WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

CLOUD COMPUTING

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Introduction to Cloud Computing

The supply of computer services through the Internet is known as "cloud computing." It offers a variety of services, including networking, analytics, software, and storage. With cloud computing, customers may access resources and services whenever they need them and only pay for what they really need. Typically, a network of distant servers located on the Internet offers cloud computing services. A cloud service provider, such as Amazon Web Services or Microsoft Azure, owns and maintains these servers. The infrastructure is managed by the cloud provider, who also makes sure it is safe and accessible when needed.

Users may access services with cloud computing from any computer or device with an Internet connection. As a result, scaling up or down computer resources for enterprises is made simpler. Additionally, it lessens the necessity for companies to acquire and support their own gear and software. Businesses may also process and store a lot of data with cloud computing without investing in costly internal servers. Companies can use various cloud services such as storage, analytics, and machine learning to help them better understand and manage their data.

Cloud computing also offers a variety of advantages over traditional computing. It is more cost-effective, faster, and more secure. It also makes it easier for businesses to collaborate and share resources with remote work facilitation and easy backups, accessible data, automatic syncing.

Abstract in cloud computing:

The term "abstract" in the context of cloud computing refers to the idea of cloud computing without getting into too much technical information regarding the hardware, software, and networking components. It usually refers to the idea of providing computer resources as a service across the internet as a whole. Various cloud service types, including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS), can also be referred to as abstract cloud computing.

Areas of Cloud Computing

Cloud-First & Cloud Native Approaches

Both cloud-first and cloud-native strategies provide the cloud an advantage over on-premises models in order to accomplish dynamic scaling, streamline integration and orchestration, and cut costs. Cloud native is a development strategy that includes building apps that are only intended to operate on the cloud utilising methods like containerization and microservices. Cloud-first is an approach used by the IT industry that prioritises cloud infrastructure.

Legacy Integration Challenges

A significant obstacle for businesses moving to cloud-based solutions is legacy integration. CIOs deal with a variety of problems, including cross-platform connection, data normalisation, API development, latency/downtime difficulties, and security administration. The replacement of ancillary apps like HCM, portals, and team management tools with cloud-native alternatives, however, is making it easier to integrate and manage both hybrid-cloud ecosystems and older settings.

Multi Cloud Strategies

As businesses embrace a use-case-driven strategy for adopting cloud services and cloud vendors, multi-cloud solutions have grown in popularity. Analysts from firms like Gartner, Forrester, and IDC are optimistic about this development and forecast that the multi-cloud industry will reach $240 billion in size in 2019. Building multi-cloud strategies will be a top priority for organisations this year as they seek to overcome issues with technology stacks, migration, integration, workloads, security, and skills.

Cloud Security

In recent years, both the quantity and severity of cyberattacks have substantially grown. As a result of the fear of significant financial penalties for non-compliance, organisations are placing a high priority on the security of personal data. Endpoint security, crypto threats, and social engineering assaults will receive more attention in 2019. Traditional remediation-based security practises will be replaced by managed detection and response (MDR) strategies. Managed Security Service Providers (MSSPs) will also provide more thorough services to assist IT companies in reducing cloud vulnerabilities and dangers.

Cloud-Based Network Services

On-demand network services have become more widely used over the past year as a result of benefits such unified security, network analytics, cloud integration, and dynamic traffic optimisation. Even though NFV, NaaS, and SD-WAN started to gain popularity in 2018, their widespread implementation remained still limited. Leading providers of infrastructure, like Cisco, IBM, VMware, and NTT Communications, provide cutting-edge SD-WAN and NaaS solutions. Traditional networking infrastructure is being replaced by network-as-a-service, which enables businesses to create virtual, centralised management systems. As top manufacturers extend their product portfolios and increase market penetration, we should see a steady increase in the usage of SD-WAN and NaaS in 2019. Despite this, there is still a long way to go before these technologies are widely used.

Types of Cloud Computing

Private Clouds: A private cloud is a cloud computing infrastructure that is operated exclusively within an organization's own data centres. It is dedicated to the organization and provides a higher level of control and security than a public cloud.

Public Clouds: A public cloud is a cloud computing infrastructure hosted by a third-party provider and accessible to anyone on the Internet. It provides pay-as-you-go access to computing resources and applications, and is usually the most cost-effective option.

Hybrid Clouds: Combining a private cloud and a public cloud, a hybrid cloud is what it sounds like. It enables businesses to use the scalability and cost-savings of a public cloud while retaining sensitive data and apps on their own private cloud.

Multi-clouds: A multi-cloud computing environment is one that makes use of several cloud computing services from various suppliers. As a result, businesses are able to independently manage various components of their IT infrastructure and benefit from the finest attributes of each cloud provider.

Types of Cloud Computing Services

Infrastructure as a Service (IaaS): IaaS, or infrastructure as a service, is a cloud-based service that gives consumers access to a virtualized IT infrastructure. Users may access and use computer resources like servers, storage, and networking with the help of this sort of service without having to create and maintain the necessary physical infrastructure.

Platform as a Service (PaaS): Users that utilise PaaS have access to a platform for creating, maintaining, and deploying applications. PaaS is a cloud-based service. Developers and companies who require a platform to create, test, and launch their apps without having to handle the supporting infrastructure would find this kind of service to be excellent.

Software as a Service (SaaS): SaaS is a cloud-based service that gives customers access to software programmes that are housed elsewhere. Users that utilise this kind of service may access and use programmes without needing to locally install and maintain the software. For companies that require access to software programmes but don't want to spend money on hardware and software, this is a cost-effective alternative.

Cloud computing subtopics include:

Cloud Storage: Users can save data online using a service called cloud storage, usually in a remote location, such as a cloud provider's server. It provides users with access to their data from any device, anytime and anywhere.

Cloud Security: Cloud security is a set of measures designed to protect data stored in the cloud from unauthorized access, malicious activities and data loss. It includes security measures such as encryption, authentication and access control.

Cloud Hosting: An example of a hosting service that gives customers access to their data and apps on a distant server is cloud hosting. It allows users to store and access their data on a virtual environment rather than on their own physical server.

Cloud-Based Application Development: The process of developing apps and software utilising cloud computing technology is known as "cloud-based application development." It involves using cloud-based tools and services to build, deploy and manage applications.

Cloud Networking: Cloud networking is a type of networking that uses cloud computing technologies to provide users with secure, reliable and efficient access to their data and applications. It typically involves using remote servers, storage systems and other cloud-based services to deliver services over the internet.

Cloud Virtualization: The process of constructing a virtual server, network, or storage device for a cloud computing resource is known as cloud virtualization. By virtualizing a cloud resource, organizations can quickly and easily deploy a fully functional computing environment without the need for physical hardware or costly software licenses.

Cloud Computing Services: In order to access a scalable pool of computing resources, such as networks, servers, storage, applications, and services, on-demand, a provider often offers cloud computing services, a category of computing services that are offered via the internet.

Cloud-Based Business Models: Cloud-based business models provide organizations with the ability to leverage cloud computing to deliver products, services, and solutions to customers in a cost-effective way. Cloud-based business models involve the use of cloud technologies to create an agile, secure, and cost-effective platform for delivering services.

Cloud Migration: The process of moving data, apps, and other IT infrastructure elements of a company to a cloud computing platform is known as cloud migration. Organisations may benefit from the scalability, financial savings, and dependability of cloud computing by migrating to it.

Cloud Computing Economics: It refers to the financial aspects of cloud computing, such as cost savings and cost efficiencies that can be achieved through the use of cloud services. It includes factors such as pricing models and cost optimization strategies for cloud-based solutions.

Cloud Virtualization

The practise of building a virtual replica of a real server or other computer resource is known as virtualization in cloud computing. By enabling different operating systems and applications to operate on the same physical server at once, it is a means to make the best use of the server's physical resources. Organisations may manage their cloud infrastructure more effectively and boost efficiency by virtualizing resources.

Types of Virtualizations:

1. Hardware Virtualization.
2. Operating system Virtualization.
3. Server Virtualization.
4. Storage Virtualization.

1) Hardware virtualization: Installing virtual machine management (VMM) or virtual machine software on the hardware system is known as hardware virtualization. The hypervisor's main job is to manage and watch over the hardware resources, including the CPU, memory, and others. Once the actual system has been virtualized, we may install a variety of operating systems and run different applications on them. Usage: Hardware virtualization is mostly utilised for server platforms since managing virtual computers is much easier than managing a real server.
2) Operating System Virtualization: When virtual machine management (VMM) or virtual machine software is placed on the host operating system rather than directly on the hardware system, operating system virtualization takes place. Operating system virtualization is mostly used for application testing across many platforms.3. Virtualization of servers
3) Installing virtual machine management (VMM) software or virtual machine software directly on a server system is known as server virtualization. Application: A single physical server can be split into numerous servers depending on demand and the amount of work that has to be balanced out.
4) Storage Virtualization: Storage virtualization is a technology that combines the physical storage from several network storage devices to provide the impression that there is just one storage device. Software programmes are also used to implement storage virtualization. Storage virtualization is used mostly for backup and recovery procedures.

Ways in which cloud virtualization can be implemented

Cloud virtualization can be implemented in several different ways, including:

1) Infrastructure as a Service (IaaS): This kind of cloud virtualization gives consumers access to the hardware that supports the software for managing and provisioning these resources, including servers, storage, and networks.

2) Platform as a Service (PaaS): This kind of cloud virtualization gives customers access to a platform for creating, evaluating, and deploying software in a cloud setting.
3) Software as a Service (SaaS): This form of cloud virtualization gives customers access to a number of apps that they may use whenever they need to in a cloud setting.
   Containers: This type of cloud virtualization provides users with access to a container-based environment for deploying and managing applications in a cloud environment.
   Serverless Computing: With this form of cloud virtualization, customers may run applications in a serverless environment without worrying about maintaining servers.

Implementation of Cloud Virtualization

A hypervisor, a piece of software that builds and controls virtual machines, is used to achieve cloud virtualization. The hypervisor allots resources to each virtual machine while running on a real server in the cloud. Each virtual machine appears to be a separate physical machine with its own operating system, memory, and storage, but it is actually a software simulation of a physical computer. This allows multiple users to access the same physical server in the cloud and run multiple virtual machines.

Implementation Levels of Virtualization in Cloud Computing

1) Instruction Set Architecture Level (ISA)
   ISA emulation can be used to implement ISA virtualization. This is used to run a large number of outdated programmes created for various hardware. These applications operate on any virtual machine thanks to the ISA. As a result, binary programmes that previously required extra layers to execute may now be executed on x86 processors. It may also be altered to function on an x64 computer. With ISA, the virtual computer may be independent of the hardware.
   An interpreter is required for basic emulation, which translates the source code into a read-friendly hardware format. After that, processing can begin. In Cloud Computing, this is one of the five virtualization implementation levels.
2) Hardware Abstraction Level (HAL)
   HAL, as its name implies, enables virtualization to function at the hardware level. This employs a hypervisor to carry out its operations. The virtual computer that employs virtualization to handle the hardware is constructed at this level. The CPU, memory, input/output devices, and other hardware components may all be virtualized thanks to this technology.
   Numerous clients cannot utilize a similar equipment and furthermore utilize various virtualization examples at exactly the same time. This is most frequently utilised in cloud-based infrastructure.
3) Operating System Level
   The virtualization concept has the ability to create an abstract layer between the operating system and the application. It uses the operating system, as well as the hardware and software, of the actual server in a separate container. Then, each of them functions as a server.
   The virtualization level is utilized in situations where multiple users do not wish to share hardware. A dedicated virtual hardware resource will be used to provide each user with their virtual environment. There will be no conflict in this manner.
4) Library Level When applications use the API from the libraries at the user level, the operating system becomes cumbersome. Because these APIs are well-documented, the library virtualization level is preferable in these situations. Because it regulates the communication link between the application and the system, API hooks make it possible.
5) Application Level In Cloud Computing, application-level virtualization is the final implementation level of virtualization and is used when only one application is to be virtualized. The platform's entire environment need not be virtualized.
   When running high-level language virtual machines, this is typically used. The virtualization layer, which is on top of the application program, will be positioned above the application.
   It allows for the trouble-free operation of high-level language programmes created for usage at the virtual machine's application level.

Hardware Abstraction Level (HAL)

Hardware Abstraction Level is a software layer that sits between the hardware and higher-level software applications. Regardless of the implementation of the underlying hardware, its main goal is to offer a uniform interface to the hardware. To put it another way, it serves as a translator between the hardware and the software, making it simpler for developers to design code that can work on several hardware platforms without having to worry about the peculiarities of each one.

Some examples of HAL Layer are:

- Boot code
- Code for Context switch

- Configuration Codes
- Access to Hardware resources

The HAL is typically divided into multiple layers, each providing a different level of abstraction. The lowest layer is responsible for communicating directly with the hardware, while higher layers build on top of it to provide more advanced functionality. The exact number and structure of the layers can vary depending on the specific implementation.

The working of HAL involves the following steps:

1) STEP 1: Initialization- When the system starts up, the HAL initializes itself and the underlying hardware. This includes configuring hardware registers, setting up interrupt handlers, and other low-level tasks.
2) STEP 2: Abstraction- Once the hardware is initialized, the HAL starts providing an abstraction layer for the software to interact with. This abstraction layer typically consists of a set of APIs (Application Programming Interfaces) that, no matter the underlying implementation, offer a constant interface to the hardware.
3) STEP 3: Device Management- The HAL also provides device management services to the operating system or application software. This includes detecting new hardware devices, configuring them, and managing them throughout their life cycle.
4) STEP 4: Hardware Access- Applications can use the APIs provided by the HAL to access the underlying hardware. The HAL translates these requests into low-level hardware operations and sends them to the appropriate hardware device.
5) STEP 5: Error Handling- The HAL also handles errors that occur during hardware access. If an error occurs, the HAL can either attempt to recover from the error or notify the application of the error so that it can take appropriate action.

The Hardware Abstraction Level provides a consistent and abstract interface to the underlying hardware, making it easier for developers to write code that can run on multiple hardware platforms without having to worry about the specifics of each one. The HAL achieves this by providing a set of APIs, managing hardware devices, handling errors, and translating requests into low-level hardware operations.

Hardware abstraction layer within the Android architecture

The Hardware Abstraction Layer (HAL), which offers a standardised interface for hardware manufacturers to deploy lower-level driver updates, is an essential part of the Android system design. Developers can add features to a higher-level framework without changing it by utilising a HAL. The Android device uses HAL applications to gain hardware support and loads the implementations as modules at the right time. The C/C++-written Android HAL serves as a supply layer for Android apps or the framework code by utilising functions made available by the Linux kernel's lower layers.

The Hardware Abstraction Layer, Android System Services, Binder IPC, Linux Kernel, and Application Framework are the five primary parts of the Android system architecture. The Application Framework is used by the majority of application developers; nevertheless, hardware developers should be conversant with developer APIs to obtain insight into driver implementation. The Android System Services are modular, focused components that enable the application framework APIs to communicate with system services, and the Binder IPC technology enables calls into the Android system services code to be made across process boundaries. While the Linux Kernel is in charge of operating the system and offers functionality essential to a mobile embedded platform, the HAL creates a standard interface for hardware makers to implement.

Conclusion

The way that organisations and people store, manage, and access data and applications has been completely transformed by cloud computing. The technology has a number of advantages, such as increased accessibility, cost effectiveness, and scalability.

One key aspect of cloud computing is cloud virtualization, which enables multiple users to access shared resources in a way that appears as if they have their own dedicated resources. This is made possible through the use of a virtualization layer, which abstracts the physical hardware and presents it to users as virtual machines or containers.

Hardware abstraction layer (HAL) is another important component of cloud computing, which enables the operating system to interact with the physical hardware without needing to understand its specific details. This allows for greater flexibility and scalability, as well as easier management of resources.

Overall, the storage and access of data and applications for both enterprises and consumers has been revolutionised by cloud computing and its associated technologies, like virtualization and HAL. They provide better adaptability, scalability, and cost-effectiveness, making it simpler for businesses to expand their operations and boost overall effectiveness.