جامعة المستقبل
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Department of Cyber Security

Subject: Enabling Technologies and Cloud Computing

Class: Third stage

Lecture: (4)

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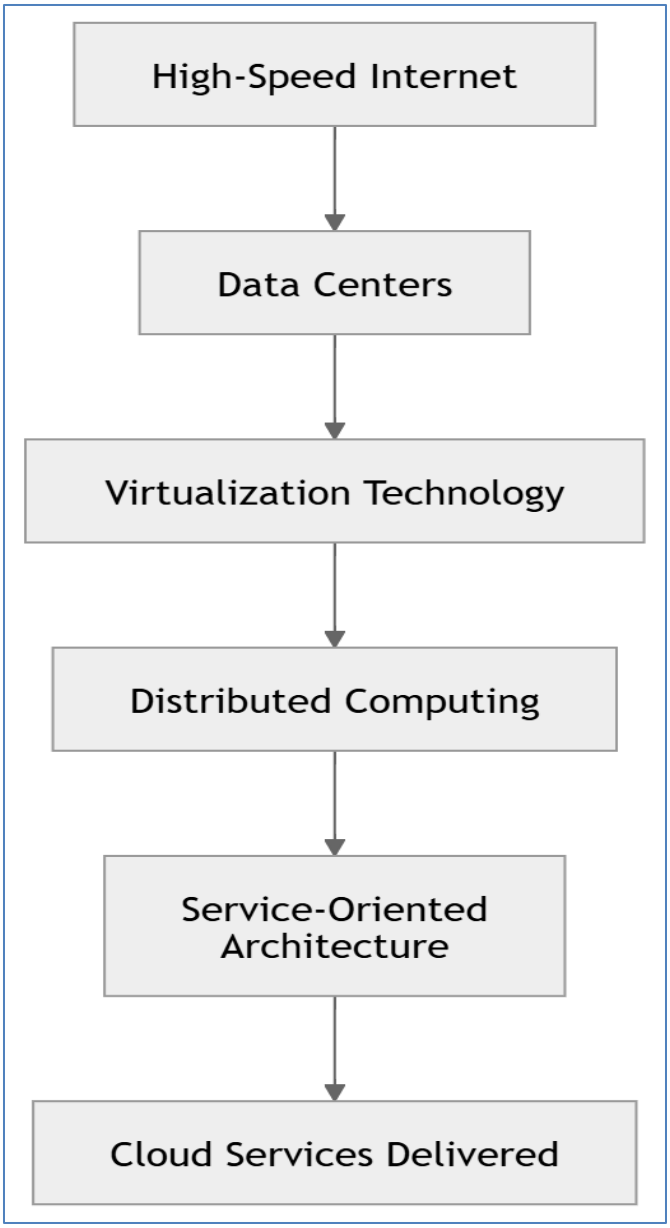
Introduction to Enabling Technologies

What Are Enabling Technologies?

Enabling Technologies are advanced digital technologies that make modern IT systems possible.
They provide the foundation that supports innovation, automation, scalability, and intelligent services.

Enabling technologies are the “building blocks” that allow modern digital systems to work efficiently and grow.

Without these technologies, systems like cloud computing, artificial intelligence, big data analytics, and smart applications would not function properly.



Sequence of technologies to enable cloud computing

Major Enabling Technologies:

IoT Enabling Technologies

- **Wireless Sensor Network**

- **Cloud Computing**

- **Big Data Analytics**

- **Communication Protocols**

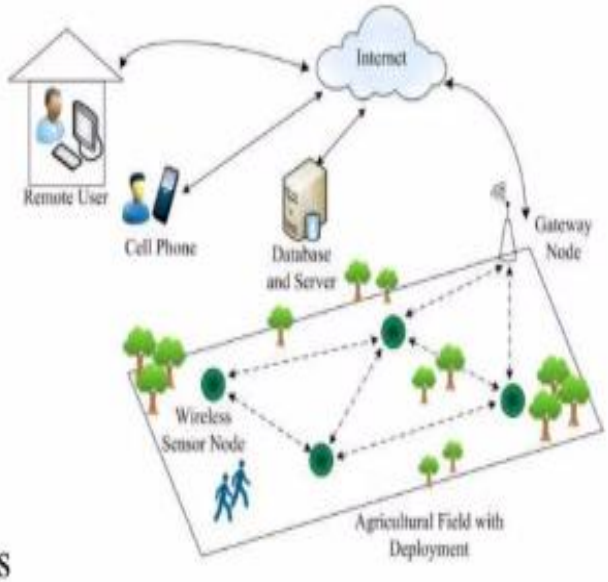
- **Embedded Systems**

These technologies collectively build the foundation of modern digital infrastructures.

•**Distributed Devices with sensors** used to monitor the environmental and physical conditions

Or

•It is a network formed by **large no. of sensor nodes** to detect light, heat , pressure ect.
i.e. used to monitor environmental and physical conditions.
• Each node can have several sensors attached to it.
• Each node can also acts as a routers
• **Coordinator** collects data from all nodes
• Coordinator acts as **gateway** that connects WSN to the internet.



Examples of WSNs

- Indoor Air Quality Monitoring system
- Weather Monitoring System
- Soil Moisture Monitoring System
- Survelliance Systems
- Health Monitoring Systems

Protocols used

WSNs are enabled by wireless communication protocols such as **IEEE802.15.4**

Zigbee is one of the most popular wireless technology used by WSNs. Zigbee specifications are based on **IEEE802.15.4** which is used for low powered devices.

Data rate: up to **250KBps**. Range: upto **100 Meters**

2. Cloud Computing

- Deliver applications and services over internet

Provides computing, networking and storage resources on demand

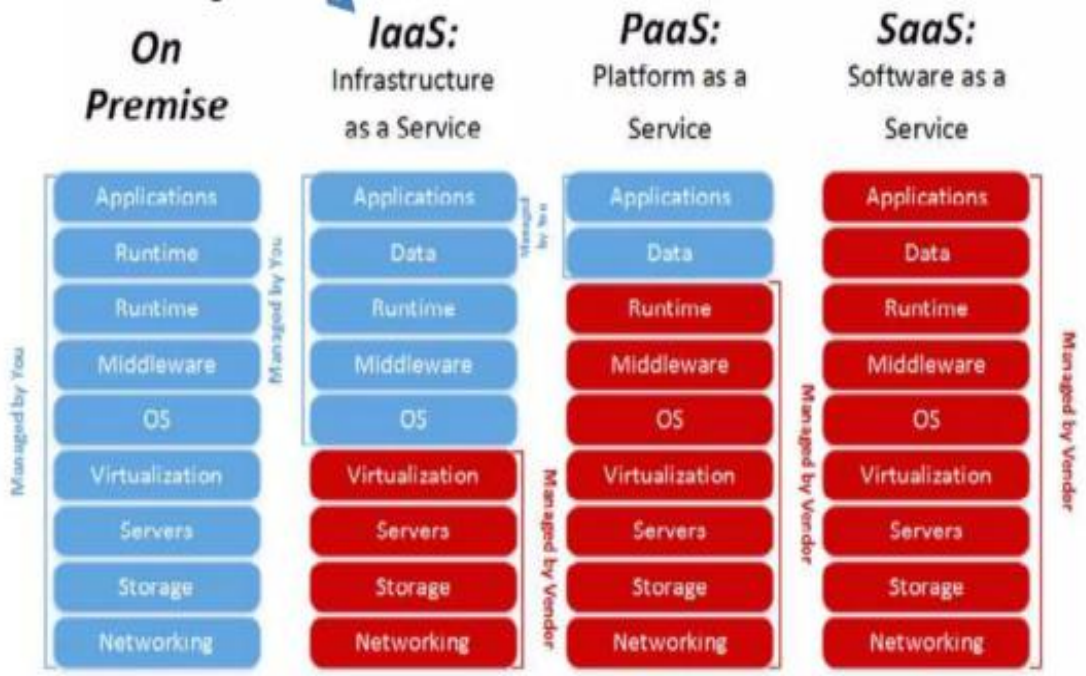
Cloud Computing is a way of making use of virtual computer world wide using the same personalized experience.

Types of Cloud computing services

1. IaaS(Infrastructure as a Service),
2. PaaS(Platform as a Service and
3. SaaS(Software as a Services)

IaaS: Clients can use **storage** to install and manage **operating systems** and any **desired applications**.(i.e Virtual machines + virtual storage)

Ex: Web Hosting.



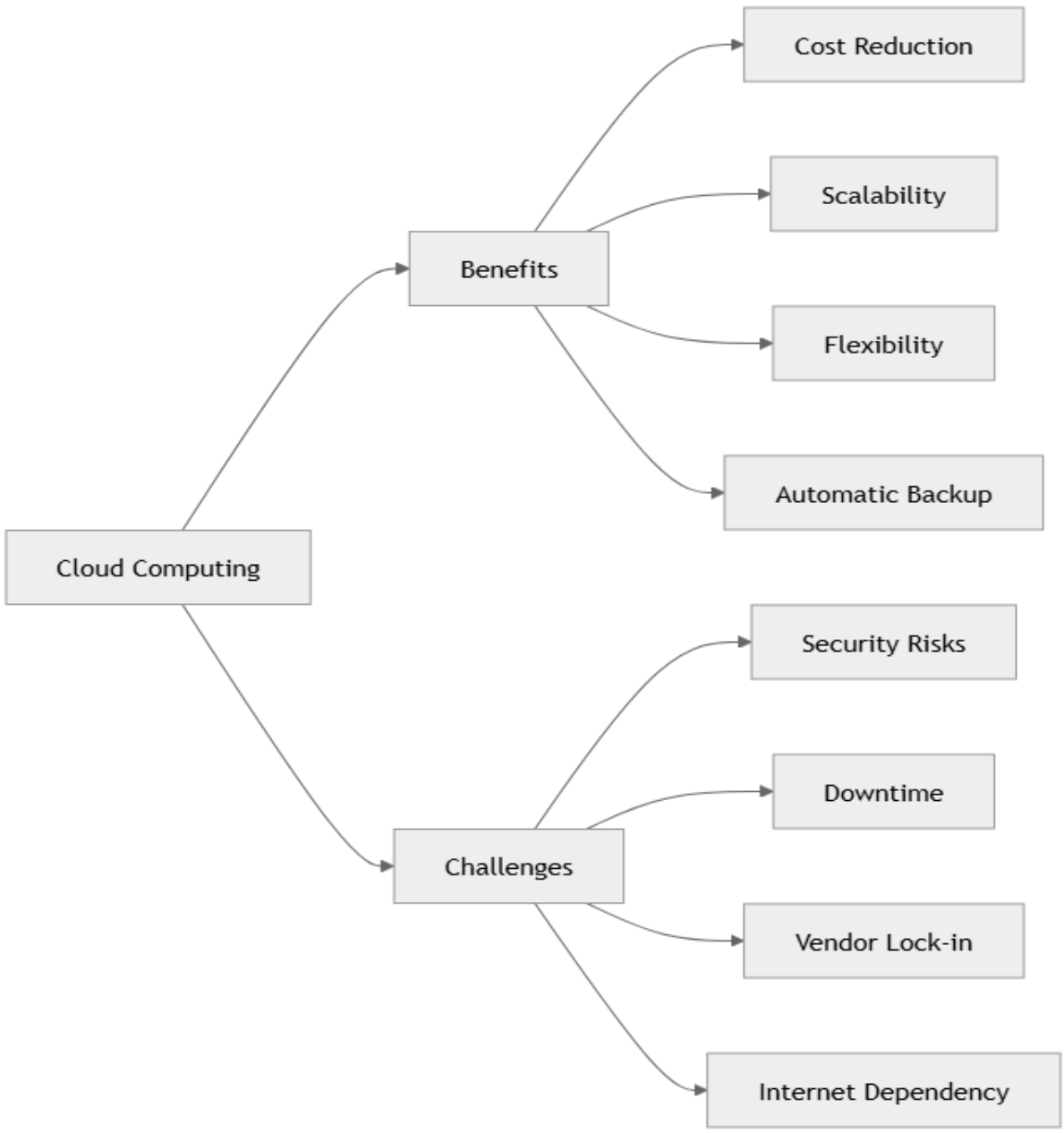
- **Paas** : Clients can install, build and modify or control applications.

Ex: App cloud, Google App Engine

- **Saas :** Clients can access and use software at remote location using a web browser.

Ex: Google documents

Mind Map to enable cloud computing



Cloud Computing Feature

Cloud computing has five essential characteristics:

1. On-Demand Self-Service

Users can automatically provision computing resources without human interaction.

2. Broad Network Access

Services are accessible over the Internet via various devices (laptops, tablets, smartphones).

3. Resource Pooling

Resources are shared among multiple customers using a multi-tenant model.

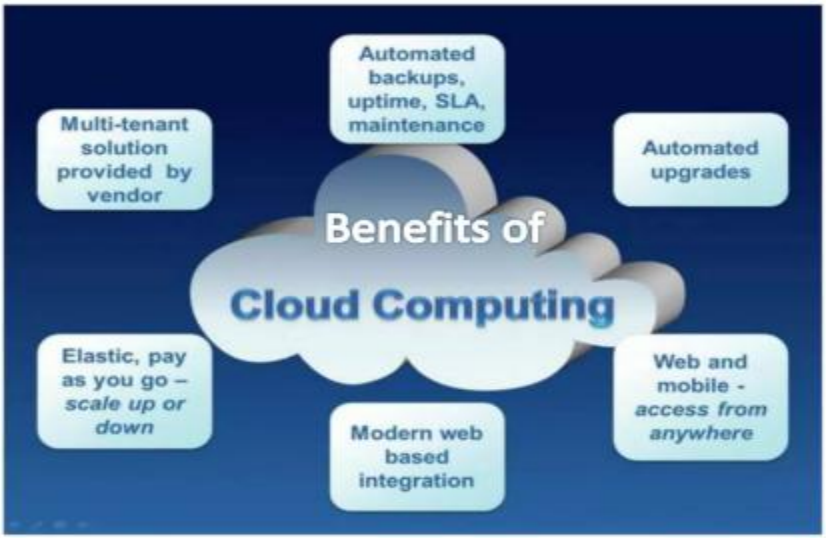
4. Rapid Elasticity

Resources can scale up or down quickly depending on demand.

5. Measured Service

Usage is monitored, controlled, and billed based on consumption (pay-as-you-go).

Cloud Computing Benefits



1. Cost Efficiency

No need for heavy upfront investment in hardware.

2. Scalability

Resources can expand or shrink based on workload.

3. Flexibility

Organizations can deploy services rapidly.

4. Accessibility

Data and applications can be accessed from anywhere.

5. Disaster Recovery

Cloud providers offer backup and recovery solutions.

6. Automatic Updates

Software updates are managed by the provider.

Challenges of Cloud Computing

Challenges refer to operational and management difficulties organizations face.

1. Data Management Complexity

Handling large volumes of data across distributed systems.

2. Integration with Legacy Systems

Older systems may not easily integrate with cloud environments.

3. Security Management

Ensuring data protection in shared environments.

4. Cost Management

Unexpected usage may increase expenses.

5. Skills Gap

Organizations may lack trained cloud professionals.

Comparison: Benefits vs. Risks

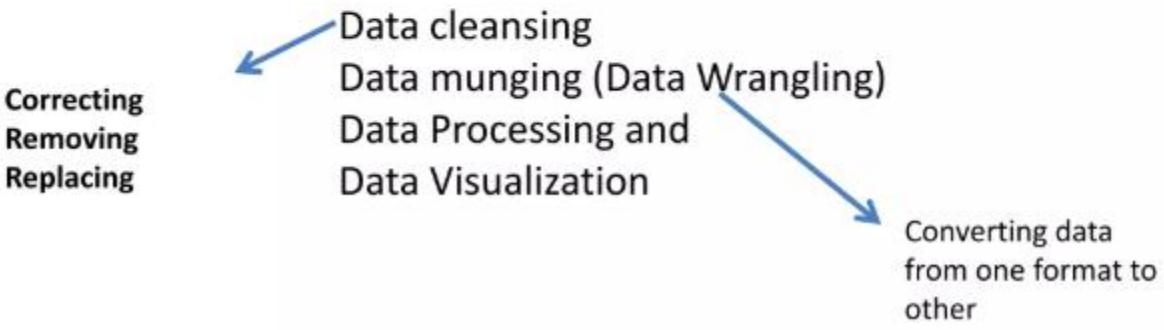
Benefits	Risks
Cost reduction	Data breaches
Scalability	Downtime
Global access	Vendor lock-in
Backup & recovery	Privacy concerns
Innovation support	Compliance challenges

Cloud computing offers strong advantages, but proper risk management is essential.

Big Data Analytics

- Collection of data whose volume, velocity or variety is too large and difficult to store, manage, process and analyze the data using traditional databases.

Big data Analytics involves



Big Data Analytics

Characteristics of Big Data is 3V

Variety Includes different types of data

Structured
Unstructured
Semi-Structured
All of above
-text, audio , video

Velocity Refers to speed at which data is processed

Batch
Real-time
Streams

Volume refers to the amount of data

Terabyte
Records
Transactions
Files
Tables

Acc to IBM in 2012: **2.5 Billion GB** data was generated **everyday**!
Forbes states: in 2020, **1.7 MB** of **new information** is will be created

Examples

- Lots of data is being collected and warehoused
  - Web data, e-commerce
  - purchases at department/ grocery stores
  - Bank/Credit Card transactions
  - Social Network

3. Communication Protocols

- Backbone of IOT system
- Allows devices to exchange data over networks.
- Define data exchange formats
  - Data encoding
  - Addressing Schemes
  - Routing of packets from sources to destination
- Other Functions
  - Sequence control(ordering data packets)
  - Flow control(controlling transfer rate)
  - Retransmission of lost packets

4. Embedded Systems

- A microcontroller-based, software-driven, reliable, **real-time control system**, designed to perform a **specific task**..
  - **It can be thought of as a computer hardware system having software embedded in it.**
  - **An embedded system can be either an independent system or a part of a large system.**

What is the difference between a PC and an Embedded system?

Embedded Systems found in..

Key Components

- Microprocessor or micro controller
- Memory (RAM, ROM ect.)
- Storage (Flash Memory)
- Networking units(Ethernet, Wifi adaptors)
- I/O units (Keyboard, display ect)

Some Embedded systems have

- DSP(Digital Signal Processor)
- Graphics Processor
- App Specific Processor

•Embedded systems run embedded OS

Ex: RTOS(Real Time OS)(like symbian, Vxworks , Windows embedded compact ect.)