Parul® University

Specialization - Cloud Computing - I

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Parul®
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DIGITAL LEARNING CONTENT

Unit – 2

Cloud Computing Models

Types of Cloud

- **Public cloud:** This computing infrastructure is hosted at the vendor's workplace. The end user cannot view the infrastructure. The computing infrastructure is shared between companies.
- **Private cloud:** Here the computing infrastructure is dedicated to the customer and is not shared with any other companies. They are costly and highly secure than public clouds. Private clouds may be hosted externally as well as in their own premise hosted clouds
- **Hybrid cloud:** Organizations can submit less valued applications in public cloud and high valued applications in the private cloud. The combination is known as hybrid cloud. Cloud bursting is used to define a system where the organization uses its own infrastructure for normal usage and cloud is used for peak times
- **Community cloud:** The cloud infrastructure is shared between the companies of the same community. For example, all the government organizations in a city can share the same cloud but not the non-governmental organizations

Six different types of cloud computing follows:

1. **WWW-based cloud computing service** is a type of cloud service that exploits certain web service functionalities, rather than deploying applications. For example, it can use Google Maps API.
2. **Software as a service** is an idea, where an application can be used by multiple tenants, using the browser. For example, SaaS solutions are used in sales, ERP and HR.
3. **Platform as a service** is a variant of SaaS, one can run their own applications but by executing on the cloud provider's infrastructure.
4. **Utility cloud computing services** offer virtual storage and server options, where the companies can access it on demand. This allows easy creation of virtual data centre.

Six different types of cloud computing follows:

5. **Managed services** are the oldest cloud computing solutions. In this, a cloud computing provider utilizes an application than the end customers. Examples are using anti-spam services and application monitoring.
6. **Service commerce** is a mix of SaaS and managed services. It provides a hub of services, where the end user interacts. Examples are tracking expenses, virtual assistant services and travel bookings.

Public Cloud

Definition:

- A public cloud provides resources like storage and applications to the public over the web. Services are available on a free or pay-per-use model.

Advantages:

- Cost-Effective: Inexpensive and easy to set up.
- Scalable: Easily adjust resources as needed.
- Efficient: Eliminates resource wastage.

Examples:

- IBM Blue Cloud
- Amazon EC2
- Google AppEngine
- Sun Cloud
- Microsoft Azure

Private Cloud

Definition:

- A private cloud (also known as internal or corporate cloud) is a proprietary computing model offering services to users within a firewall.

Key Features:

- Exclusive Access: Restricted to organization members.
- Enhanced Security: Operates behind a firewall.
- Efficient Resource Use: Optimized through distributed computing and virtualization.

Purpose:

- Provides tailored, secure services to meet the organization's internal needs.

Key Differences: Public Cloud vs. Private Cloud

Feature	Public Cloud	Private Cloud
Deployment	Hosted over the World Wide Web (WWW).	Deployed inside the organization's firewall.
Ownership	Managed by a third-party service provider.	Fully managed and controlled by the enterprise.
Cost Model	Pay-per-usage; monthly charges for data and bandwidth.	High upfront cost for hardware and software.
Scalability	On-demand scalability without hardware purchase.	Scalable by adding servers to existing architecture.
Security	Shared environment; lower security.	Dedicated resources; high security.
Usability	Available to public users.	Restricted to organization members.
Hardware Needs	No hardware purchase required.	Requires Hardware

Factors for Public vs. Private Cloud

Factor	Public Cloud	Private Cloud
Elementary Expense	Low initial cost; no hardware/software needed.	Built on a low budget with efficient deployment.
Volume of Data	Smaller scale; easy to back up small data sets.	Starts from TBs, scalable by adding nodes.
Performance	Limited by Internet accessibility.	Enhanced with Ethernet and additional nodes.
Data Storage Duration	Flexible, based on service terms.	Long-term, dependent on organizational needs.
Access Patterns & Location	Global, Internet-based.	Localized within the firewall.
Security	Lower; shared resources.	High; isolated and confidential.
SLAs (Service Level Agreements)	Provider-dependent.	Fully customizable by the organization.
Technical Crew	Managed by service provider.	Requires in-house expertise.

Cloud Service Models

Software as a Service (SaaS):

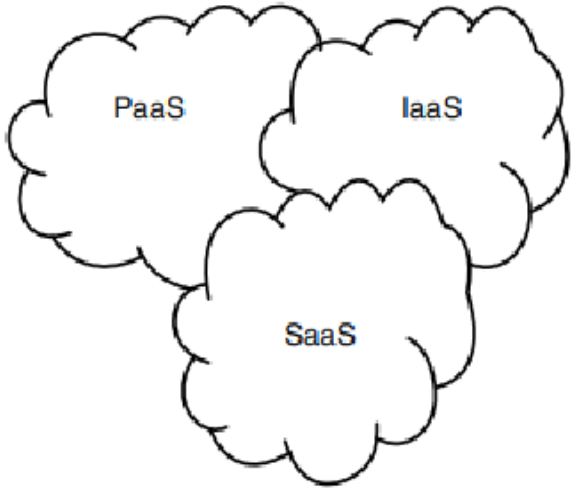
- Delivers software applications over the web.
- Example: Google Workspace, Microsoft Office 365.

Platform as a Service (PaaS):

- Provides platforms for application development and deployment.
- Example: Microsoft Azure, Google App Engine.

Infrastructure as a Service (IaaS):

- Offers virtualized computing resources (e.g., servers, storage).
- Example: Amazon Web Services (AWS), IBM Cloud.



SAAS

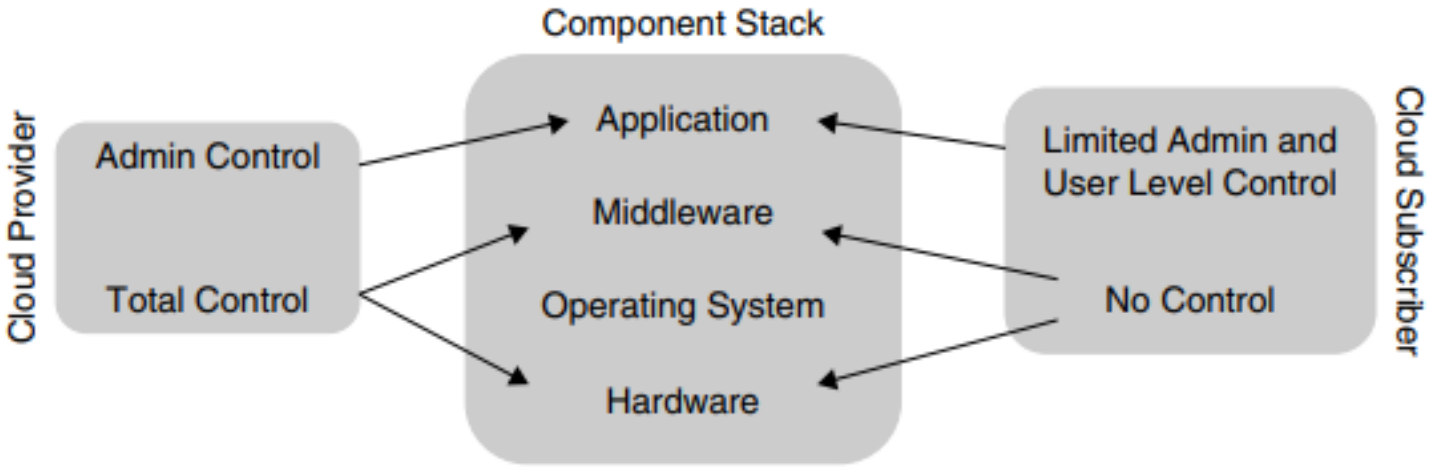


Figure 4.3 SaaS Component Stack and Scope of Control

SAAS

Definition:

- Software as a Service (SaaS) allows customers to access software applications over the cloud, managed entirely by the provider.

Provider Responsibilities:

- Full control over hardware, middleware, OS, and application maintenance.
- Handles deployment, updates, and infrastructure management.

Subscriber Role:

- Limited to admin and user-level controls.
- Avoids managing OS or hardware.

SAAS

Benefits:

- Eliminates the need for old hardware replacement and infrastructure maintenance.
- Saves time and cost of hiring technical staff.
- Ideal for improving business productivity and collaboration.

- **Examples:**
- Productivity Apps: Google Apps.
- Online Project Management: Zoho Mail, Deskaway.
- CRM Apps: Salesforce.com, Impel CRM, Microsoft Dynamics.
- Cloud Services: Skydrive, Google Docs, Dropbox.
- SME Solutions: EazeWork.

PAAS

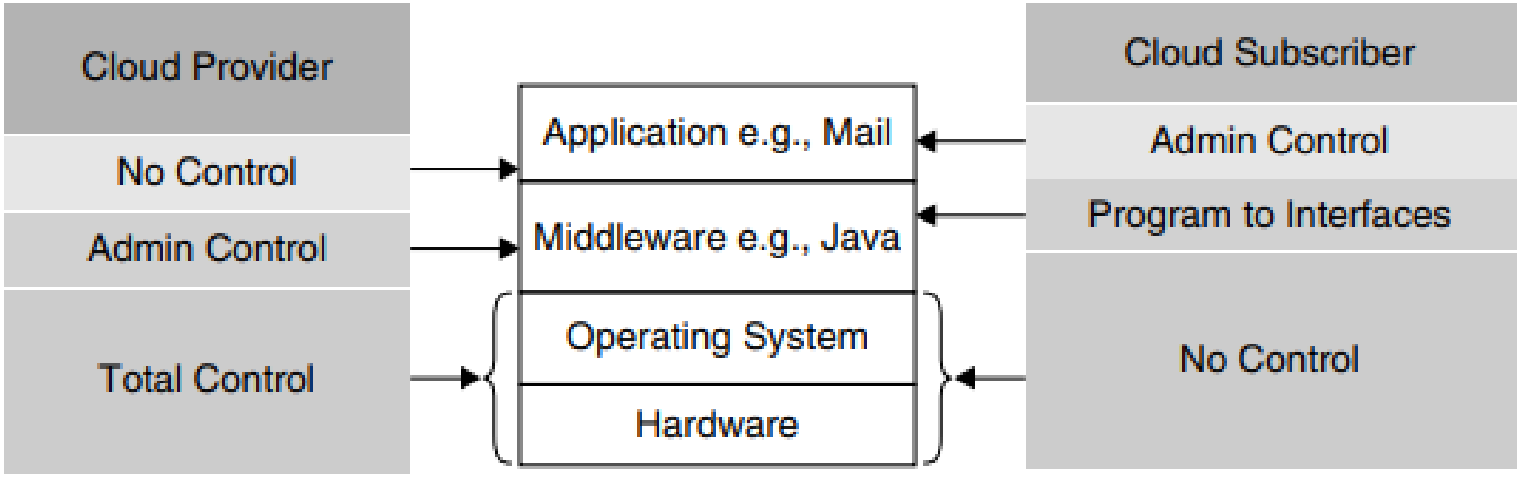


Figure 4.4 PaaS Component Stack and Scope of Control

PAAS

Definition:

- Platform as a Service (PaaS) provides an environment for building, testing, and deploying applications, offering essential tools and frameworks for developers.

Provider Responsibilities:

- Full control over hardware and operating system.
- Admin control over middleware.
- Maintains infrastructure, OS, and middleware.

Subscriber Role:

- Full admin rights over the application.
- Limited control over middleware; no control over hardware or OS.

Key Features:

- Includes development environments, programming languages, compilers, and testing tools.
- Suitable for developers aiming to focus solely on application development.

PAAS

Benefits:

- Provider handles all non-development tasks.
- Helps developers meet deadlines effectively.

Subscribers:

- Third-party software vendors.
- Individual developers.
- IT service providers.

Examples of PaaS Providers:

- India: Wolf Frameworks, OrangeScape.
- PHP Developers: PHP Fog, CloudControl.

IAAS

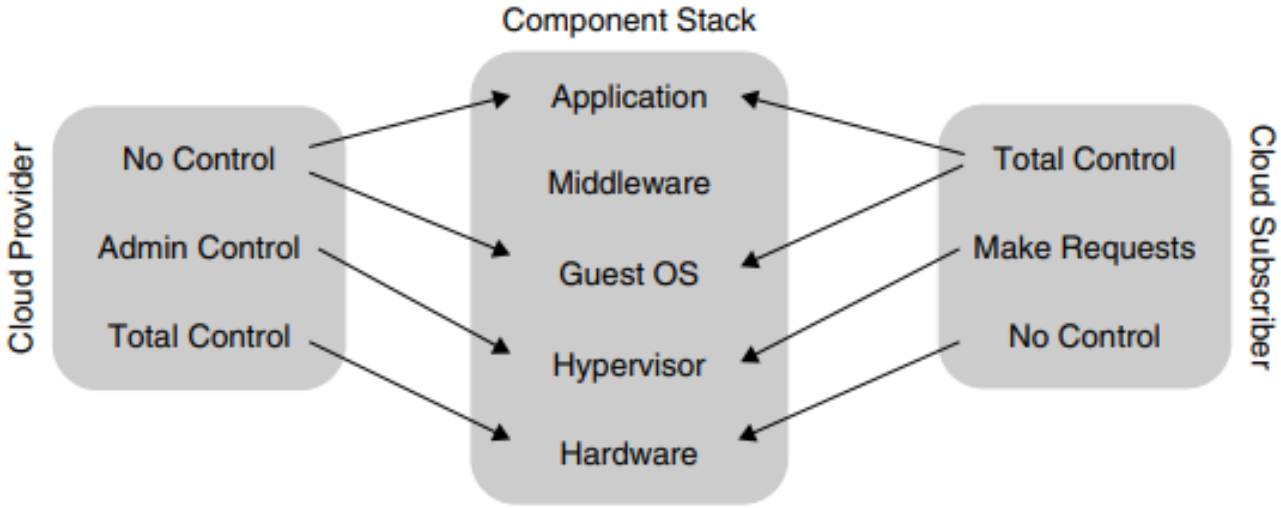


Figure 4.5 IaaS Component Stack and Scope of Control

IAAS

Definition:

- Infrastructure as a Service (IaaS) offers end-to-end infrastructure, including computing resources, storage, and networking, on a pay-as-you-go model.

Provider Responsibilities:

- Full control over hardware.
- Admin rights over the virtualization layer (hypervisor).
- No control over application, middleware, or OS.

Subscriber Role:

- Full admin rights over the application, middleware, and OS.
- Limited ability to make requests to the hypervisor but no hardware control.

IAAS

Key Features:

- Billing based on:
- CPU hours.
- Data size (GB) per hour.
- Bandwidth consumed.

Benefits:

- Suitable for beginners testing application success rates.
- Customers can choose their own OS, databases, and platforms.

Examples of IaaS Providers:

- Global: Amazon, Rackspace, Joyent, GoGrid, Verizon Teeremark, Rightscale.
- India: NetMagic Solutions, InstaCompute (Tata Communications).

Cloud Service Models

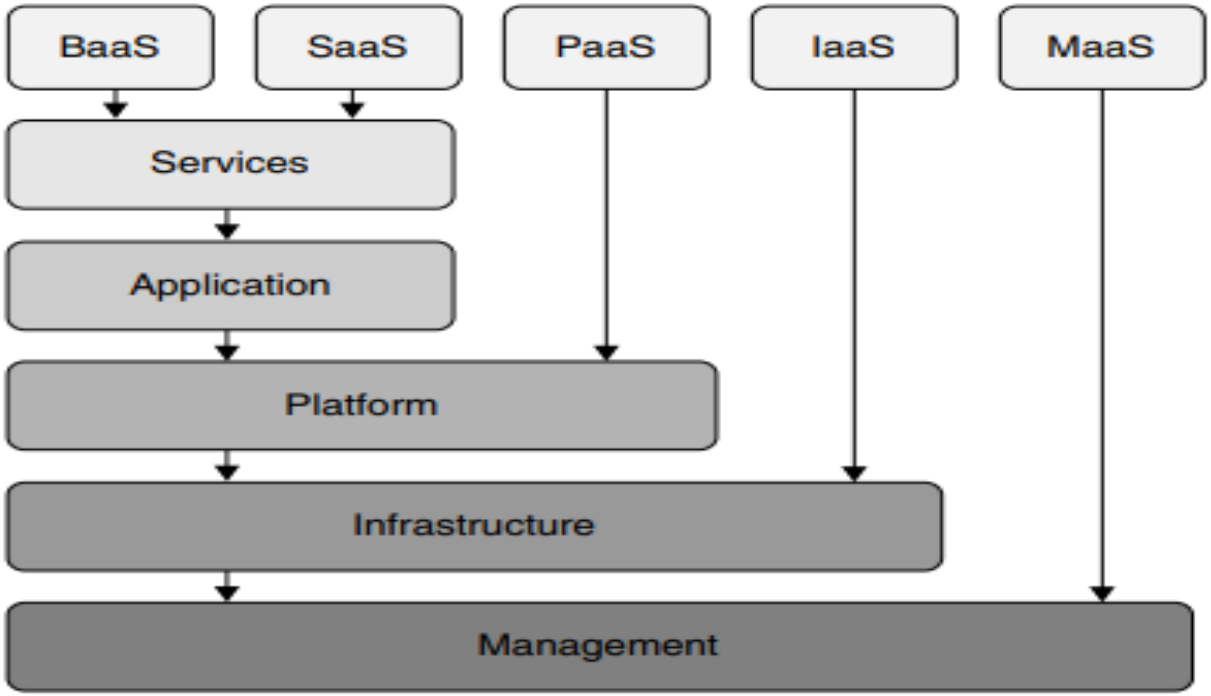
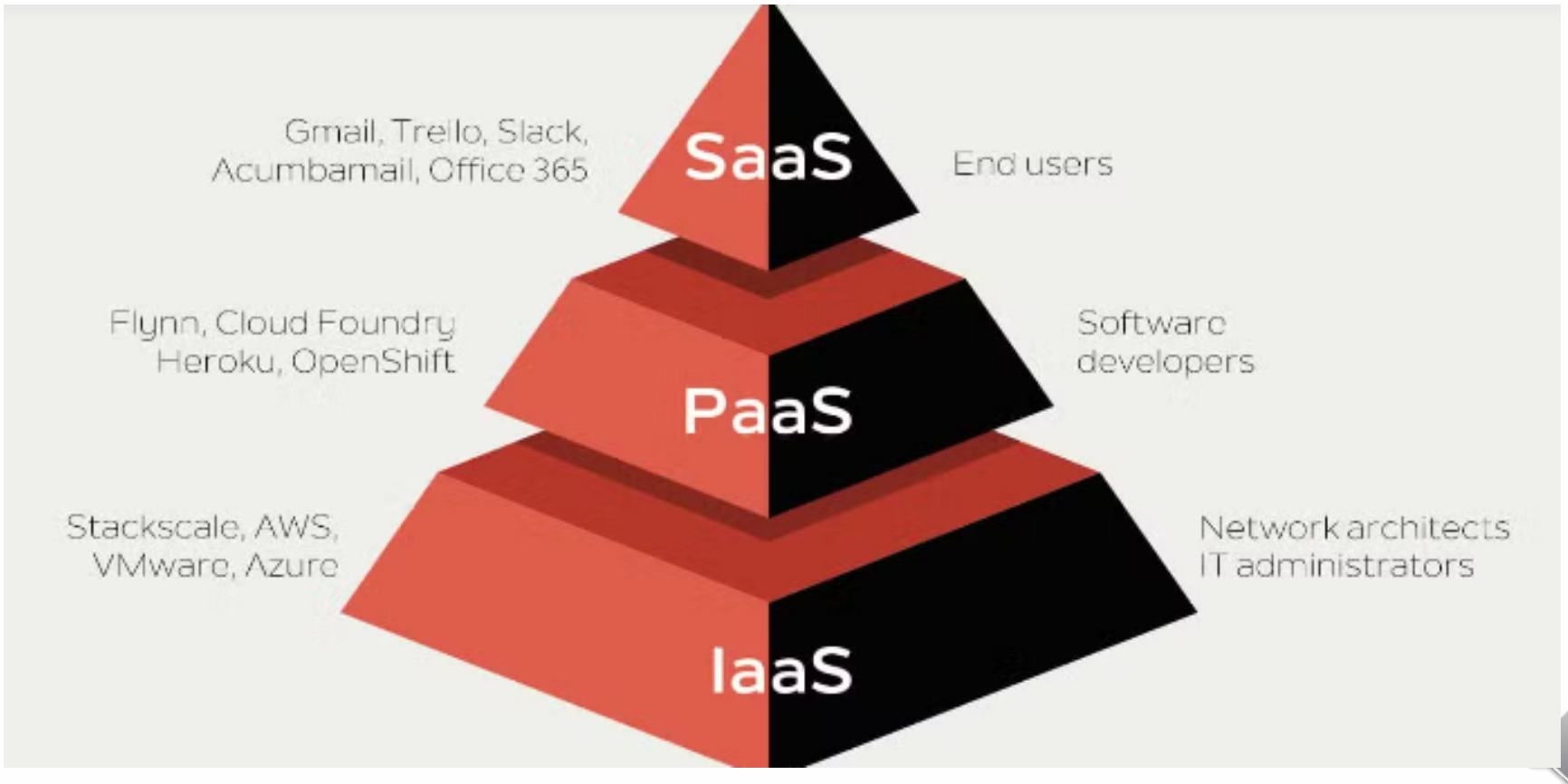


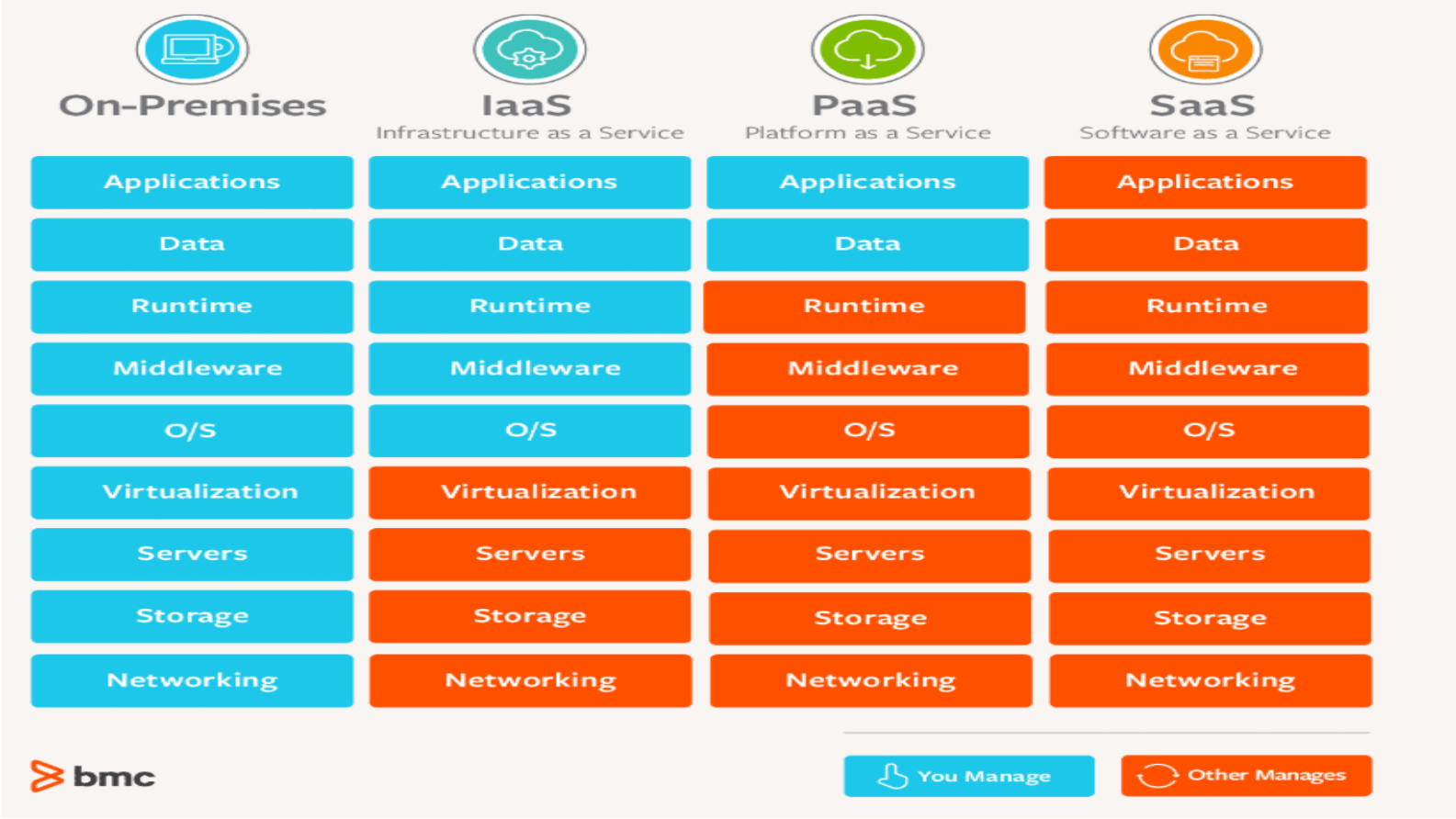
Figure 4.6 Cloud Service Models Comparison

Other cloud services

1. Business as a service
2. Software as a service
3. Platform as a service
4. Infrastructure as a service
5. Management as a service


Gmail, Trello, Slack,
Acumbamail, Office 365
SaaS
End users
Flynn, Cloud Foundry
Heroku, OpenShift
PaaS
Software
developers
Stackscale, AWS,
VMware, Azure
IaaS
Network architects
IT administrators

Management in cloud services



Other cloud services

Storage as a Service (STaaS)

Overview:

- A methodology where large organizations lease storage to small businesses or individuals. Aims to reduce storage space and ensure backups.

Merits:

- Saves revenue on hardware.
- Private and secure storage.
- Reduces workload by eliminating:
- Library maintenance.
- Tape storage.
- Backup requirements.

Adoption:

- Ideal for SMEs/SMBs for low initial investment.
- Facilitates disaster recovery, long-term record keeping, and sustainability.

Trends:

- Growing demand across businesses of all sizes.
- A precursor to cloud storage and computing.

Other cloud services

Database as a Service (DBaaS)

Overview:

- Provides database access on-demand without installation on-premises.
- Operates on a pay-per-usage model with minimal user responsibility.

Features:

- Relational or non-relational databases with APIs or SQL.
- Supports languages like Java, .NET, and PHP.

Key Concerns:

Security and privacy of user data on provider premises.

Research Focus:

- Encrypted data storage and processing.
- Query optimization and integrity in encrypted databases.
- Advanced key management.

Other cloud services

Information as a Service (INaaS)

Overview:

- Facilitates data sharing as a distributed service across the organization.
- Integrates heterogeneous data efficiently.

Benefits:

- Creates a single source of truth.
- Reduces operational hurdles in data synchronization.
- Simplifies cross-organizational data sharing.

Adoption:

- Provides agility and effectiveness for business and IT sectors.
- Widely adopted in enterprises and governments for seamless data integration.

Cloud Computing Architecture

Introduction

Definition: Cloud computing is an internet-based technique that uses shared, remotely available resources.

Key Features:

- Internal functions hidden from end users.
- IT businesses outsource computing needs (software, storage, databases, etc.) via the web.

Key Components:

- Front-end: Customer devices and interfaces.
- Back-end: Service providers, infrastructure, and storage.

Cloud Computing Architecture

Examples of Cloud Computing Email Services: Gmail and Yahoo.

Key Benefits:

- Access to applications via the internet without software installation.
- Low operational costs compared to individual infrastructure.
- Main Concern: Security and privacy of data.

Cloud Computing Architecture

Types of Cloud Computing

- **Public Cloud:**
  - Off-premises infrastructure managed by a provider.
  - Suitable for general applications and non-sensitive data.
- **Private Cloud:**
  - On-premises setup, behind a firewall.
  - Exclusive to an organization for enhanced security.
- **Hybrid Cloud:**
  - Combination of public and private clouds, balancing flexibility and security.

Cloud Computing Architecture

Understanding Cloud Computing Architecture

Challenges:

- No defined standard or architecture.
- Collection of functionalities deployed in remote locations.

Basic Cloud Model:

- Collection of virtualized servers appearing as a single resource pool.
- Example: IBM/Google cloud computing model.

Advanced Model:

- Full-scale virtualization of resources (network, storage, and computing).
- Providers offer virtualized servers and consumers create instances remotely.

Cloud Computing Architecture

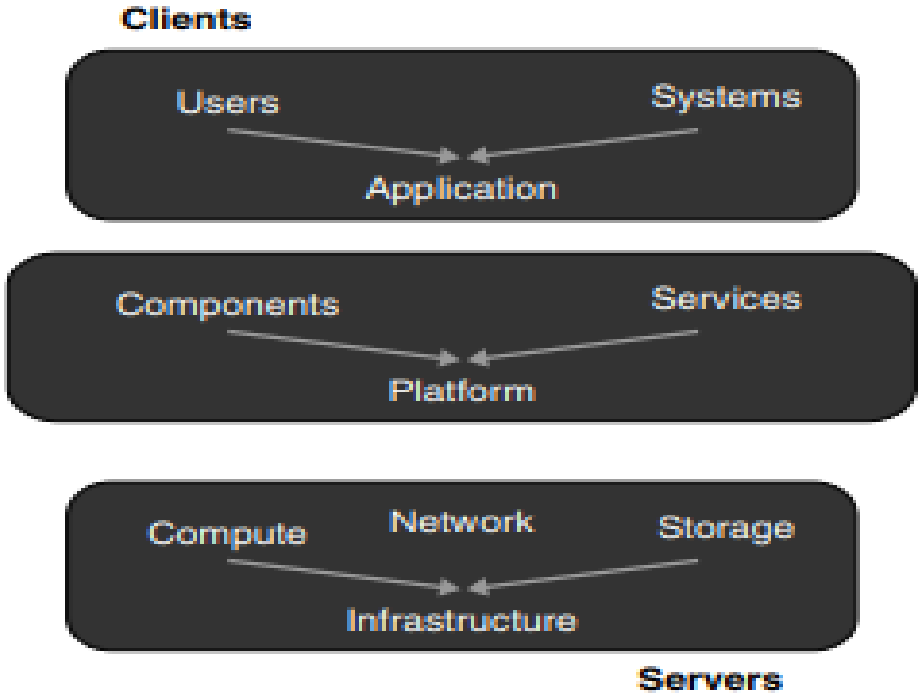


Figure 6.1 Cloud Computing Stack

Cloud Computing Reference Model (CC-RM)

Purpose:

- Facilitates cloud architecture modeling and deployment planning.
- Provides a foundation for addressing business and technical challenges.
- Emphasizes that cloud is a collection of services rather than a single architecture.

Key Models in CC-RM:

- Cloud Enablement Model:
- Describes cloud layers and benefits for business operations.

Cloud Deployment Model (CDM):

- Explains private, public, hybrid, and community clouds.
- Cloud Governance & Operations Model:
- Addresses governance, privacy, security, and monitoring.

Cloud Ecosystem Model (CEM):

- Focuses on development, sustenance, and relationships among providers, consumers, and networks.

Cloud Computing Reference Model (CC-RM)

Cloud Virtualization Tier:

Tools for hardware, infrastructure, and network virtualization.

Cloud Operating System Tier:

Enables resource virtualization; includes billing, load balancing, and orchestration.

Cloud Platform Tier:

Supports PaaS services and leverages SOA and web service technologies.

Cloud Business Tier:

Offers business solutions as services via the cloud.

Cloud Deployment Model (CDM)

Purpose:

- Framework for various deployment environments:
- Private Internal Cloud
- Public External Cloud
- Hybrid Integrated Cloud
- Community Cloud

Key Considerations:

- Security, architecture, and management challenges.
- Core element in CC-RM alongside the Cloud Ecosystem Model (CEM).

Cloud Ecosystem and Governance

Cloud Governance & Operations Model:

- Focuses on deployment approaches, security, management, and monitoring.

Cloud Ecosystem Model (CEM):

- Encompasses providers, consumers, and technology enablers.
- Key Elements:
- Cloud network and enablement.
- Collaborative environment for smooth operations.

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