1.2 Virtualization Defined Q. Define

Virtualization is not a vague concept – you probably are already engaged in virtualization in some fashion – but it helps to understand virtualization as a process. So, how can a virtualized environment help an organization?

Virtualization is an abstraction layer (hypervisor) that decouples the physical hardware from the operating system (OS) to deliver greater IT resource utilization and flexibility.

The virtualization platform provides the isolation of platform and allows multiple businesses to run multiple virtual machines on the same physical machine.

Virtualization represents the logical view of data representation – the power to compute in a virtualized environment, storing data at different geographies, and availing various computing resources. So, virtualization removes restrictions on computing such as difficult infrastructure deployments, collocated computing resources, physical movement, and packaging of resources.

This statement can be clarified by the following two points:

1. To virtualize systems, there is a need to separate the physical from the logical, and manage and utilize IT resources as a cohesive, holistic unit that is constantly adjusting, reallocating, and responding to changes in the business environment.
2. Virtualization is a liberating technology which implies to a having a better and more responsive access to the existing information. IT management can be further simplified by instituting a policy-based response that ultimately reduces the cost of operations.

7.3.1 Current Virtualization Initiatives Q. Explain

We will now discuss new initiatives that are being used in the industry and how they help in the infrastructure domain:

1. **Virtual CPU and memory:** Physical CPUs and RAM can be dedicated or dynamically allocated to virtual machines. As there is no OS dependency on the physical hardware, with the CPU checking off, virtual machines can be seamlessly migrated to different hosts, with background changes to the physical CPU and memory resources being transparent to the guest OSs running on virtual machines.
2. **Virtual networking:** This creates a virtual 'network in a box' solution that allows the hypervisor to manage virtual machine network traffic through the physical network interface controller (NIC) and allows each of the virtual machines to have a unique identity on the network from the physical host.
3. **Virtual disk:** Storage area network (SAN)–based storage is presented as storage targets to the physical host, which in turn are then used to host virtual machines' vdisks (virtual disks).
4. **Consolidated management:** The performance and health of virtual machines and guest OSs can be monitored and 'console' access to all of the servers can be obtained via single console.
5. **Virtual motion:** Active virtual machines can be seamlessly and transparently transferred across physical hosts with no downtime and no loss of service availability or performance. The virtual machine's execution state, active memory, network identity, and active network connections are preserved across the source and destination hosts so that the guest OS and running applications are unaware of the migration.
6. **Storage virtual motion:** Vdisks of active virtual machines can be seamlessly and transparently transferred across data stores, while the execution state, active memory, and active network connections remain on the same physical host.
7. **Dynamic load balancing:** Dynamically load balances virtual machines across the most optimal physical hosts to ensure that pre-defined performance levels are met. Virtual machines can be automatically and seamlessly transferred to a less busy host if a particular host in a resource pool is in a high-utilization state. Different resource pools can be defined for different business needs. For instance, production pools can be defined with more stringent service-level requirements, while development pools can be used with more relaxed service-level requirements.

8. **Logical partitions (LPARs):** LPARs result in hardware layer logical partitioning to create two or more isolated computing domains, each with its own CPU, memory address space and I/O interface, with each domain capable of housing a separate OS environment on single physical server. LPARs can share CPUs or have dedicated physical CPUs. Likewise, an LPAR can be a dedicated physical memory address space or memory addresses can be dynamically allocated among LPARS as needed.
9. **Logical domains (LDOMs):** Operating systems running in each logical domain can be independently managed, that is, stopped, started, and rebooted without impacting other LDOMs running on the host. A Type 1 'bare-metal' hypervisor isolates computing environments from physical resources. For example, domains across distinct threads can be separated using the multi-threading technology, because the hypervisor is dynamically managing and encapsulating the allocation of physical resources.
10. **Zones:** Zone is an OS-level virtualization solution rather than a hardware-level hypervisor solution. Each zone is an encapsulated virtual server environment running within a single OS instance. As such, zones share a common kernel, through a global zone, although 'non-native' zones can emulate an OS environment other than that of the host's native OS. Zones allow virtualization across a single physical server platform, but some applications may still be limited in their ability to run within zones if they require direct manipulation of the kernel or its memory space (since the kernel is shared across zones), or if the application requires privileges that cannot be granted within a non-global zone.

3.3 Virtu...

The following subsections describe the virtualization functionalities that can be used for datacenter applications and how virtualization improves the functionality of any datacenter environment.

Q. Explain

Availability of Machines

This feature makes machines in a virtualized datacenter as 'highly available'. This feature ensures that multiple datacenter activities are carried out even in the case of hardware failures. This feature should be configured and used for all virtual machines in a virtual environment, as during a hardware failure, running virtual machines are started on another host machine and the downtime is reduced to minimal. If a server fails, the affected virtual machines are re-started on other production servers that have spare capacity. In a datacenter, this feature would give high availability to virtual machines by starting them on other servers, thus minimizing the impact of failures.

It is very useful to use the bare-metal hypervisor as it is less expensive and provides an increased level of availability for critical applications. It helps to increase the target level of availability to all application servers in a simpler and economical fashion.

By implementing the high availability (HA) feature of any datacenter, it is possible to reduce both planned and unplanned downtime. HA, a feature of bare-metal hypervisors, specifically reduces unplanned downtime by leveraging multiple hypervisor servers configured as a cluster to provide rapid recovery from outages, as well as cost-effective HA feature for applications running on virtual machines.

The HA feature protects application availability against hardware failure by restarting the virtual machines on other hosts within the cluster. Protection against OS failure is obtained by continuously monitoring a virtual machine and resetting it when an OS failure is detected. Unlike other clustering solutions, the HA feature provides the infrastructure to protect all workloads within the cluster. There is no need to install additional software within the application or on the virtual machine. This feature protects all workloads that are in the infrastructure. Once the HA feature is implemented, there is no action required to save VMs as they are protected.

Compared with traditional failover solutions, following are the advantages when we configure the HA feature:

1. Minimal setup.
2. Reduced complexity (e.g., no need for quorum disks).
3. Reduced hardware cost and setup.
4. Application availability without the investment of idle physical servers and complex identical failover servers.

A datacenter can be supported with the load balance feature as it is virtualized with a bare-metal hypervisor. The action taken by the HA feature for virtual machines running on a host when the host has lost its ability to communicate with other hosts over the management network and

Fault Tolerance

Fault tolerance feature of a virtualized datacenter leverages the well-known encapsulation property of virtualization by building the HA feature directly into the bare-metal hypervisor to deliver hardware style fault tolerance to virtual machines. This feature is to be used for all virtual machines that require 100% uptime.

Dynamic Movement

Dynamic movement of virtual machines in a virtualized datacenter could give more options for load balancing and hardware maintenance. Usage of this feature does not have any impact on services offered by the virtual machine. This functionality is used by the distributed resource scheduling algorithm. Live migration of VMs is enabled by virtual dynamic motion from one physical host to another without impacting the business, with continuous availability, and tight integrity throughout the transaction. Storage dynamic movement enables to send VM files from one data store to another data store without service interruption. It is highly customizable to choose the target server that may be available at a single location with a single server, or multiple locations with multiple servers, with the required VM configuration and associated data store file disks.

This could be achieved using the distributed power management algorithm, which will help to reduce energy consumption in the datacenter by optimizing workload placement for low power consumption with distributed power management. The algorithm consolidates workloads when distributed resource clusters need fewer resources and switches off powers of host servers to conserve energy. When resource requirements increase, the algorithm brings hosts back online to ensure that service levels are met.

In any datacenter, this feature would be effectively used while provisioning machines on demand. A distributed power management algorithm would also use this feature to save energy during off-peak hours. Migration with dynamic movement allows moving a virtual machine to a new host without any interruption in the availability of the virtual machine. However, migration with dynamic movement cannot be used to move virtual machines from one datacenter to another.

Q. Dig and explain

7.4 Server Virtualization

Server virtualization covers different types of virtualization, such as client, storage, and network virtualization. In this section, different implementations of virtualization, management software, constituents of virtualization platforms support, and other related topics such as appliance and cloud computing are discussed.

Server virtualization works as a masking of the server compute that comprises the count and identity of resources with servers, storage, processors and OS from the end user. Administrators actually divide the physical server into multiple isolated VMs talking to same resource pools. Virtualization of servers provides an abstraction of the physical server/s by maintaining resource pools for server users (Fig. 7.1).

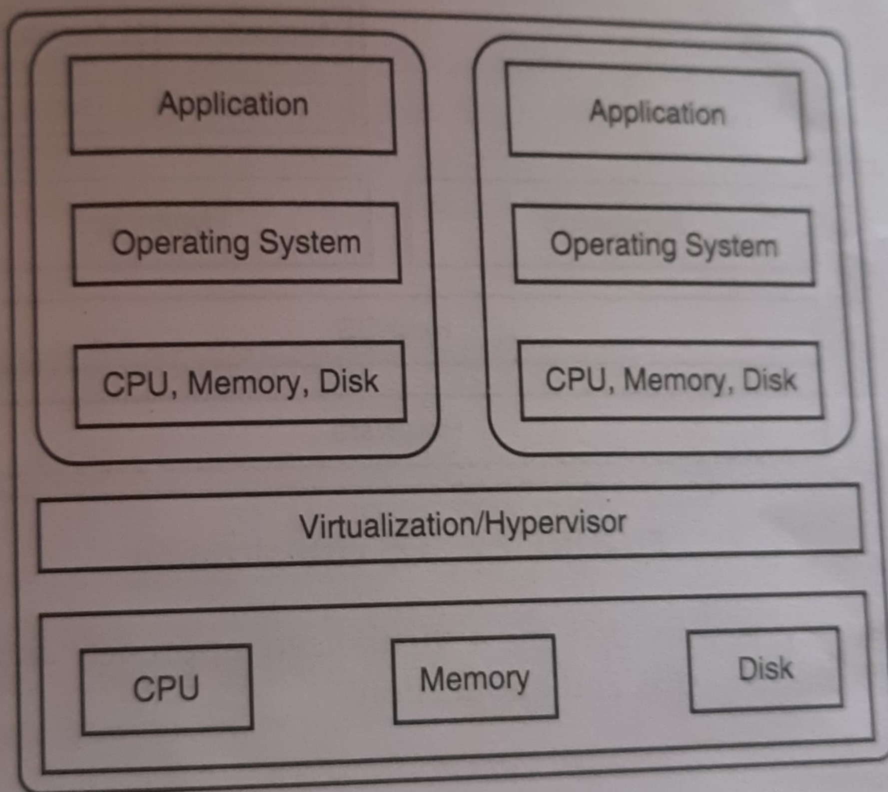

FIGURE 7.1 Server virtualization.

Hardware Virtualization

Hardware virtualization is also known as hypervisor-based virtualization, bare-metal hypervisor, type 1 virtualization, or simply hypervisor. This virtualization technology has a virtualization layer running immediately on the hardware which divides the server machine into several virtual machines or partitions, with a guest OS running in each of these machines (Fig. 7.2).

Q. Explain H/w & OS virtualization

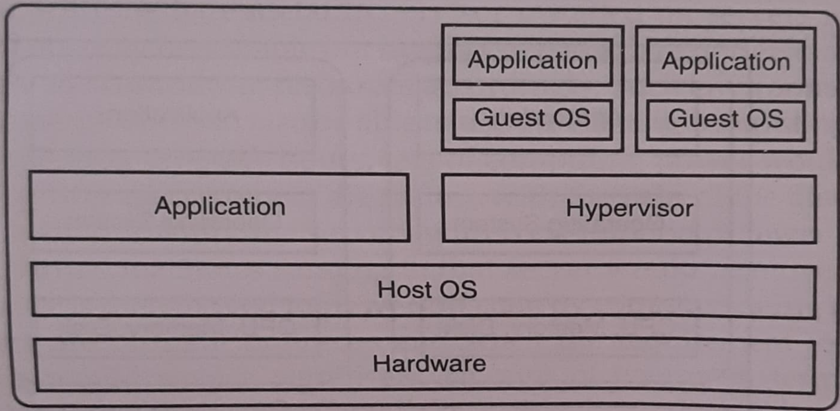

FIGURE 7.2 OS virtualization.

The binary transparency is provided by a virtualized approach and products enable the transparency for OSs, middleware, and applications.

OS Virtualization

This type of server virtualization is also known as OS-based virtualization, OS-level virtualization, or type 2 virtualization. OS virtualization creates virtualization environments within a single instance of an OS. Virtual environments created by OS virtualization are often called 'containers'.

Because all virtualization environments must share resources of a single OS while having a private virtual OS environment, a particular implementation of the technology may alter the file system orientation and often introduce access restrictions to global system configuration or settings.

partition that is allowed to up... the virtualization eng...
hypervisor is the nerve center of the virtualization
CPU and the memory pool.

Q. Explain

Imp

7.7 Virtual Infrastructure Requirements

Virtualization products have strict requirements of back-end infrastructure components, including storage, network, backup, systems management, security, and time synchronization. Ensuring that these existing components are of a supported configuration is critical to the success of the implementation. During this engagement, an IT architect reviews and documents the current environment and, where applicable, recommends changes required to optimize the infrastructure.

Where applicable, enterprise tools are used to gain a clear understanding of the environment, and the configuration and utilization of various systems. A virtualization sizing tool is then used to accurately calculate the size of a potential virtualization platform.

7.7.1 Server Virtualization Suitability Assessment

One of the key advantages of virtualization is the greater utilization of physical server resources. However, achieving this advantage must not be at the cost of service to the business. It is imperative to ensure that the virtualization host server is sized such that it can deliver acceptable levels of service to all guests.

To ensure that existing servers operate in a shared environment, detailed hardware inventory and performance utilization information must be obtained, extrapolated, and analyzed for suitability and host server sizing.

At the completion of the collection phase, the architect evaluates results and provides documented recommendations on virtualization suitability across server candidates.

7.7.2 Detailed Design

Virtualization introduces many changes in the environment and ensures that the platform co-exists and interacts with the existing infrastructure, which is the key to a successful implementation.

The purpose of the design is to set naming and security standards, define the disk and network structure, document any required system-tuning elements, and produce a virtual infrastructure design capable of meeting specific requirements for a virtualized Intel server environment.

Detailed Design Document

Virtualization design document should include the following:

1. Security and administration model.
2. Backup methodology.

3. Host physical and virtual disk layout, specifically around file system structure, and dedication of disks to guests where applicable.
4. Virtual network topology structure/format and interconnection with the physical network.
5. Virtualization service console configuration.
6. Virtualization kernel device share factor configuration.
7. Host server hardware specifications.
8. Configuration of VM server with required database.
9. Virtual machine distribution among hosts.
10. Processes and procedures for ongoing management.
11. Implementation tables and configuration settings.