White Paper

The Convergence of Containers and VMs in Modern IT Infrastructure: Simplification with a Single Platform

Sponsored by: Broadcom

Gary Chen
November 2025

IDC OPINION

Containers and VMs have much less overlap than most people think and will remain key technologies going forward. What IDC now observes in the market is a much clearer separation of duties between VMs and containers in the software stack. VMs are still needed to manage and partition servers, while containers are optimized to package and distribute application components. IDC believes that the large majority of containers will continue to run in VMs for reasons of security and scalability. In fact, IDC forecasts that 85% of containers will run in VMs in 2028. Meanwhile, there is a huge installed base of traditional applications in VMs that will be around for a very long time.

A recent trend in IT has been the convergence of VM and container management with a single-platform approach to simplify operations, increase efficiency, and solve integration problems when applications and workflows cross both areas. This paper explores the benefits, trends, and challenges associated with deploying and managing both VMs and containers. It also provides insights into how converging these technologies can help companies modernize their IT operations and discusses the challenges with unifying both environments.

SITUATION OVERVIEW

The Rise of Containers

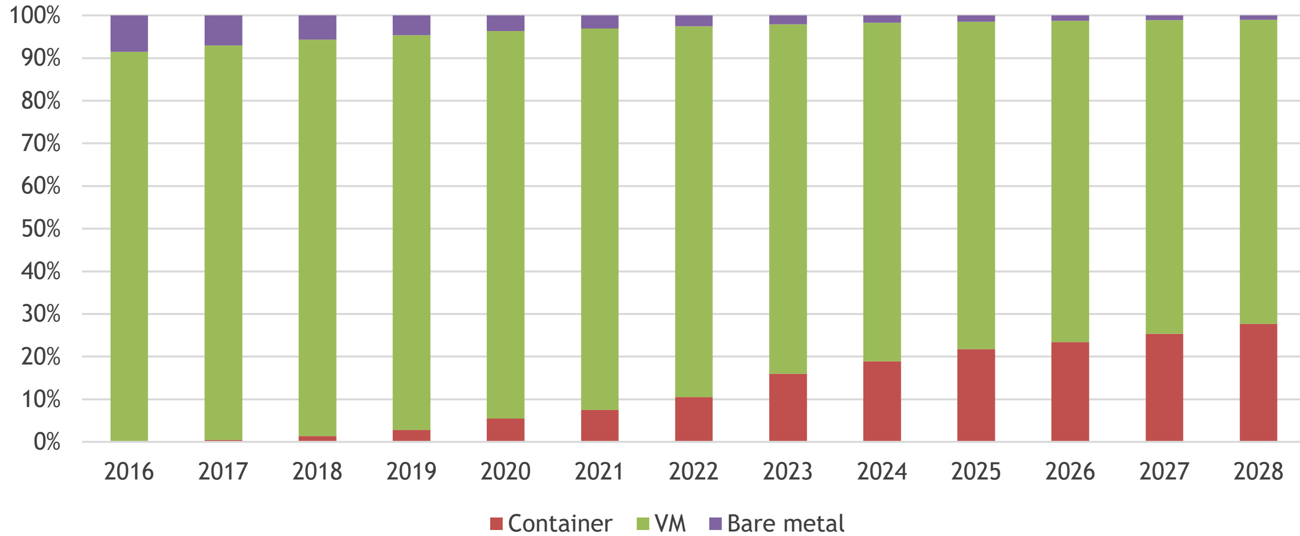
The era of software-defined compute started with VMs and has grown to include containers. VMs have been the cornerstone of enterprise IT for decades, a mature yet still crucial technology that provides strong isolation and resource management capabilities. As IT moved into the cloud era, hypervisors provided the underpinnings of public and private clouds.

In 2013, a more application-centric abstraction exploded onto the scene with Docker containers. A couple of years later the Kubernetes orchestrator debuted and eventually became the industrywide container platform for modern applications, driving the next generation of compute infrastructure. The standardization and open source nature of the container format (through the Open Container Initiative) and the Kubernetes orchestrator provided organizations and vendors with a singular platform to invest in, and thus Kubernetes has become the default platform for modern applications. A common platform also enabled a level of uniformity in multilocation and global deployment strategies, which has recently expanded into edge computing due to the efficiencies of containers and the strength of Kubernetes in managing distributed deployments. Kubernetes also accelerated and enabled many changes that were happening around development and infrastructure methodologies such as microservices architectures, agile development, DevOps, and platform engineering. Today, as we enter the AI era, Kubernetes is again playing a key role, leveraging its scalability and flexibility to become the primary host for many AI and ML workloads.

Figure 1 shows a deployment-based view of the various compute types (bare metal, VMs, and containers), which is indicative of the installed base's compute footprint. Containers continue to grow, but VMs will still account for the majority for quite some time. Whatever the long-term mix ends up being, it is certain that enterprises will have to manage both types for the foreseeable future. It is also very common to see mixed-mode applications where components are deployed in both VMs and containers (for example, the database in a VM and the front end in containers).

FIGURE 1

Worldwide Logical Server Installed Base by Deployment Model (Enterprise, Excluding DSP), 2016–2028



Note: For more details, see *Market Analysis Perspective: Worldwide Software-Defined Compute, 2024* (IDC #US52787524, December 2024).

Source: IDC, 2024

It is important to keep in mind that the various deployment types are not always mutually exclusive. For example, when virtualization came into the market, physical servers did not go away. Instead, most operating systems and applications over time were installed into a VM instead of bare metal. Likewise, containers do not eliminate the need for VMs. While the container host operating system can be run on bare metal, the large majority are run in VMs for security and manageability reasons. VMs and containers are fundamentally different technologies but can work synergistically together. VMs operate at the hardware level, partitioning physical servers. Containers operate at the OS level, essentially providing a sandbox for applications.

As VM technology evolved, it was co-opted to be more than just a server partitioning and consolidation tool. Users began to take a "one app to one OS instance in one VM" approach, effectively turning VMs into a way to package and distribute applications. Containers, which were built from the ground up to be more application centric, offered a more modern approach to application packaging and distribution. While containers are gradually taking over this type of functionality, there are many core VM functions that containers do not replace. A modern container system expects users to provide it with a robust and cloudlike infrastructure layer underneath, and VMs are the standard way cloud IaaS is built today. Containers do not remove the need for VMs but instead redefine their role within the stack. One proof point for this fact is that nearly all public clouds continue to run their containers in VMs for reasons of multitenant isolation, scalability, and utilization maximization. This architectural choice reinforces that VMs remain essential for secure and efficient container operations at scale.

Containers and VMs: Coexistence and Convergence

Enterprises will need to manage VM technology for the foreseeable future, for a variety of reasons:

- There are many existing applications in VMs that have years or even decades of investment into them and do not have a business case to rebuild or refactor them. These applications are very mature, stable, and often have low rates of change.
- Most containers today run on a VM layer to benefit from the greater security and operational efficiencies that a virtualized environment delivers over bare metal, and there will continue to be many valid reasons to do so in the future. Users will still need to maintain a VM infrastructure even in a highly containerized world.
- Not all parts of an application are easily containerized. For instance, many users prefer to have centralized databases versus an instance for every application. In addition, databases are stateful and often more monolithic, which fits in better with VM architectures.
- While containers are ideal for large-scale microservices applications, not all apps fit this model. Monolithic and stateful workloads can often be faster to develop and easier to manage for small-scale or early stage applications. In addition, not all parts of enterprises are enabled for containers yet. Thus the VM install base is still growing, albeit not as fast as containers.

The mix of VMs and containers is constantly evolving. What is clear is that both technologies will be relevant for the future and operating them in silos creates huge inefficiencies in infrastructure and human resources. The integration of VMs and containers is crucial for multilocation and global deployment strategies to enable consistent management of both traditional and cloud-native applications. It is perhaps oversimplistic to categorize VMs as strictly for traditional applications and containers for modern ones. There are certainly containers running legacy code and VMs running modern code, and there are many applications that have been refactored to some state between legacy and fully modern. Unifying VMs and containers in a common platform can simplify operations and reduce complexity in the following ways by:

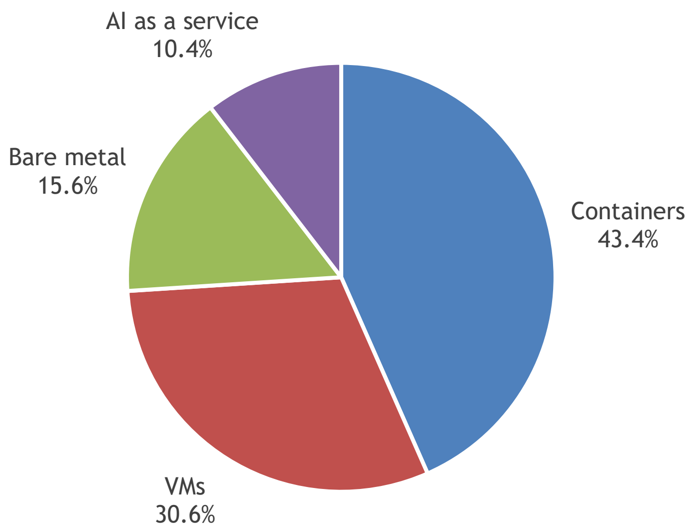
- Leveraging as many common resources as possible, such as storage and networking

- Implementing common security frameworks, tools, and processes to enable a consistent security posture across all applications
- Extending consistent high availability, resiliency, and disaster recovery policies across all infrastructure to ensure that both VM-based and container-based workloads benefit from robust operational capabilities
- Allowing for unified management of mixed-mode applications (The number of mixed-mode applications that have both VM and container components is expected to increase, making unified management even more essential for seamless deployment and operations. A major factor for this increase is the AI revolution. While much of the new AI buildout is done modern style in containers, AI functionality is being grafted onto many existing applications, many of which run in VMs. Thus VM-based applications will often be extended with containers, requiring the need for consistent deployment and visibility across both systems.
- Providing unified self-service access to all infrastructure resources, VMs, and containers (This allows users to independently leverage the appropriate compute type while maintaining governance and control, enhancing operational efficiency. The trend toward platform engineering and creating internal developer platforms [IDPs] also pushes the market in the direction of unified and centralized platforms that can serve the majority of enterprise application and development needs.)
- Enabling the ability to implement a unified and modern cloud interface to the platform, which can provide a user-friendly and API-driven platform for provisioning, automating, and managing all resources, VMs, and containers (This is especially critical for modern platform engineering and platform ops approaches.)

Figure 2 illustrates the multi-deployment needs of current AI applications, showing that AI will be deployed across bare metal, VMs, and containers and as outsourced as-a-service models.

FIGURE 2

Breakdown of Deployment Models for AI Applications



n = 996

Source: IDC's *Container Infrastructure Software Survey*, December 2023

VMWARE TECHNOLOGY PROFILE

VMware solutions have led the software-defined compute market for decades. The offerings have evolved over time to include software-defined datacenters, private cloud, and container solutions. Broadcom acquired the company in late 2023, which brought a new level of investment and the integration of a modern private cloud platform (VMware Cloud Foundation), encompassing both VMs and containers.

VMware Cloud Foundation (VCF) is a comprehensive platform that integrates multiple VMware technologies (VMs, containers, compute, storage, networking, and management) into a unified private cloud platform. VCF includes VMware vSphere Kubernetes Service (VKS), which runs and manages containerized workloads alongside VMs. VMware VKS provides CNCF-certified Kubernetes versions so that the platform remains current with the latest features and security updates. VKS can also be updated independently of vSphere and allows the latest three Kubernetes versions to be run simultaneously. Besides the core Kubernetes integration, VCF includes several other key container components:

- **VKS cluster management** (previously known as VMware Tanzu Mission Control), a global multicluster management system that enables enterprises to manage all their Kubernetes clusters regardless of where they reside. In addition, VKS cluster management facilitates delivery of infrastructure for multiple user audiences. Platform engineers and application teams can access the resources they need when they need them, and cloud admins can apply consistent policy against a single cluster or fleets of clusters.

- **Istio Service Mesh,** an enterprise-class service mesh solution that provides reliable control and security across multicluster and multicloud environments with zero-trust networking, policy-driven traffic control, and observability. Istio Service Mesh can run on multiple application platforms, public clouds, and runtime environments, including Kubernetes clusters.
- **Ubuntu** Linux operating system integration via a partnership with Canonical that delivers a unified stack with enterprise support that includes Ubuntu Linux and VCF Kubernetes-based containers. Chiseled Ubuntu containers, integrated with VKS, are ultrasmall container images that reduce the attack surface and improve performance. GPU-optimized images that include precompiled vGPU drivers will also be available to enable rapid AI deployments in air-gapped environments.

VCF also includes many other native cloud services, such as the Contour ingress controller, Prometheus monitoring, Harbor container registry, ArgoCD, and Velero for backups.

With VKS, VCF offers a single platform for all workloads (traditional and modern), VMs, and containers. Integrating Kubernetes into VCF and deploying Kubernetes with vSphere has many benefits:

- It offers platform engineers self-service access to VMs and containers while cloud admins can maintain governance and control.
- VKS deploys and manages Kubernetes clusters at scale with a built-in CNCF-certified Kubernetes and supports N-2 Kubernetes versions to provide maximum flexibility when planning upgrades.
- By automating cluster provisioning, upgrades, and life-cycle management at scale, VCF removes operational complexity and reduces costs.
- VKS inherits and shares robust infrastructure capabilities from vSphere and VCF, such as security capabilities and high availability.
- The security of vSphere, such as FIPS mode, end-to-end data encryption, and live patching, is extended to the Kubernetes environment. In addition, leveraging the security isolation of vSphere VMs and the vSphere Supervisor provides multilayered isolation of Kubernetes workloads (six layers of isolation).
- VCF provides consistency of operations by using a unified API and common tools. Users can interact with compute resources in a consistent manner, eliminate the need for separate tooling, and lower training costs.

- VCF reduces TCO by eliminating silos, leveraging existing tools and skill sets without retraining and process changes, and unifying life-cycle management across all infrastructure.

The integration of core Kubernetes functionality into VCF and the expansion of container platform functionality with VKS create a unified platform that reflects VMware's strategy of offering comprehensive, integrated solutions for modern platform engineering and operations.

CHALLENGES/OPPORTUNITIES

Creating a single VM and container platform is challenging from a technical point of view. Vendors, including Broadcom and others, will have to meet consistently high bars on both the VM and container sides for customers seeking best of breed. A unified platform also requires deeper commitments from customers, which will emphasize the customer's faith in the vendor's execution, relationships, and long-term viability.

However, it is worth noting that Broadcom's VMware technology is dominant in enterprise datacenter virtualization and there is ample opportunity for it to capitalize on this installed base to extend into the container market.

CONCLUSION

The coexistence and convergence of VMs and containers in modern IT infrastructure are evolving into complementary roles. VMs, a mature technology, provide robust isolation and resource management; containers, driven by Kubernetes, offer agility and scalability for modern applications with a modern API. Despite the rise of containers for modern applications, VMs remain essential as the infrastructure foundation underpinning containers for security and manageability, as seen in all the major public clouds. The convergence of VMs and containers into a single platform will be critical for more simplified and unified management, enabling seamless operations across traditional and cloud-native workloads.

ABOUT IDC

International Data Corporation (IDC) is the premier global provider of market intelligence, advisory services, and events for the information technology, telecommunications, and consumer technology markets. With more than 1,300 analysts worldwide, IDC offers global, regional, and local expertise on technology, IT benchmarking and sourcing, and industry opportunities and trends in over 110 countries. IDC's analysis and insight helps IT professionals, business executives, and the investment community to make fact-based technology decisions and to achieve their key business objectives. Founded in 1964, IDC is a wholly owned subsidiary of International Data Group (IDG, Inc.).

Global Headquarters

140 Kendrick Street
Building B
Needham, MA 02494
USA
508.872.8200
Twitter: @IDC
blogs.idc.com
www.idc.com