

Hybrid Cloud: The New Architecture for Today's Business

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The IT Paradigm Shift

Modern business is inextricably linked to the technology that powers it. While business transformation and digital transformation are terms frequently used in the technology sector, rarely do we understand where this intersection lies. For nearly all organizations, digital transformation is driven by the applications that drive the business. These are the means by which all organizations generate revenue, engage customers, expand into new markets, and make employees not just more efficient, but more effective at serving their markets. And increasingly it is this portfolio of applications that is shaping the way an organization operates, defines itself, and redefines its market.

But today, businesses have more options than ever in how they build, run, and manage their applications. There has been massive innovation in cloud computing. New models for data center infrastructure and operations; diverse tools and frameworks that boost the productivity and performance of developers; and the continuous growth of intelligent automation, all serve to give IT unprecedented power to drive the business forward.

Increasingly IT organizations are turning to the hybrid cloud to deliver the optimal environment for all of their applications. The hybrid cloud model holds the promise to deliver optimal performance for each application, with access to the broadest set of innovative services, the greatest flexibility for how applications are supported, at the best price. Even more, the hybrid cloud enables each organization to build upon years of investments to leverage the systems, teams, tools, skills, and policies already proven to deliver for their business.

In short, the hybrid cloud is giving every organization the power to drive their businesses today, and the freedom to access incredible innovation for the future.

Application Needs Driving New IT Initiatives

Supporting business applications will always be the core priority for any IT organization. Every business must manage a complex set of existing and new applications, each with specific requirements for performance, reliability, security, and capabilities. And each application holds a unique value for the business, whether running a core operation or building differentiation in the market. Every IT organization today is evaluating the future model to best support existing applications, and to enable developers to more rapidly deliver more powerful applications that set them apart in the market.

As a result, businesses are investing in a combination of initiatives to give each of these applications what they need for success, aligned to their business value:

- **Data center modernization through integrated solutions** – Nearly every organization realizes that there are still massive opportunities in the data center to improve capacity, efficiency, and operations. While much of the world is heavily virtualized, organizations are still extending proven virtualization concepts to storage and networking to create a complete software-defined data center. Evolving this core infrastructure to a software model unlocks significant gains in efficiency for how on-premises systems are managed and operated. And new advances in hyperconverged infrastructure take this even further by delivering complete infrastructure stacks, pre-integrated, pre-configured, and more efficiently managed. In addition, a modernized data center more efficiently supports a complete cloud strategy, enabling IT to operate in a hybrid model.

- **Extend to hybrid cloud** – For years, the cloud environment and the data center environment have remained distinct resources, separated by architectural and operational boundaries. Businesses that have wanted to extend to the cloud have endured complex, time-consuming, and costly efforts to refactor applications for their new cloud provider. Many of these efforts have struggled with extended delays and cancellations as organizations realized the true cost and risk of moving business-critical apps to a new environment. Today's hybrid solutions promise to reshape this model for IT, delivering consistent infrastructure and operations from the data center to the cloud to the edge. By extending the proven environment already standardized in global enterprises, these organizations have the ability to freely extend their data centers to the cloud, migrating applications at ease, and leveraging the public cloud for supporting disaster recovery needs, seasonal scale-out requirements, and geo expansion. This model furthers the investment in skills, tools, processes, and teams, bringing new value to these resources.
- **Increase automation to drive IT efficiency** – As the complexity of applications continues to rise and the expectations of the IT organization only grow, there comes an even greater dependency on automation and intelligent systems to maintain optimal performance for the business. Despite significant gains in productivity due to IT automation and operations, nearly every IT organization continues to struggle to dedicate resources to innovation. The need for intelligent automation only grows as IT expands to the cloud, introduces cloud native applications, and looks to support increasingly complex services for the business. Hybrid operations enable businesses to extend proven models, tools, and policies across the data center, cloud, and edge, consistently. This means there is only one model for applications, no matter where they are run. Application performance can be monitored in a single view. Policies for security, business continuity, and disaster recovery can be applied uniformly. And IT organizations can transform the way they operate, establishing a model for hybrid operations to shape their future.
- **Embed security intrinsically in infrastructure** – As applications seamlessly scale between the data center and cloud to provide hybrid solutions, securing them is getting more complicated as this dramatically expands the attack surface that must be protected. IT organizations try to secure these applications by bolting on multiple point security products that solve a niche problem. Seventy-four percent of C-level executives don't think they've invested enough to mitigate the risk of insider threats¹ and 35 percent of cybersecurity professionals say they are struggling to set consistent security policies across cloud and on-premises environments.² Embedding security intrinsically in the infrastructure enables IT organizations to apply security policies around the application boundary, and not infrastructure boundaries. This ensures that security policies scale with the application as it extends from the data center to the cloud or to the edge.
- **Deliver modern apps** – For nearly every organization, the application landscape is rapidly evolving. Organizations anticipate a massive growth in the volume of applications. From 2018 to 2023—with new tools and platforms, more developers, agile methods, and lots of code reuse—500 million new logical apps will be created, equal to the number built over the past 40 years.³ In addition, every organization is seeing unprecedented growth in the diversity and complexity of applications. New frameworks like Kubernetes will be joining virtual machines as mainstream application models, while artificial intelligence, machine learning, and data requirements put massive demands on developers, IT operations, and IT systems. Every business must determine how to best harness the incredible innovation being introduced to the market, and to turn this innovation into advantages for their businesses without introducing complexity or risk for IT or the business.

1 BetterCloud Monitor. "State of Insider Threats in the Digital Workplace 2019." Christina Wang, March 20, 2019.

2 Crowd Research Partners. "2018 Cloud Security Report." 2018.

3 IDC. "IDC FutureScape – Doc # US44403818." October 2018.

Hybrid Cloud: The New Model for IT

Hybrid cloud is the new and optimal model that can help IT rapidly deliver on these core initiatives. Hybrid cloud is defined as the combination of data center, cloud, and edge environments unified with consistent infrastructure and consistent operations. This model builds on existing, proven systems for supporting the most demanding and essential applications in the world, and enables organizations to tap into the most powerful innovations in IT today. It's no surprise that hybrid architecture continues to be identified as the optimal and preferred environment for the vast majority of today's IT organizations.

The hybrid cloud enables organizations to:

- **Optimize infrastructure for all applications** – Because a hybrid cloud is based on consistent infrastructure deployed across the data center, cloud, and edge, organizations have the freedom to match the needs of every application to the best infrastructure environment as part of a single pool of resources. IT teams can migrate applications seamlessly without the cost of refactoring applications for a new environment. And applications can take advantage of a new, modern infrastructure across these environments.
- **Operate efficiently across data center, cloud, and edge** – The hybrid cloud is also driven by consistent operations across the entire environment. Organizations can deploy a single model for securing, governing, and operating the entire hybrid cloud, benefitting from the significant efficiencies of extending a single, proven model everywhere. This also allows organizations to extend existing investments in teams, processes, policies, and skills to the cloud.
- **Modernize existing infrastructure investments** – Organizations that choose to upgrade to a hyperconverged infrastructure as part of a hybrid cloud strategy will see significant benefits as a result of improved operations and reduced dependence on storage and network specialists. This shift unlocks greater agility and productivity, and eliminates the operational bottlenecks of legacy infrastructure.
- **Migrate seamlessly to the cloud** – Nearly every organization has a target or goal for a percentage of applications running in the cloud. But traditional approaches to app migration required significant refactoring of production applications to run in a new cloud environment. The cost and complexity of refactoring apps typically proves too significant for most organizations. Even more, the risk of rewriting a production application for an unproven environment often delays or halts migration efforts. Because hybrid cloud is based on consistent infrastructure and consistent operations, organizations can freely migrate to the cloud without the cost, complexity, or risk.
- **Rapidly deliver modern apps** – The hybrid cloud is designed to be the optimal environment for all applications, from virtual machines and containers, to packaged apps and new frameworks like Kubernetes. Because of the consistency of the hybrid cloud, organizations can deploy common policies and models for deploying and operating applications regardless of where they run. In addition, applications that are migrated to the cloud benefit from access to cloud services that can be used for app modernization strategies.

Solutions for a Broad Range of IT Initiatives

The following table summarizes the IT initiatives that hybrid cloud addresses.

IT INITIATIVE	SOLUTION	DESCRIPTION
Modernizing and standardizing infrastructure	A hyperconverged infrastructure (HCI)	<ul style="list-style-type: none"> • A hyperconverged infrastructure is a universal software stack that brings together compute, storage, and networking, all defined in software, with cloud management. • Bringing these siloed resources together into a holistic, software-defined, and integrated system allows consistent operations through a single management interface. Organizations can realize significant benefits in efficiency as well as CapEx and OpEx reduction through this approach. • Hyperconverged infrastructure is increasingly the standard model for the modern data center, enabling it to extend from private cloud to public cloud and edge, creating a universal infrastructure platform that delivers consistent infrastructure and operations <i>anywhere</i>.
Migrating to the cloud and supporting hybrid apps	Intrinsic security	<p>Cloud gives every organization new possibilities to deliver the optimal environment for each application, and helps IT meet specific goals for their application portfolio.</p> <p>Within a hybrid cloud environment, organizations have the ability to move applications freely across environments with consistent infrastructure and consistent operations. This model eliminates the unnecessary cost, complexity, and risk of refactoring applications simply to move to a new environment.</p> <p>Organizations can also access services from multiple cloud environments, supporting hybrid app strategies.</p>

IT INITIATIVE	SOLUTION	DESCRIPTION
<p>Simplifying and automating IT operations</p>	<p>Streamlined and automated operations across clouds</p>	<p>Hybrid cloud operations gives organizations the freedom to greatly simplify the way they manage their systems and applications across the data center, cloud, and edge.</p> <p>Hybrid cloud operations includes:</p> <ul style="list-style-type: none"> • Managing the complete set of infrastructure resources (creating and retiring) • Managing capacity and inventory of services across the hybrid cloud • Troubleshooting infrastructure issues and monitoring health • Delivering end-to-end network visibility • Automating workload deployment across private, public, and edge for all workloads: <ul style="list-style-type: none"> – VM-based app workloads – Desktop workloads – Modern app workloads – Run OSS and ISV workloads from a marketplace • Migrating and moving workloads • Ensuring disaster recovery and business continuity • Understanding the costs of each location across the hybrid cloud and providing visibility • Ensuring the configuration posture meets security and governance guidelines
<p>Reducing security and compliance risks</p>	<p>Streamlined and automated operations across clouds</p>	<p>Security also includes application agility with intrinsic security, where IT enforces security postures for new and updated applications from an end-to-end perspective. This involves securing infrastructure, data, and applications against threats by reducing the attack surface, thus eliminating as many risks as possible. It also provides IT and security teams with increased visibility into their virtual machines and workloads, to identify threats and secure against them.</p>

TABLE 1: Hybrid cloud supports a range of IT initiatives.

VMware Cloud Foundation: The Ubiquitous and Proven Hybrid Cloud Platform

VMware has been laying the foundation for hybrid cloud for years. As the de facto leader in the data center—nearly 70M virtualized workloads are currently running on VMware vSphere®—VMware supports the most demanding, most critical applications in the world. VMware has extended more than two decades of experience in the data center to deliver VMware Cloud Foundation™—unified compute, storage, networking, and management to meet the needs of today's demanding applications. Deployed ubiquitously across the data center, cloud, and edge, this is among the most powerful, most complete hybrid cloud infrastructures.

VMware Cloud Foundation gives every customer the ability to extend proven models of virtualization and management to any environment, to support any application. The platform has been widely adopted by enterprises looking for the most modern, most powerful environment on premises. It also has been widely embraced by cloud providers—forming the core of VMware Cloud™ on AWS, Azure VMware Solutions, Google Cloud VMware Solution, IBM Cloud for VMware, and more than 60 VMware Cloud Verified providers operating globally.

VMware Cloud Foundation offers distinct advantages for businesses looking to support diverse and demanding applications while pursuing a hybrid cloud model for their organization:

1. **Complete software-defined infrastructure** – VMware Cloud Foundation offers a hyperconverged infrastructure optimized for all applications, from virtual machines and containers to packaged applications and open source. As a unified stack of compute, storage, networking, and management, VMware Cloud Foundation delivers consistent infrastructure and operations across the entire hybrid cloud. VMware Cloud Foundation will help customers rapidly modernize their existing data center infrastructure, more efficiently manage on-premises environments, extend to the cloud seamlessly, and operate the entire hybrid cloud with a single model of operations.

2. **Ubiquitous, flexible hybrid cloud services** – VMware Cloud Foundation is one of the most broadly deployed solutions for hybrid cloud. It is the core of the VMware preferred hybrid cloud offering, VMware Cloud on AWS. This solution, jointly engineered with AWS and available globally through 16 AWS regions, delivers a seamless extension to on-premises implementations of VMware Cloud Foundation. Organizations can rapidly move applications to the cloud, support business continuity and disaster recovery strategies, deliver modern apps, and access more than 160 native AWS services to support app modernization initiatives. In addition, VMware Cloud Foundation is powering a wide range of cloud services, including Azure VMware Solutions, Google Cloud VMware Solutions, and IBM Cloud for VMware. In all, more than 60 global cloud providers have built on VMware Cloud Foundation for the core of their cloud services. This gives customers the broadest set of options for building, running, and migrating their applications, all on infrastructure and operations consistent with what they are already using in the data center.

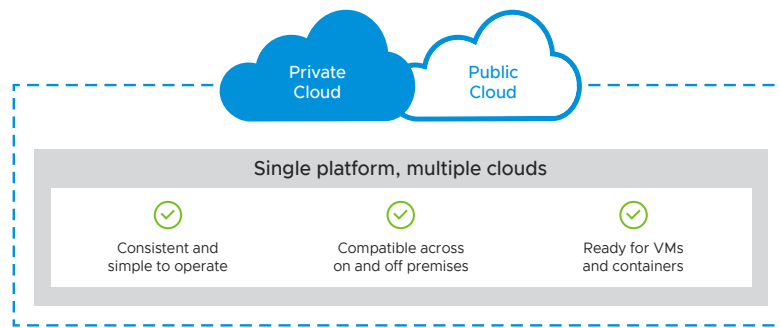


FIGURE 1: VMware Cloud Foundation provides a single platform for multiple clouds.

3. **Hybrid cloud operations** – Organizations deploying VMware Cloud Foundation and consistent operations can increase efficiency through hybrid cloud operations delivered from the data center to the cloud and the edge. Organizations can manage the complete inventory of infrastructure services, efficiently provision and retire each environment, and manage the capacity and inventory of services to match application requirements as they shift and change over time. With unified visibility into resources, organizations can troubleshoot and proactively drive resolution across the hybrid cloud. To establish governance for how services are consumed and allocated, IT can automate how workloads are deployed in any environment. And every organization can benefit from a single model for disaster recovery and business continuity that protects data and business operations. With hybrid cloud operations, organizations have a deep visibility into the complete costs of each environment, enabling them to balance decisions like application migration against business goals for each application. In the end, hybrid cloud operations supports requirements for self-service access to infrastructure services and developer productivity, while preserving security, governance, and operations.
4. **Support for modern apps** – VMware Cloud Foundation is an optimal environment for all applications, from virtualized apps to containers, desktop workloads, modern app workloads, and OSS and ISV apps. Organizations benefit from having a single environment by which to deploy and manage this broad portfolio of applications across the data center, cloud, and edge. IT can drive consistent policies for workload placement, security, capacity, and disaster recovery, significantly increasing the efficiency of operating this diverse portfolio of apps. And the same environment can be used for test and development and production. Organizations can migrate freely across the hybrid cloud and access innovative services from all VMware cloud partners, AWS, Microsoft Azure, Google Cloud, IBM Cloud, and more. VMware Cloud Foundation delivers a wide range of capabilities to support the broadest set of modern app initiatives today.

Cost Advantages of Hybrid Cloud Built on VMware

VMware Cloud Foundation is the natural evolution of VMware and its customers. This solution builds upon 20 years of VMware expertise in the data center delivering unparalleled value for some of the most demanding applications in the world. As the new platform for hybrid cloud, VMware Cloud Foundation represents a new path for customers seeking to unlock the power of the cloud, while building on proven investments, policies, teams, and systems. As a hyperconverged infrastructure solution, VMware Cloud Foundation enables inherent cost advantages over traditional multi-tier infrastructures. Customers deploying on VMware Cloud for hybrid cloud report a 26 percent reduction in infrastructure costs and 35 percent lower operational costs (over a 3-year period).⁴

At the same time, standardizing on VMware Cloud Foundation for hybrid cloud helps organizations eliminate or avoid potential costs associated with supporting key IT initiatives. By extending existing tools, processes, teams, and skills, organizations can eliminate silos dedicated to unique environments, eliminating the costs of reskilling or retraining teams, creating new policies, or managing diverse operations across unique cloud environments. VMware customers estimate a 40 percent reduction in costs of staff training when migrating to the cloud using VMware over migrating to a native public cloud provider.⁴ Migration to the cloud continues to require significant reskilling of existing teams to manage the diverse silos of clouds adopted as part of a multi-cloud strategy. VMware can help eliminate this unnecessary cost, and extend the proven teams and skills your organization already has.

This model of consistent infrastructure and operations based on the VMware approach to hybrid cloud also accelerates cloud migration strategies by eliminating the cost, complexity, and risk associated with refactoring existing applications.

According to multiple external industry analyst studies and VMware experience, customers are spending \$1,000 per VM (\$1 million for every 1,000 virtual machines)^{4, 5, 6} refactoring apps for the cloud. This cost can be all but eliminated with VMware Cloud, where customers can accelerate their stalled migration strategies and move large volumes of applications—unchanged—with little to no downtime.

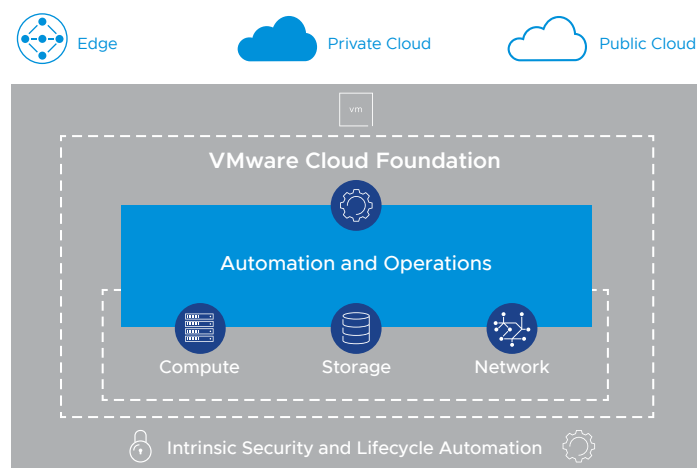


FIGURE 2: VMware Cloud Foundation enables consistent infrastructure and operations.

⁴ In August 2019, VMware commissioned research with IDC to evaluate eight organizations currently using VMware Hybrid Cloud solutions and measure the benefits of these solutions in terms of IT staff efficiencies and productivity gains, reductions in IT costs, and increases in user productivity and revenue. IDC. "The Business Value of Hybrid Cloud with VMware." August 2019.

⁵ Forrester. "The Total Economic Impact™ of VMware Cloud on AWS." August 2019.

⁶ Taneja Group. "When Comparing Cloud Alternatives, For the Best TCO Leverage VMware Cloud Foundation." April 2019.

Advantages of VMware Cloud Foundation Infrastructure

Cloud Foundation offers software-defined storage and network that helps to simplify operations, while also offering powerful new capabilities to storage and network teams to secure and accelerate infrastructure and workloads across hybrid clouds. This unlocks greater agility and productivity by eliminating the operational bottlenecks of legacy infrastructure. Cloud Foundation accomplishes this by delivering:

1. **Integrated stack** – Engineered integration into a single solution of the entire software-defined stack with guaranteed interoperability. No more dealing with complex interoperability matrixes.
2. **Standardized infrastructure** – Cloud Foundation automatically deploys standardized infrastructure that reduces up-front architecture efforts, is simple to consume, and requires less effort to support.
3. **Infrastructure deployment automation** – Cloud Foundation automates the deployment of the full stack of compute, storage, network, and management capabilities into Workload Domains. This level of automation enables quick, repeatable deployments while eliminating the operational cost of engineering the environment with in-house skillsets, and reducing the inherent risk of manual misconfigurations.
4. **Automated lifecycle management** – Cloud Foundation includes unique lifecycle management services that automate day 0 to day 2 operations of administering the cloud environment, from establishment in a standardized architecture, to configuration and provisioning of infrastructure resources in a modular, cloud-like operational manner, to patching/upgrading of the software stack.

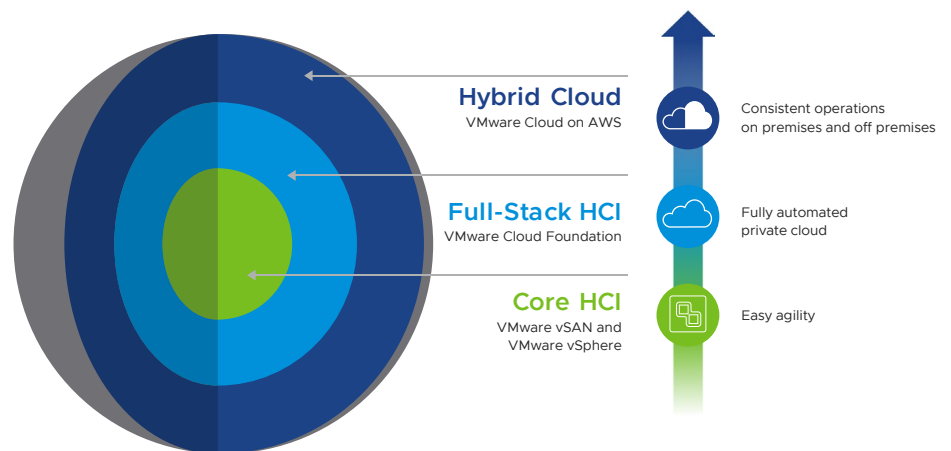


FIGURE 3: Modernize your infrastructure at your own pace.

Best Practices on the Journey to Hybrid Cloud

VMware Services is focused on empowering your business to gain a lasting edge across your organization's people, process, and cloud technologies. There are four ways VMware Services suggest you make the best journey to hybrid cloud:

1. **Start the journey down the right path.**
 - Evaluate current infrastructure on premises, in the cloud, and edge.
 - Understand unique needs across your application portfolio.
 - Outline business goals associated with hybrid cloud investments.
 - Leverage highly certified architects and engineers from VMware.
 - Understand key use cases for hybrid: hybrid operations, cloud migration, and disaster recovery.
2. **Streamline complexity.**
 - Gain visibility into current cloud resource commitments and relationships.
 - Establish architectural guidelines for hybrid environment.
 - Build relationships with cloud services that deliver consistent infrastructure and consistent operations with your data center.
 - Eliminate operational patterns that are consuming resources without returning value.
 - Evaluate policies, tools, and practices to extend across hybrid model.
 - Operate and configure solutions for maximum impact.
3. **Secure the IT environment.**
 - Understand the composition of your application and lock down its known good state.
 - Build-in security intrinsically in the infrastructure by micro-segmenting the network and encrypting data at rest.
 - Ensure that you maintain the security posture of your IT environment by applying patches promptly, controlling least privilege user access, and verifying with multi-factor authentication.
4. **Maximize your investment.**
 - Take advantage of proven deployment methodologies and validated designs.
 - Integrate people and process changes.
 - Align current and future investment to business goals and targets.
 - Revisit and revise earlier decisions based on new opportunities.
 - Deploy tools for efficient implementations.
 - Incorporate automated, proactive support technology.
5. **Empower your teams.**
 - Accelerate technology proficiency to meet goals.
 - Boost skills and certifications with industry-leading training and development programs.
 - Redeploy teams to high impact initiatives.
 - Provide a path forward for existing teams to increase value and impact.

LEARN MORE

- [*Infographic: Guide to Hybrid Cloud*](#)
- [*Harnessing the Hybrid Cloud to Drive Greater Business Agility*](#)

Conclusion

The hybrid cloud is unlocking massive opportunities for organizations to deliver more value for the business, and support the strategic needs of existing and new applications. While the diversity in today's environment can be daunting, it can also deliver unprecedented opportunities. Building a strategy for the data center, cloud, and edge that takes advantage of consistent infrastructure and operations can help organizations unlock the value of this diversity, without being impacted by the complexity and associated risk. The VMware model for hybrid cloud, based on VMware Cloud Foundation, builds upon 20 years of success in the market and provides a path forward for all businesses, no matter where they are today in their cloud journey, or where they want to go.



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