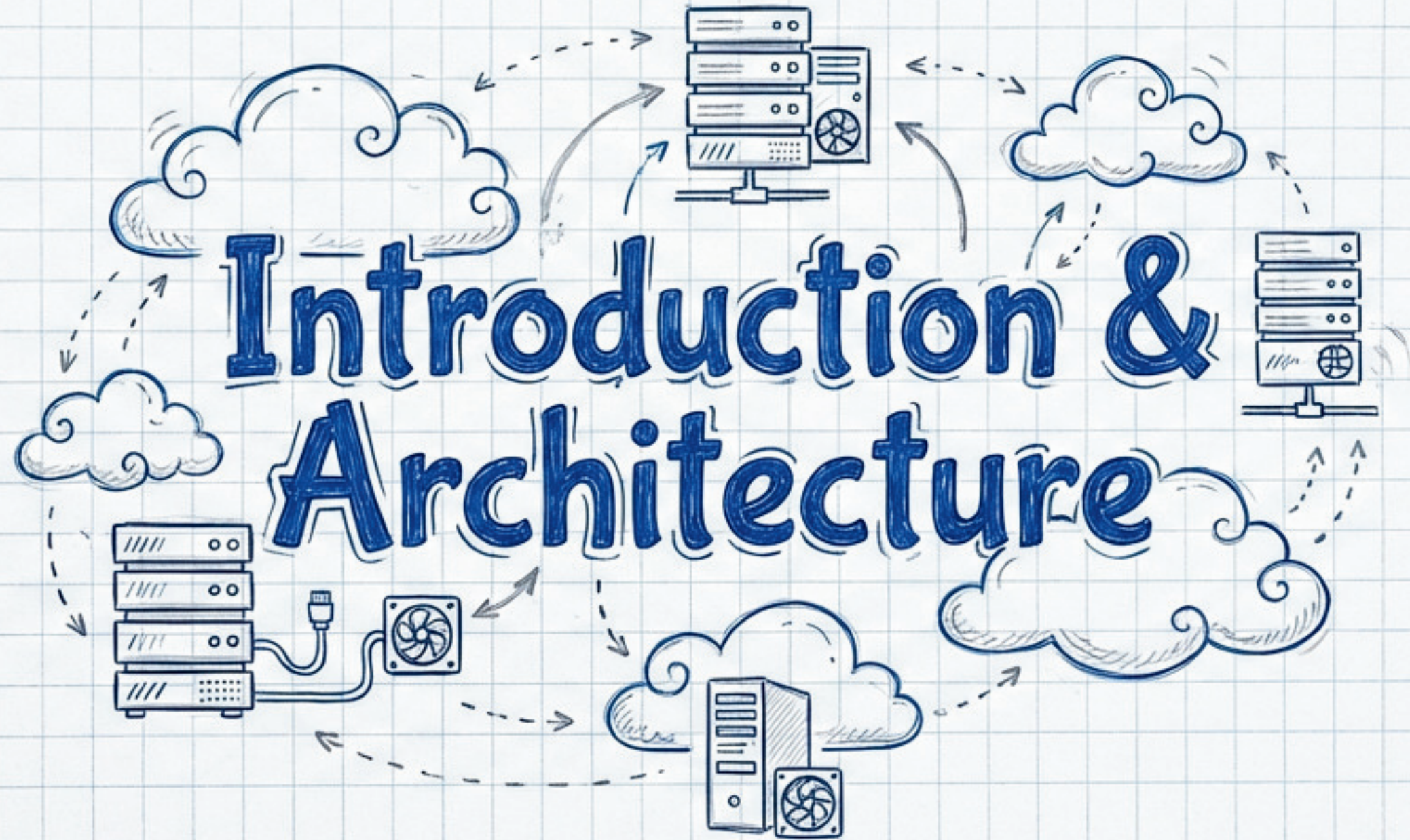


CSA 7115T CLOUD COMPUTING

(Detailed Notes for BCA Students)

Syllabus Overview

- Introduction
- Architecture
- Service Models (XaaS)
- Deployment Models
- Virtualization
- Security



Hand Notes by Kamal Kishor

1. Introduction to Cloud Computing

1.1 What is Cloud Computing?

Cloud Computing is a computing model in which computing resources such as servers, storage, databases, networking, software, and analytics are delivered over the Internet (cloud) instead of being installed on a local computer or on-premise data center. Instead of buying, owning, and maintaining hardware/software, users rent resources on demand from cloud service providers.

In simple words:

Cloud computing means using someone else's computer (server) via the internet to store data, run applications, and perform computing tasks.

1.2 Key Characteristics of Cloud Computing

1. **“On-Demand Self-Service”**: Users can provision resources automatically without human interaction. (Ex: Creating a virtual machine in minutes.)
2. **“Broad Network Access”**: Services are accessible via internet using devices like mobiles, laptops, tablets.
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3. **“Resource Pooling”**: Provider pools computing resources to serve multiple users. Uses multi-tenancy model.
4. **“Rapid Elasticity & Scalability”**: Resources can be increased or decreased quickly. (Ex: Scaling servers during peak traffic.)
5. **“Measured Service (Pay-as-You-Go)”**: Users pay only for what they use. (Ex: Pay per hour of VM usage.)

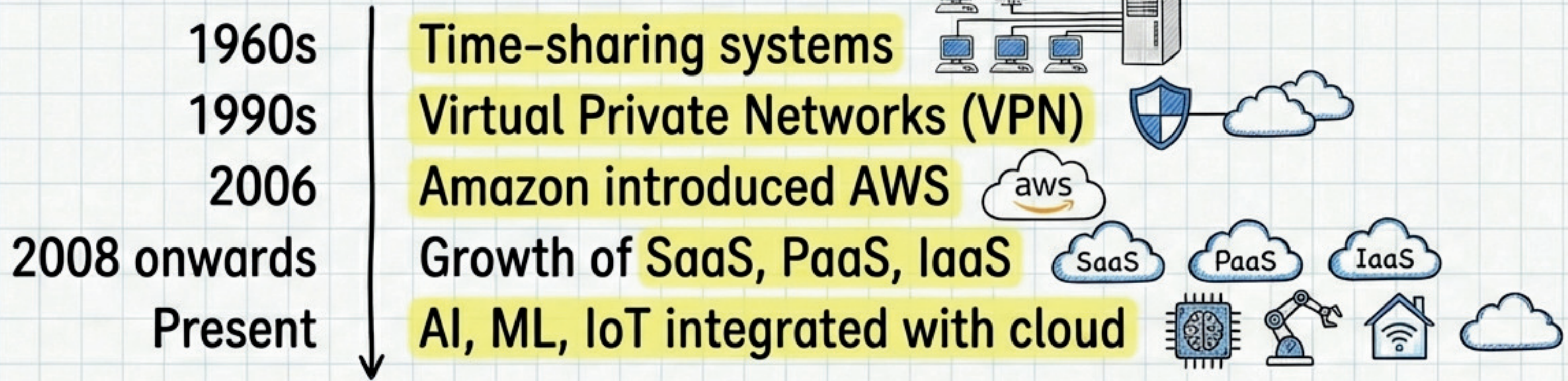
1.3 Benefits of Cloud Computing

- **Cost Reduction** – No need to buy hardware ✓
- **Scalability** – Easy to scale up/down ✓
- **High Availability** – Minimal downtime ✓
- **Global Access** – Access from anywhere ✓
- **Disaster Recovery** – Backup & recovery support ✓
- **Automatic Updates** – Provider handles maintenance ✓

1.4 Usage Scenarios of Cloud Computing

- **Web hosting and application hosting**
- **Online storage** (Google Drive, Dropbox)
- **Software development & testing**
- **Big data processing & analytics**
- **E-learning platforms**
- **E-commerce applications**
- **Online collaboration tools**

1.5 History of Cloud Computing



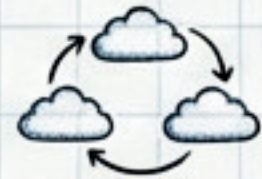
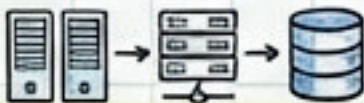
2. Cloud Computing Architecture

2.1 Cloud Architecture Overview

Cloud architecture defines how cloud components are structured and how they interact.

It consists of:

1. **Front End**
2. **Back End**
3. **Cloud Delivery Models**
4. **Networking**



2.2 Front End



Client side. Responsible for user interaction.

- Web browsers
- Mobile apps
- Thin clients

2.3 Back End



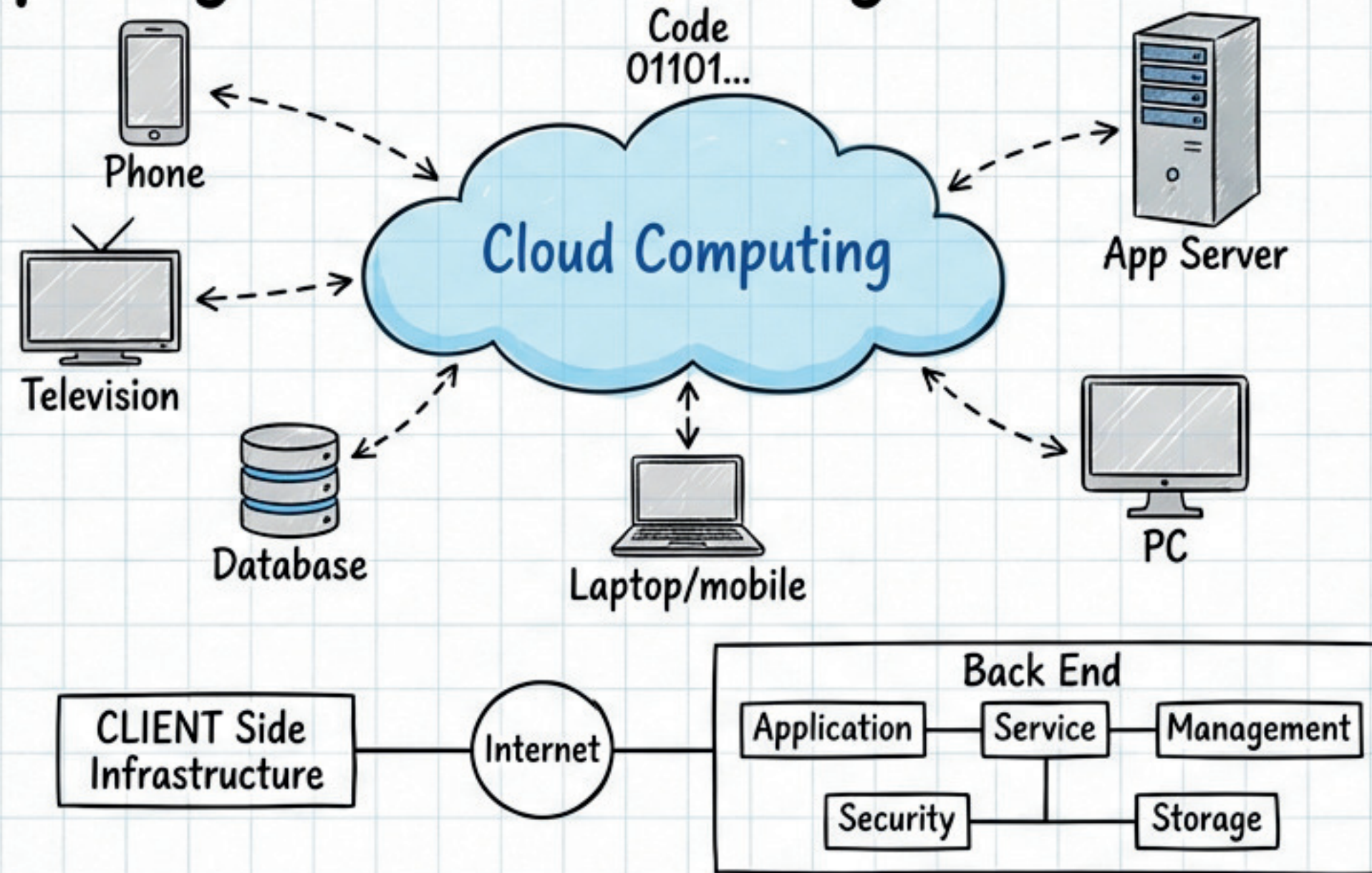
Provider side.

- Servers
- Storage systems
- Databases
- Virtual machines
- Management software

2.4 Cloud Computing Stack

1. Application Layer: End-user applications (Ex: Gmail, Salesforce).
2. Platform Layer: Development environment, APIs, runtime, databases.
3. Infrastructure Layer: Physical hardware, Virtual machines, storage, networking.

1. Cloud Computing Architecture Diagram



Explanation (How to write in exam):

Cloud Architecture is divided into Front End and Back End, connected through the Internet.

- **Front End (Client Side)** - User interface. Includes: Web browser, Mobile apps, Thin clients. Used by users to access cloud services.
- **Back End (Cloud Side)** - Includes: Application servers, Database servers, Storage systems, Virtual machines, Cloud management software.
- **Internet** - Medium that connects users to cloud resources.

2.5 Comparison: Cloud vs Traditional Computing

Traditional Computing	Cloud Computing
High initial cost	Low initial cost
Limited scalability	Highly scalable
Manual maintenance	Automatic maintenance
Fixed capacity	Elastic capacity
On-premise	Internet-based

2.6 Role of Networks in Cloud Computing

- Enables communication between users and cloud servers.
- Uses high-speed internet.
- Supports:
 - Data transfer
 - Load balancing
 - Virtual private networks

2.7 Protocols Used in Cloud

- HTTP/HTTPS – Web access
- FTP/SFTP – File transfer
- TCP/IP – Data communication
- SOAP & REST – Web services

2.8 Role of Web Services

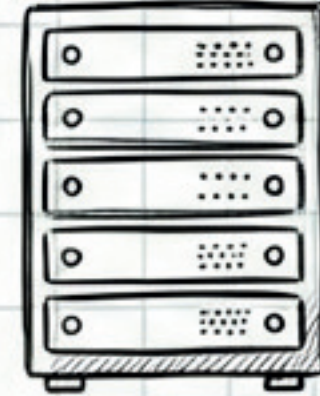
Web services allow interoperability between different applications using standard protocols.

Types:

- SOAP-based services
- RESTful services

3. Cloud Service Models (XaaS)

3.1 Infrastructure as a Service (IaaS)



- Provides virtualized hardware resources.
- Users manage: OS, Applications.
- Provider manages: Hardware, Networking.
- **Examples:** Virtual machines, Storage, Load balancers.
- **Advantages:** High flexibility, Full control.

3.2 Platform as a Service (PaaS)



- Provides platform to develop, test, and deploy applications.
- Includes: OS, Runtime, Database, Development tools.
- Users focus only on application code.
- **Advantages:** Faster development, No infrastructure management.

3.3 Software as a Service (SaaS)

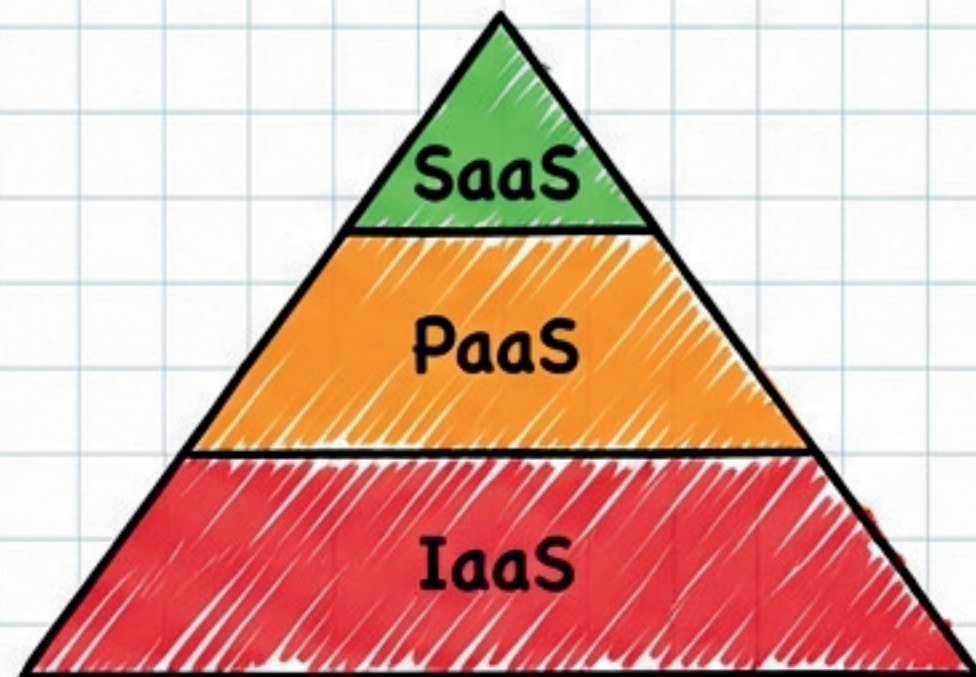
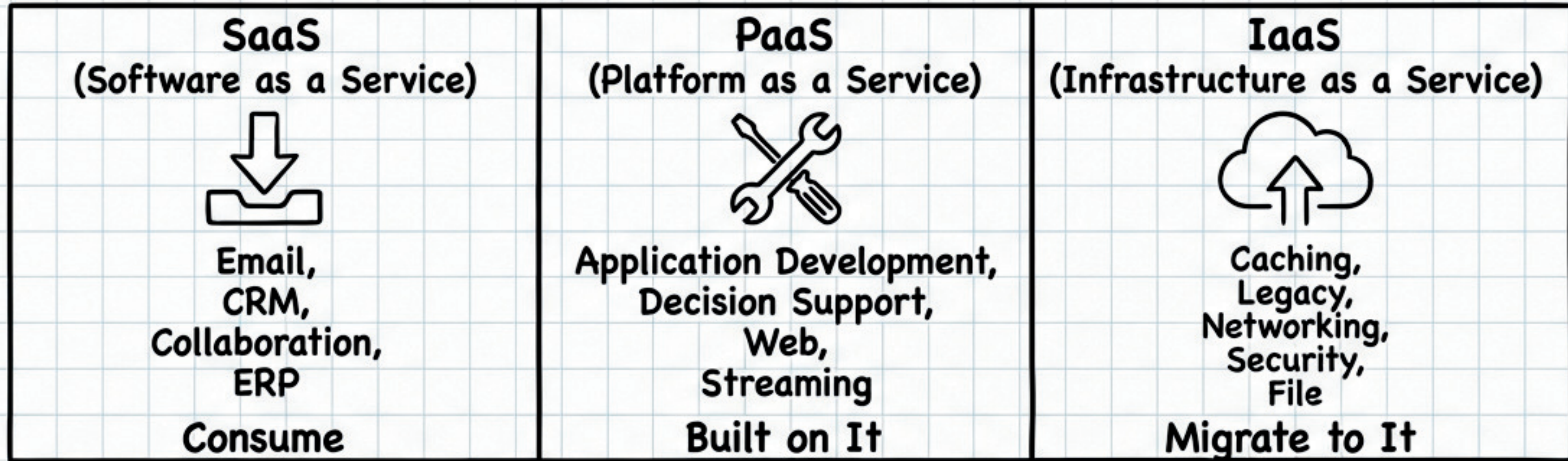


- Complete software delivered via internet.
- No installation required.
- Examples: Email services, CRM software, Office tools.
- Examples: Email services, CRM software, Office tools.
- Advantages: Easy to use, Automatic updates.

3.4 Other Cloud Services

- DBaaS – Database as a Service
- MaaS – Monitoring as a Service
- CaaS – Communication as a Service

2. Cloud Service Models Diagram



This diagram shows layer-wise service responsibility.

- IaaS: Provides Virtual machines, Storage, Networking. User controls OS & apps.
- PaaS: Provides OS, Runtime, Database. User focuses only on application development.
- SaaS: Provides Complete application. No installation needed.

Exam Line: As we move from IaaS to SaaS, user control decreases and provider responsibility increases.

4. Cloud Deployment Models

1. Public Cloud

- Shared infrastructure
- Cost-effective

2. Private Cloud

- Dedicated to one organization
- More secure

3. Hybrid Cloud

- Combination of public & private
- Flexible

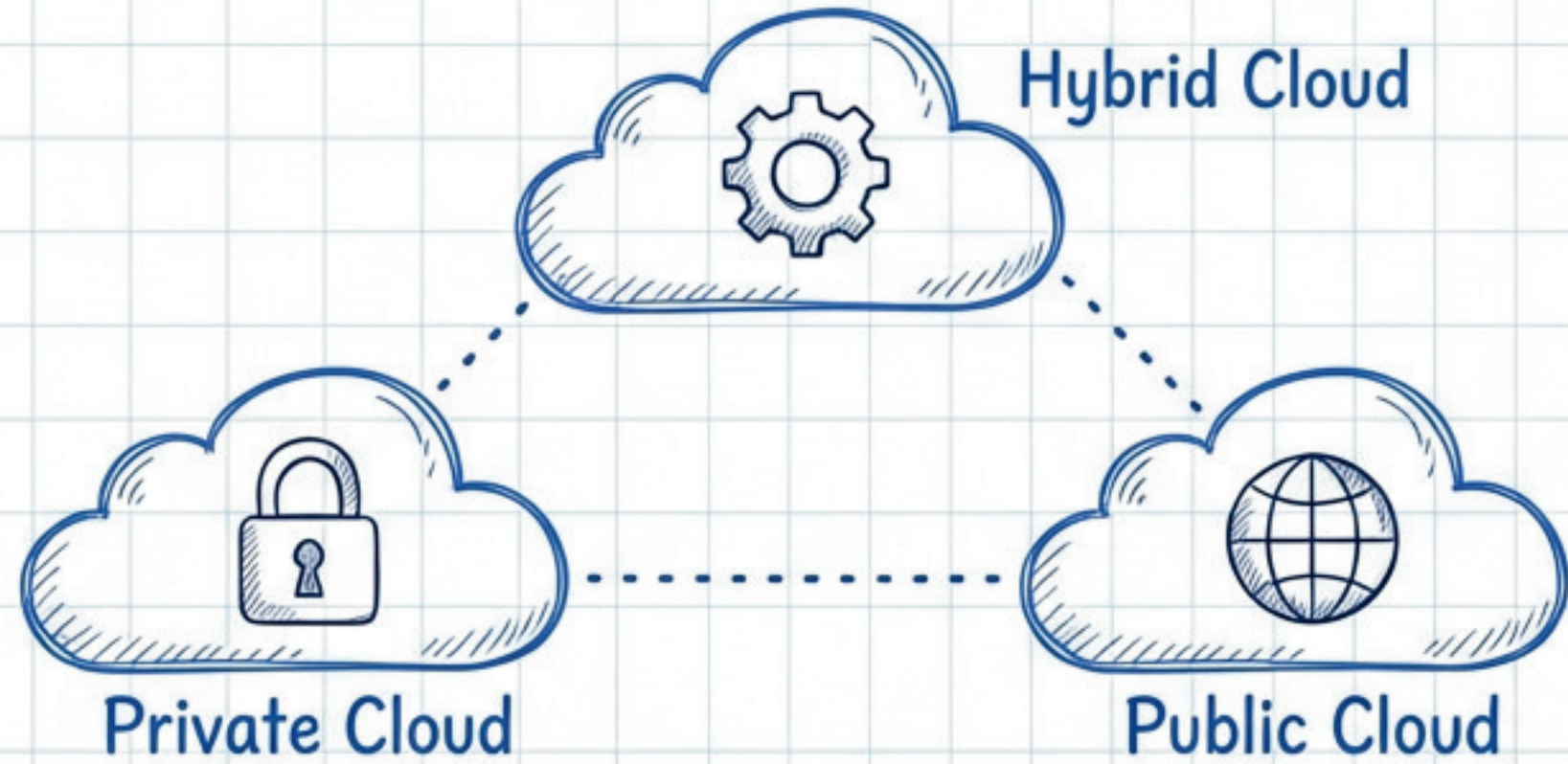
4. Community Cloud

- Shared among organizations with common needs

5. Cloud Service Providers

- Major providers include: Google, Amazon, Microsoft, IBM, Salesforce.
- They provide: Storage, Computing, AI services, Databases, Security tools.

3. Cloud Deployment Models Diagram



- **Public Cloud:** Shared infrastructure, Cost-effective, Less control.
- **Private Cloud:** Dedicated to single organization, High security, Expensive.
- **Hybrid Cloud:** Combination of public & private. Sensitive data in private cloud, Public cloud for scalability.
- **Community Cloud:** Shared by organizations with common requirements.

Caveat Brush

Exam Tip: Label each cloud clearly and show data flow in Hybrid Cloud.

6. Collaborating Using Cloud Services

Cloud enables real-time collaboration.

Applications include:

- Email communication
- CRM management
- Project management
- Event management
- Task scheduling
- Online documents
- Spreadsheets
- Databases
- Social networks
- Groupware tools.

Benefits:

- Real-time access
- Multi-user editing
- Version control.

7. Virtualization for Cloud Computing

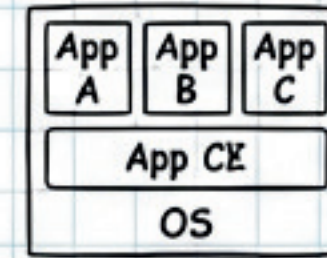
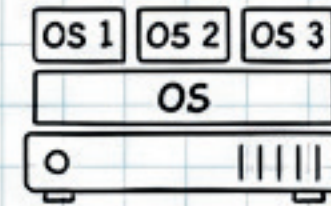
7.1 Need for Virtualization

Virtualization allows multiple virtual machines to run on a single physical machine.

It improves: Resource utilization, Scalability, Isolation, Cost efficiency.

7.2 Types of Virtualization

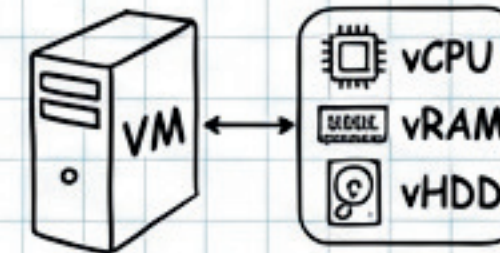
1. System Virtualization: Entire OS virtualized.
2. Process Virtualization: Application-level virtualization.



7.3 Virtual Machine (VM)

A VM is a software-based computer that behaves like a physical computer.

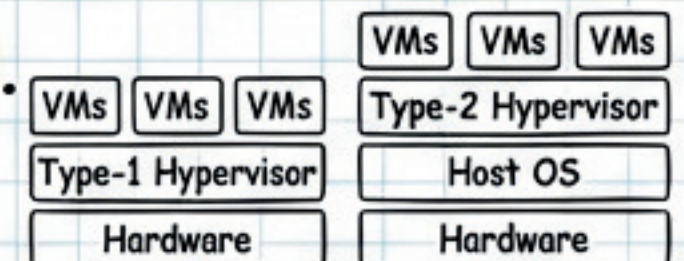
Components: Virtual CPU, Virtual memory, Virtual disk.



7.4 Hypervisors

Hypervisor manages virtual machines. Types:

1. Type-1 (Bare Metal): Runs directly on hardware. (Examples: Xen, KVM, VMware, Hyper-V).
2. Type-2 (Hosted): Runs on operating system. (Example: VirtualBox).

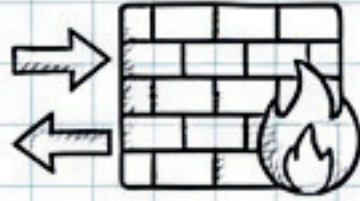


Exam Tip: Type-1 Hypervisors offer better performance and security.

8. Cloud Security

8.1 Network Level Security

- Firewalls
- VPN
- Intrusion detection systems



8.2 Host Level Security

- OS hardening
- Patch management
- Antivirus



8.3 Application Level Security

- Secure coding
- Authentication
- Authorization



8.4 Data Security

- Encryption (at rest & in transit)
- Backup
- Access control



8.5 Authentication in Cloud

- Username/password
- Multi-factor authentication
- Digital certificates



8.6 Cloud Security Challenges

- Data breaches
- Data loss
- Insider threats
- Compliance issues
- Shared responsibility risks

