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ROLE OF VIRTUALIZATION IN CLOUD COMPUTING

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Abstract: Virtualization & Cloud computing are two popular research directions in recent times. Today, Virtualization is being used by a growing number of organizations to reduce power consumption, Server Consolidation, Testing and Development, Dynamic Load Balancing & Disaster Recovery, Virtual Desktops and Improved System Reliability & Security. Virtualization also provides high availability for critical applications, and streamlines application deployment and migrations. Through cloud computing, Information Technology resources can be delivered as services over the Internet to the end user. Virtualization is one of such important core technologies of cloud computing.

Keywords: Cloud Application, Virtualization, Testing and Development, cloud computing.

I. INTRODUCTION

There are salient business benefits in the adoption of cloud computing such as accessibility, unlimited geographic coverage, reduced investment regarding on premise infrastructure, etc. However, there are significant issues in cloud computing like data security, resource limitations & shortage of skills and expertise etc. Among all the challenges, protection of data, aka, data security tops the list. Data is key to decision making related to investments, engineering, marketing, & sales etc. Compromise to data as well as leakage can mean losing the competitive edge for many organizations in commercial space.

Industrial automation & control systems are integral part of critical infrastructure sectors. Several companies in the energy generating sector that use hydroelectric, nuclear reactors, coal, geothermal, solar, and wind as sources have a high degree of automation in operational management & maintenance. They are usually composed of a collection of networked hardware devices like controllers, sensors, actuators, & communication equipment.

The Control & input/output networks are typically industry owned, meaning they live within their physical premises. The key critical component of ICS architecture is SCADA application. There are two possibilities associated with where the SCADA application resides. The SCADA application is hosted on-premise & connected to the control network The SCADA application is architected entirely within the cloud & remotely connected to the control network .

1.2 SCADA Network

SCADA network through command control interface collects near real-time data from all controllers in the control network. SCADA can issue commands to Programmable Logic Controllers & initiate a variety of actions like turning a grid off or diverting water through a gate in hydroelectric dam.

1.3 Control Network

Control networks, on the contrary, comprise Remote Terminal Units, Programmable Logic Controllers that continuously poll sensors that monitor various parameters like pressure, voltage, and temperature. In addition, the PLCs relay commands issued by SCADA network to the devices and sensors in the I/O network.

1.4 Input Output Network

Input Output Network comprise several sensors that are directly interfaced to the machinery supporting such as generators, boiler, nuclear reactors, filtration, and transportation etc.

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1.5 Enterprise Network

An enterprise network, in many situations, is connected to a SCADA network. Access from enterprise or corporate network will be tightly controlled & restricted.

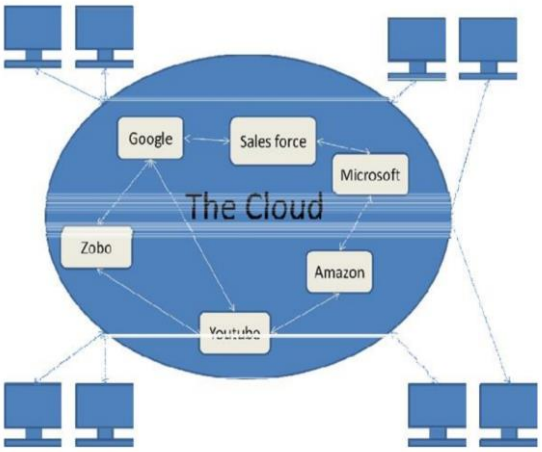

Fig 1: Cloud Computing

Cloud computing is the outcome of grid computing, utility computing and automatic computing. Cloud is a parallel & distributed computing system which consists a set of inter-connected & virtualized computers which gives one or more unified computing resources based on the requirements between service providers and service consumers.

Cloud computing is on demand pay-as-use i.e billing is done based on the usage of the customer which downs the operational and capital cost. Users can access applications which are present outside the working site which can access remote applications through internet connection devices. By this, computer resources can be efficiently used and consume less computing power and resources are shared cooperatively.

II. FUNDAMENTALS

Both the Hot/Cold Storage model & the data carousel model were developed based on the computing infrastructure of the ATLAS experiment, which obtains its resources from the Worldwide LHC Computing Grid (WLCG) .As mentioned before, globally distributed storage & computing resources are pooled in data centres. In the context of grid resources, those data centres are called sites. The storage resources of a site are logically grouped in storage elements. Storage elements could difer in the attributes of their underlying physical storage media or simply by the type of data they store.As mentioned before, the Hot/Cold Storage model allows the usage of commercial cloud resources. The VR Observatory has already decided to use cloud resources from

Google as an interim data facility in 2020/23 [16]. Moreover, ATLAS is investigating diferent approaches to adopt commercial cloud resources . For this reason, the implementation and evaluation of the HCDC model have been performed considering resources from the Google Cloud Platform (GCP) . Google Cloud Storage (GCS) denotes only the storage resources of the GCP.Analogously to grid resources, clouds usually provide their resources pooled in regions, which represent the data centres. Storage resources are logically divided into buckets. In contrast to storage elements, cloud providers often allow buckets to be multi-regional. This means the data stored in a multi-regional bucket is transparently replicated across multiple data centres. In the scope of the Data Ocean project the possibility of a scalable, globally accessible bucket was discussed with Google.

Originally, the HCDC model was developed based on such a bucket. However, for the implementation presented here, the bucket is not required to be globally accessible. The possible options for implementing such a bucket still have to be investigated. A straightforward approach would be a transparent replication of the data in the bucket to regional data centres. The HCDC model was evaluated based on the derivation workfow described in the introduction. The proposed model requires the workfows to be executed in one of two modes.

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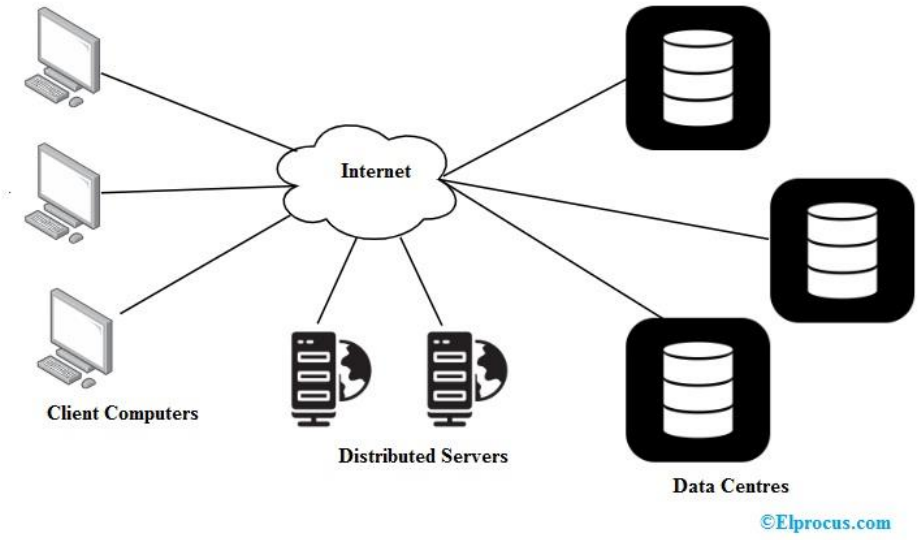
The frst mode assumes the derivation workfow is organised in predictable campaigns, resulting in an infrequent requirement of the input data. The other mode assumes the derivation runs continuously, which leads to a more frequent and less predictable demand for the input data. The existence of a popularity metric, such as the access frequency of a fle, is assumed for the continuous mode.

III. COMPONENTS OF CLOUD COMPUTING



https://www.elprocus.com/cloud-computing-technology/

Cloud computing has clients, data centers, distributed servers as the components.
Clients: Users like computers, laptops, tablets computers mobile phones or PDA's.
Data Centers: These are a collection of servers where the application is hosted. Virtualization is done where multiple instances of virtual servers are created.
Distributed Server: Servers which reside nonlocally which are geographically far.

3.1 CLOUD DEPLOYMENT MODELS:

In the cloud computing deployment model services likesoftware and hardware infrastructure, networking, storage are provided to the clients. Cloud has three working models

3.2 Private Cloud

Private Cloud is a model of cloud computing whose frame is permitted to use with a particular organization. All the resources and services are keen to a limited number of peoples. The server & data center is also setup within organization. Occasionally infrastructure is setup by third party but it is in full control of organization. The private clouds are good to privacy and security.

3.3 Public Cloud

Public cloud is model of cloud where all users are allowed to access the services using internet. The user need only internet connection & web browser to access with pay per use scheme.

3.4 Hybrid Cloud

Hybrid cloud combines both public & private cloud with their advantages. Hybrid cloud offers the benefits of both the public & private cloud. The hybrid cloud is the good explanation for purely business oriented thought because many contemporary businesses have a wide range of concerns to support user's requirement.

3.5 VIRTUALIZATION IN CLOUD COMPUTING:

Virtualization in computing is creation of virtual (not real) of virtual something such as hardware, software, platform or a operating system or a storage or a network device . In a virtualized environment IT enterprise has to manage many changes as the changes occur more quickly in virtual environment than in a physical environment. Because of virtualization clouds are scalable & agile.

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IV. ADVANTAGES OF VIRTUALIZATION IN CLOUD

4.1 COMPUTING:

Virtualization technology makes cloud computing environment easily to manage the resources. It abstracts and isolates the underlying hardware, & networking resources in a single hosting environment. It increases the security of cloud computing by protecting both the integrity on guest virtual machine & cloud components virtualized machines can be scaled up or down on demand and can provide reliability.

It provides resource sharing, high utilization of pooled resources, rapid provisioning and workload isolation.The recent trends in virtualization are consolidation of data centers thus reducing the managing cost. Apart of its benefits it has some drawbacks like managing virtual resources is critical and migrating services of these resources are difficult in achieving high availability.

4.2 Hypervisor: A hypervisor is software, hardware or a firmware that provides virtual partitioning capabilities which runs directly on hardware. It is defined as the virtual machine manager which allows multiple operating systems to run on a system at a time providing resources to each OS without any interaction. Hypervisor controls all the guest systems. As the operating system number increases managing is difficult these leads to security issues. If a hacker gets control over the hypervisor he can control the guest systems by knowing the behavior of the system which causes data processing damage. Advanced protection system is to be developed to monitor the activities of the guest Virtual machine .

V. APPLYING VIRTUALIZATION TO CLOUD COMPUTING

https://www.analyticssteps.com/blogs/what-virtualization-cloud-computing-characteristics-benefits

Cloud computing is the delivery of computing as a service rather than as a product, whereby shared resources, software, and information are provided to computers and other devices as a utility over a network[7]. A well-designed cloud computing platform should have the characteristics of dynamic scalability, on-demand division of resources, high availability, high performance and load balancing.

Cloud computing involves a lot of research themes including power management, stability, virtualization & scalability, etc. The virtualization technology is just one of several important technologies in cloudcomputing. Through virtualization, Cloud computing manages the hardware in a distributed shared resource pool. All IT resources through virtualization can improve resource utilization & allocated dynamically.

At present, the products of VMware, vCloud and Xen Cloud Platform is generally used to build the cloud platform. The Xen Cloud Platform is an enterprise-ready sever virtualization & cloud computing platform based on the powerful Xen hypervisor. Though Xen Cloud Platform, users can access VM consoles, view VM properties, perform power operations,

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manage VM snapshots, & migrate VMs between server hosts in a pool. The VMware vCloud is a virtual VMware's cloud infrastructure tools. Here we demonstrate how to build a cloud computing infrastructure using the VMware vCloud tools. The cloud computing platform solution also has three-tier structure. The SAAS layer is mainly for terminal applications virtualization. The PAAS layer provides cloud application platform-it allows developers to create portable cloud applications. The IAAS layer is a cloud-based infrastructure & is built by the VMware vCloud. The VMware vCloud has five main components, which are VMware vCloud Director, VMware vSphere, VMware vShield, VMware vCenter Chargeback and VMware vCenter. They are the core of computing services infrastructure. The VMware vCloud Director component can allow customers integrate infrastructure resources into virtual data centre resource pool, & allow them to on-demand consumption of these resources. It can also use technologies such as linked clones & snapshots to dramatically speed up access to the infrastructure.

The VMware vShield component provides network security services including Layer 2 isolation, NAT, firewall, DHCP, and VPN. It supports virtualization protection for virtual data centres & cloud computing environments, & it also allows the user to increase application & data security. The VMware vCenter component provides a central control point to monitor every aspect of virtual infrastructure and achieve daily automate tasks. It also manages large data centre with scalability. The VMware vCenter Chargeback component provides resource metering & cost models.

It is mainly to help users get accurate cost estimates and analysis of cloud computing services. It also can help users better understand what the cost of resources is, & how to optimize resource utilization & reduce the overall infrastructure costs of cloud computing services. The VMware vCloud tools constructed based on vSphere-the vSphere component has many features such as server virtualization, storage virtualization & network virtualization.

It can perform automatic load balancing across hosts & real-time virtual machine migration. It also performs non-disruptive storage migration, eliminates virtual machine storage and I/O bottlenecks & frees up valuable storage capacity. In short, the IAAS layer is the core layer in the cloud computing services platform, & we can build the IAAS layer using the VMware vCloud tools. Through this framework shown in figure 3, a public or private cloud platform can be built for enterprises.

VI. PERFORMANCE EVALUATION

Server virtualization (SV) is a proven technology that enables multiple virtual machines to run on a single physical server. At present, server virtualization has been widely used in the architecture of the data centres and cloud computing platforms. It has a myriad of advantages such as scalability, cost savings & energy efficiency among others. With these advantages, this technology could be easily inculcated in cloud computing. Below is the performance evaluation through several application examples.

6.1. The evaluation of the total cost benefit

At present, there have been many new problems in the data centres, such as difficulty in management & excessive costs of hardware & maintenance. Jing Nie [10] concludes that, there are five types of costs which are hardware cost, energy cost, software cost, maintenance cost, downtime and recovery cost in data centre. They analysed the total cost benefit using server virtualization. Their experiments was carried out to contrast the total costs between using 20 physical host severs and 20 virtual host severs. The result indicates that the cost reduced significantly by using the server virtualization technology in the long run.

6.2 The evaluation of energy efficiency

In recent times, it is regarded as out of place to excessively purchase physical servers for enterprises. The SV technology can enable server consolidation and reduce the number of physical servers. It can also achieve the goal of reduction of power usage & carbon footprint. Lu Liu gave detailed analysis about how server virtualization offers an energy efficiency solution. The experiments was carried under three conditions including VMware workstation, VMwarer ESX/ESXi and physical servers. The data collected in the experiments shows a similarity in consumption between VMware Workstation and VMware ESX/ESXi under the four different type's workloads. The collected data also shows that virtualized severs can significantly reduce energy consumption compared with the physical servers under the same workloads.

6.3 The evaluation of time efficiency

CIVIC is a hypervisor-based computing platform proposed by Jinpeng Huai. The CIVIC platform consists of five layers from bottom to top, including Resource layer, Container layer, Coordination layer, Instance layer & Interaction layer. The resource layer is formed by physical machines distributed over the Internet. The container layer can deploy the hypervisor on the top of physical machines & provide some interfaces for remote management & interaction. The virtual

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machine instance can be hosted in the container layer. The coordination layer has many different kinds of coordination functions.

The instance layer provides virtual machine instance, virtual machine network instance, & virtual application instance for users. The interaction layer contains two types of interaction modules for users & managers respectively. In CIVIC architecture, the SV technology is applied in the container layer composed of many container nodes. Each node can install hypervisor. The experiments based on CIVIC platform shows that the installation time of virtual machine templates is far less than the installation time of physical machines. It also shows that the time to deploy a virtual network is far less than to configure a physical network. For this reason, we can conclude that time efficiency can be obtained using SV technology.

VII. CONCLUSION

In this paper, we have introduced the development of virtualization & analysed. We further applied the virtualization technology to cloud computing, & built the cloud platform using the VMperformance evaluation of server virtualization in the cloud platform is summarized through some implementation examples. Through the research and analysis related to the technologies on virtualization & cloud computing, we presented some performance advantages, including gaining .

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