



CLOUD COMPUTING

SIT 1304

Unit 2

UNIT II

- **CLOUD SERVICE MODELS**



UNIT 2 CLOUD SERVICE MODELS :



- Software as a Service (SaaS) - Infrastructure as a Service (IaaS)- Platform as a Service (PaaS)- Service Oriented Architecture (SoA) - Elastic Computing - On Demand Computing.

Software-as-a-Service (SaaS)



- Software-as-a-Service (SaaS) model allows to provide software application as a service to the end users. It refers to a software that is deployed on a host service and is accessible via Internet. There are several SaaS applications listed below:
- Billing and invoicing system
- Customer Relationship Management (CRM) applications
- Help desk applications
- Human Resource (HR) solutions

Characteristics



Here are the characteristics of SaaS service model:

- SaaS makes the software available over the Internet.
- The software applications are maintained by the vendor.
- The license to the software may be subscription based or usage based. And it is billed on recurring basis.
- SaaS applications are cost-effective since they do not require any maintenance at end user side.
- They are available on demand.
- They can be scaled up or down on demand.
- They are automatically upgraded and updated.
- SaaS offers shared data model. Therefore, multiple users can share single instance of infrastructure.
- All users run the same version of the software.

Benefits of SaaS



Using SaaS has proved to be beneficial in terms of scalability, efficiency and performance.

Some of the benefits are listed below:

- Modest software tools
- Efficient use of software licenses
- Centralized management and data
- Platform responsibilities managed by provider
- Multitenant solutions

Modest software tools



The SaaS application deployment requires a little or no client side software installation, which results in the following benefits:

- No requirement for complex software packages at client side
- Little or no risk of configuration at client side
- Low distribution cost

Efficient use of software licenses



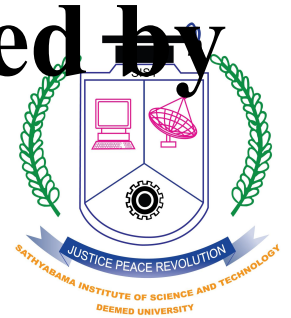
- The customer can have single license for multiple computers running at different locations which reduces the licensing cost. Also, there is no requirement for license servers because the software runs in the provider's infrastructure.

Centralized management and data



- The cloud provider stores data centrally. However, the cloud providers may store data in a decentralized manner for the sake of redundancy and reliability.

Platform responsibilities managed by providers



- All platform responsibilities such as backups, system maintenance, security, hardware refresh, power management, etc. are performed by the cloud provider. The customer does not need to bother about them.

Multitenant solutions



- Multitenant solutions allow multiple users to share single instance of different resources in virtual isolation. Customers can customize their application without affecting the core functionality

Issues



There are several issues associated with SaaS, some of them are listed below:

- Browser based risks
- Network dependence
- Lack of portability between SaaS clouds

Browser based risks



- If the customer visits malicious website and browser becomes infected, the subsequent access to SaaS application might compromise the customer's data.
- To avoid such risks, the customer can use multiple browsers and dedicate a specific browser to access SaaS applications or can use virtual desktop while accessing the SaaS applications.

Network dependence



- The SaaS application can be delivered only when network is continuously available. Also network should be reliable but the network reliability cannot be guaranteed either by cloud provider or by the customer.

Lack of portability between SaaS clouds



- Transferring workloads from one SaaS cloud to another is not so easy because work flow, business logics, user interfaces, support scripts can be provider specific.

Applications provided by SAAS are



- CRM Applications
- Human Resource Solutions
- Preexisting Billing and Invoicing System
- Other daily usable application suites

Infrastructure-as-a-Service



- IaaS, as the name suggests, is a way of providing cloud computing infrastructure such as virtual machines, storage drives, servers, operating systems & networks, which is also an on-demand service like that of SaaS.
- Rather than purchasing servers or developing software, clients buy those resources as a fully outsourced service based on their requirement

Infrastructure-as-a-Service



- "Public cloud" is considered as an infrastructure that consists of shared resources, based on a self-service over the Internet.
- In one word, it is the only layer of the cloud where the customer gets the platform for their organization to outsource IT infrastructure on a pay-per-use basis.
- Infrastructure-as-a-Service provides access to fundamental resources such as physical machines, virtual machines, virtual storage .It also provides

Infrastructure-as-a-Service

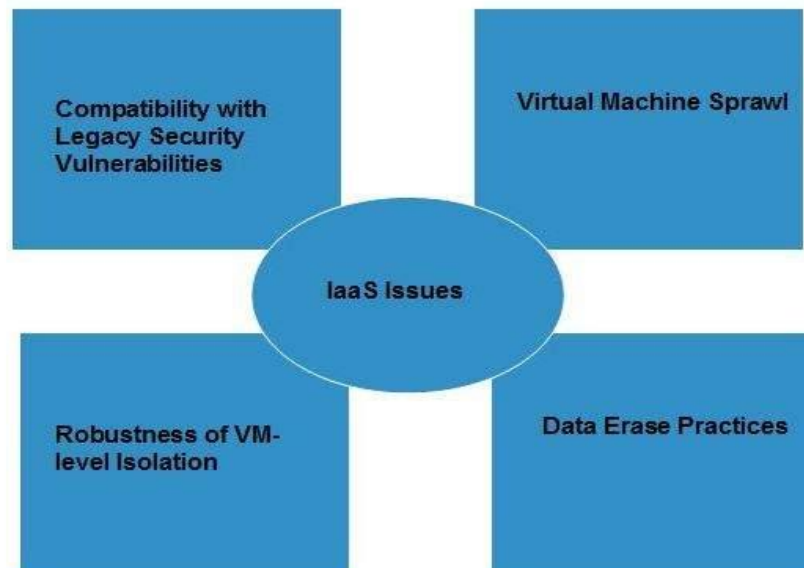


- Virtual machine disk storage
- Virtual local area network (VLANs)
- Load balancers
- IP addresses
- Software bundles

Issues



- IaaS shares issues with PaaS and SaaS, such as Network dependence and browser based risks. It also has some specific issues, which are mentioned in the following diagram:



Compatibility with legacy security vulnerabilities



- Because IaaS offers the customer to run legacy software in provider's infrastructure, it exposes customers to all of the security vulnerabilities of such legacy software

Virtual Machine sprawl



- The VM can become out-of-date with respect to security updates because IaaS allows the customer to operate the virtual machines in running, suspended and off state. However, the provider can automatically update such VMs, but this mechanism is hard and complex.



VM sprawl

- VM **sprawl**, also known as virtualization **sprawl**, happens when an administrator can no longer effectively control and manage all the **virtual machines** on a network. This can happen with rapidly growing networks when multiple VMs are set up for use by different departments.

Robustness of VM-level isolation



- IaaS offers an isolated environment to individual customers through hypervisor. Hypervisor is a software layer that includes hardware support for virtualization to split a physical computer into multiple virtual machines.

Data erase practices



- The customer uses virtual machines that in turn use the common disk resources provided by the cloud provider. When the customer releases the resource, the cloud provider must ensure that next customer to rent the resource does not observe data residue from previous customer.

Characteristics of IaaS



Here are the characteristics of IaaS service model:

- Virtual machines with pre-installed software.
- Virtual machines with pre-installed operating systems such as Windows, Linux, and Solaris.
- On-demand availability of resources.
- Allows to store copies of particular data at different locations.
- The computing resources can be easily scaled up and down.

Advantages of IaaS are:



- **Dynamic:** Users can dynamically opt & configure devices such as CPU, storage drive, etc.
- **Easy Access:** Users can easily access the vast cloud computing power.
- **Renting:** Flexible and efficient while renting IT infrastructures.
- **Full control** of computer resources along with portability.

Disadvantages of IaaS are as follows:



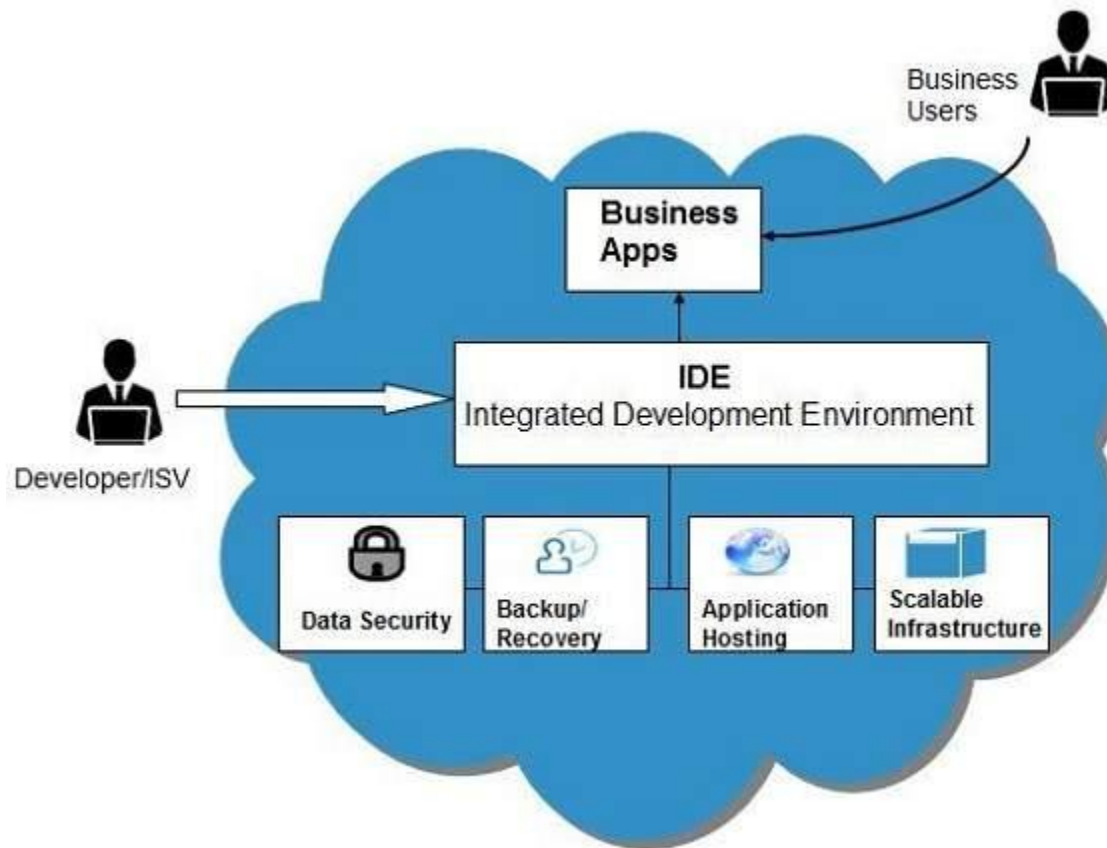
- Internet connection is a must.
- IaaS depends on virtualization services.
- This service restricts the user-privacy & customization.

Platform-as-a-Service



- It offers the runtime environment for applications. It also offers development and deployment tools required to develop applications.
- PaaS has a feature of **point-and-click** tools that enables non-developers to create web applications.

Platform-as-a-Service

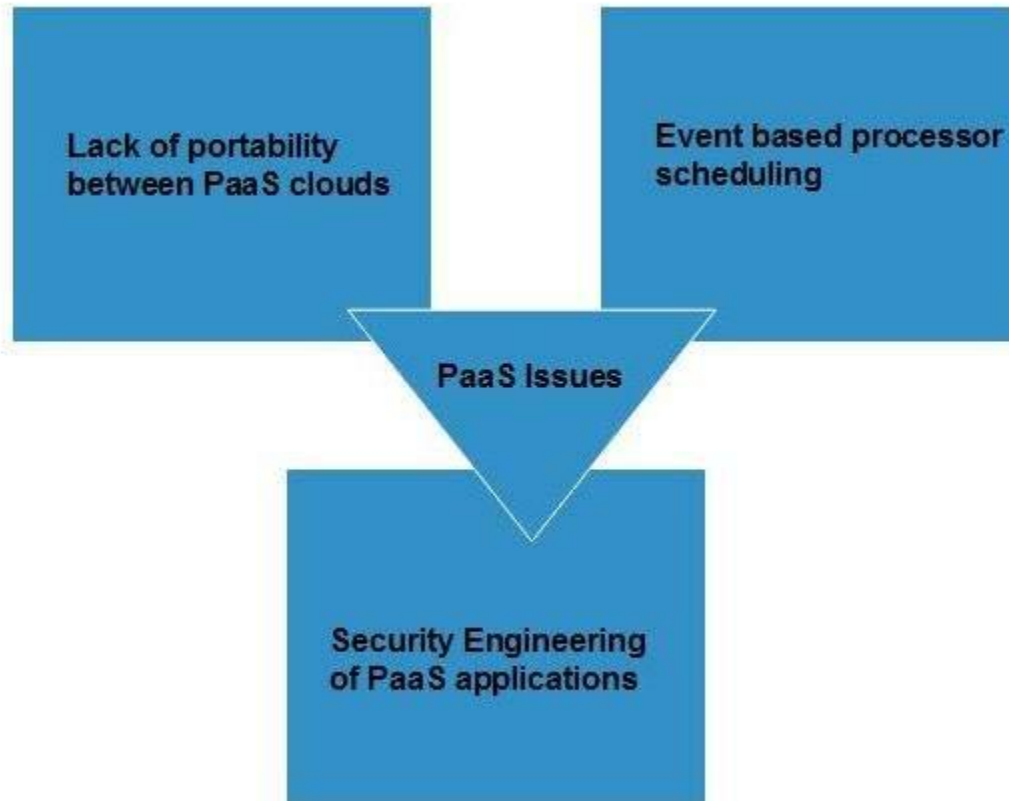


Issues



- Like SaaS, PaaS also places significant burdens on customer's browsers to maintain reliable and secure connections to the provider's systems. Therefore, PaaS shares many of the issues of SaaS. However, there are some specific issues associated with PaaS as shown in the following diagram:

Issues of PaaS



Portability between PaaS clouds



- Although standard languages are used, yet the implementations of platform services may vary. For example, file, queue, or hash table interfaces of one platform may differ from another, making it difficult to transfer the workloads from one platform to another.

Event based processor scheduling



- The PaaS applications are event-oriented which poses resource constraints on applications, i.e., they have to answer a request in a given interval of time.

Security engineering of PaaS applications



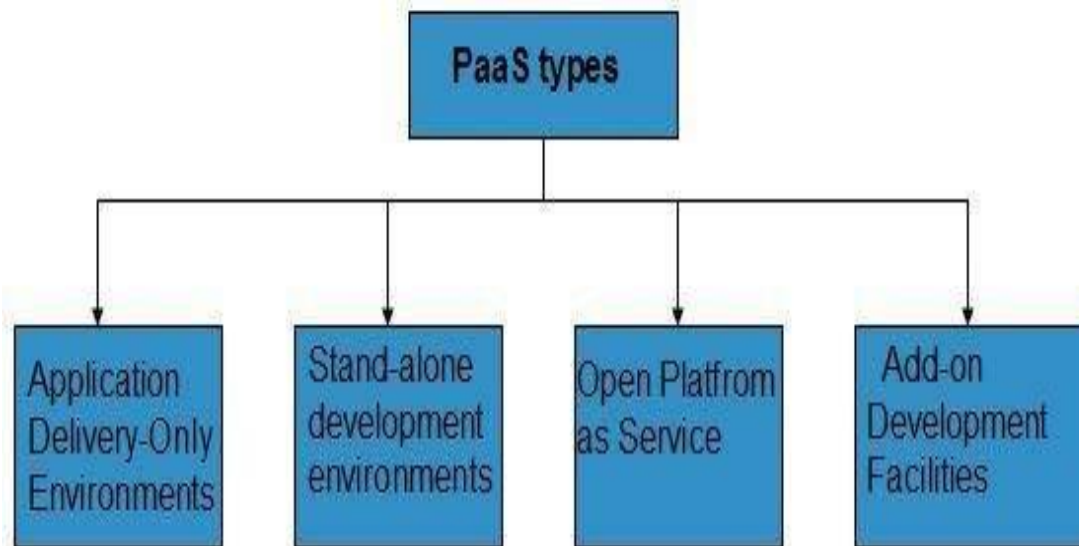
- Since PaaS applications are dependent on network, they must explicitly use cryptography and manage security exposures.



Characteristics of PaaS service model

- PaaS offers **browser based development environment**. It allows the developer to create database and edit the application code either via Application Programming Interface or point-and-click tools.
- PaaS provides **built-in security, scalability, and web service interfaces**.
- PaaS provides built-in tools for defining **workflow, approval processes**, and business rules.
- It is easy to integrate PaaS with other applications on the same platform.
- PaaS also provides web services interfaces that allow us to connect the applications outside the platform.

PaaS Types





PaaS Types

Stand-alone development environments

- The **stand-alone PaaS** works as an independent entity for a specific function. It does not include licensing or technical dependencies on specific SaaS applications.

Application delivery-only environments

- The **application delivery PaaS** includes **on-demand scaling** and **application security**.

Open platform as a service

- **Open PaaS** offers an **open source software** that helps a PaaS provider to run applications.

Add-on development facilities

- The **add-on PaaS** allows to customize the existing SaaS platform.

Advantages of PaaS:



- **Scalability:** of users ranges from hundreds to thousands.
- **Prebuilt Business Plan:** PaaS vendors provide pre-defined business functionality for users to directly start the project.
- **Low Cost:** Development via PaaS requires a computer & a good internet connection and hence less investment in hardware & software.
- **Instant Community:** PaaS providers facilitates user providing online communities where a developer can get new ideas & share their experience & advice.
- **Simple & easy to use**

Disadvantages of PaaS are as follows:



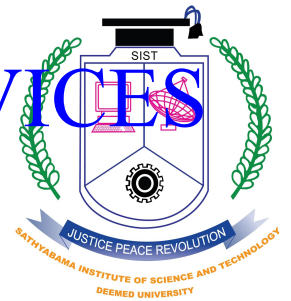
- **Vendor Migration:** Migration from one PaaS vendors' application to another PaaS vendor will create some problem.
- **Data-Privacy:** Privacy of data can get hamper if it is not held within the boundary of the company or organization.
- **Mix-up Complexity:** Some of the applications developed may be local while others are from the cloud which may increase the complexity.



SOA (Service Oriented Architecture)

- An architectural style that model system's information into services
- It provide architecture based on reusable , well defined services
- Components of SOA are loosely coupled
- It ensures platform , technology and language independence

DIFFERENCES BETWEEN WEB SERVICES AND SOA.



- There are some key **differences** between **Web services** and **SOA**.
- **Web services** define a **web technology** that can be used to build applications that can send /receive messages using SOAP over HTTP.
- However, **SOA** is an architectural model for implementing loosely **coupled service** based applications.



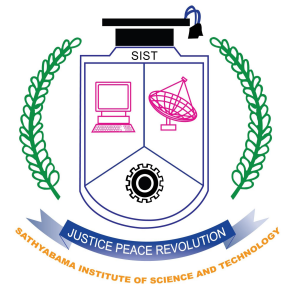
□ Web Services are self describing services that will perform well defined tasks and can be accessed through the web.

□ Service Oriented Architecture (SOA) is (roughly) an architecture paradigm that focuses on building systems through the use of different Web Services, integrating them together to make up the whole system.

Characteristics of SOA



- **Stateless**
- **Discoverable**
- **Self-describing**
- **Compostable**
- **Loose coupling**
- **Governed by policy**
- **Independent location, language, and protocol**

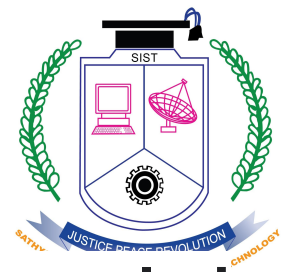


Stateless

SOA services should not save any information about session data, previous events, or previously reported service results. That is, the services must not have status.

Services must only provide the behavior that corresponds to the input received and the business rules involved.

For example, *autonomy*, *reusability* and *loose coupling*.



Loosely coupled connections

One key feature of SOA is the use of **loosely coupled connections**.

Traditionally, connections between applications or between applications and services have been tightly coupled, as with CORBA (Common Object Request Broker Architecture). ..

However, making a telephone call to order a book is a loosely coupled system.



Loosely coupled connections

Loose coupling is the concept typically employed to deal with the requirements of scalability, flexibility, and fault tolerance.

The aim of loose coupling is to minimize dependencies.

When there are fewer dependencies, modifications to or faults in one system will have fewer consequences on other systems.

	Tight coupling	loosely coupling
Physical connections	Point-to-point	Via mediator
Communication style	Synchronous	Asynchronous
Data model	Common complex types	Simple common types only
Type system	Strong	Weak
Interaction pattern	Navigate through complex object trees	Data-centric, self-contained message
Control of process logic	Central control	Distributed control
Binding	Statically	Dynamically
Platform	Strong platform dependencies	Platform independent
Transactionality	2PC (two-phase commit)	Compensation
Deployment	Simultaneous	At different times



Discoverability

The principle of service discoverability refers to the **essential need for** our SOA Services Catalog to be available, published, accessible and informed with a series of meta data that allow us to launch rich searches to identify the services that we can reuse.

Governed by policy



SOA governance refers to the processes used to oversee and control the adoption and implementation of service-oriented architecture (SOA) in accordance with recognized practices, principles **and regulations**.



Self Describing

Service-oriented architecture (SOA) is a software development model that allows services to communicate across different platforms and languages to form applications. In SOA, a service is a self-contained unit of software designed to complete a specific task. Service-oriented architecture allows various services to communicate using a loose coupling system to either pass data or coordinate an activity.

Benefits of SOA:



- **Language Neutral Integration:** Regardless of the developing language used, the system offers and invoke services through a common mechanism. Programming language neutralization is one of the key benefits of SOA's integration approach.
- **Component Reuse:** Once an organization built an application component, and offered it as a service, the rest of the organization can utilize that service.
- **Organizational Agility:** SOA defines building blocks of capabilities provided by software and it offers some service(s) that meet some organizational requirement; which can be recombined and integrated rapidly.
- **Leveraging Existing System:** This is one of the major use of SOA which is to classify elements or functions of existing applications and make them available to the organizations or enterprise.

- **Agility**



Service Oriented Architecture (SOA) is a design approach to organizing existing IT assets such that the heterogeneous array of distributed, complex systems and applications can be transformed into a network of integrated, simplified and highly flexible resources. ... The net result is an increase in organization agility.

SOA architecture:



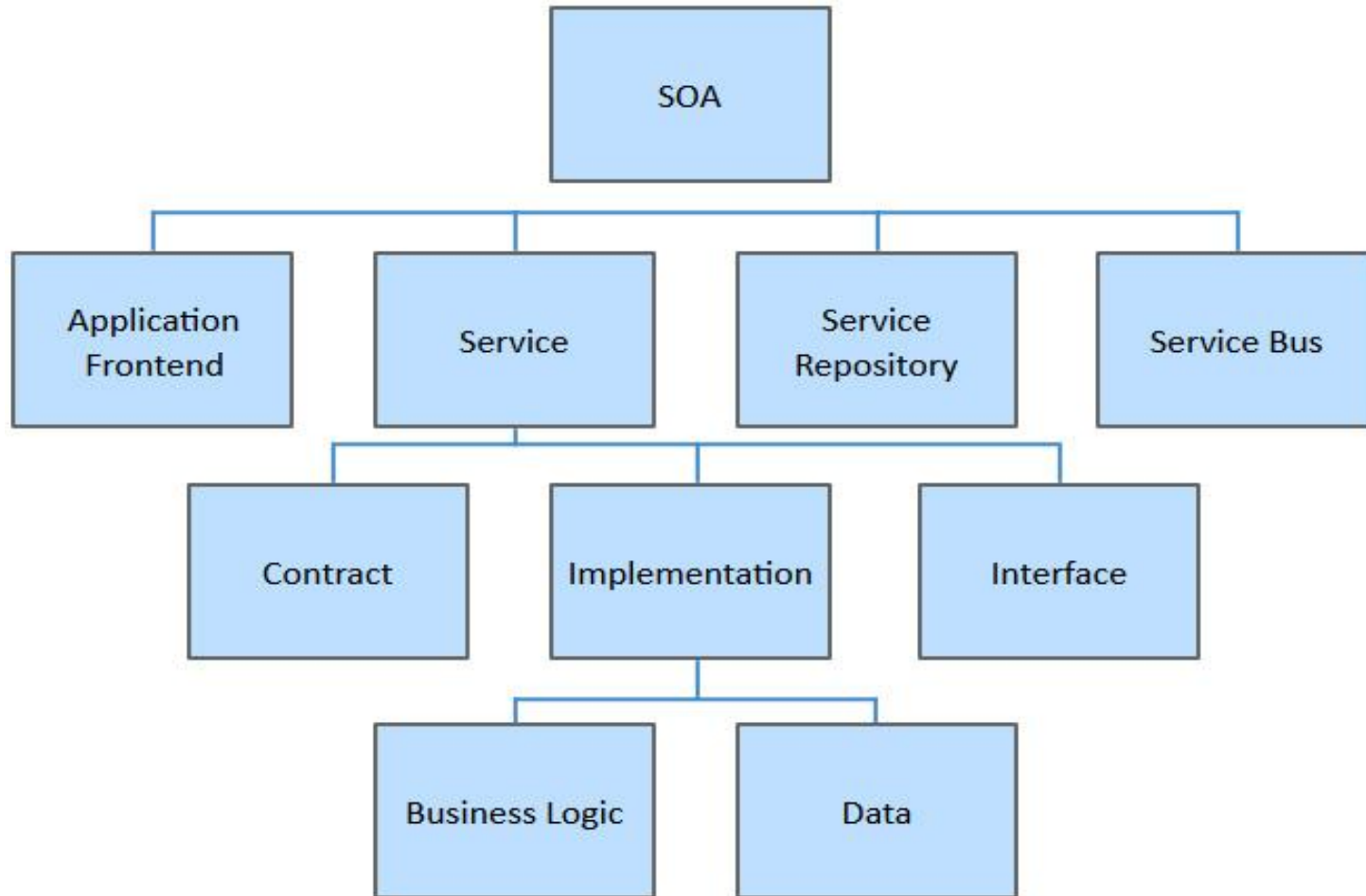
- SOA architecture is viewed as five horizontal layers. These are described below:
- **Consumer Interface Layer:** These are GUI based apps for end users accessing the applications.
- **Business Process Layer:** These are business-use cases in terms of application.
- **Services Layer:** These are whole-enterprise, in service inventory.
- **Service Component Layer:** are used to build the services, such as functional and technical libraries.
- **Operational Systems Layer:** It contains the data model.

SECURITY IN SOA:



- With the vast use of cloud technology and its on-demand applications, there is a need for well-defined security policies and access control.
- Actions can be taken to ensure security and lessen the risks when dealing with SOE (Service Oriented Environment).
- We can make policies that will influence the patterns of development and the way services are used.
- Moreover, the system must be set-up in order to exploit the advantages of public cloud with resilience.
- Users must include safety practices and carefully evaluate the clauses in these respects.

Figure - Elements Of SOA:

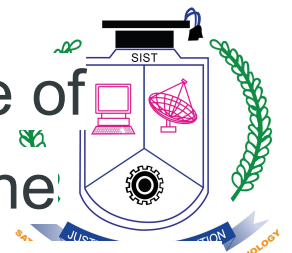




. FEATURES OF CLOUD COMPUTING

The unique and incredible features of cloud computing make it very popular amongst users. The major features can be summarized as follows:

- **Resource pooling:** The cloud service provider pools the resources and the same can be provided to many different consumers on the basis of the multi-tenant model. On the basis of the requirements of the users, several virtual and physical resources can be assigned and reassigned to the users.



- **On-Demand Self Service:** With this vital feature of elastic computing, the user can simply monitor the computing capabilities such as allotted network storage, server uptime, etc.
- **Easy maintenance:** The elastic computing servers are maintenance-free and regularly updated. The updates make them compatible with more and more devices with faster speed.
- **Large Network access:** With the convenience of device and internet, the data can be uploaded and access the same from anywhere over the network.



- **Availability:** Modification and extension of the cloud storage is easily available across the network usage.
- **Automatic System:** Cloud computing is an automated system and analyses the data from time to time as per the requirements and capabilities. The user can easily monitor, report, and control the usage and thus the system is very transparent.
- **Economical:** This service is highly economical and is just a one-time investment for purchasing the storage. Thereafter the user has to just pay for the maintenance charges which are very minimal.



- **Security:** Elastic computing is a highly secure feature. The data loss due to damage is next to impossible. The storage services are reliable, quick, and hack-free.
- **Pay as you Go:** The consumer is liable to pay for only those spaces or services that he has utilized. There are no other additional costs or hidden charges.
- **Measured Service:** The resource usage and services on the virtual server are measured, monitored, and reported to the service provider.

ELASTIC COMPUTING:



- Elastic computing is the ability to quickly expand or decrease computer processing, memory and storage resources to meet changing demands without worrying about capacity planning and engineering for peak usage.
- Typically controlled by system monitoring tools, elastic computing matches the amount of resources allocated to the amount of resources actually needed without disrupting operations.

Benefits of Elastic Computing



Benefits/Pros of Elastic Cloud Computing

Elastic Cloud Computing has numerous advantages. Some of them are as follow:-

1. **Cost Efficiency:** - Cloud is available at much cheaper rates than traditional approaches and can significantly lower the overall IT expenses. By using cloud solution companies can save licensing fees as well as eliminate overhead charges such as the cost of data storage, software updates, management etc.
2. **Convenience and continuous availability:** - Cloud makes easier access of shared documents and files with view and modify choice. Public clouds also offer services that are available wherever the end user might be located. Moreover it guaranteed continuous availability of resources and In case of system failure; alternative instances are automatically spawned on other machines.
3. **Backup and Recovery:** - The process of backing up and recovering data is easy as information is residing on cloud simplified and not on a physical device. The various cloud providers offer reliable and flexible backup/recovery solutions.
4. **Cloud is environmentally friendly:-**The cloud is more efficient than the typical IT infrastructure and it takes fewer resources to compute, thus saving energy.
5. **Scalability and Performance:** - Scalability is a built-in feature for cloud deployments. Cloud instances are deployed automatically only when needed and as a result enhance performance with excellent speed of computations.
6. **Increased Storage Capacity:-**The cloud can accommodate and store much more data compared to a personal computer and in a way offers almost unlimited storage capacity.

Unit 1 quiz



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