White Paper

Enabling a Cloud Operating Model for Software-Defined Infrastructure

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IDC OPINION

Every cloud strategy requires a cloud operating model that will implement a governance, management, and multicloud orchestration control plane. This control plane drives consistency, generates higher ROI, and enables faster cycle times for deploying and managing applications across any cloud architecture. Of course, cloud begins with modern, agile infrastructure (aka software-defined everything). But software-defined infrastructure is just a collection of infrastructure resources — however fancy it may be. It requires an advanced layer of management software on top to activate the infrastructure into an operational cloud. Enterprises are increasingly turning to fuller stacks of infrastructure, orchestration, and management that can deliver cloud in a more turnkey and supportable fashion.

The need to deliver high-performing digital services and products has never been more important for business success. Successful business outcomes today depend on a complex, multicloud architecture. The ability to use common cross-cloud technologies can drive a high ROI and competitive advantage. It also enables team collaboration and the use of advanced analytics to deliver faster decision making — and a more cost-effective cloud strategy.

SITUATION OVERVIEW

When server virtualization began about two decades ago, the initial driver was server consolidation to improve server utilization rates. However, soon after, the agility benefits of having software-defined compute became equally apparent, and customers began driving toward a whole new operating model. First, other parts of the datacenter also became software defined, such as storage and networking. Now that a server could be provisioned quickly, the storage and network attached to it had to catch up in order not to hold processes up. Once all the infrastructure in the datacenter became software defined, a layer of advanced and intelligent automation, orchestration, and management software was the next step to turn agile infrastructure into a fully operational cloud. At a high level, we call the operational disciplines of managing and governance across multiple clouds from a single control plane the cloud operating model, a model that should be part of the broader enterprise cloud strategy. This model drives consistency, generates higher ROI, and enables faster cycle times for deploying and managing applications across any cloud architecture.

Today, a common trend in infrastructure is the move toward fully integrated stacks. Clouds are highly complex and require a huge number of components. In the early days, some users themselves stitched together parts and often wrote custom integration code. This approach is highly resource intensive and can be fragile to maintain. Most users today are moving toward a complete cloud platform, where all the components are validated and tested together. This ensures that changes to one component will not break the underlying cloud architecture, as most organizations use multiple clouds and various application technologies. Modern life-cycle management tools allow the platform to be deployed as one unit and upgraded together, across any cloud architecture.

Containers are the newest application architecture and are set to become the foundation for next-generation modern applications. Many existing applications are also being refactored to run in containers. However, it will be a mixed virtual machine (VM) and container world for the foreseeable future. Many applications, or parts of applications, cannot be easily refactored to run in a container. Also, most containers today still run in a VM for reasons of security and management. Containers are largely application constructs and still require software-defined infrastructure underneath, so they are an additive layer to the cloud infrastructure that exist today.

The Role of Management Software for Software-Defined Infrastructure

Software-defined infrastructure by itself is not enough to create a cloud as they are simply pools of raw infrastructure. They may be highly agile and malleable, but a suite of advanced management software is required to operationalize this infrastructure into defined cloud services and make it consumable by end users and developers. Many management capabilities are needed to create and operate a cloud, the key ones being:

- **Automation and orchestration.** The speed of cloud simply is not possible with manual processes, and automation is required across the entire stack. Automation and orchestration software typically comprises multiple functions such as:
  - Configuration automation with vulnerability remediation and compliance enforcement
  - Centralized policy and control to maintain compliance across environments
  - Cloud templates to deploy infrastructure as code
  - Self-service to enable users to request resources from a catalog
- **Visibility, observability, and reporting.** Operating a cloud means having rich and actionable insights. Clouds can run at large scale and are made up of many individual components, creating a level of complexity that can make traditional monitoring and reporting methods ineffective. Rich analytics and artificial intelligence (AI)-powered insights are needed for admins to make sense of the massive amount of data, often in a proactive versus reactive fashion. Clouds are also dynamic, so traditional reports are not fast enough to keep up with the changes. Dynamic reporting, which in some cases might happen in near real time, that are accessed via smart dashboards are needed to operate a cloud system. Applications are also becoming more complex with microservices architectures, and observability of these applications requires more agile tools.
- **Capacity and cost management.** The cloud model can enable greater efficiency, and a new generation of data-driven tools are needed to deliver optimized consolidation and provide maximum performance per dollar for each workload. Performance optimization also needs to be a continuous process where workloads may have to be rebalanced and workloads rightsized as the environment changes. Managing growth effectively is also key to cloud operations, so proactive forecasting and planning tools are needed to ensure the capacity is available when it is needed.

- **Compliance.** For many industries, compliance is crucial for many workloads. Compliance must be met throughout the entire workflow and workload life cycle that may span multiple management tools. Having a centralized way to manage policy and enforcement throughout the entire toolchain is critical in ensuring that compliance is always met.
- **Analytics-powered monitoring and troubleshooting.** Every IT operations, SRE, and development team increasingly requires analytics-powered monitoring capabilities to quickly identify and resolve the root cause of performance problems across services, infrastructure, and clouds. The customer experience depends heavily on high-performing services and high-quality digitally delivered products.
- **Migration.** Workloads will need to be migrated into the cloud, and workloads may also need to move from cloud to cloud. Complex workloads may have many dependencies, and intelligent migration tools are needed to analyze, test, plan, and automate the movement of the workload to cloud while maintaining cost targets and compliance.

Enabling a Cloud Operating Model

A cloud operating model is part of an effective cloud strategy that enables IT to provide the foundation for successful multicloud deployment, management, orchestration, cost insights, and security mechanisms. It helps inform and shape a strong service delivery foundation using modern technologies and practices to deliver IT services. IDC defines the cloud operating model as: *"The use of an IT and business partnership that enables a data-driven, actionable culture using a multicloud strategy with automation, operations, governance, orchestration, cost insights, analytics, and self-service interfaces that enable the efficient operations and delivery of services to meet business and customer demands."*

The cloud operating model enables a new, modern approach to consuming resources. Developers can take advantage of automated workflows to speed application deployment frequency and reduce code error rates. IT operations teams can provide self-service interfaces to engineering, cloud platform, and DevOps teams to deliver resources quickly and in an automated fashion via self-service resource access. Infrastructure teams can provide multicloud options based on cost, security, and performance requirements of new application architectures as business requirements demand.

The cloud operating model supports the growing requirement for standardized governance, management, and orchestration capabilities that can be applied to both traditional virtual machines and containerized applications. These capabilities are enabled through a consistent set of integrated solutions and policies, regardless of the underlying cloud. This approach facilitates the alignment of IT budget and resources to business outcomes, including lower cost of operations, more secure service delivery, and higher levels of agility and collaboration through automation. It provides a collaboration accelerator that lets key business and technology stakeholders access dashboards and critical data in context to their roles. A cloud operating model accelerates the executive shift from an IT project to a product-led operating culture.

A cloud operating model has several business and technology benefits:

- **Speed:** The ability to move faster increases team collaboration and enables business agility through high levels of automation across processes and workflows. Automation drives an increase in security, consistency, and standardization across multiple clouds while allowing teams to choose between semi-automated or fully automated process capabilities.
- **Service delivery quality:** Tighter integrations between the infrastructure, applications, and operations and orchestration capabilities drive higher-quality service delivery, improved team collaboration, and improved end-to-end visibility between the product owners and customers. A focus on quality also improves customer feedback mechanisms between developers and customers.
- **Conversion to anything-as-a-service (XaaS) models:** XaaS capabilities empower the IT consumer with the pricing flexibility to choose the best-fit pricing model for system reliability and service delivery while complying with application requirements for scalability, security, compliance, and business risk factors.
- **Cost optimization:** The requirement to understand the cost of service delivery from a user, team, group, and business unit perspective enables high transparency for services, matching service supply with demand and allowing for a strategic conversation between the business owners and IT to drive optimized cost-based decisions that match changing business priorities. Performance management is also a key part of cost optimization, with most workloads striving to achieve the balance that maximizes performance at minimal cost.
- **Governance and trust:** Dynamic compliance requirements can be matched for each service or each cloud while enhancing security mechanisms that use policy-based orchestration. This includes the ability to share requirements across security, development, and IT operations teams, using critical data from each group and creating audit trials and dashboards to reduce costs and increase security, audit, and compliance capabilities early in the application development life cycle.
- **Enhanced controls:** The ability to use intrinsic guardrails and security mechanisms early in the software development life cycle enables operations, security, and cloud teams to improve governance, costs, and access while reducing business risks.

In addition, many IT consumers obtain benefits such as improved agility for business teams, optimized business value from each cloud architecture, reduced security and business risks, and an overall, consistent set of control and governance guardrails across all clouds.

The cloud operating model provides a foundation for consistency across any cloud and application stack as part of an overarching cloud strategy. It provides the ability to operationalize and enable higher-level enterprise cloud priorities outlined in a cloud strategy. This includes managing and deploying applications across multiple clouds, enabling cloud cost transparency, automating processes, and enabling cross-team governance and control points for service visibility. It empowers CIOs, SREs, and operations and development teams to lay the operational foundation for a multicloud control plane, supporting both development and operational requirements. It also fits into any organizational construct — from Agile to DevOps to SRE and enterprise platform teams.

As part of a cloud strategy (or cloud operating model), some customers consider the use of VMware Cloud Foundation (VCF) solution. VMware Cloud Foundation is a full-stack hyperconverged infrastructure solution that includes VMware vSphere, VMware vSAN, VMware NSX, and VMware vRealize Suite, providing a complete set of software-defined services for compute, storage, networking, security, and cloud management to run enterprise apps — traditional or containerized — across hybrid clouds.

CUSTOMER STUDY — EUROPEAN PUBLIC HEALTHCARE PROVIDER

A large European public healthcare provider began deploying VMware Cloud Foundation in 2018, migrating from a competitor's virtualization solution. The company had a goal to more closely integrate compute, storage, and networking in an integrated stack. The other primary driver was to increase the level of automation for its core infrastructure in order to serve applications teams better. The company ultimately decided on VMware Cloud Foundation for its leadership in software-defined compute, storage, and networking and for vRealize Suite capabilities. Another deciding factor was that while VMware had public cloud capabilities, it had not lost its focus on on-premises solutions, which was still the primary deployment location for the company.

Today, the company runs about 1,500 VMs over 40 hosts in its VCF deployment. It began its VCF deployment with only two administrators and in five months the solution was fully deployed and had exceeded all the goals set out. In fact, the solution was such a success that the team was given more budget than originally planned to increase the scale and buy as much as needed.

The main objective was to provide application owners a quicker and more accurate VM provisioning process, which was done with vRealize Automation. Before VCF, it would take weeks to provision a VM, and because of poor communication between the application and infrastructure teams, the provisioned VM was often configured incorrectly, leading to even lengthier delays. Implementing VCF led to several improvements:

- **VMs are now provisioned almost right away.** The provisioning process is still managed by the server operations team as current company policy prevents the use of fully automated self-service, but most requests are taken care of quickly.
- **VMs are now consistently configured correctly.** In the past, application owners had to check and verify the VM, but now those checks can be skipped, saving time.
- **The previous solution only provided a bare VM, with no applications or components installed.** With VCF, the team was able to automate the process of installing required apps within the VM and configuring the underlying operating system, eliminating more manual processes that the applications owners had to do.
- **Key metrics of uptime and performance have improved.** One challenge to measuring performance is that the customer is not fully DevOps, so there can be a lot of layers between IT and developers that prevent effective communication. However, the team is better able to rightsize VMs for workloads and check for abnormal operations such as performance degradation over time.

For the infrastructure team, the benefits are that the core infrastructure is much more automated, which results in better patch management, faster onboarding of new physical hosts, and managing more infrastructure with minimal admin resources. Beyond vRealize Automation, the customer also leverages other parts of the vRealize VCF stack for benefits such as:

- **Better capacity planning using vRealize Operations.** The old process was described by the customer as "random people guessing," but with vRealize Operations, the process is now data based.
- **Better cost insights with vRealize Operations.** By using cost information in vRealize Operations, the customer can continuously calculate the cost of VMs. While the customer is not doing chargeback yet due to its accounting structure, assessing cost per application or business unit is critical in planning.
- **Data-driven insights with vRealize Log Insight.** Using a centralized logging location for all VCF components enables customers to conduct powerful queries for analysis. The customer found that the many built-in queries enabled it to get useful insights immediately and lets people without the query skills to use the product. Another benefit that the customer highlighted was the ease of exporting data from VCF to feed into nearly any system.
- **Better network troubleshooting and micro-segmentation guidance with vRealize Network Insight.** Determining the proper micro-segmentation rules was difficult for IT and vRealize Network Insight assists the IT admins with creating the proper policy. The customer found that the product presents analytics and data in a useful way to help the customer optimize the network.

This customer has also done two major version upgrades since the initial deployment. SDDC Manager (VCF life-cycle management tool) and vRealize Lifecycle Manager automate much of the upgrade process. There are safety checks at multiple points, and rollbacks are available so that upgrades are faster and more reliable. The customer is able to do upgrades during business hours with no service downtime and an upgrade has never disrupted a customer's VM.

For the future, the customer described several key areas of change:

- **Container adoption.** The customer currently has Tanzu in a lab setting for experimentation with the goal of rolling out Tanzu in production in two years with the same infrastructure team managing both VMs and containers. The customer is limited in how and when they can migrate to containers as the majority of the customer's applications are off-the-shelf, packaged applications that do not always support containers. The customer said the applications in its industry often take a long time to modernize, and those applications often have strict requirements for the IT stack. However, the company does develop its own integration and analytics platform, and this is moving the quickest toward containers.
- **Cloud operating model.** While the company has been moving toward a more modern operating model, it is again held back by legacy apps that do not use a new way of operation. These apps often dictate the system software that can be used, and sometimes even the hardware. However, the customer continues to improve on moving people closer to the application to deliver more value. The operating model and organization changes are a work in progress, and the customer is moving to it where it can, but there is still a long way to go.
- **Public cloud/SaaS.** The company currently has very little public cloud deployments because of the lack of clarity about where data can be stored in its country's regulations. If that is resolved, the customer could begin to use cloud more, and VMware Cloud would be of interest to complement its VCF on premises. However, one concern the customer has with public cloud, specifically with things like SaaS-based management, is operating when completely cut off from the internet. One aspect of cloud and on-premises subscription model that is quite attractive to the company's finance department is the move to a constant expense rather than large expenses every few years.

One essential piece of advice the customer gave for potential VCF users was that VCF includes many components and capabilities, which can be overwhelming. However, one does not have to use every part of it right away to be successful and realize huge benefits from the product.

VMWARE PROFILE

VMware Cloud Foundation is a unified hybrid cloud platform for managing both VMs and containers, supported by several VMware management solutions (i.e., vRealize Suite). VCF is available with integrated VMware Tanzu Kubernetes Grid, enabling vSphere to host both VM and container workloads. VCF with Tanzu allows container- and Kubernetes-based workloads to be deployed and managed using the same set of VMware management tools that existing VM admins are familiar with today. It avoids disruptions to Kubernetes APIs and allows developers to manage VMs via Kubernetes, if desired. Integrations with Tanzu Mission Control and Tanzu Observability allow DevOps teams to extend control across multicluster, multicloud deployments and have deep visibility into the application stack.

VCF's capabilities for operations, governance, orchestration, and automation are provided by VMware's vRealize line of management products. It enables consistent deployment and operations of apps, infrastructure, and platform services, from the datacenter to the cloud to the edge. It is designed to help organizations optimize, control, and secure self-service hybrid clouds, providing self-service operations and multicloud automation with governance, as well as DevOps-based infrastructure delivery. With vRealize, internal IT operations, DevOps engineers, developers, and the lines of business get the environments and resources that they need faster with a public cloud–like user experience, while IT maintains security, compliance, and control. The components of vRealize included with VCF are:

- **vRealize Automation.** A modern infrastructure automation platform for consistent automation across clouds and datacenters
  - Multicloud self-service
  - Policy-based infrastructure provisioning and management
- **vRealize Operations.** IT operations management in a unified, AI-powered platform
  - Performance management
  - Capacity and cost optimization
  - Intelligent remediation (analytics-powered monitoring, troubleshooting, and remediation)
  - Configuration and compliance
- **vRealize Log Insight.** Managing data at scale with centralized log management, deep operational visibility, and intelligent analytics for troubleshooting and auditing across private, hybrid, and multicloud environments
  - Actionable insights from log data
  - Rapid troubleshooting and analysis
- **vRealize Network Insight.** Monitoring and building an optimized, highly available, and secure network infrastructure across clouds
  - Application discovery and visibility
  - Secure migration planning
  - Proactive network optimization

- **vRealize Lifecycle Manager.** To install, configure, upgrade, and patch vRealize Suite

VCF is also the foundation for VMware-based public clouds that are available on most major public clouds such as AWS, Azure, Google Cloud, and IBM Cloud. VCF allows existing VMware VM-based applications to be migrated to a VMware cloud without refactoring to drive consistent operational constructs.

CHALLENGES/OPPORTUNITIES

Almost every IT organization is using a multicloud strategy to deliver business results, increase innovation, and drive business speed and agility. A cloud operating model provides a control plane for transparency, consistency, and governance. As organizations continue to mature across staffing skills and development, technology, and process automation capabilities, organizations must overcome common challenges and take advantage of opportunities to move forward. Some of these are:

- **The management, governance, automation, and orchestration of traditional and cloud-native application architectures.** Besides the required skills and expertise, the ability to manage multiple layers of complexity across these application environments is a requirement for delivering business results.
- **The ability to organize different technology requirements for traditional and cloud-native applications.** There is an opportunity for tool rationalization to create a common, consistent tool and process framework to manage complexity, deployment models, and performance.
- **The management of both private, on-premises cloud environment and public clouds.** Each cloud has unique advantages and business opportunities; managing all clouds is an important requirement for delivering a great customer experience.
- **The need for integration across people, technology, and processes.** This enables streamlined cross-team collaboration, streamlined process automation, and improved transparency.
- **The need to include a cloud operating model in the cloud strategy as a foundational investment for reducing complexity across multiple environments.** The fastest way to improve cloud ROI is to standardize where possible. Management, automation, orchestration, and governance capabilities are areas where standardization can create operating efficiencies and reduced costs.

CONCLUSION

IT executives continue to build, adjust, and implement their multicloud strategies to drive business outcomes. The cloud operating model, cloud-native infrastructure and applications, and software-defined infrastructure are all critical ingredients of a successful strategy. Aligning and connecting people, process, and technologies across layers of the IT and business organizations is an important success factor for cloud deployments. For most businesses, the technology architecture is now their business architecture. The customer experience depends on efficiently delivered, high-performing services and digital products. Using software-defined infrastructure with a cloud operating model has shown to have numerous advantages, including simplified life-cycle operations, streamlined management and infrastructure orchestration, increased levels of automation, and improved service performance, enabling users to quickly integrate emerging technologies with predictable, consistent, and repeatable results.

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