharing
- Systems and associated resources, such as printers, were interconnected to form local networks (LANs)
- These small networks evolved to form ARPANET, which finally evolved to the Internet.

ARPANET: It stands for Advanced Research Projects Agency NET. ARPANET was first network which consisted of distributed control. It was first to implement TCP/IP protocols.

Client Server Computing Environment

- In client server computing, the client requests a resource and the server provides that resource.

- A server may serve multiple clients at the same time while a client is in contact with only one server.

- Both the client and server usually communicate via a computer network but sometimes they may reside in the same system.

Client/ Server Architecture

Clients

Client

Client

Client

LAN

Requests for data

Selected data only

Server

Data-base Server

Data

Distributed Computing Environment

- A distributed computing environment contains multiple nodes that are physically separate but linked together using the network.
- All the nodes in this system communicate with each other and handle processes in tandem.
- Distributed system architectures are bundled up with components and connectors.
- Components can be individual nodes or important components in the architecture whereas connectors are the ones that connect each of these components.
- Component: A modular unit with well-defined interfaces; replaceable; reusable.

Distributed System Architecture
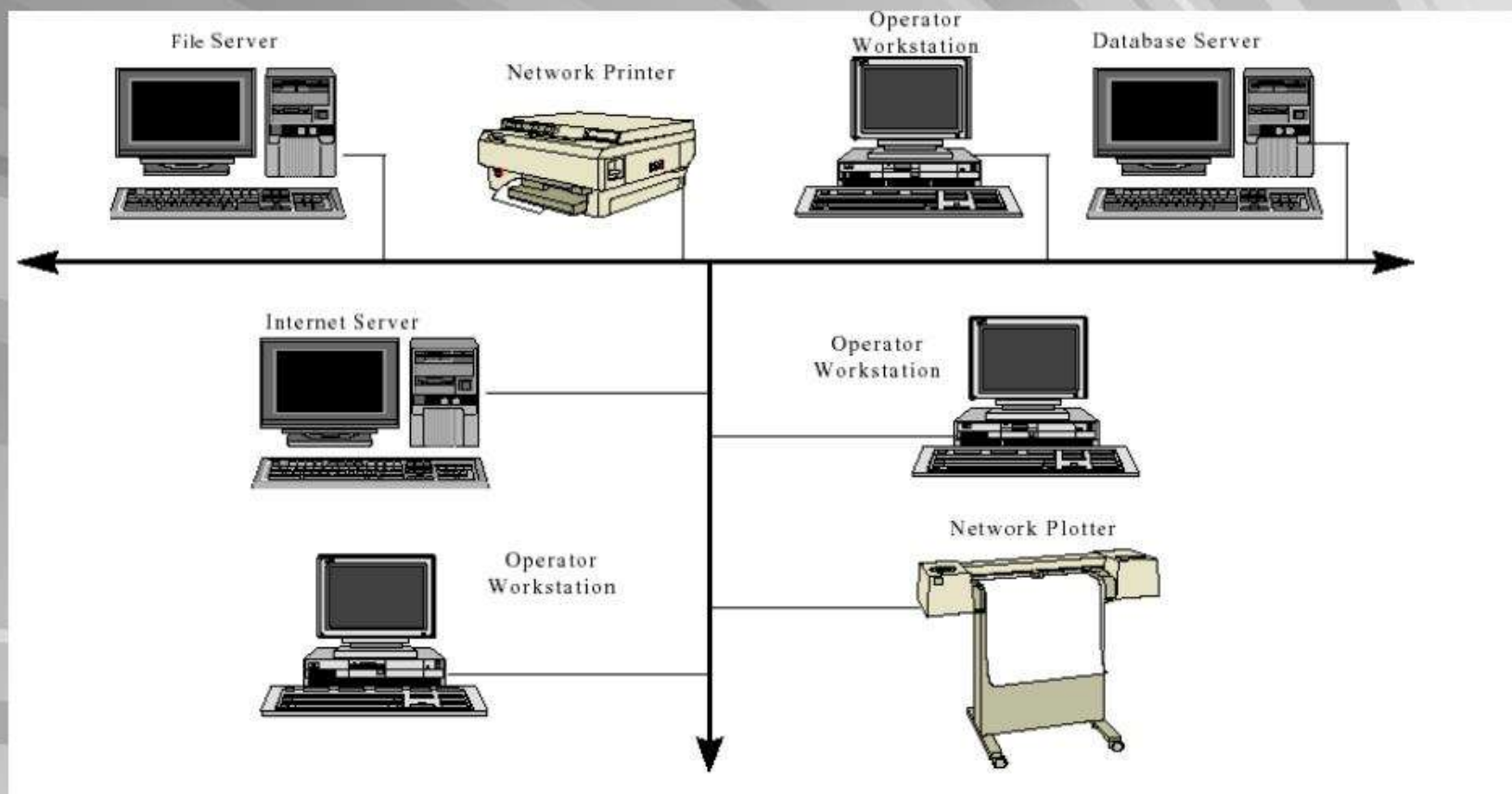
Grid Computing

- The volunteer computing projects are often compared to electric grids

  - *Large number of connected nodes which act like a single entity.*

  - *Users do not know which node serves their requests.*

- Multiple physically separated systems share data and resources for **performing a common task.**

- Often, the original **task is split and distributed** among different systems or nodes.

- Requires **special software** to be installed on the systems ("middleware").

TERAGRID
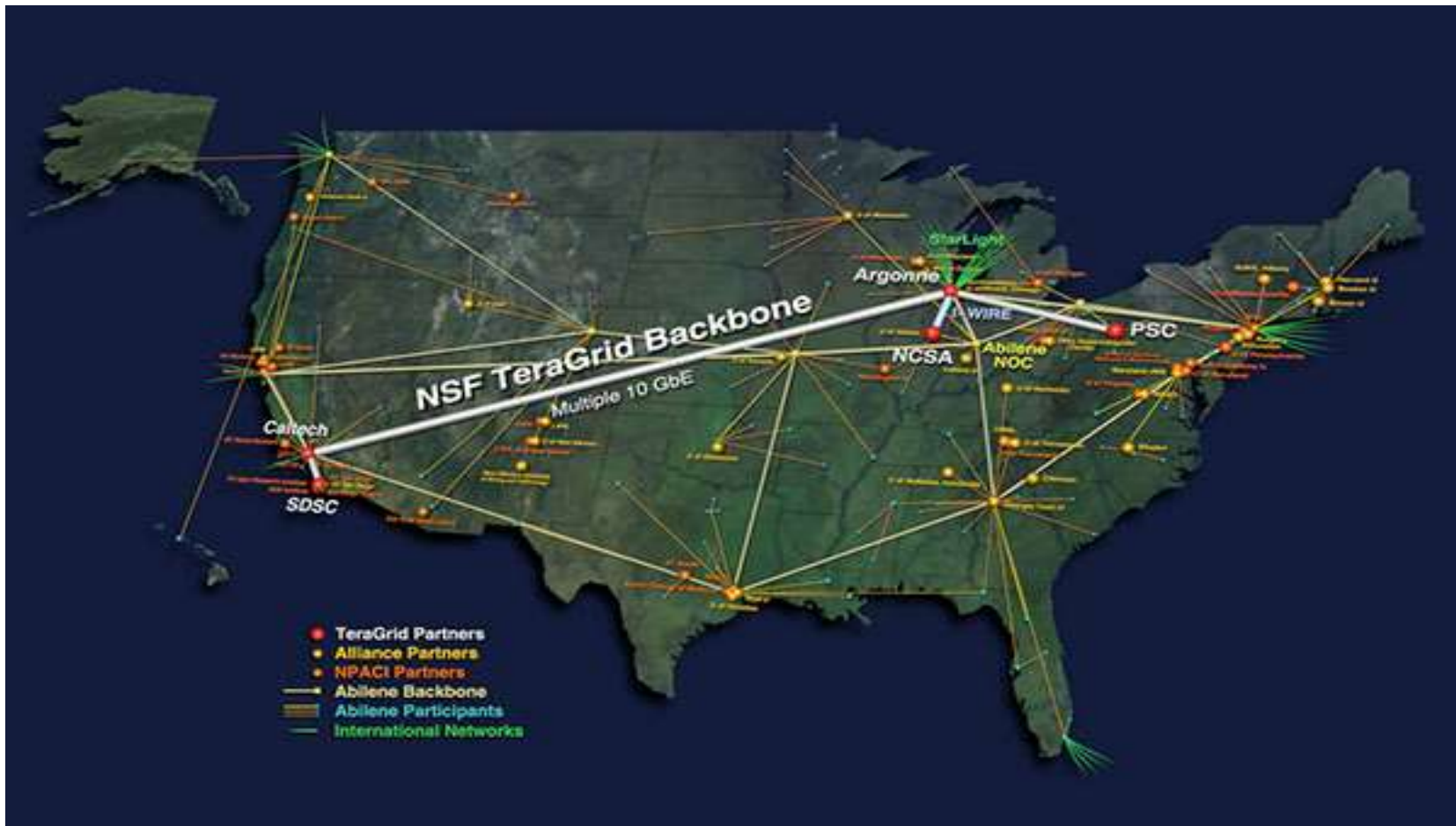
TeraGrid users primarily came from U.S. universities. There are roughly 4,000 users at over 200 universities. Academic researchers in the United States can obtain exploratory, or development allocations (roughly, in "CPU hours") based on an abstract describing the work to be done.

TERAGRID

- e-Science grid computing **spread over 11 sites** across USA.
- **Petaflops of computing capability** and more than **30 petabytes of online and archival data storage** connected by **high speed optic fibre (10 Gbps)**
- Coordinated TeraGrid Software and Services (CTSS).
  - single-sign on
  - remote job submission
  - workflow support
  - distributed accounting and account management software
  - verification and validation software
  - set of compilers, programming tools etc

Advantages of Grid Computing

- Improved resource utilization
- General performance increase – parallel processing
- Easier collaboration
- Increased robustness