

**Hardware Networking**

**Virtualization And Storage Management**

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**1. What is Virtualization and Virtualization Types?**

Virtualization is the process of creating a virtual version of computing resources, such as hardware, storage, networks, or applications, instead of relying on physical components. It enables multiple virtual environments to run on a single physical system, improving resource utilization and flexibility.

**Types of Virtualization:**

| **Type** | **Description** |
| --- | --- |
| **Hardware Virtualization** | Uses a hypervisor to create virtual machines (VMs) that run on a physical server. |
| **Operating System Virtualization** | Allows multiple isolated user-space environments (containers) to run on a single OS kernel. Examples: Docker, LXC. |
| **Network Virtualization** | Abstracts physical networking components to create virtual networks, improving flexibility and security. Examples: VLAN, SDN. |
| **Storage Virtualization** | Pools storage resources from different devices and presents them as a unified storage system. Examples: SAN, NAS. |
| **Application Virtualization** | Runs applications in an isolated environment, preventing conflicts. Examples: Citrix XenApp, VMware ThinApp. |
| **Desktop Virtualization** | Allows remote desktop access to virtualized OS instances. Examples: VDI (Virtual Desktop Infrastructure). |

**2. Types of Hypervisors and How to Manage Them**

A hypervisor is a software layer that enables virtualization by creating and managing virtual machines (VMs).

**Types of Hypervisors:**

| **Type** | **Description** | **Examples** |
| --- | --- | --- |
| **Type 1 (Bare Metal)** | Runs directly on physical hardware, providing better performance and security. | VMware ESXi, Microsoft Hyper-V, Xen, KVM |
| **Type 2 (Hosted)** | Runs as software on an existing OS, making it easier to install but less efficient than Type 1. | VMware Workstation, Oracle VirtualBox |

**Managing Hypervisors:**

* **Command-Line Tools**: virsh for KVM, xe for Xen, PowerCLI for VMware.
* **Graphical Interfaces**: VMware vCenter, Microsoft Hyper-V Manager.
* **Automation Tools**: Ansible, Terraform, vSphere Automation API.

**3. Roles of Virtualization in Cloud Computing**

Virtualization is a core component of cloud computing, enabling resource abstraction, scalability, and cost efficiency.

| **Role** | **Description** |
| --- | --- |
| **Resource Pooling** | Virtualization enables cloud providers to pool resources and allocate them dynamically to users. |
| **Scalability** | VMs and containers can be scaled up or down based on demand. |
| **Cost Efficiency** | Reduces hardware costs by consolidating workloads on fewer physical machines. |
| **High Availability** | Ensures minimal downtime through redundancy and live migration. |
| **Security** | Isolates workloads to prevent security breaches between tenants. |

**4. What is a Container?**

A **container** is a lightweight, portable, and isolated environment for running applications. It shares the host OS kernel but has its own filesystem, libraries, and dependencies.

**Containers vs. Virtual Machines (VMs)**

| **Feature** | **Containers** | **Virtual Machines** |
| --- | --- | --- |
| OS Overhead | Shares host OS kernel | Each VM runs a separate OS |
| Performance | Faster, lightweight | Slower, requires more resources |
| Isolation | Process-level isolation | Full OS-level isolation |
| Portability | High (can run anywhere) | Lower (dependent on hypervisor) |
| Examples | Docker, Kubernetes, LXC | VMware, Hyper-V, KVM |

**5. High Availability and Live Migration in Virtualization**

**High Availability (HA)**

High Availability ensures minimal downtime by using redundant systems and failover mechanisms.

* **HA Clusters**: A group of servers configured to provide continuous service in case of failure.
* **Load Balancing**: Distributes workloads to prevent any single point of failure.
* **Failover Mechanisms**: Automatically switches to a standby system if the primary one fails.

**Live Migration**

Live migration is the process of moving a running VM from one physical server to another without downtime.

* **Cold Migration**: VM is shut down before migration.
* **Warm Migration**: VM is paused, copied, and resumed.
* **Live Migration**: VM continues running while being moved. (Used in VMware vMotion, KVM, Hyper-V).

**6. Storage Configuration**

There are three main types of storage:

| **Storage Type** | **Description** | **Use Cases** |
| --- | --- | --- |
| **Block Storage** | Divides storage into fixed-size blocks and manages them separately. High-speed and low-latency. | Databases, Virtual Machines |
| **File Storage** | Stores data in a hierarchical directory structure. Uses protocols like NFS, SMB. | File sharing, Media Storage |
| **Object Storage** | Stores data as objects with metadata and unique identifiers. Scalable and distributed. | Cloud storage, Backups |

**DAS, NAS, and SAN**

| **Type** | **Description** | **Pros** | **Cons** |
| --- | --- | --- | --- |
| **DAS (Direct-Attached Storage)** | Storage directly attached to a server. | Low latency, Cost-effective | Not easily shareable |
| **NAS (Network-Attached Storage)** | Shared file storage accessed over a network. | Scalable, Easy access | Network dependency |
| **SAN (Storage Area Network)** | High-performance block storage network. | High-speed, Reliable | Expensive, Complex |

**7. Storage Allocation and Provisioning**

**Storage Allocation**

Storage allocation is the process of assigning storage resources to users, applications, or virtual machines.

| **Method** | **Description** |
| --- | --- |
| **Thick Provisioning** | Pre-allocates full storage space at creation. Ensures performance but wastes unused space. |
| **Thin Provisioning** | Allocates storage on demand, optimizing space usage but potentially causing performance issues if over-allocated. |
| **Dynamic Allocation** | Adjusts allocation based on real-time demand, balancing efficiency and performance. |

**Storage Provisioning**

Storage provisioning is the process of making storage available to users or applications.

| **Provisioning Type** | **Description** | **Use Case** |
| --- | --- | --- |
| **Manual Provisioning** | Admin manually assigns storage resources. | Small-scale deployments |
| **Automated Provisioning** | Uses policies and automation to allocate storage dynamically. | Cloud environments |
| **Software-Defined Storage (SDS)** | Decouples storage management from hardware using software. | Large-scale datacenters |