

INTRODUCTION

1. **What if your company or department only paid for the computing resources that it uses?**

- it would transition from a capital expenditure (CapEx) model, where you invest upfront in purchasing infrastructure, to an operating expenditure (OpEx) model. Instead of spending on hardware and resources in advance, the company would sign up with a service provider and adopt a pay-as-you-use billing approach. This would allow the company to pay only for what it needs as expenses are directly tied to actual resource usage.

2. **Cloud computing:** is the delivery of computing services Eg storage, networking, databases, etc over the internet (the "cloud") rather than through local servers or personal devices.

3. **Importance of using cloud computing:**

- Availability - Cost savings - Scalability - Security (ACSS)

4. Cloud computing resources are hosted at a remote data center managed by:

- **Cloud Service Provider (CSP)**

5. **Data center:** is a physical facility that houses an organization's critical IT infrastructure, including servers, storage systems, security systems, and networking equipment.

6. **An optimal IT infrastructure:** It balances performance, scalability, and cost-effectiveness while minimizing downtime and security risks.

7. **Key elements of an optimal IT infrastructure:**

- High-Performance Storage Systems
- Low-inactivity Networks
- Secure infrastructures
- Zero Downtime
- Traffic prioritization management

8. **Data center infrastructure components:**

- Rackmount / Blade Servers and /or Mainframes
- Storage systems:
 - **direct-attached storage (DAS):** enables the most frequently used data (hot data) to remain close to the CPU
 - **network-attached storage (NAS):** provides data storage and access to multiple servers over a standard ethernet connection.
 - **storage area network (SAN):** enables shared storage
- Redundancy and disaster recovery
- Power supply and capable management

9. **Types of data centers:**

- **Enterprise (on-premises):** All IT infrastructure and data are hosted on-premises.

- **Public cloud:** Cloud providers like Amazon, Google, and Microsoft offer shared IT infrastructure resources for multiple customers.
- **Managed:** Organizations lease dedicated servers, storage, and networking hardware, with all setup and management handled by the provider
- **Colocation:** Organizations own their hardware but rent secure, dedicated space within a data center, managing their equipment while optional support services are available.

10. **Cloud computing components:**

- Data center
- Networking capabilities
- Virtualization

11. **Bare metal servers:** are dedicated physical machines rented from a provider, offering users exclusive access without sharing resources with other tenants.

12. **Advantages of bare metal servers:**

- Complete control over the physical machine
- Flexibility to choose operating system
- Easily scalable
- Reduce multi-tenant security risks

13. **Load balancing:** is the distribution of network or application traffic across multiple servers to ensure no single server becomes overwhelmed.

- **Example:** E-commerce sites use load balancing to ensure web applications deliver data, images, video, and pricing to consumers promptly, without delays or downtime.

14. **Content Delivery Network (CDN):** is a geographically distributed network of servers designed to improve web performance by storing copies of web content closer to users.

15. **Each CDN server (edge server) is located on the:** network edge

16. **Software-Defined Networking (SDN):** is a network architecture that separates the control plane (where decisions are made) from the data plane (where data is forwarded), centralizing network management.

17. **Virtualization:** uses software, such as hypervisor, to create an abstraction layer over hardware, allowing a single computer's resources to be divided into multiple independent VMs.

18. **Virtual Machine Monitor (VMM):** prevents virtual machines from interfering with each other (if one OS suffers a crash or a security compromise, the others survive)

19. **Benefits of virtualization:**

- Enhances disaster recovery
- Reduces hardware cost
- Increases efficiency and productivity
- Increases scalability and flexibility

20. **Virtual Desktop Infrastructure (VDI)**: is a technology that creates and manages desktop environments on a centralized server, allowing employees to securely access their desktop and applications from any location and device.
21. **Application virtualization**: allow users to run software applications without installing them directly on their operating system.
22. **Server virtualization**: allows multiple virtual servers to run on a single physical server
23. **Enablers for cloud computing**:
- Virtualization technology
 - Demand management
 - Reporting
 - Billing
24. **Cloud computing actors**:
- **Service consumer**: utilize cloud services for various purposes. Eg. Businesses using SaaS
 - **Service provider**: offer cloud computing services. Eg. Amazon Web Services
 - **Service creator**: creates and supplies the service to the SPs
 - **Service broker**: act as intermediaries between consumers and providers.
25. **To deploy a cloud**:
- Create a set of standardized cloud services
 - Provide a user-friendly interface for consumers
 - Track usage and cost information
 - Establish a robust security framework
26. **Service in IT**: refers to collection of IT systems, components, and resources that work together to provide value to users.
27. **Parameters used to assess a service**:
- Cost
 - **Service Level Agreement (SLA)**: a contract between the service consumer and the service supplier in terms of when the service will be delivered, its quality, and scope.
28. **Service Level Objectives (SLOs)**: is a specific measurable goal that defines the target level of service for a particular metric within a (SLA).
29. **Software as a Service (SaaS)**: is a cloud computing model in which applications are hosted in the cloud and made available to users over the internet.
30. **Responsibilities of SaaS vendor**:
- Managing servers, storage, software, and networking.
 - Applying feature updates and security patches.
 - Ensuring load balancing, backups, and disaster recovery.
 - Providing APIs for integration with other applications.
31. **SaaS advantages**
- Eliminates hardware, software, and maintenance costs.

- Flexible payments with predictable budgeting.
 - Customizable and integrates with other applications
 - Automatic updates, reducing IT staff workload
32. **SaaS challenges and risks:**
- Switching vendors can be complex due to data migration
 - Security and compliance shift to external providers
 - Limited ability to assess security, like penetration testing
 - Issues like disruptions or security breaches affect customers
33. **Platform as a Service (PaaS):** is a cloud computing model that provides a complete development and deployment environment in the cloud.
34. **Container:** is a lightweight, portable, and consistent environment for running applications.
35. **Containers are lightweight because:** they share the host machine's OS kernel, eliminating the need to duplicate the OS for each container.
36. **Kernel:** is the core part of an operating system (OS) that manages the system's hardware and software.
37. **Functions of the kernel:**
- Manages memory
 - Manages resource sharing and synchronization
 - Manages peripherals
 - Manages requests from software
38. **Advantages of containers:**
- Lightweight, sharing the OS Kernel
 - Portable and platform-independent with built-in dependencies
 - Improve CPU and memory utilization
 - Faster deployment and management than VMs
39. **The main parts of PaaS Solutions:**
- Cloud infrastructure e.g. storage, networking, etc.
 - Software for building, deploying, and managing applications
 - GUI for managing the entire application lifecycle
40. **PaaS Advantages:**
- Freedom to experiment with low investment risk
 - Easily scalable
 - Affordable access to diverse application stack resources
 - Faster time to market without hardware/ software purchases
41. **Purpose-built PaaS Types:**
- **AI PaaS(PaaS for AI):** build AI apps without infrastructure costs.
 - **iPaaS(integration PaaS):** integrate data and services across environments easily.
 - **cPaaS(Communication PaaS):** add communication features without extra hardware
 - **mPaaS(mobile PaaS):** low-code access to device features

42. **IaaS (Infrastructure as a Service)**: It's a cloud computing model that provides a fundamental computing infrastructure, including servers, storage, and networking over the internet, as a service.

43. **Serverless Computing**: is an application development and execution model that enables developers to build and run application code without provisioning or managing servers or back-end infrastructure.

44. **BPaaS(Business Process-as-a-Service)**: is a cloud computing service model that focuses on delivering business process outsourcing (BPO) services through the cloud.

45. **BPaaS services in different domains**:

- **Information Technology**
 - ❖ Software development
 - ❖ Network management
- **Knowledge Process**
 - ❖ Data analysis
 - ❖ Market research
- **Legal Process**
 - ❖ Contract management
 - ❖ Legal research
- **Human Resource**
 - ❖ Recruitment
 - ❖ Payroll processing
- **Finance and Accounting**
 - ❖ Financial reporting
 - ❖ Tax preparation

46. **BPaaS advantages**:

- Lower operational costs from third-party services
- Staff focus on core tasks
- Specialized teams handle complex process
- Easily scale operations without extra investment

47. **BPaaS challenges**:

- Quality control compliance
- Data security vulnerabilities
- Communication gap
- Risk management complexity

48 **INaaS(Information-as-a-Service)**: is a cloud computing model that provides on-demand access to information, data, and analytics over the internet as a service.

49. **Organizations can capture, organize, integrate, transform, analyze, and use information that can be incorporated with**:

- Content management
- Business Intelligence (BI) tools
- Relational Databases

50. **Types of content management:**

- Enterprise Content Management (ECM)
- Web Content Management (WCM)
- Document Management (DM)
- Records Management (RM)

51. **NaaS(Network-as-a-Service):** is a cloud computing service model that provides network infrastructure and services over the internet.

52. **When NaaS is needed:**

- Network refresh
- Security improvement
- Mixed-technology management
- IoT adoption

53. **Things to consider in choosing a NaaS provider:**

- Provider should manage evolving networks with up-to-date security.
- Work with one vendor to simplify contracts and improve interoperability.
- Adopt NaaS for scalable services and supply chain certainty.

54. **NaaS advantages:**

- Easily purchase more capacity without new hardware.
- Use from any device with an Internet connection.
- Provider handles software and hardware upgrades.
- No hardware purchase or maintenance needed.

55. **NaaS Challenge and risk:**

- Vendor infrastructure may not work with legacy systems.
- On-premises applications complicate migration to NaaS.
- Over-reliance on one provider poses risks if issues arise.

56. **DWaaS(Data warehouse as a service):** is a cloud-based service that provides data warehousing capabilities without the need for on-premises infrastructure or management.

57. **DWaaS advantages:**

- Lower IT costs
- Easier scalability
- Reduced staffing needs
- Faster access to new software features

58. **DWaaS challenges and risks**

- Delays in transferring operational data
- Large queries risk slower response times
- Hard to switch providers

59. **Types of cloud computing:**

- Public cloud
- Private cloud
- Hybrid cloud

- Multi- cloud
- Community cloud

60. **Public cloud:** is a type of cloud computing in which a cloud service provider makes computing resources available to users over the public internet

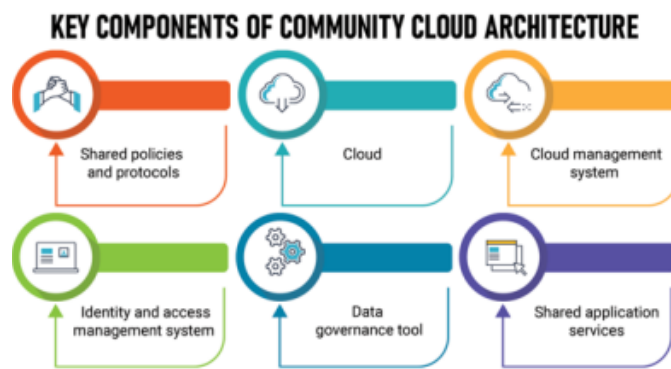
61. Public cloud architectures are **multi-tenant** environments - users share auto-allocated resources via self-service interface.

62. **Private cloud:** is a cloud computing environment dedicated to a single customer based on their unique high-security needs.

63. **Virtual private cloud(VPC):** allows an enterprise to define and control a virtual network that is logically isolated from all other public cloud tenants, creating a private, secure space on the public cloud.

64. **Community clouds:** is a shared cloud infrastructure used by multiple organizations with similar interests, such as security, compliance, or industry-specific requirements.

65. **Key components of community cloud infrastructure:**



66. **Hybrid clouds:** combines both private and public cloud infrastructures, allowing data and applications to be shared between them.

67. **Multi Cloud:** the use of cloud services from more than one cloud vendor.

68. **Multi cloud advantages:**

- Reduced downtime risk
- Rapid adoption of emerging technologies
- Flexibility to choose cloud services.

69. **A national societal cloud could exist for: (HTPF)**

- Healthcare
- Training
- Politics
- Farming

70. **Organizational & Business Paradigm Shift**

- The IT department's role will shift to managing cloud service contracts with providers, with the services outlined and detailed in a cloud service catalog that the department will maintain.

PRICE & VALUE MODELS

1. Every price model starts its life as a **cost model**
2. Cost model: is a financial model used by cloud service providers to estimate the costs of creating, operating, and upgrading a cloud service over its lifecycle.
3. Note that **3 years** is the usual lifespan of a technology before it becomes outdated, and **5 years** is generally the absolute maximum the cloud provider will have before replacing the technology.
4. The cost model will include:
 - Inflation
 - Exchange rate variations
 - Depreciation
 - Electricity costs
 - Floor-space costs
 - Software license costs
 - Labor costs
 - Capital costs to buy and operate servers.
5. Utility Models: are metered price models whereby usage of the service is monitored, and you pay accordingly.
6. Consumption-Based Price Model: involves paying for the computing resources that you use. Commonly used for IaaS and PaaS.
7. Transaction-Based Price Model: involves charging customers based on the number or volume of transactions they perform.
8. **Transactions** can be business related, such as invoices processed for an invoicing BPaaS, data related for INaaS, or application related for SaaS
9. **Cost of a transaction** is calculated by dividing the cost of providing a cloud service by the estimated transaction volume over a given period (unit transaction price)
10. Circumstances under which the Transaction-Based Price Model is suitable:
 - Transaction volumes are predictable
 - Processes are clearly defined and measurable in discrete units
 - Transaction volume aligns with cost drivers
 - Providers standardize processes based on transactions
11. Subscription-Based Price model: a fee, usually monthly, in order to use a service regardless of whether those allocated resources are used.
12. Service-Based Price Model: sets the price based on the benefits delivered, like SLA performance, risk transfer, or cost savings.
13. Fixed Price Model: The price for this service is fixed on a yearly, quarterly, or monthly basis.
14. Note that the Fixed Price Model is usually used to transfer risks related to delivery, people, and quality.

15. Note that the risk transferal occurs through the SLAs that define and agree with the CSP

16. Volume-Based Price Model can relate to:

- Number of users
- Amount of storage space
- Speed of transaction
- Amount of bandwidth
- Processing power utilized

17. Volumes-Based Price Model are most often used in: IaaS and PaaS.

18. Tiered Price Model: uses a tiered(level) form of pricing that is based on SLAs, volume, or amount spent.

19. Utility Price Models:

- Consumption-Based Price Model
- Transaction-Based Price Model
- Subscription-Based Price Model
- Service-Based Price Model
- Fixed Price Model
- Volume-Based Price Model
- Volume-Based Price Model:

20. Performance Price Models:

- Outcome-Based Performance Price Model
- Gain-Shared Performance Price Model

21. Outcome-Based Performance Price Model: provide a bonus if an outcome is achieved.

22. Gain-Share Performance Price model: instead of having penalties should certain SLAs not be met, you reward the service provider by sharing your profits if the SLAs are exceeded.

23. Marketing Price Models:

- Freemium Marketing price Model
- Razor-and Blades Marketing Price Model

24. Freemium marketing price model includes:

- Try before you buy a more enhanced service.
- Get a free service but with advertisements

25. Freemium marketing price model is suited for SaaS.

26. Razor-and-Blades Marketing Price Model: A device or app may be given away, with costs recouped through data storage, analysis, and presentation via the cloud service.

27. Cloud security: is a discipline of cybersecurity focused on the protection of cloud computing systems.

28. Strong cloud security involves shared responsibility between these CSPs and their customers.

29. Cloud security solutions:

- Cloud-Native Application Protection Platform (CNAPP)
- Cloud Security Posture Management (CSPM)
- Cloud Infrastructure Entitlement Management (CIEM)
- Data Security Posture Management (DSPM):

30. CIEM enforces the principle of least privilege

31. Cloud Native: is the concept of building and running applications to take advantage of the distributed computing offered by cloud model.

32. Security Information and Event management (SIEM): a centralized solution that helps organizations detect, analyze, and respond to security threats before they harm business operations.