

Why is it necessary to deploy an Orchestration over a Hypervisor?

To answer this question we have to go through the definitions of some main concepts, such as:

-**virtual machine**, which is a software-based emulation of a physical computer, allowing multiple operating systems to run on the same hardware.

-**hypervisor**, which acts as a layer between the physical hardware and the virtual environment, managing resources and isolating VMs from each other.

In today's IT landscape, VMs and hypervisors play a central role in creating flexible, efficient, and scalable computing environments . In addition, as organizations grow, so does the complexity of managing these virtualized environments, leading to the need for **orchestration** a set of automated processes that manage, coordinate, and scale virtualized resources. Orchestration over a hypervisor is essential in maximizing the benefits of VMs, improving efficiency, and managing the dynamic demands of modern applications.

-Virtual Machines, Hypervisors, and their Limitations

A virtual machine encapsulates an entire operating system within a software environment, allowing users to run multiple OS instances on a single physical host. Hypervisors, either Type 1 (bare-metal) or Type 2 (hosted), make this possible by dividing and allocating physical resources such as CPU, memory, and storage to each VM, thus enabling resource sharing and isolation. This setup provides numerous benefits, including flexibility in running different applications, operating systems, and cost efficiency by reducing the need for physical servers.

However, as the number of VMs grows, so does the complexity of managing them. Each VM may require different resources, unique network configurations, and specific policies for deployment and scaling. Hypervisors alone lack the capability to handle such demands efficiently. While hypervisors manage individual VMs and allocate resources to them, they do not provide centralized management or the ability to handle complex deployment processes, inter-VM communications, or automated scaling. This is where orchestration becomes essential.

-Orchestration: The Key to Effective Virtualization Management

Orchestration refers to the automated configuration, coordination, and management of complex IT environments. In virtualized environments, orchestration takes over where the hypervisor leaves off, offering centralized control over resources, workflows, scaling, and fault management. Orchestration enables VMs to be deployed, monitored, and scaled automatically according to preset rules or real-time demand. This automation ensures that virtualized infrastructure remains agile, consistent, and responsive to changes.

Some of the most popular orchestration tools include Kubernetes, Docker Swarm, and Apache Mesos for containerized environments and Ansible, Puppet, and Chef for configuration management. Although originally developed with containerized applications in mind, orchestration tools are increasingly applied to virtual machine environments, creating a powerful combination when used alongside hypervisors.

-Why Deploy Orchestration Over a Hypervisor?

There are several reasons why orchestration is necessary for virtual machine environments, especially when managed through hypervisors:

1. **Automation and Efficiency:** As the number of VMs grows, manually deploying, configuring, and managing each one becomes time-consuming and error-prone. Orchestration automates these processes, streamlining the setup and deployment of VMs across multiple nodes. This automation not only saves time but also reduces the risk of misconfigurations that could compromise performance or security.
2. **Scalability and Flexibility:** Modern applications, particularly those based on microservices, often require dynamic scaling to accommodate fluctuating workloads. While a hypervisor can start and stop VMs, it doesn't inherently provide dynamic scaling based on demand. Orchestration tools can automatically scale VMs up or down, ensuring that resources are used efficiently. This capability allows organizations to meet high demands without over-provisioning, thereby optimizing costs.
3. **Resource Optimization and Allocation:** Orchestration helps optimize resources by managing the allocation of CPU, memory, and storage among VMs according to demand. For example, orchestration can redistribute resources to high-priority applications during peak times, ensuring that critical applications remain operational and efficient. Hypervisors alone lack this level of fine-grained resource management, but when paired with orchestration, resource allocation can be continuously adjusted based on real-time needs.
4. **Enhanced Fault Tolerance and Resilience:** In large virtualized environments, hardware or software failures are inevitable. Orchestration tools can detect failures and automatically redeploy or restart affected VMs on other hosts, minimizing downtime and maintaining system resilience. Hypervisors, while they isolate VMs, do not have built-in capabilities for failure recovery or redundancy. Orchestration provides this layer of reliability, which is essential for applications that require high availability.
5. **Simplified Network Management:** Virtual environments often involve complex network configurations to enable communication between VMs, load balancers, and storage resources. Orchestration simplifies network setup and management, handling connectivity and security configurations across multiple VMs. Hypervisors handle only basic networking, whereas orchestration can manage networking at a higher level, defining policies and routing traffic as needed.
6. **Consistency and Standardization:** Orchestration ensures that VMs are deployed in a standardized way, regardless of the environment or host machine. By using predefined templates and automation, orchestration removes inconsistencies that could arise from manual deployment. This consistency makes it easier to scale, monitor, and manage virtualized environments over time, ensuring reliable performance across different deployments.

-Conclusion

Deploying orchestration over a hypervisor in virtual machine environments is essential for managing modern, complex IT infrastructures effectively. While hypervisors provide the fundamental capability to create and manage VMs, they lack the advanced features needed to handle large-scale deployments, automated scaling, resource optimization, and fault tolerance. Orchestration adds this missing layer, transforming a hypervisor-based VM environment into a scalable, resilient, and efficient infrastructure.

By combining hypervisors and orchestration, organizations can achieve the best of both worlds—virtualization's flexibility and efficiency with orchestration's automation and manageability—paving the way for more robust, responsive, and cost-effective IT solutions.