SPOTLIGHT

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As containers and VMs continue to grow in popularity, both will coexist for the foreseeable future as enterprises juggle existing and new applications.

OpenStack and Its Role in Infrastructure Modernization and Containers

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Written by: Gary Chen, Research Director, Software-Defined Compute

Introduction

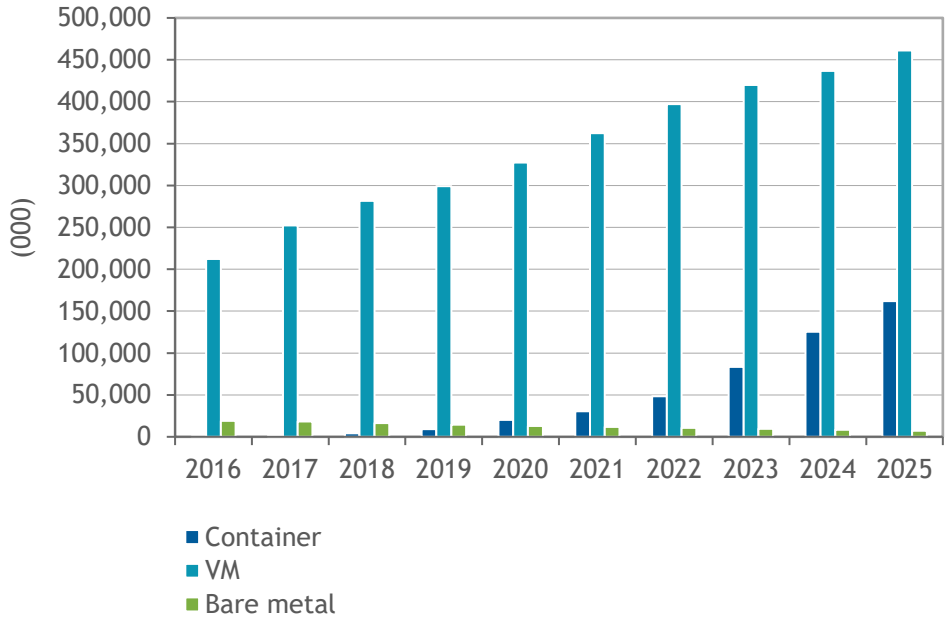
As containers increase in popularity, they are beginning to grow their footprint in the world of compute consumption. As shown in Figure 1, containers are the fastest-growing forecast compute type but are still fairly modest in overall percentage, due to the complexity, skill sets, and processes required. However, virtual machines (VMs) are still growing as well, and both will coexist for the foreseeable future as enterprises juggle existing and new applications. Industries are also beginning to leverage the cloud operating model everywhere, including their on-premises datacenters, which requires deployment of cloud infrastructure and cloud operational tools. These platforms can provide modern, agile features such as developer APIs, orchestration and automation, and self-service and will need to accommodate both traditional VMs and containers.

AT A GLANCE

WHAT'S IMPORTANT

IT technologies are moving to an increasingly mixed and hybrid world that encompasses on-premises datacenters, public cloud, edge, VMs, and containers. However, migrating applications to containers can be very complex and requires a change of skill sets, culture, and processes. As a result, enterprises will need technologies that can accommodate both their existing estates and their new modern assets as well as offer transitional solutions for modernization.

FIGURE 1: ***Worldwide Logical Server Installed Base by Deployment Model (Commercial Enterprise), 2016-2025***



Source: IDC, 2021

Benefits

The cloud era has transformed IT, and the cloud-native operating model is now used by industries for private on-premises environments as well. Private cloud currently is one of many deployment destinations in enterprises' multicloud and hybrid cloud strategy. As the leading open source cloud platform, OpenStack is a large project that encompasses multiple software components. It is used to deploy customizable and highly configurable IaaS clouds for either private use (for example, by an enterprise) or public use by a service provider. OpenStack provides:

- Programmable infrastructure via modern APIs for agile workflows for both infrastructure and ops professionals and developers
- Open interoperability with servers, hypervisors, containers, operating systems, storage, and networking
- The ability to provide self-service to a modern catalog of cloud services
- A modern orchestration and automation platform for infrastructure

A more recent development in cloud native is the rise of Kubernetes and containers. Containers are an efficient application-centric packaging format that runs inside an operating system sandbox. Kubernetes is the most popular orchestration platform for containers. Both Kubernetes and the container format specification (Open Container Initiative [OCI]) are open source. Containers have had a fast rise in adoption due to several benefits and attributes:

- Designed to efficiently encapsulate and orchestrate microservices-based applications with industry recognized standards (OCI container format and Kubernetes orchestration) that enables portability and reuse
- Easier, faster, and more reactive scaling
- Modern, declarative APIs for more agile DevOps workflows
- Support for cloud-native deployment patterns such as blue/green and A/B testing
- Easier shipping of software through CI/CD pipelines for faster software deployment velocity

With the rise of containers, is there any need for VMs? Indeed, VMs still serve many purposes. Monolithic, stateful applications can often be difficult to containerize and these may live out their (often long) lives in a VM. Even if all applications eventually ended up in containers, VMs are still needed to partition servers into smaller slices, particularly for the cloud and for security isolation between tenants.

The scope of Kubernetes focuses on application delivery and orchestration and does not handle many of the infrastructure tasks underneath. Kubernetes expects the user to supply it with a robust physical or virtual cloud infrastructure underneath, such as OpenStack. While OpenStack was initially developed for VMs prior to the emergence of containers, it has evolved to integrate with Kubernetes and containers in multiple ways. Containers are now supported in OpenStack as a native compute object, alongside VMs and bare metal. OpenStack also has services that enable the management and provisioning of Kubernetes as a cloud service.

Trends

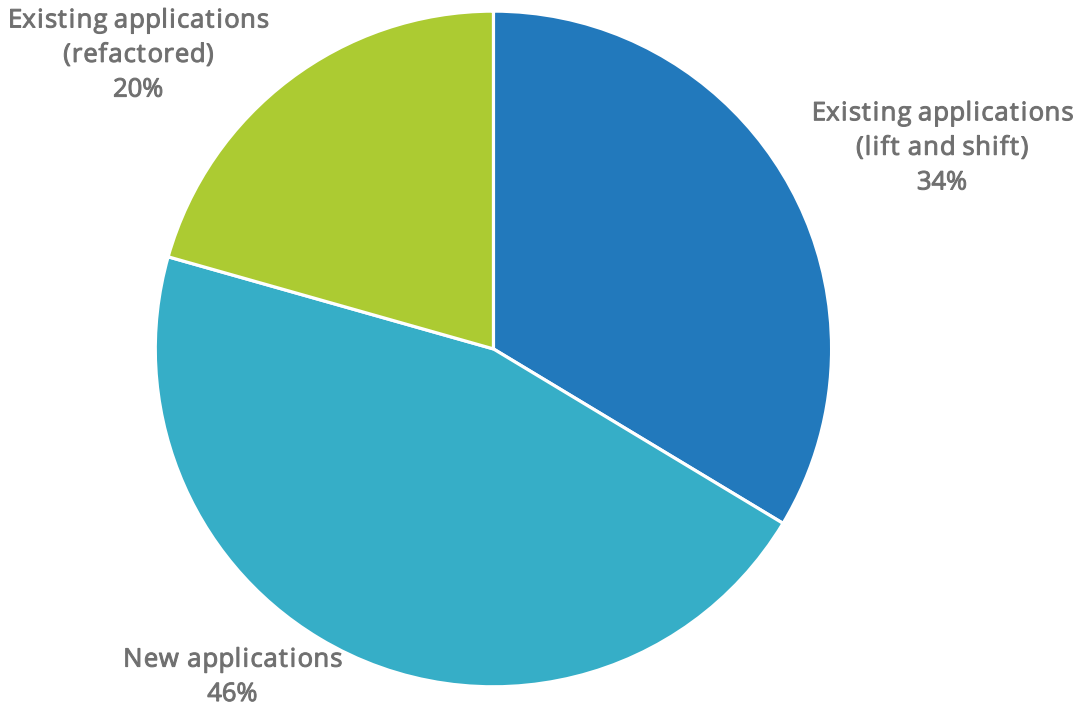
Enterprises want to leverage the cloud model not just in public cloud but also in on-premises dedicated environments and the edge and are transitioning to a hybrid and multicloud cloud operating model. The cloud operating model requires a number of new technologies as well as organizational and process changes. From a technology perspective, organizations will need a modern stack consisting of:

- A software-defined infrastructure that encompasses compute, storage, and networking
- A programmable infrastructure interface with orchestration capabilities
- A cloud-native application orchestration and deployment platform such as Kubernetes
- Cloud-native operational tools for service assurance that can handle the rate of change and the volume of data generated by complex, distributed cloud-native applications

IT will have a hybrid mix of traditional (VMs) and modern applications (containers) for the foreseeable future. Some VMs can be refactored into fully or partially cloud-native designs. Other VMs can be lifted and shifted into containers with little change. IDC's data on containers shows that even within the modern container space, it is not all new greenfield cloud-native applications (see Figure 2).

FIGURE 2: ***Existing Versus New Applications in Containers***

Q ***What percentage of your containerized applications are existing applications migrated to a container (from a VM or bare metal) versus a new application that started in a container from day 1?***



n = 1,030

Source: IDC's Container Infrastructure Software Survey, December 2021

Many applications deployed in VMs may be exceedingly difficult to containerize, and the effort and time to do so may not be worth it. Enterprise applications can live a very long time, so there will be a mix of VMs and containers for at least the foreseeable future. For example, telecommunications has long invested in virtualized network functions and cannot throw those out overnight and migrate to containerized functions. It is also common today to find different parts of the same application in VMs and containers. For instance, the database tier of an application might be running in a VM, while the front end is in containers. Integrated management of both estates will be critical to support such apps and prevent siloing, which can create barriers within clouds. OpenStack is an example of a platform that can help with crossing between VMs and containers. OpenStack can provide VMs in the context of IaaS services, while also providing the IaaS foundation to host Kubernetes and containers as a service. Some of the top use cases for OpenStack include:

- **Telco network virtualization:** Telcos are currently focused primarily on virtual network functions (VNFs) that are deployed on VMs but are starting to adopt cloud-native network functions (CNFs) that are deployed in containers. CNFs are particularly attractive for radio access networks (RAN) and core network function virtualization due to their efficient size and runtime. Telco applications often have a very long life cycle, which means most telcos will have a mix of VNFs and CNFs for a long time.

- **Service providers who need to offer various cloud services such as IaaS or SaaS:** For IaaS, many use OpenStack to build the core foundational elements that every cloud needs (compute, storage, networking). OpenStack is built for scale and for multitenancy. Increasingly, containers as a service is becoming a requirement for customers, so service providers are also using OpenStack to host containers and to offer Kubernetes orchestration as a service. Other types of service providers are pursuing SaaS offerings and need a robust and highly customizable cloud to host their software for customers.
- **Providing access to custom hardware that is not readily available in public clouds:** These could include very specific GPU types and other specialized accelerators that are critical for workloads such as RAN, AI/ML and high-performance computing (HPC). These customers need a customizable cloud platform that allows them to integrate these components, while still providing access to them in a cloud model.

The integration between OpenStack and Kubernetes provides a bridge between generations of technology. The fact that both are also open source platforms can help address issues around lock-in, portability, and hybrid cloud deployments.

Red Hat Profile

Red Hat is an open source software and services company that has deep commitments across the open source landscape including OpenStack and Kubernetes.

Red Hat OpenStack Platform is a cloud computing platform that brings together open, community-powered innovation with enterprise scale and confidence. The OpenStack platform is made up of many subprojects upstream that Red Hat carefully curates to create the Red Hat OpenStack Platform. While the OpenStack project releases twice a year, this cadence is not often practical for many industries. Red Hat OpenStack Platform features long life-cycle releases with five years of support. Fast-forward upgrades allow customers to upgrade from one long life version to another without having to upgrade to the incremental in-between versions. Red Hat also backports upstream features to allow users to get the latest functionality and fixes without having to upgrade.

Red Hat OpenShift is the industry's leading hybrid cloud application platform powered by Kubernetes. It includes many developer and platform components to create a complete system for building and deploying cloud-native applications. Red Hat OpenStack Platform and OpenShift are co-engineered and developed together for reliable interoperability. The OpenStack control plane is being transitioned to run on OpenShift to allow customers to rapidly scale using fewer resources and to run VMs and containers side by side. This will allow more resilient, easier upgrades of OpenStack by leveraging OpenShift's Kubernetes orchestration features.

In addition, Red Hat OpenStack Platform provides a robust cloud infrastructure upon which to host OpenShift as a service. OpenStack has several projects to integrate containers into the platform such as supporting containers as a native compute object alongside VMs as well as the ability to provide Kubernetes orchestration as a service.

Challenges

Kubernetes has rapidly become the standard for modern applications, and it can run on a wide variety of infrastructures. Kubernetes runs best on a robust, agile, cloud infrastructure such as OpenStack, but increasingly, enterprises also have other options including public cloud, managed local cloud, incumbent virtualization platforms, and portable overlay cloud platforms. OpenStack will have to compete to prove its value and differentiation against other competing infrastructure.

OpenStack is very powerful and highly customizable but therefore very complex, which may limit the accessibility of who can deploy it. While commercial distributions or managed services can help hide some of this complexity, enterprises will need to evaluate their needs for control/customization versus their operational skills.

Conclusion

OpenStack is a powerful open source cloud platform that gives enterprises full control and customization over their cloud infrastructure. It also recognizes that containers are the future of compute and has added robust support for containers and container orchestrators such as Kubernetes, alongside the original VM support. VMs and containers will be running side by side for the foreseeable future, and there are key considerations for enterprises to think about as they decide whether to deploy a workload in a VM or container:

OpenStack is a powerful open source cloud platform that gives enterprises full control and customization over their cloud infrastructure.

- How practical is it to refactor the application? While some benefit can be achieved from a simple lift and shift to a container, greater benefits will come from refactoring. This will be highly dependent on the application architecture and the age and support for the component technologies used to build the application. Another key factor is the knowledge level of the code within the organization. Are any of the original developers still available and if not, are there developers with in-depth knowledge of the code base? This will be key to how comfortable an organization is with making code changes, especially with older applications. For some applications, the cost and time involved may not be worth it, and containerization could instead wait for the next rebuild or instantiation. For other applications, they may be critical to the business and increased speed is an immediate necessity that can justify extended efforts to modernize them.
- How modern is the development workflow and how amenable is that process to change? Container platforms are usually tied to agile CI/CD pipelines that are highly automated with testing, phased rollout, and rollback functionalities. This agile approach is critical to achieving faster deployment rates than monolithic and waterfall-based systems.

As IT technologies move to an increasingly mixed and hybrid world that encompasses on-premises datacenters, public cloud, edge, VMs, and containers, enterprises will need technologies that can both accommodate the existing estate and the new modern assets and offer transitional solutions for modernization.

About the Analyst

Gary Chen, *Research Director, Software-Defined Compute*

Gary Chen is IDC's Research Director for Software-Defined Compute. His research focuses on server virtualization, container infrastructure and management, and cloud system software.

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IDC Research, Inc.
140 Kendrick Street
Building B
Needham, MA 02494, USA
T 508.872.8200
F 508.935.4015
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idc-insights-community.com
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