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Thursday

CS 468.
CLOUD COMPUTING

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(1) Virtualization:

- It improves computer performance in terms of resource utilization and application flexibility.
- Hardware or software resources can be virtualized in various functional layers.

Eg: Virtual memory.

→ The VMM is responsible for allocating h/w resources for programs
→ It is possible under certain circumstances for a VMM to regain control of resources already allocated.
→ It is not possible for a pgm to access any resource not explicitly allocated to it.

(2)

Conventional computer	Virtual machine
• Single os image	• Underutilized resource
• Rigid architecture	• Application inflexibility.
• S/w compatible with one machine may not be compatible with another.	• Software manageability & security concerns in existing physical machine.

(4) cloud

A cloud is a unique form of cluster. The main goal of the cloud is the effective use of resources. The cloud is virtualized, in the sense that the workload is not aware about the actual physical location and resource processing it. The cloud is also built for self-service.

Cluster.

A cluster is usually a concept of several that work together, usually dividing the load between them so that from the outside they can be regarded as a single system. Simply, cluster is a very general pattern for dividing workload & providing redundancy to prevent failure.

Grid

A grid often refers to a set of servers that work together on a given massive computation. Instead of just distributing the workload coming from many customers, they divide a single job into sub parts.

(3) Cloud Computing

A cloud is a pool of virtualized computer resources. A cloud can host a variety of different workloads, including batch-style backend jobs and interactive and user-facing application.

→ Resource Pooling

The customer generally has no control or information over the location of the provided resources but is able to specify location at a higher level of abstraction.

→ Easy Maintenance

The updates are more compatible with the devices and perform faster than older ones along the bugs which are fixed.

→ Availability

The capabilities of the cloud can be modified as per the use and can be extended a lot.

→ Security

Cloud security is one of the best features of cloud computing. It creates a snapshot of the data stored so that the data may not get lost even if one of the servers get damaged.

(5)

(a) Implementation levels of virtualization

(*) instruction set Architecture (ISA) level
(*) hardware level
(*) operating system level
(*) library support level
(*) application level.

→ ISA Level

- Virtualization is performed by emulating a given ISA by the ISA of the host machine.
- Legacy binary code various processors can be run on any given new hardware host machine.
- Dynamic binary translation can be used for better performance.

→ Hardware Level

- Performed right on top of the bare hardware, generates a virtual hardware env. for a VM.
- Also manages the underlying h/w through virtualization.

→ Operating System Level

- Abstraction layer b/w traditional OS & user applications.
- OS-level virtualization creates isolated containers on a single physical server and the OS instance to utilize the h/w & s/w in data centers.

→ Library Support Level

- Most applications use APIs exported by user-level libraries rather than using lengthy system calls by the OS.

→ User Application Level

- Virtualize an application as a VM. Also known as process-level virtualization.

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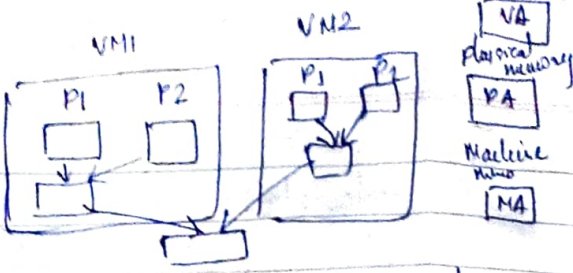
(b) Memory virtualization



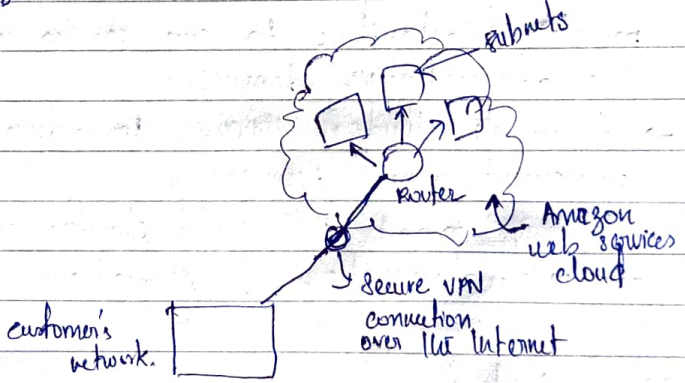
- Virtual memory virtualization involves sharing the physical system memory in RAM and dynamically allocating it to the physical memory of the VMs.
- Two-stage mapping process should be maintained by the guestOS and the VMM respectively, virtual memory to physical memory to machine memory.
- Mapping of virtual addresses to the physical memory addresses of VMs → GuestOS.
- GuestOS cannot directly access the actual machine memory.
- Guest physical memory to the actual machine memory → VMM.
- The MMU handles virtual-to-physical translations as defined by the OS.
- Physical memory addresses are translated to machine addresses using another set of page tables defined by the hypervisor.
- VMware uses shadow page tables to perform virtual memory to-machine-memory address translation.
- Processors use TLB h/w to map the virtual memory directly to the machine memory to avoid the two levels of translation on every access.
- When the guestOS changes the VM to a physical memory mapping, the VMM updates the shadow page tables to enable a direct lookup.

⑥

ⓐ Infrastructure - as - a - Service (IaaS).

→ The services are performed by rental cloud infrastructure.
→ The IaaS model encompasses:
  • storage as a service, compute instance as a service, & communication as a service.
→ Instead of purchasing h/w, user pay for IaaS on demand.
→ Infrastructure is scalable depending on processing and storage needs.
→ Because data is on the cloud, there can be no single point of failure.
→ Enable the virtualization of administrative tasks, freeing up time for other works.

eg: Amazon Virtual Private cloud (Amazon VPC)



⑦

ⓑ Quality of Service (QoS)

→ Critical QoS parameters to consider in a service request, such as time, cost, trust/security and reliability.
→ Greater importance on customers since they pay to access service in clouds.
→ QoS requirements cannot be static and may changes over time due to continuing changes in business operations and operating environments.

→ Negotiation mechanisms are needed to respond to alternate offers protocol for establishing SLAs.
→ The state of the art in cloud computing has no or limited support for dynamic negotiations of SLAs b/w participants and mechanisms for automatic allocation of resources to multiple competing requests.

(6)

(b) . Private cloud

→ It attempts to achieve customization and offer higher efficiency, resiliency, security & privacy.
→ A private cloud is built within the domains of an intranet owned by a single organization.
→ Private clouds give local users a flexible and agile private infrastructure to run service workloads, within their administrative domains.
→ A private cloud is supposed to deliver more efficient & convenient cloud services.
→ It may impact the cloud standardization, while retaining greater customization & organizational control.

Public cloud

→ Public cloud promote standardization, preserve capital investment and offer application flexibility.
→ A public cloud delivers a selected set of business process.
→ Amazon web services (AWS), Microsoft Azure, Google App Engine (GAE)
→ A public cloud is built over the Internet and can be accessed by any user who has paid for the service.
→ Public clouds are owned by service providers and are accessible through a subscription.

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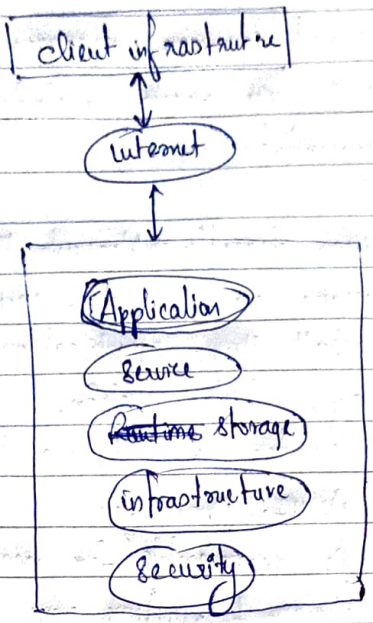
(a). Generic cloud Architecture and components.



Front End : It is used by the client. It contains the client-side interfaces and applications that are required to access the cloud computing platforms.
eg: chrome, Firefox, Brave

Back End : The back end is used by the service provider. It manages all the resources that are required to provide cloud computing service. It contains huge amount of data storage, security etc.
eg: Google App Engine (GAE), AWS.

Components of Generic cloud architecture

(1) Client Infrastructure

It is a front end component. It provides Graphical user interface to interact with the cloud.

(ii) Application : The application may be any s/w or platform that a client wants to access.

(iii) Service : A cloud services manages that which type of service you access according to the client's requirement.

(iv) → Saas → runs directly through the web browser means we do not require to download & install their applications.
eg: Slack, WebEx.
→ Paas = Provides a platform for s/w creation,
eg: Azure, Openshift.
→ Iaas = It is responsible for managing application data, middleware & runtime env.
eg: Aws, EC2, GAE..

(iv) Storage : One of the most imp. components of cloud computing. It provides a huge amount of storage capacity in the cloud to store and manage data.

(v) Security : It is an built in back end component of cloud computing.

(vi) Infrastructure : It provides services on the host level, application level & n/w level. cloud infrastructure includes h/w & s/w components such as servers, storage, n/w devices & other storage resources that are needed to support the cloud computing model.