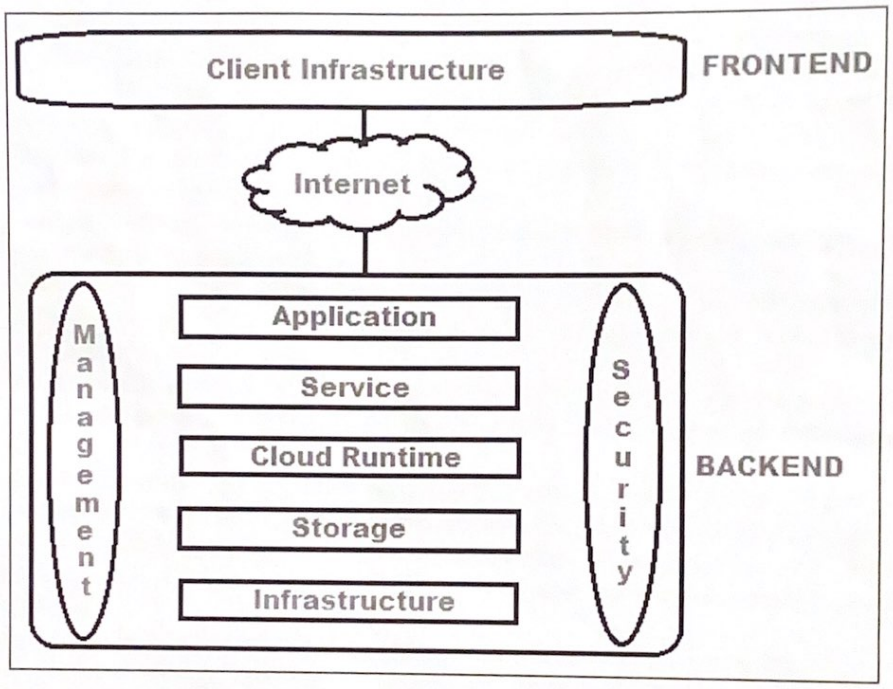
Cloud Fundamentals and Terminology

- Cloud computing architecture
- Advantages of Cloud Computing
- Cloud Computing Challenges
- Cloud Computing Infrastructure

Cloud computing architecture is the structural framework that outlines how cloud services are organized, delivered, and managed. It defines the components and relationships between them within a cloud environment.

The cloud architecture is divided into 2 parts i.e.

1. Frontend



Architecture of Cloud Computing

Architecture of cloud computing is the combination of both SOA (Service Oriented Architecture) and EDA (Event Driven Architecture). Client infrastructure, application, service, runtime cloud, storage, infrastructure, management and security all these are the components of cloud computing architecture.

1. Frontend

Frontend of the cloud architecture refers to the client side of cloud computing system. Means it contains all the user interfaces and applications which are used by the client to access the cloud computing services/resources. For example, use of a web browser to access the cloud platform.

- **Client Infrastructure**: Client Infrastructure is a part of the frontend component. It contains the applications and user interfaces which are required to access the cloud platform.
- In other words, it provides a GUI (Graphical User Interface) to interact with the cloud.

2. Backend

Backend refers to the cloud itself which is used by the service provider. It contains the resources as well as manages the resources and provides security mechanisms. Along with this, it includes huge storage, virtual applications, virtual machines, traffic control mechanisms, deployment models, etc.

1. **Application**: Application in backend refers to a software or platform to which client accesses. Means it provides the service in backend as per the client requirement.
2. **Service**: Service in backend refers to the major three types of cloud based service; like SaaS, PaaS and IaaS Also manages which type of service the user accesses.
3. **Runtime Cloud**: Runtime cloud in backend provides the execution and Runtime platform/environment to the Virtual machine.
4. **Storage**: Storage in backend provides flexible and scalable storage service and management of stored data.
5. **Infrastructure**: Cloud Infrastructure in backend refers to the hardware and software components of cloud like it includes servers, storage, network devices, virtualization software etc.
6. **Management**: Management in backend refers to management of backend components like application, service, runtime cloud, storage, infrastructure, and other security mechanisms etc.
7. **Security**: Security in backend refers to implementation of different security mechanisms in the backend for secure cloud resources, systems, files, and infrastructure to end-users.
8. **Internet**: Internet connection acts as the medium or a bridge between frontend and backend and establishes the interaction and communication between frontend and backend.
9. **Database**: Database in backend refers to provide database for storing structured data, such as SQL and NOSQL databases. Example of Databases services include Amazon RDS, Microsoft Azure SQL database and Google Cloud SQL.
10. **Networking**: Networking in backend services that provide networking infrastructure for application in the cloud, such as load balancing, DNS and virtual private networks.
11. **Analytics**: Analytics in backend service that provides analytics capabilities for data in the cloud, such as warehousing, business intelligence and machine learning.

Benefits of Cloud Computing Architecture

- Makes overall cloud computing system simpler.
- Improves data processing requirements.

- Helps in providing high security.
- Makes it more modularized.
- Results in better disaster recovery.
- Gives good user accessibility.
- Reduces IT operating costs.
- Provides high level reliability.
- Scalability.

Advantages of Cloud Computing

1. *Scalability:* One of the best advantages of cloud computing is scalability. Maintaining a business, organization, or another element is trying in ideal circumstances. Especially amid the stresses of downturn, expansion, pandemic, war, work putting together, and store network disturbances. Cloud Computing provides the opportunity to scale at your own speed. Organizations are savvy to have their significant developments plotted out three to five years ahead of time, however, the world can be unpredictable. Whether you need to develop forcefully or carefully or downsize decisively during seasons of unrest, cloud computing is a business resource you pay for just as and when you want it.

2. *Security:* According to certain reports, small private companies are multiple times more likely to suffer a cyberattack than large organizations. That most likely shocks numerous owners of companies. The reasons are obvious, but – only 33% of organizations with four or fewer representatives register hacks as a danger. The year 2021 reported 52,974 cybercrime, whereas the year 2020 reported 50,035 cases in India. Migrating business to the cloud implies approaching industry-standard information data protection/assurance, firewalls, and robotized all-day, everyday network observing. Few out of every odd organization can bear to hold that sort of IT ability and foundation in-house.

3. *Accessible to modern technology:* Cloud computing is far more than an internet-based storage service for data. Organizations worldwide currently use cutting-edge technologies they need to get done with their responsibilities and run their business over the web utilizing the cloud. Some technology available on a cloud platform includes Artificial Intelligence and Machine Learning, Data Analytics, Data Visualization, Containerization, etc. The Public Cloud Market Set to Surpass US $500 BN by 2023. The opportunity to build powerful AI applications and machine learning models without buying actual physical servers is a strong motivation.

4. *Cheaper:* The cloud computing model is based on the 'pay-as-you-go' principle and offers a possibly less expensive way for organizations to remain coordinated and online. Albeit the costs for hard drives, strong state drives, servers, and other fundamental things have fallen lately, cloud computing proves to be the best regarding cost expenses. It's still more affordable much of the time to pay a continuous membership expense for cloud computing access than to buy and afterward keep an in-house data-processing or warehousing contraption. Organizations don't

have to look at, search for, and buy actual physical infrastructure when they have a dependable cloud computing partner.

5. *Mobility:* One of the main advantages of cloud computing is mobility. Employees have the option to compute heavy tasks from anywhere. Work-life balance and working from home on everyone's brains nowadays, information and workflow through the cloud introduces itself as a sensible investment.

6. *Easy Collaboration:* A benefit of distributed computing firmly connected with mobility is simple collaboration. It's one thing to take your platform, administration, and information mobile. It's one more challenge to gather all the data gathered by your company's agents, organize it, and ensure there are no errors or duplicates. Cloud services mean less complex and less mistake-inclined coordination between organizations, departments, clients, customers, etc. There's less time expected to exchange information and reach a significant conclusion from it, and everyone works from a similar single source of truth.

7. *Prediction ability:* Data analytics deserves more consideration. Cloud computing has accomplished more powerful predictive analytics than other technologies. In any event, when you don't have the machines you really want under your rooftop, someone on the opposite side of the globe has a processing limit accessible for you to access for a lower charge.

Cloud Computing Challenges

Digital security specialists exhibit a heightened concern regarding the security of cloud computing, surpassing the level of apprehension prevalent among other IT professionals. The preponderance of security expert's expresses apprehensions principally pertaining to the domain of cloud security. To be more precise, their apprehensions revolve around issues concerning data loss, data leakage, data privacy infringements, and breaches of confidentiality. As organizations accrue greater experience with cloud technologies, the primary challenge at hand undergoes a transition. For neophyte cloud adopters, security looms as the paramount concern, whereas for intermediates and advanced users, cost considerations ascend in significance. The ongoing embrace of cloud computing is accompanied by a multitude of challenges, as clients continue to harbor reservations concerning its veracity.

1. *Security:* The foremost security concerns encompass data security, safeguarding the privacy of client data, ensuring the stability of the cloud computing platform, and the effective administration of cloud computing resources. Cloud computing must furnish robust client access control mechanisms to fortify facets such as licensing, authentication, quarantine, and various facets of data management. Clients remain uninformed about the data's physical location and the servers responsible for processing the data. This lack of transparency hinders the assurance of data privacy when entrusted to the cloud. Data stored within the cloud infrastructure remains susceptible to illicit theft and tampering. Encryption methods, security authentication protocols, and access control solutions represent some of the technological advancements employed to mitigate these vulnerabilities.

2. *Data Communication Expense:* Cloud consumers must carefully consider the trade-offs inherent in computation, communication, and integration when transitioning to the cloud. Although cloud adoption can substantially reduce infrastructure costs, it concomitantly escalates data communication expenses. These expenses manifest in the form of the costs associated with transmitting an organization's data to and from public and networked cloud environments, coupled with the higher cost per unit of computing resources utilized.

3. *Genuineness and Authorization:* Effective identity management plays a pivotal role in access control. Employing robust, regularly changed passwords in accordance with conventional IT security protocols serves as a fundamental measure to bolster access security. Properly managing factors such as password strength, recovery procedures, and audit logs is imperative.

4. *Service Level Agreement (SLA):* Procuring assurances from cloud service providers concerning service delivery assumes paramount importance. A significant challenge faced by cloud users involves the assessment of the SLAs put forth by cloud vendors. Often, vendors craft SLAs primarily to shield themselves against legal repercussions, offering minimal guarantees to their clients. SLA specifications would more effectively align with clients' needs if they are addressed comprehensively and proactively.

5. *Virtual Machine Migration:* Virtualization constitutes a pivotal enabler of cloud computing, facilitating the dynamic migration of virtual machines to distribute workloads across the data center. Peripheral functions such as IT management and personal applications are intertwined with this process.

6. *Unwavering Reliability and Availability:* Cloud providers continue to grapple with intermittent service disruptions, emphasizing the need for rigorous monitoring of services, either through internal or third-party tools. Formulating contingency plans for guiding usage in accordance with SLAs, performance metrics, resilience, and critical business dependencies is of paramount significance.

7. *Cloud Interoperability Issue:* Interoperability, denoting the ability of multiple systems to cooperate for data exchange and utilization, is a prevailing challenge within the cloud landscape. Presently, each cloud offering adheres to distinctive standards for interactions between cloud customers, applications, and clients, resulting in the "Hazy Cloud" phenomenon. This phenomenon significantly impedes the evolution of cloud ecosystems by fostering a lack of interoperability.

Ways to Manage Computing Capacity

- Find patterns in historical and current data.
- Make predictions about the market, competitors, and other businesses.
- Reproduce the logical impacts of the business choices you're thinking about.
- Automate essential fundamental but low-value processes.
- Have gear and resources screen their condition and trade machine telemetry.

- Concentrate on client behavior, feeling, and purchasing behaviors to make more marketing-promoting efforts or item procedures.

Cloud Computing Infrastructure

Cloud Computing which is one of the demanding technology of current scenario and which has been proved as a revolutionary technology trend for businesses of all sizes. It manages a broad and complex infrastructure setup to provide cloud services and resources to the customers. Cloud Infrastructure which comes under the backend part of cloud architecture represents the hardware and software component such as server, storage, networking, management software, deployment software and virtualization software etc. In backend, cloud infrastructure enables the complete cloud computing system.

Cloud computing refers to providing on demand services to the customer anywhere and anytime irrespective of everything where the cloud infrastructure represents the one who activates the complete cloud computing system. Cloud infrastructure has more capabilities of providing the same services as the physical infrastructure to the customers. It is available for private cloud, public cloud, and hybrid cloud systems with low cost, greater flexibility and scalability.

Cloud infrastructure components

Different components of cloud infrastructure support the computing requirements of a cloud computing model. Cloud infrastructure has number of key components but not limited to only server, software, network and storage devices. Still cloud infrastructure is categorized into three parts in general i.e.

- Computing
- Networking
- Storage

The most important point is that cloud infrastructure should have some basic infrastructural constraints like transparency, scalability, security and intelligent monitoring etc.

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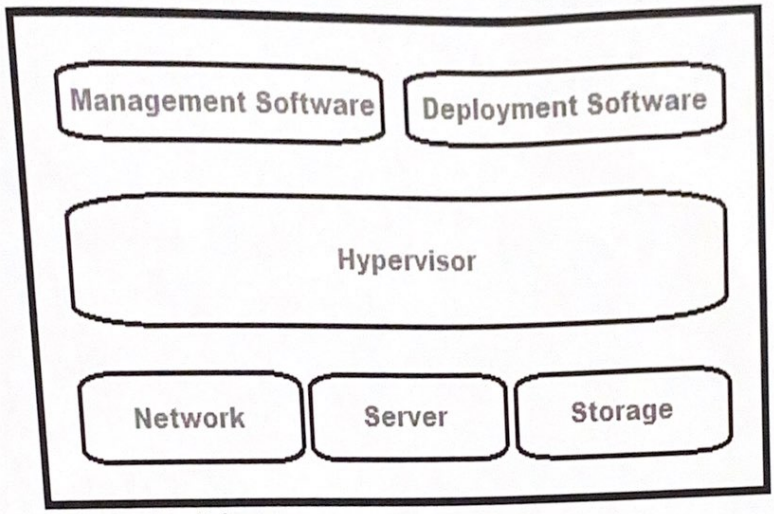

Components of Cloud Infrastructure

1. *Hypervisor:* Hypervisor is a firmware or a low level program which is a key to enable virtualization. It is used to divide and allocate cloud resources between several customers. As it monitors and manages cloud services/resources that's why hypervisor is called as VMM (Virtual Machine Monitor) or (Virtual Machine Manager).

2. *Management Software:* Management software helps in maintaining and configuring the infrastructure. Cloud management software monitors and optimizes resources, data, applications and services.

3. *Deployment Software:* Deployment software helps in deploying and integrating the application on the cloud. So, typically it helps in building a virtual computing environment.

4. *Network:* It is one of the key component of cloud infrastructure which is responsible for connecting cloud services over the internet. For the transmission of data and resources externally and internally network is must.

5. *Server:* Server which represents the computing portion of the cloud infrastructure is responsible for managing and delivering cloud services for various services and partners, maintaining security etc.

6. *Storage:* Storage represents the storage facility which is provided to different organizations for storing and managing data. It provides a facility of extracting another resource if one of the resource fails as it keeps many copies of storage.

7. *Virtualization:* Virtualization is also considered as one of important component of cloud infrastructure. Because it abstracts the available data storage and computing power away from the actual hardware and the users interact with their cloud infrastructure through GUI (Graphical User Interface).