

# VMware Cloud Foundation on Dell VxRail

## Accelerating the Journey to VMware Software-Defined Data Center and Hybrid Cloud

May 2024

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### Abstract

VMware Cloud Foundation on Dell VxRail, the foundation for APEX Hybrid Cloud, delivers a simple and direct path to the hybrid cloud and Kubernetes at cloud scale with one complete, automated platform. By deploying VMware Cloud Foundation on VxRail HCI, customers get full-stack integration with both the infrastructure layer and VMware Cloud software stack. Automated life cycle management is provided as a single complete turnkey hybrid cloud experience that greatly reduces risk and increases IT operational efficiency. VxRail HCI System Software's unique integration between SDDC Manager and VxRail Manager combines operational transparency with automation, support, and serviceability capabilities not found when VMware Cloud Foundation is deployed on any other infrastructure.

White Paper

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## Revisions

Date	Part number/ revision	Description
July 2019		Initial version
October 2019		Updated to cover VMware Cloud Foundation on VxRail version 3.8.1 feature set
September 2020		Updated to cover VMware Cloud Foundation 4.0.1.1 on VxRail 7.0.010 feature set
December 2020		Branding updates
February 2021		VxRail integrated rack updates
July 2021		Updated to cover VMware Cloud Foundation 4.2 on VxRail 7.0.131 feature set
December 2021		Updated to cover VMware Cloud Foundation 4.3.1 on VxRail 7.0.241 feature set
February 2022	H17854	Minor edits
April 2023	H17854.1	Updated to cover VMware Cloud Foundation 4.5.0 on VxRail 7.0.400 feature set and subscription licensing options
May 2024		Updated to cover VMware Cloud Foundation 5.1.1 on VxRail 8.0.210 feature set and changes to the subscription licensing options

## Acknowledgments

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## Executive summary

VMware Cloud Foundation on Dell VxRail hyperconverged infrastructure (HCI) provides a simple path to the hybrid cloud and Kubernetes at a cloud scale. It is a fully integrated platform that leverages native VxRail hardware and VMware Cloud Foundation software capabilities. It includes unique features jointly engineered by Dell Technologies and VMware to deliver a turnkey user experience with full-stack integration. With full-stack integration, customers experience both the infrastructure layer and cloud software stack in one complete, automated life cycle, turnkey experience.

VMware Cloud Foundation on Dell VxRail provides a consistent hybrid cloud experience unifying customer public and private cloud platforms under a common operating model and management framework. Customers can operate both their public and private platforms using one set of tools and processes with a single management view and provisioning experience across both platforms. Customers can build, run, and manage a broad set of workloads from traditional and legacy applications to virtual desktops, as well as next generation workloads from artificial intelligence and machine learning to cloud native and container-based workloads. VMware Cloud Foundation with Tanzu, available since version 4.0 of the platform, is a major architectural upgrade thanks to integration of Kubernetes directly into the vSphere hypervisor.

The SDDC Manager and VxRail HCI System Software integration allows VMware Cloud Foundation to build a complete software-defined data center on VxRail. SDDC Manager orchestrates the deployment, configuration, and life cycle management of vCenter, NSX, and some of the Aria Suite (formerly vRealize Suite) components above the ESXi and vSAN layers of VxRail. It enables VxRail clusters to serve as a resource platform for workload domains or as multicluster workload domains. It can also automatically enable VMware Tanzu for container-based and VM-based workloads with integrated native Kubernetes orchestration. Integrated with the SDDC Manager management experience, VxRail Manager is used to deploy, configure, and life cycle manage ESXi, vSAN, and HCI infrastructure hardware firmware. VxRail life cycle management is accomplished using fully integrated and seamless SDDC Manager orchestration that leverages VxRail Manager APIs to perform it natively.

Through the standardized hardware and software architecture that is integrated into VMware Cloud Foundation on VxRail, customers can build and run heterogeneous workloads on a common hybrid cloud infrastructure. Infrastructure building blocks based on native VxRail clusters are created using SDDC Manager which enables customers to scale up and scale out incrementally.

VxRail Manager delivers automation, life cycle management, support, and serviceability capabilities that are integrated with SDDC Manager and vCenter to extend the VMware Cloud Foundation management experience and simplify operations. VxRail management functionality is available in vCenter through a VxRail Manager vCenter plug-in.

All VMware Cloud Foundation on VxRail life cycle updating and upgrade operations are orchestrated using SDDC Manager. As a part of this monitoring, SDDC Manager automatically discovers when new VxRail and VMware Cloud Foundation updates are available for download and proactively notifies the administrator accordingly within the user interface. All updates are scheduled and orchestrated by SDDC Manager but may be

performed by either SDDC Manager directly or by VxRail Manager using SDDC Manager integrated VxRail APIs.

Dell delivers the top hyperconverged (HCI) infrastructure portfolio purpose-built for HCI with the latest generation Dell PowerEdge server platform. This portfolio delivers tailor-made performance and reliability powerful enough for any workload, combined with an advanced approach to intelligent deployment and operations that simplify and accelerate IT. Dell HCI on the latest generation of PowerEdge servers are powerful and purpose-built platforms that provide the ideal foundation for software-defined data center initiatives.

VxRail nodes are available with different compute power, memory, and cache configurations to closely match the requirements of new and expanding use cases. As requirements grow, the platform easily scales up or out in granular increments.

VMware Cloud Foundation on Dell VxRail can be delivered as either a cluster of nodes that leverages the customer's existing network infrastructure, or as a custom integrated rack system with or without integrated networking. With rack assembly services from Dell, VxRail rack-integrated systems can be delivered with customer-chosen rack and networking component options.

Dell Services accelerates the deployment of VMware Cloud Foundation on VxRail with a full range of integration and implementation services. Dell Services helps IT organizations quickly realize the value of their investment both by deploying the hardware and software components of VMware Cloud Foundation on VxRail. Dell Services also helps organizations achieve IaaS through integration of this integrated cloud platform into their application portfolio, operating model, and enterprise infrastructure.

Customers have a choice of support and maintenance options that can align to their business model. Options range from a single-vendor Dell Support experience to obtaining support from Dell, VMware, and third parties for network switches and racks. Dell Support is recognized with an over 95 percent customer satisfaction rating<sup>1</sup> and has received multiple awards.

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<sup>1</sup> <http://i.dell.com/sites/doccontent/business/solutions/brochures/en/Documents/prosupport-enterprise-suite-brochure.pdf>

## Introduction

Information Technology (IT) departments are under significant pressure to deliver new applications to market, to innovate with technology to beat competitors, and to do it faster with more choice. At the same time, there are requirements for stricter compliance, improved security, controlled costs, and increased efficiency. To solve these problems, the modern data center is trending towards converged and hyperconverged infrastructures, virtualization, and software-defined infrastructures and public and hybrid cloud solutions.

The VMware vision of the modern data center is a software-defined, standardized architecture. It is a fully integrated hardware and software stack that is simple to manage, monitor, and operate. The VMware architecture for the software-defined data center (SDDC) empowers companies to run hybrid clouds and to leverage unique capabilities to deliver key outcomes that enable efficiency, agility, and security. The VMware SDDC is based on VMware vSphere, VMware vSAN, and VMware NSX. It provides compute, storage, and networking virtualization to the SDDC, as well as the VMware Aria Suite (formerly vRealize Suite) for additional cloud management, self-service, automation, intelligent operations, and financial transparency.

VMware Cloud Foundation provides integrated cloud infrastructure (vSphere compute, vSAN storage, NSX networking, and security) and cloud management services (with the Aria Suite) to run many types of enterprise applications in both private and public environments. Applications range from traditional applications deployed as virtual machines and virtual desktops, to Kubernetes-powered containerized cloud native applications. VMware Cloud Foundation helps break down the traditional administrative silos in data centers, merging compute, storage, network provisioning, and cloud management to facilitate end-to-end support for application deployment. VMware Cloud Foundation's SDDC Manager component automates the life cycle management of a complete software-defined data center on standardized hyperconverged architecture. VMware Cloud Foundation can be deployed on premises on a broad range of supported hardware or consumed as a service in the public cloud.

Dell Technologies shares VMware's vision of the modern data center and extends that to the infrastructure. For customers that choose VMware as the primary technology for modernizing their data center or building a multicloud IT environment, Dell offers an accelerated path to the VMware SDDC by jointly developing a fully automated and turnkey cloud infrastructure platform.

VMware Cloud Foundation on Dell VxRail delivers a simple and direct path to the hybrid cloud and Kubernetes at cloud scale while allowing customers to maintain flexibility of networking and topology. VMware Cloud Foundation on VxRail builds on native VxRail and VMware Cloud Foundation capabilities. It provides additional unique integration features that are jointly engineered by Dell and VMware that no other VMware Cloud Foundation infrastructure offer can provide. These features simplify, streamline, and automate SDDC operations from deployment through Day 2 operations (including support and serviceability capabilities).

## VMware Cloud Foundation on Dell VxRail

VMware Cloud Foundation on Dell VxRail is an integrated VMware Cloud Foundation stack running on top of a VxRail HCI system. It provides automated hardware and software life cycle management and fully automated deployments of the VMware SDDC and HCI infrastructure while still providing customers with flexible topologies and networking in one, complete, seamless user experience.

VMware Cloud Foundation leverages Dell VxRail APIs to consume the value-added capabilities in VxRail. VMware has made architectural updates to the platform that pair well with core VxRail functionalities, such as networking flexibility, enabling Dell integration benefits, and deployment options ranging from a cluster of nodes to integrated rack offerings.

### Operational hub for hybrid cloud

VMware Cloud Foundation on Dell VxRail provides a simple and direct path to the hybrid cloud. It is a fully integrated platform that leverages native VxRail hardware and software capabilities and other VxRail unique integrations, such as vCenter plug-in, SDDC Manager and VxRail Manager integration. VxRail architecture awareness is engineered into VMware Cloud Builder to deliver a turnkey hybrid cloud user experience with full-stack integration.

Full-stack integration means that customers get both the infrastructure layer and cloud software stack that leverages native VxRail hardware and software capabilities and other VxRail unique integrations (such as vCenter plug-in) in one, complete, automated life cycle, turnkey experience. The platform delivers a set of software-defined services for compute (with vSphere and vCenter), storage (with vSAN), networking (with NSX), security, cloud management (with Aria Suite), and container-based cloud native platform services (with VMware Tanzu) in both private or public environments. These features make it the operational hub for customers' hybrid clouds, as shown in Figure 1.

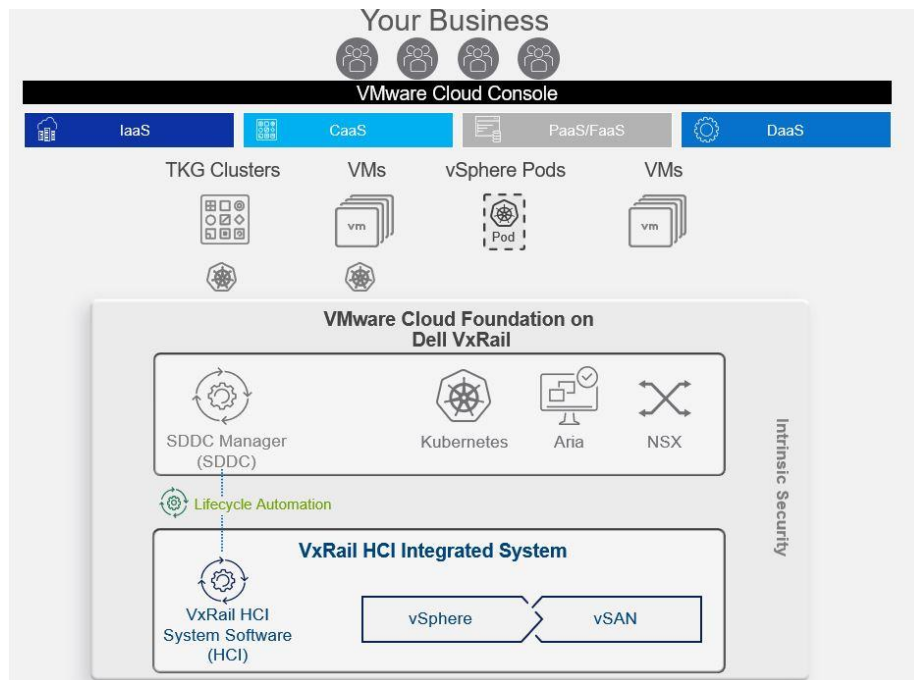


Figure 1. Operational hub for customers' hybrid cloud



## Consistent hybrid cloud platform

The consistent hybrid cloud is a paradigm that has emerged in the market, as a response to the complexity of multicloud.

VMware Cloud Foundation on Dell VxRail provides a consistent hybrid cloud unifying customer public and private cloud platforms under a common infrastructure, operating environment, and management framework. Customers can operate both their public and private platforms using one set of tools and processes, with a single management view and provisioning process across both platforms. This consistency allows for easy portability of applications and IT operations.

### How Dell VxRail complements VMware's SDDC and hybrid cloud vision

Dell VxRail is the foundation for the APEX Hybrid Cloud. APEX Hybrid Cloud is a part of the Dell APEX Cloud Services portfolio that offers integrated compute, storage, networking, and virtualization resources that enable consistent, secure infrastructure and operations for workloads across public and private clouds. With a simple way to order and manage cloud resources, customers can easily build the cloud of their choice with solutions that are tailored to their most pressing business needs.

VxRail delivers the fastest and simplest path to achieving IT outcomes, from modernizing data center at the core with new platforms and faster network connectivity, to automated and accelerated hybrid cloud deployment with VMware Cloud Foundation on VxRail.

The Dell VxRail turnkey experience starts with full-stack integration of software and hardware, for a consistent and deeply integrated VMware environment. VxRail goes even further to deliver even more highly differentiated features and benefits based on the VxRail HCI System Software. The software automates deployment, delivers complete life cycle management, and facilitates key upstream and downstream integration points. The result is a better-together experience for hybrid cloud infrastructure use cases, with VxRail as the foundation. VxRail is the only jointly engineered HCI system with VMware and supports synchronous releases with VMware. This means that the latest HCI and cloud software updates are available to customers sooner.

## VMware Cloud Foundation on Dell VxRail

VMware Cloud Foundation on VxRail builds upon native VxRail and VMware Cloud Foundation capabilities with additional unique Dell and VMware jointly engineered integration features. These features simplify, streamline, and automate the operations of your entire SDDC from deployment through Day 2 operations, including support and serviceability capabilities that no other VMware Cloud Foundation infrastructure offering can provide.

Full-stack integration with VMware Cloud Foundation on VxRail means both the HCI infrastructure and VMware cloud software stack life cycle are managed as a single automated turnkey hybrid cloud experience that reduces risk and increases IT operational efficiency. VMware Cloud Foundation on VxRail delivers a consistent infrastructure and consistent operations experience with edge, private, and native public cloud workload deployment options for a true hybrid cloud solution.

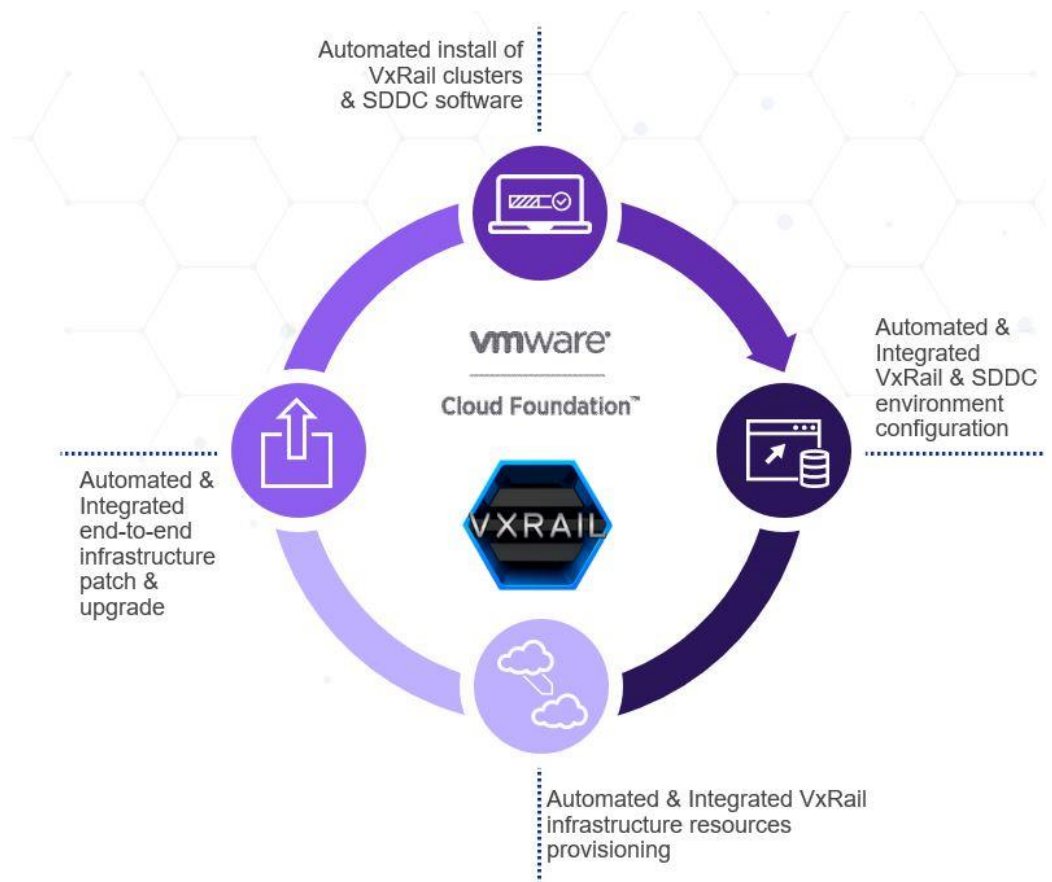
VMware Cloud Foundation on Dell VxRail can be delivered several ways while providing customers with the flexibility to use their own or Dell networking systems:

- A cluster of nodes where customers can integrate it into their own racks with their choice of existing networking components.
- A customized integrated rack system with integrated networking built and delivered to a customer's site, saving hours of building and testing the infrastructure themselves.

Based on VMware SDDC best practices, VMware Cloud Foundation on VxRail ensures that customers are future-proofed for next generation VMware cloud technologies that will be innovated around the same architectural design principles.

### Full-stack integration

VMware Cloud Foundation on VxRail makes operating the data center fundamentally simpler. It brings the ease and automation of the public cloud in-house by deploying a standardized and validated network flexible architecture with integrated life cycle automation for the entire cloud infrastructure stack, including hardware. As shown in Figure 2, full-stack automation is in place for Day 0, Day 1, and Day 2 operations. Day 0 operations consist of automating deployment and installing VxRail clusters and SDDC software. Day 1 operations include automating the environment configuration and resource provisioning. Finally, Day 2 consists of automating end-to-end infrastructure updating, upgrading, and the serviceability and support experience.



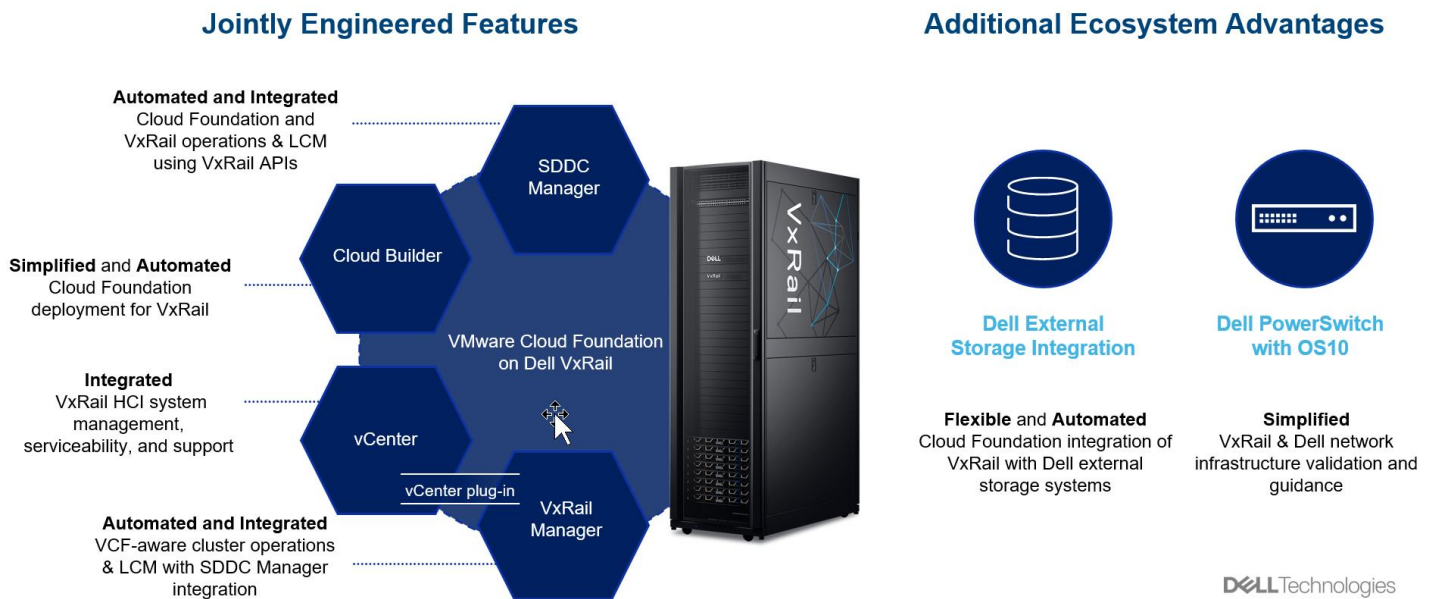
**Figure 2. VMware Cloud Foundation on VxRail delivers end-to-end stack life cycle automation**

Core components for VMware Cloud Foundation on VxRail come from VxRail and VMware Cloud Foundation. VxRail provides the base HCI hardware, ESXi, vSAN, VxRail Manager, and Dell Secure Remote Gateway appliance. VMware Cloud Foundation provides SDDC Manager, vCenter, and NSX. Optional add-on components include the VMware Aria Suite (formerly vRealize Suite: VMware vRealize Operations, VMware vRealize Log Insight, and VMware vRealize Automation). VMware Tanzu is also an optional add-on component.

Every VxRail provides the benefits of a jointly engineered HCI system that is built for VMware and is powered by vSphere, vSAN, and VxRail HCI System Software (which includes VxRail Manager) according to standardized HCI designs. With VxRail, a customer gets several highly valuable integrated features that are driven by the capabilities of VxRail HCI System Software. These features include scalable VxRail deployments, VxRail cluster creation, node addition and removal capabilities, and serviceability and support creation in vCenter, vCenter plug-in for VxRail workflow automation, and more.

Every VMware Cloud Foundation on VxRail deployment is based on a standardized VMware best practices architecture. VMware has validated the suite of components (vSphere, vSAN, NSX, Aria Suite, Tanzu, and others), that when used together, provide all the data center virtualization and cloud management services that a customer must build to have a full-stack HCI private cloud. VMware takes these components and performs interoperability testing on them, but also develops a set of standardized component-level designs for how they should be configured with each other according to these VMware best practices. Combining the component qualification with a standardized SDDC-level architecture creates a fully validated SDDC design.

The following figure shows how Dell Technologies joint engineering efforts for VMware Cloud Foundation on VxRail fit together and the unique value-added features are introduced by each component.



The following list provides details of the VxRail integration features:

- **Dell VxRail Manager**  
VxRail Manager is the primary management and automation tool used for VxRail cluster operations. It features end-to-end life cycle management of HCI software and hardware (optionally including FC HBAs and GPUs). It also features automated cluster deployment and configuration, and an integrated serviceability and support experience. Examples of these serviceability features are the native integration with VxRail Manager and Dell Secure Remote Gateway proactive phone-home support system and capabilities to automate serviceability tasks such as proactive drive replacements. VxRail Manager extensibility is a key enabler to how VMware Cloud Foundation and VxRail are integrated.
- **VMware vCenter**  
The VxRail HCI System Software is integrated with vCenter through the VxRail Manager vCenter plug-in. This integration provides operational transparency that enables customers to manage 100 percent of VxRail Manager HCI system management tasks from within the familiar vCenter console. It also provides additional serviceability and support capabilities, also from within the vCenter console. These capabilities essentially eliminate any friction for customers who want seamless management of their VxRail from the vCenter interface. Examples of some of these management capabilities include: physical and logical detailed graphical node views with integrated physical geo-location tags, centralized HCI system events and alerting, eServices access, automated failed disk drive serviceability automation, and VxRail dashboards.
- **VMware Cloud Builder**  
This is a standardized automation tool for deploying and configuring VxRail according to VMware's SDDC best practices and standardized architecture. This tool has been exclusively engineered to be "VxRail aware" and integrate with VxRail to deploy the additional VMware Cloud Foundation components that have not already been deployed by VxRail Manager. This aligns the VMware Cloud Foundation deployment to existing VxRail deployment operating models.
- **VMware SDDC Manager**  
This feature is responsible for the automated configuration and life cycle management of the SDDC software components. SDDC Manager is integrated with VxRail Manager. They work together to streamline how the layers of the stack are managed, leveraging a consistent operating experience that VxRail customers are already used to and extending that to include an end-to-end full-stack experience. SDDC Manager leverages the VxRail API to natively perform VxRail cluster management operations such as cluster deployments and LCM workflows, all from within the SDDC Manager UI.

In addition, VMware Cloud Foundation on VxRail enables customers to take advantage of VxRail Additional Ecosystem Advantages, which include:

- **Dell PowerSwitch with OS10**  
VxRail has been qualified with Dell PowerSwitch with OS10 Enterprise Edition networking switches. For information about deploying Dell network switches for VMware Cloud Foundation on VxRail, see [Appendix A: References](#). In addition, tools such as the Dell Networking Fabric Design Center are available to help create the right network architecture based on a customer's requirements.

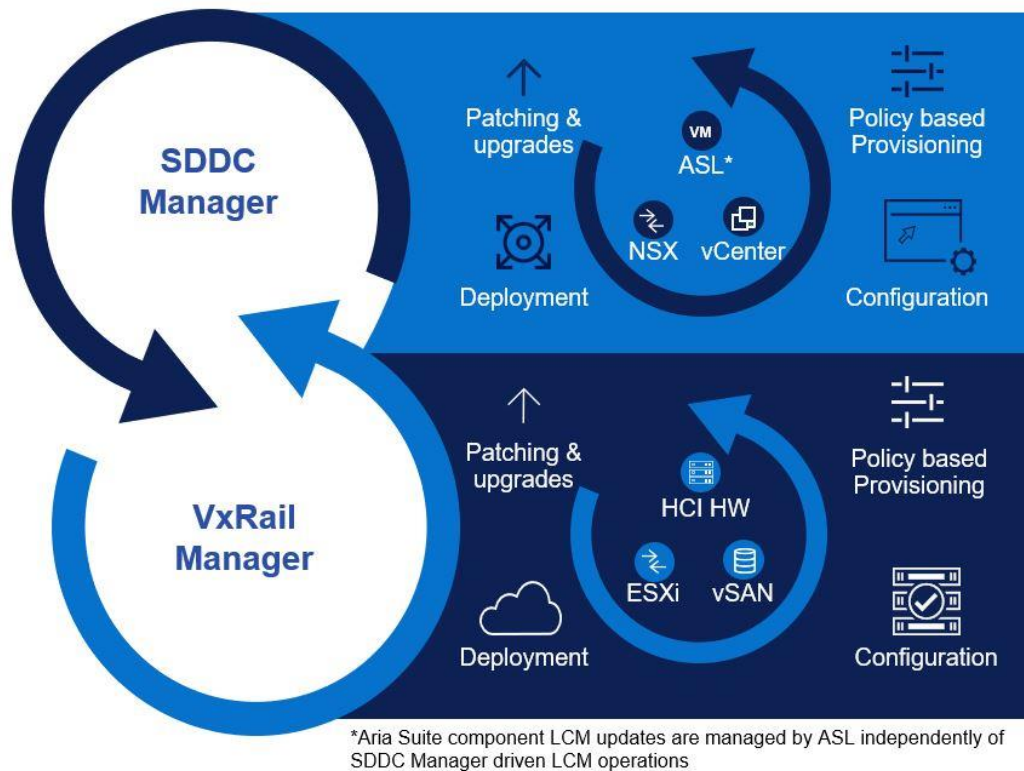
- **Dell External Storage Integration**

VMware Cloud Foundation on VxRail deployments can inherit the benefits of integration efforts engineered between VxRail and Dell external storage systems with the support of VxRail dynamic nodes with Dell PowerMax, VMAX, PowerStore-T, and Unity XT systems. This enables administrators to leverage existing Dell external storage investments in their VMware Cloud Foundation on VxRail environments while maintaining a simple and consistent operations experience. In a VMware Cloud Foundation on VxRail use case, the integration of VxRail dynamic nodes with Dell external storage is taken to the next level with the co-engineered integration between VMware Cloud Foundation, VxRail, and external storage configuration support. With the introduction of VxRail dynamic nodes, Dell PowerMax, VMAX, PowerStore-T, and Unity XT storage can be used as a VxRail cluster's principal storage. VMware Cloud Foundation is now aware of these dynamic nodes with external storage. It can automate the creation of a VI Workload Domains (VI WLDs) and the addition of VxRail dynamic node-based clusters into existing VI Workload Domains using the Dell external storage as the principal storage for those workload domain VxRail clusters. Customers now have additional flexibility on which type of storage (VxRail nodes with vSAN or VxRail dynamic nodes with VMFS on FC) they would like to use for their VI WLD clusters' principal storage that best meets their workload requirements.

## Integrated platform management

The SDDC Manager and the VxRail Manager software integration allows the VMware Cloud Foundation to build a complete SDDC on VxRail. The SDDC Manager orchestrates the deployment, configuration, and life cycle management of vCenter, NSX, and VMware Aria (formerly vRealize Suite, resulting from integration with VMware vRealize Suite Lifecycle Manager) above the ESXi and vSAN layers of VxRail. It unifies multiple VxRail clusters as workload domains or as multicluster workload domains. Integrated with the SDDC Manager management experience, VxRail Manager is used to deploy, configure, and life cycle manage ESXi, vSAN, and hardware firmware. It takes advantage of the native VxRail Continuously Validated State update bundle framework, which is only available through the VxRail HCI System Software. The deployment of VxRail clusters uses the native VxRail Manager first run cluster creation process. VxRail life cycle management is integrated into the SDDC Manager orchestrated LCM workflows that use the VxRail Manager to perform it natively. VxRail Manager also monitors health of hardware components and provides remote service support.





**Figure 4. VxRail Manager and SDDC Manager integration**

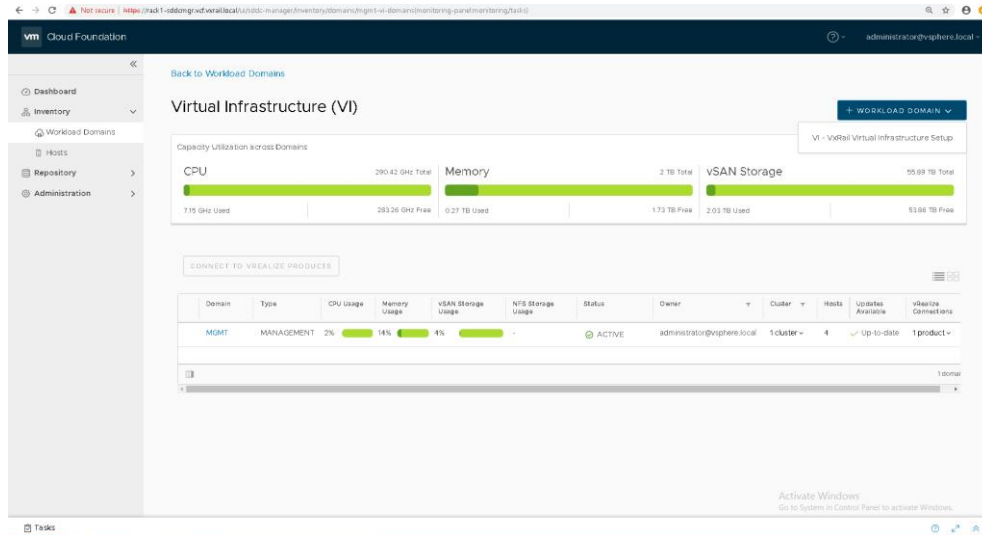
**Scalable and flexible platform for heterogeneous workloads**

Through the standardized hardware and software architecture integrated into VMware Cloud Foundation on VxRail, customers can build heterogeneous workloads. Using the SDDC Manager, infrastructure building blocks based on native VxRail clusters are created that can incrementally scale up and out.

Starting with four nodes, customers can scale up leveraging the flexible hardware configurations available within a VxRail node to increase storage capacity or memory. Similarly, customers can scale out by adding nodes in single node increments to a cluster. The physical compute, storage, and network infrastructure becomes part of a single shared pool of virtual resources that is managed as one cloud infrastructure ecosystem using the SDDC Manager. From this shared pool, customers can organize separate pools of capacity into workload domains, each with its own set of specified CPU, memory, and storage requirements to support various workloads. As new VxRail physical capacity is added, the SDDC Manager recognizes the added capacity and makes it available for consumption as part of a workload domain.

In VMware Cloud Foundation, two types of workload domains can be deployed: a VxRail virtual infrastructure (Virtual Infrastructure) workload domain and a special workload domain called the Management domain. VI workload domains can be created using the SDDC Manager UI or API. This VCF automated process has been co-engineered by design to integrate SDDC Manager with the VxRail API to automatically deploy VxRail HCI clusters and maintain a consistent operational experience for VxRail customers. Each workload domain can have administrative tasks that are performed against it such as create, expand, and delete. All of which are fully integrated into the VxRail API to drive a consistent HCI infrastructure operations experience using native VCF management

tooling. (Note: The management domain is the only one that is not allowed to be deleted; and it is created during initial system install, also known as “VCF Bring Up”). Figure 5 displays the SDDC Manager UI Workload Domain details screen after clicking the **+ WORKLOAD DOMAIN** button in the upper right, with the option showing the VxRail integration to create a **VxRail Virtual Infrastructure Setup**.



**Figure 5. Launching the create VxRail VI workload domain dialog in SDDC Manager**

The platform also supports the deployment of what is known as a VCF consolidated architecture. This is an attractive proposition for customers who value reduced footprint of the cloud platform rather than clear separation of management infrastructure from workloads. In the consolidated architecture, customer’s workloads co-exist within the management workload domain, reducing the entry point to as little as four nodes at the expense of physical separation of management and flexibility of life cycle management upgrades. Conversion from the consolidated to the standard architecture is supported as the need for environment expansions arises. Currently, the conversion process requires a Dell Professional Services engagement.

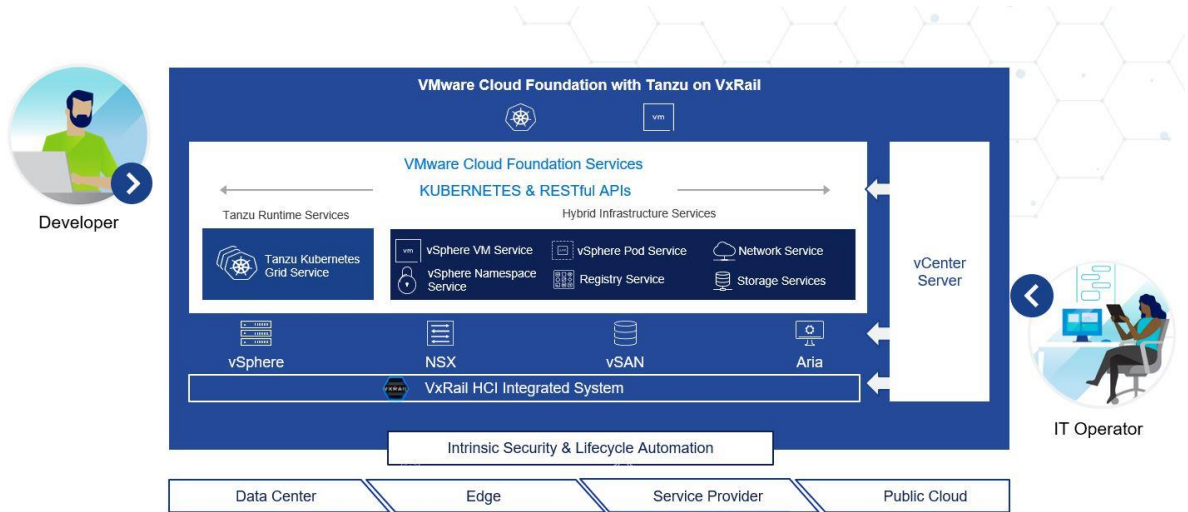
Customers may choose to enable VMware Cloud Foundation with Tanzu functionality on both VxRail virtual infrastructure workload domain and the Management Domain.

### Support for Kubernetes-based cloud native platform services

VMware Cloud Foundation 4.0 on VxRail 7.0 introduced a major architectural upgrade to the platform. The biggest innovation in this version is VMware Cloud Foundation with Tanzu, providing native integration of Kubernetes directly into the vSphere hypervisor. This integration delivers a new set of VMware Cloud Foundation services, including VMware Tanzu Runtime Services and Hybrid Infrastructure Services, providing the basis for the cloud infrastructure and container ecosystems to accelerate developer productivity.

On VMware Cloud Foundation 4.0, virtual infrastructure administrators get unified visibility of virtual machines (VMs), containers, and Kubernetes clusters directly in vCenter Server, which is also the standard management console for VxRail, they are familiar with. Containers and Kubernetes are managed alongside VMs from the same console and the concept of Kubernetes namespace is integrated into vSphere, becoming the unit of management. Resource objects, such as VMs and containers can be grouped into logical applications using namespaces, simplifying the management of cloud-native workloads at

scale. Administrators can set policies, quota, and role-based to a namespace, allowing developers to access the namespace within the predefined boundaries.



**Figure 6. VMware Cloud Foundation with Tanzu on VxRail (services view)**

Developers can also create Supervisor Clusters and Guest Clusters. Supervisor Clusters run Kubernetes natively on ESXi for better container performance and integration, while Guest Clusters run Kubernetes in Tanzu Kubernetes Grid (TKG) clusters on VMs. Similar to VMware administrators who can manage Kubernetes environment in vSphere using their native management tools (such as vCenter), developers can consume cloud resources such as Kubernetes clusters, disks, and networks using familiar Kubernetes CLI and API tools (see Figure 6).

The following list summarizes the key benefits of VMware Cloud Foundation with Tanzu functionality that is introduced in VMware Cloud Foundation 4.0:

- **Application-focused management brings VMs and containers onto the same platform:** Using the same platform enables unified visibility of VMs, containers, and Kubernetes clusters in vCenter and integrates Kubernetes namespace concept as the management entity into vSphere.
- **Enterprise-class resiliency, QoS, security, and access control for both VMs and containers:** Administrators can define QoS, security policies, firewall rules, encryptions settings, availability and backup rules, and access rules at namespace level; also, NSX integration with Kubernetes enables context-aware security policies with namespace isolation.
- **Developer self-service APIs to boost productivity:** Developers can create and consume cloud resources such as Kubernetes clusters, volumes, and networks with VMware Cloud Foundation Services using Kubernetes and RESTful APIs.
- **Rapid application deployment with full-stack agility:** VMware Cloud Foundation automates deployment not only of the underlying infrastructure (workload domain), but also Kubernetes components.
- **Enhanced infrastructure life cycle management:** Automated life cycle management on a per-workload domain basis enhances functionality.



- **Full-stack networking and intrinsic security at every layer of the stack:** For example, container registry from Tanzu Kubernetes Grid has integrated vulnerability scanning, image signing, and auditing (container image layer). It also has vSphere comprehensive security for protecting data, infrastructure, and access (compute layer) and NSX delivering micro-segmentation and granular security to the individual VM or pod workload (network layer).
- **Cloud operating model extending across private and hybrid cloud:** The same SDDC stack that is leveraged in private cloud deployments of VMware Cloud Foundation is also the underpinning technology of VMware-based public cloud offerings, resulting in consistent infrastructure and operations. These offerings include VMware Cloud on AWS, other VMware Cloud Provider Program partners, and VMware Cloud on Dell.

VMware vSAN as a core component of VMware Cloud Foundation on VxRail includes a CSI driver that enables developers to provision persistent storage for Kubernetes on vSphere on-demand in an automated fashion. VMware administrators can manage container volumes through the Cloud Native Storage UI within VMware vCenter as if they were VM volumes. Developers and IT administrators can have a consistent view of container volumes and troubleshoot at the same level.

Cloud Native Storage through the CSI driver on vSAN is natively integrated into the vCenter and provides comprehensive data management for both stateless and stateful applications. Customers using cloud native storage can create containerized stateful applications capable of surviving container restarts and outages. Stateful containers leverage storage exposed by vSphere that can be provisioned using Kubernetes primitives such as persistent volume, persistent volume claim, and storage class for dynamic provisioning.

NSX, another key component of VMware Cloud Foundation stack, removes the need for end users to understand underlying network architecture. Networking can be easily managed with Kubernetes clusters—deployment, upgrade, and scaling out. NSX can automatically create load balancers, routers, and switches to be used by Tanzu. It also provides end-to-end security by firewalls, namespace isolation, and more.

## VxRail HCI System Software and VxRail Manager

VxRail HCI System Software consists of multiple, integrated software elements. They extend VMware native capabilities to deliver a seamless and automated operational experience, keeping the infrastructure in a prevalidated configuration to ensure that workloads are consistently up and running. VxRail HCI System Software is preinstalled on the VxRail system as a single virtual machine, the VxRail Manager VM.

The software services in VxRail HCI System Software can be grouped into three main areas: life cycle management (LCM) for predictable outcomes, management flexibility and extensibility, and simplified services and support experience.

### Life cycle management for predictable outcomes

- Intelligent LCM functionality automatically updates clusters with prevalidated, pretested software and firmware components, ensuring that the HCI stack is in a Continuously Validated State.
- The electronic compatibility matrix serves as a compliance asset, providing validation that all possible configuration and update path permutations are sound.

Customers can choose the Continuously Validated State of their choice to optimize each cluster for its respective workloads.

- Ecosystem connectors tightly integrate with infrastructure components, including vSAN, PowerEdge server components, and networking. This integration enables automation and orchestration services across the entire stack for simple cluster software and firmware updates.

### **Management flexibility and extensibility**

- VxRail Manager, which is natively integrated with and accessed through vCenter, is the overall management engine for all VxRail operations. VxRail Manager is used to deploy, manage, update, patch, and add nodes to a cluster.
- SaaS multicluster management is designed to provide centralized multi-cluster management powered by AI-driven operations insights through a software-as-a-service delivery model. The continuous innovation and continuous delivery approach allows for frequent, incremental updates to introduce new capabilities. SaaS multicluster management provides detailed health checks and predictive analytics. SaaS multicluster management further simplifies the VxRail cluster update process with on-demand pre-update health checks, update bundle download and staging, and cluster updates at scale.
- A broad set of publicly available RESTful APIs are provided to customers to deliver greater cloud and IT automation extensibility.

## Simplified services and support experience

Customers always have access to Dell Secure Remote Services for all included hardware and software within VxRail throughout the entire life cycle of the infrastructure.



**Figure 7. Core components of VxRail HCI System Software**

When used for a cloud deployment use case, the VxRail HCI System Software sits in between the infrastructure layer and cloud orchestration software. Local management features include vCenter Plug-ins, life cycle management, serviceability using eServices and Secure Remote Gateway, and health alerts. The extensibility of VxRail HCI System Software is available to VMware SDDC solutions like VMware Cloud Foundation including backend APIs, SaaS multicluster management, and open REST APIs for configuration management solutions such as Puppet and Ansible.

### VxRail Manager

VxRail Manager features user-friendly workflows for automating VxRail deployment and configuration and for monitoring the health of individual systems in the entire cluster. VxRail Manager also incorporates functionality for hardware serviceability and system platform life cycle management. For instance, it guides system administrators through the process of adding systems to an existing cluster, and it automatically detects new systems when they come online. VxRail Manager is also used to replace failed disk drives without disrupting availability to generate and download diagnostic log bundles and apply VMware updates or software patches nondisruptively across VxRail nodes.

With the VxRail Manager plug-in for vCenter Server, all VxRail Manager features are integrated with and accessible from the vCenter Server so that users can benefit from them on a familiar management interface. With the VxRail Manager plug-in, the vCenter Server can manage physical hardware of the VxRail cluster.

VxRail HCI System Software simplifies system platform life cycle management by delivering patch software and update notifications that can be automatically installed without interruption or downtime.

The VxRail Manager functionality visible through the HTML5 vCenter plug-in is illustrated in the following screenshots. Figure 8 displays a vCenter view showing the VMware Cloud Foundation management domain that is built on VxRail clusters.

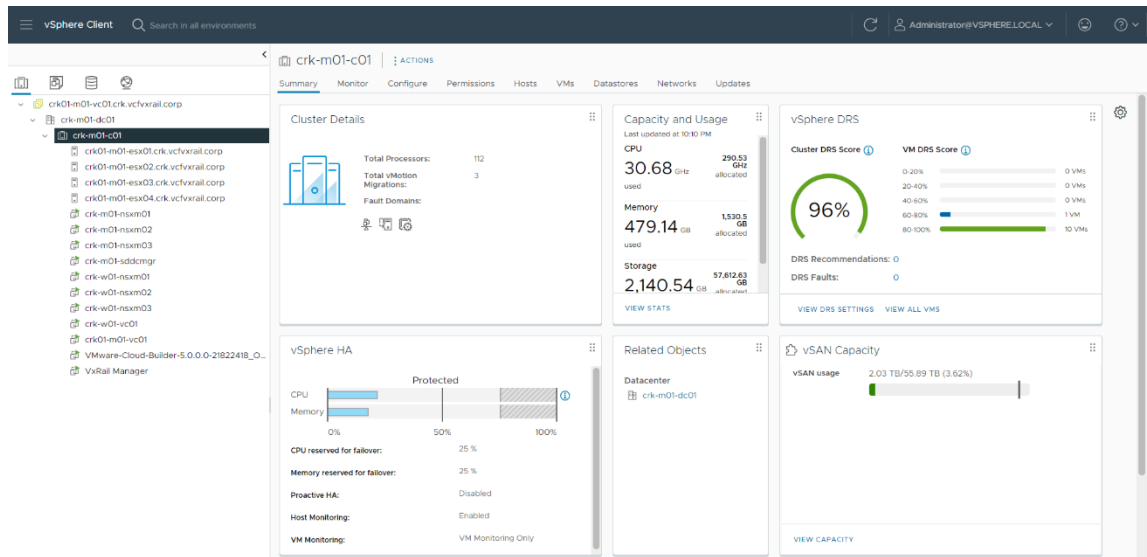


Figure 8. vCenter view showing VMware Cloud Foundation management domain

Figure 9 shows the top level four node management cluster VxRail hardware view.

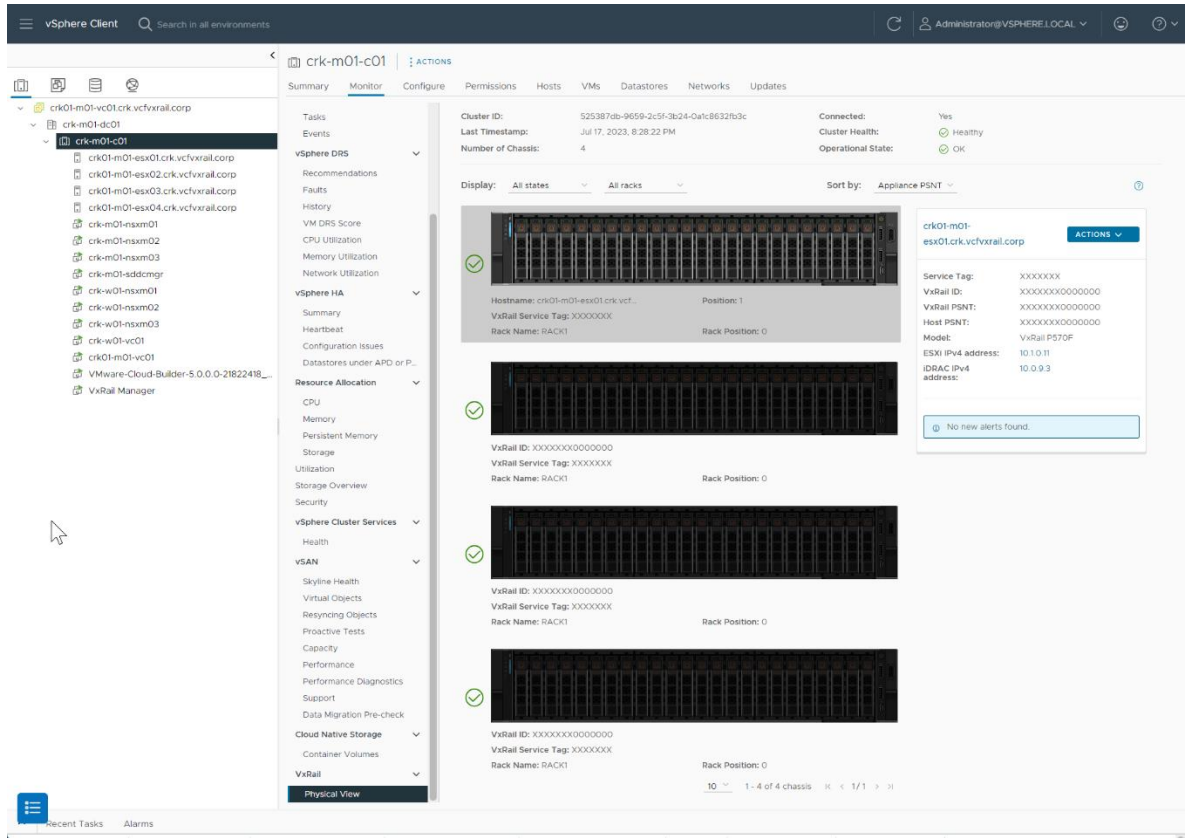


Figure 9. VxRail cluster physical view

Drilling down on the physical views can display additional details. For example, Figure 10 shows a hardware view used for disk hardware replacement.

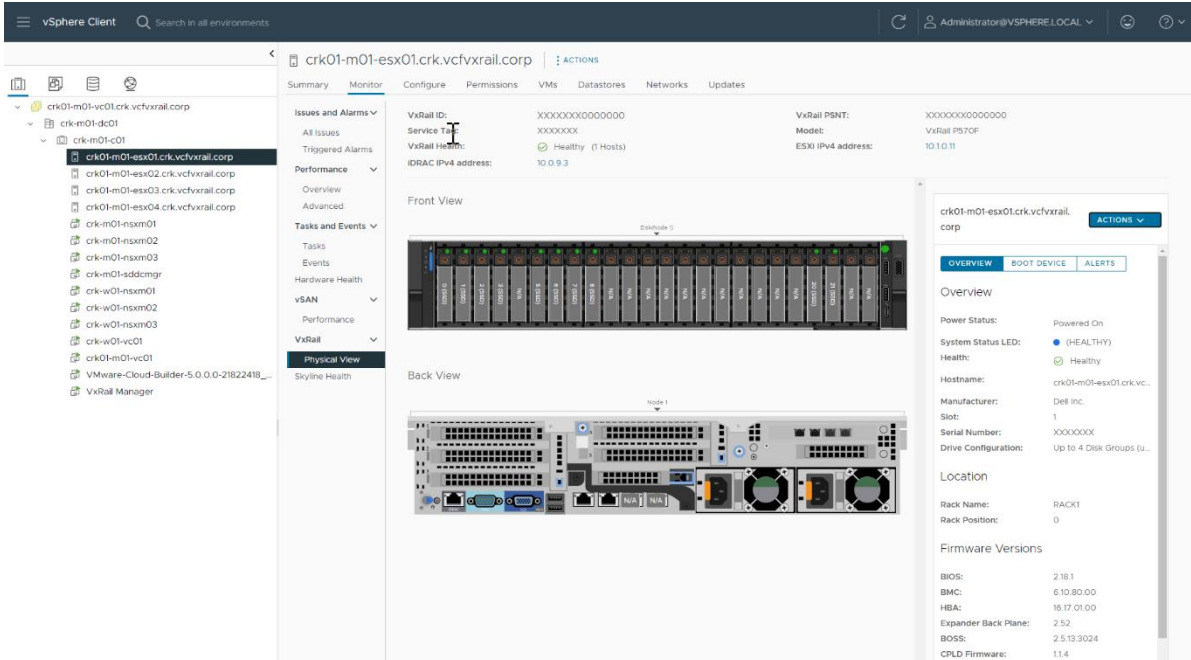
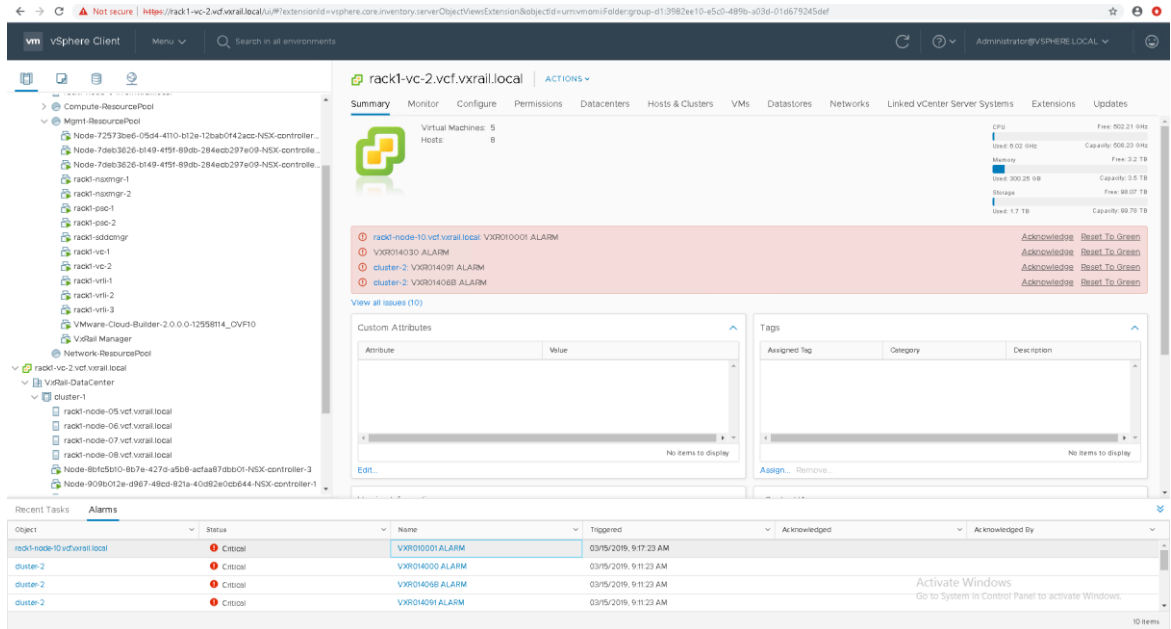


Figure 10. VxRail disk hardware replacement screen

Detailed VxRail hardware component level events and alerts are collected by the VxRail Manager and displayed in vCenter as part of the integrated vCenter HTML5 plug-in. This provides holistic, system-level health awareness within the SDDC management framework. Failure events are passed to vCenter. Alarms from VxRail start with the prefix 'VXR.' Figure 11 shows an example in vCenter that displays VxRail hardware alarms.

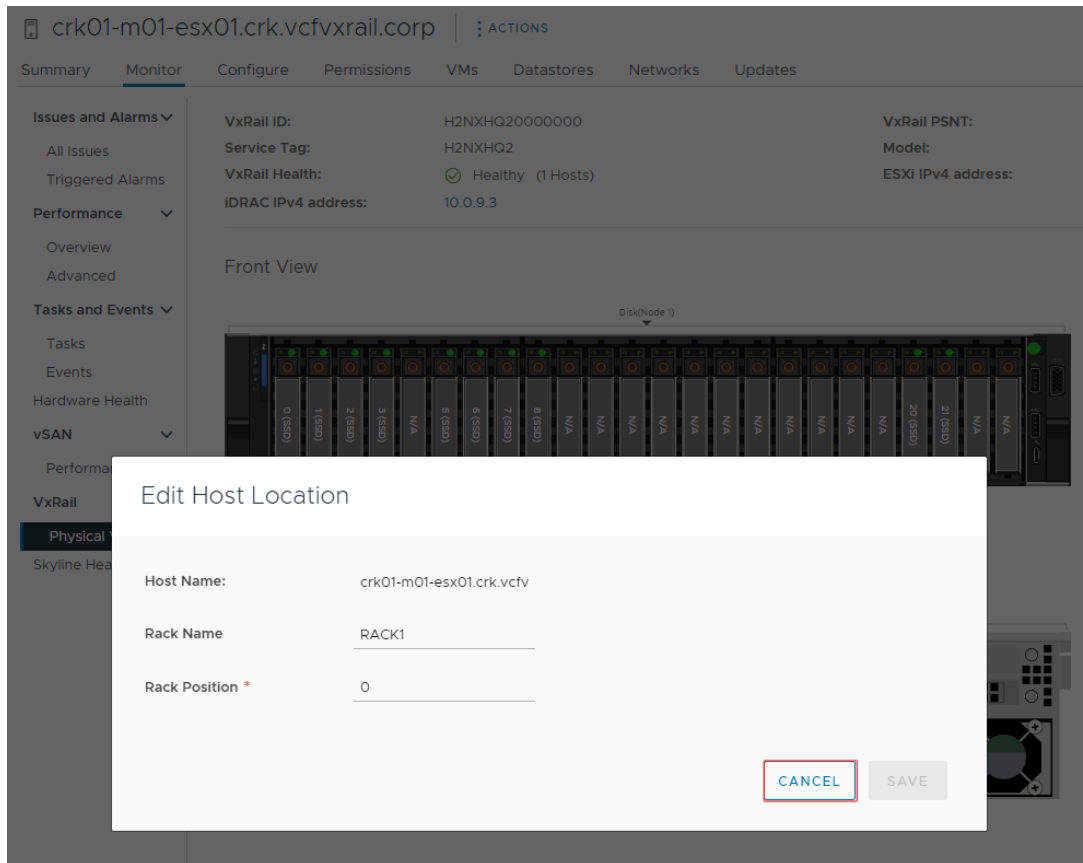


**Figure 11. Example of VxRail hardware alarms in the vCenter HTML5 plug-in**

VxRail HCI version 7.0.010 introduced support for geographic location tags for VxRail nodes. The capability allows for important user-defined node metadata that can assist many customers in gaining greater visibility of the physical location mapping of the HCI infrastructure that makes up their cloud. Customers can leverage this data to choose the node/host order to be displayed in the VxRail Manager vCenter plug-in Physical View. These geo location host attribute tags can be applied during VxRail Day 1 cluster installation or during node expansion and host edit Day 2 operations (see Figure 12).

This functionality provides customers with full-stack physical-to-virtual infrastructure mapping to help further extend the VMware Cloud Foundation management experience and simplify operations only available with VMware Cloud Foundation on VxRail.

In addition, VMware Cloud Foundation 4.5 on VxRail 7.0.400 (and higher) allows customers to add user-defined tags to VCF objects within SDDC Manager. For instance, administrators can add user-defined tags to cluster objects for a logical grouping based on location, type of environment, workload, and so on.



**Figure 12. Example of VxRail geo location host tags in the vCenter plug-in**

## REST APIs

VxRail HCI System Software includes APIs that enables customers to leverage the full power of automation and orchestration services across data centers. This extensibility allows infrastructure to operate with cloud-like scale and agility and streamlines the integration of the infrastructure into your IT environment and processes. Instead of manually managing environments through the user interface, repeatable operations can be triggered and performed programmatically by software. More customers are embracing DevOps and Infrastructure as Code (IaC) models as they need reliable and repeatable processes to configure the underlying infrastructure resources required for applications. IaC leverages APIs to store configurations in code, making it repeatable and reduces error risk.

VxRail API is a feature of VxRail HCI System Software that exposes management functions with a RESTful application programming interface. It is to simplify VxRail customer and ecosystem partner experiences, who would like to integrate third-party products with a VxRail system.

VxRail API was designed to complement VMware REST APIs, such as vSphere Automation API, and focuses on the underlying infrastructure and unique automated life cycle management capabilities. VxRail API can be used with VMware Cloud Foundation on Dell VxRail API, which is supported since version 4.0 of the platform. Most of the operations that required SDDC Manager UI can now be performed using API. This is an area of extensive development with new capabilities growing over time important



especially for service providers, who are leveraging VMware Cloud Foundation on VxRail as a platform to deliver cloud-based services for their customers.

To learn more about VxRail API, see this [solution overview](#). For more information about VMware Cloud Foundation on VxRail API, see the API [reference guide](#).

## Integrated life cycle management

Data center upgrades and patch management are typically manual, repetitive tasks prone to configuration and implementation errors. Validation testing of software and hardware firmware to ensure interoperability among components when one component is upgraded requires extensive quality assurance testing in staging environments. IT must sometimes make the difficult decision to deploy new patches before they are fully vetted or to defer new patches, which slow down the roll-out of new features, security, and fixes. Both situations increase risk for the customer environment.

Learning about the VMware Cloud Foundation concept of a Workload Domain can help customers better understand life cycle operations details. A Workload Domain is a policy-based resource container with specific availability and performance attributes that combines compute (vSphere), storage (vSAN), and networking (NSX) into a single consumable entity. In the case of running VMware Cloud Foundation on VxRail, these workload domains are built using VxRail clusters and leverage the native VxRail operations experience for tasks such as automated cluster builds and cluster expansions as examples.

Infrastructure building blocks can be created based on native VxRail clusters that can scale up and out incrementally. Customers can scale up leveraging the flexible hardware configurations available within a VxRail node to increase storage capacity or memory. Customers can similarly scale out by adding nodes in single node increments to a cluster. The physical compute, storage, and network infrastructure becomes part of a single shared pool of virtual resources that is managed as one cloud infrastructure ecosystem using the SDDC Manager.

From this shared pool, customers can organize separate pools of capacity into workload domains, each with its own set of specified CPU, memory, and storage requirements to support various workload types such as cloud native, VDI, or business critical applications, such as databases. As new VxRail physical capacity is added, it will be recognized by the SDDC Manager and be made available for consumption as part of a workload domain. Scaling workload domains beyond a single cluster gets even easier with the ability to add multiple VxRail clusters within a workload domain.

As mentioned previously, Workload Domains can be created, expanded, and deleted. They can also be upgraded independently, providing customers with the flexibility to align workload domain infrastructure requirements to the applications running on them. This can be done even at the individual cluster level within a domain. With VMware Cloud Foundation, all life cycle management occurs at the workload domain level, enabling flexibility to mix and align workloads to the appropriate underlying infrastructure dependencies.

### Life cycle management end-to-end process details

VMware Cloud Foundation on VxRail leverages both the native VMware Cloud Foundation and VxRail HCI System Software update bundles for its updates. This allows customers to take advantage of new platform features faster. There is no proprietary



package that must be generated to run VMware Cloud Foundation on VxRail that would delay the availability of these updates from being published for customer consumption when the updates are available. This allows both VMware and Dell to innovate faster within their respective layers asynchronously, updating the features without affecting the other layers of the platform stack. It also means that VMware and Dell can continue to leverage their respective streamlined development and release processes for both VxRail and VMware Cloud Foundation independently.

VxRail life cycle management is built on ecosystem connectors to integrate vSAN cluster software and PowerEdge server hardware so that the ESXi host can be managed as a single system. This system integration enables the automation and orchestration necessary to deliver nondisruptive, streamlined HCI stack upgrades. VxRail life cycle management delivers a differentiated value on its ability to deliver a prevalidated set of software and firmware that ensures compatibility and compliance of the entire configuration on HCI stack. It does that while maintaining the performance and availability required of the virtualized workloads running on the clusters.

Continuously Validated States describe the ability to test, validate, and produce a VxRail software bundle to support every vSphere release, any-to-any version upgrade path, and the millions of VxRail configurations. These Continuously Validated States are recorded on the Electronic Compatibility Matrix. The VxRail team's \$60 million in equipment investment with a team of more than 100 members dedicated to testing and quality makes this possible.

All VMware Cloud Foundation on VxRail life cycle updating and upgrade operations are orchestrated using SDDC Manager. It is responsible for monitoring the respective VMware and Dell support repositories where the VMware Cloud Foundation and VxRail update bundles are published. The various VMware Cloud Foundation update bundles include bundles for vCenter updates, NSX, SDDC Manager, and vRealize Suite Lifecycle Manager (vRSLCM). Aria Suite (formerly vRealize Suite) components (vRealize Automation, vRealize Operations, and vRealize Log Insight) are then updated by applying respective component update bundles using vRSLCM. Aria Suite has been engineered to be VMware Cloud Foundation aware, and VMware Cloud Foundation is Aria Suite aware. Each VMware Cloud Foundation release includes a qualified version of the vRSLCM in the release software bill of materials (BOM). The SDDC Manager can be used to optionally deploy the vRealize Suite Lifecycle Manager (vRSLCM) and, in doing so, establish a two-way communication channel between these two products. vRSLCM is then "VMware Cloud Foundation aware" and reports back to the SDDC Manager what vRealize components are installed.

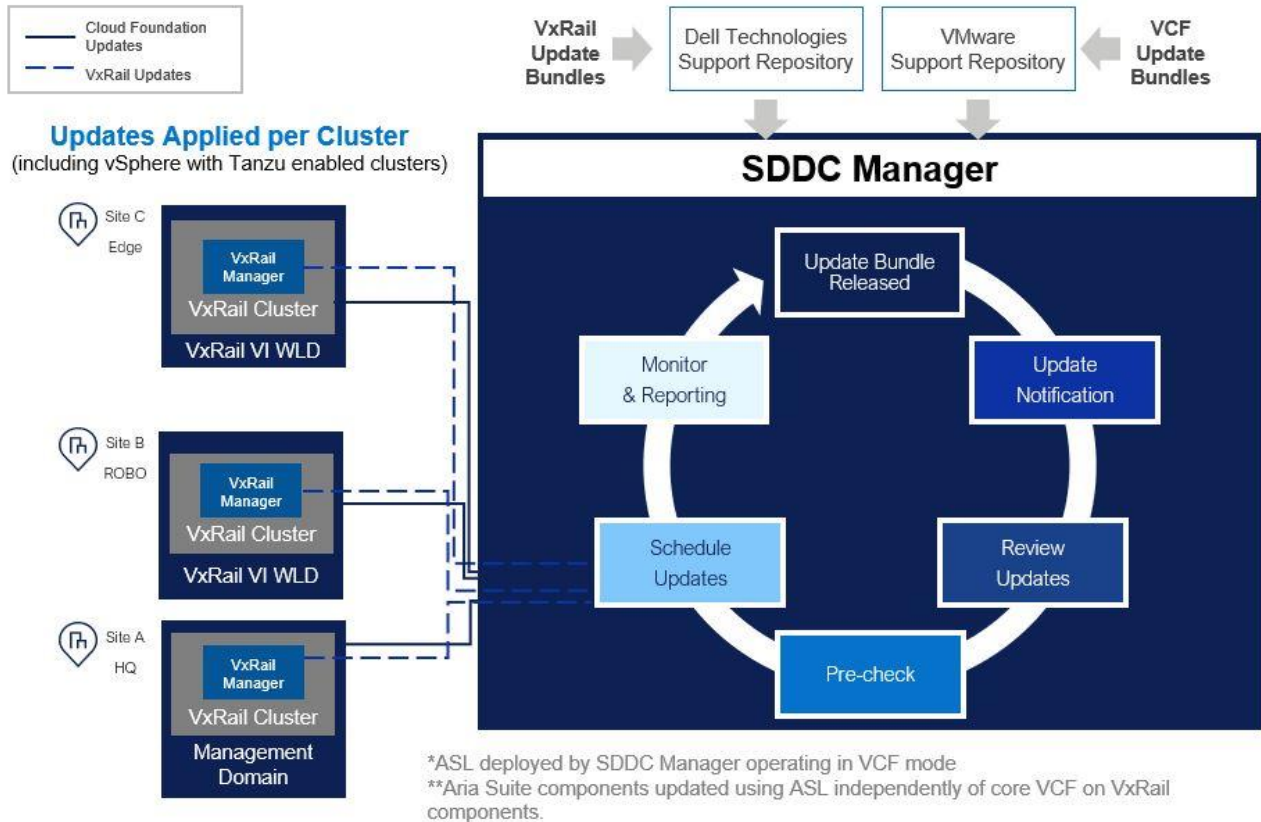
The native VxRail update bundle includes ESXi, vSAN, VxRail Manager, hardware firmware and drivers. As a part of this monitoring, SDDC Manager automatically discovers when new VxRail and VMware Cloud Foundation updates are available for download and proactively notifies the administrator accordingly within the user interface.

SDDC Manager will also ensure that all update bundles are automatically curated, guaranteeing visibility and access to only the updates that have been qualified and supported for the system configuration it is managing. For example, an update cannot be accessed for a workload domain until first applied to the management domain. SDDC Manager even controls the ordering of life cycle management updates to ensure that a bundle version cannot be applied without first verifying that all update pre-requisites are

met first. This helps mitigate risk so that the system is always at a known good state from one version to the next. This removes any need for the administrator to guess about valid releases or to cross-reference support matrixes to ensure update bundle compatibility across the system.

All updates are scheduled, performed, and orchestrated by SDDC Manager but may be performed by SDDC Manager or VxRail Manager using integrated APIs as shown in Figure 13.

Once a set of updates has been downloaded, SDDC Manager is used to schedule the updates to be applied to each of the workload domains in the environment independently.

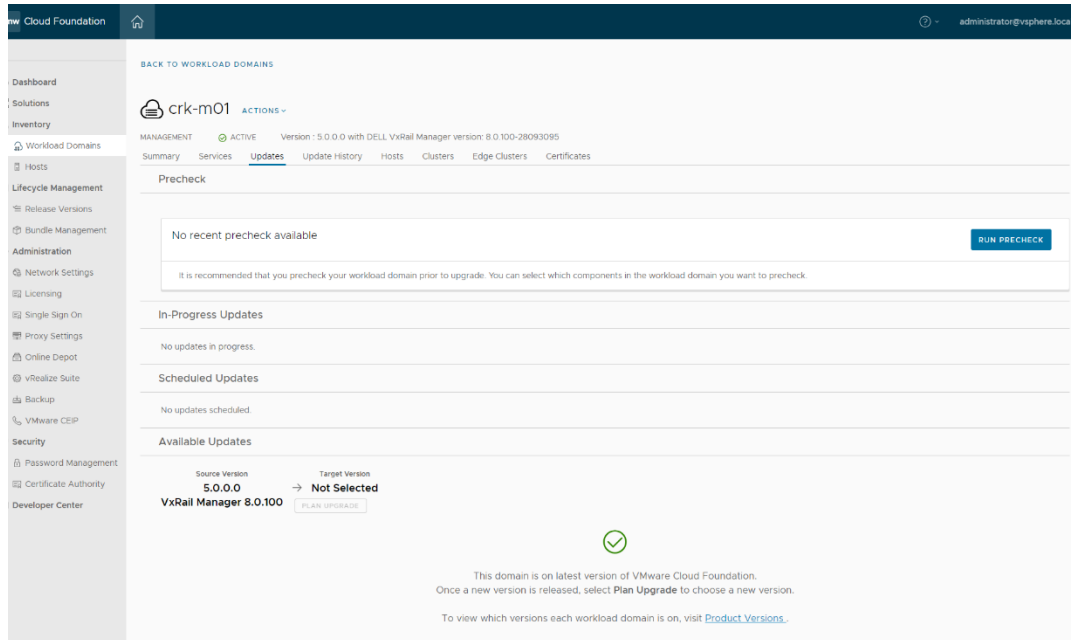


**Figure 13. SDDC Manager orchestrated life cycle management integrated with VxRail**

Lifecycle management in SDDC Manager can be applied to the Management Domain, which contains SDDC software stack or to individual workload domains and does not disrupt tenant virtual machines (VMs). Using live VM migration together with vSphere Dynamic Resource Scheduler (DRS), SDDC Manager can update software to improve infrastructure security and reliability. VMware and Dell perform extensive validation testing of the software stack before releasing software updates, which reduces risk and helps to instill confidence.

The SDDC Manager Lifecycle Management view provides notification of update availability and download of the update bundle. The SDDC Manager interface also provides for selecting update targets and scheduling the update. It is highly recommended to schedule updates at a time when the SDDC Manager is not in heavy use and avoid any changes to the domains until after the upgrade is completed.

Before starting the update, there are prerequisite tasks to ensure that the system is in a healthy state. The precheck utility can be manually triggered in the SDDC Manager update screen as shown in Figure 14.



**Figure 14. SDDC Manager Update screen example**

These VMware Cloud Foundation prechecks also natively integrate with VxRail Health Check APIs to capture native VxRail cluster-specific hardware and software health.

The update bundles can be scheduled for automatic installation which can be applied to any cluster within any workload domain across data centers and across the edge. Administrators can select and schedule which clusters in a multicluster WLD they want to update, essentially allowing for control over the order of which clusters get updated first in LCM operation. This allows the cloud administrator to target specific workloads or environments (development vs. production, for example) for updates independently of the rest of the environment.

For native VMware Cloud Foundation software updates, SDDC Manager performs the automated workflows that are required to apply those updates to the clusters within a workload domain.

For native VxRail updates, SDDC Manager orchestrates the LCM process for a given workload domain but leverages the native VxRail Manager that runs on each VxRail cluster in that workload domain to apply the VxRail update using integrated VxRail Manager REST API calls in the background. As VxRail Manager performs the cluster update, SDDC Manager monitors its progress, and the VxRail Manager will notify the user when the process is complete. In a multicluster workload domain example, this process of SDDC Manager automatically calling out a VxRail cluster's VxRail Manager APIs occurs automatically. It involves no administrator input until all clusters in the workload domain have been updated.

All these co-engineered features drive the full-stack integration life cycle management experience only available with VMware Cloud Foundation on VxRail. This integration

offers a true better together experience to help Dell customers simplify and accelerate their IT transformation.

VMware and Dell Technologies constantly strive to improve the automated life cycle management experience that is integrated in the platform. Starting with VMware Cloud Foundation 4.0.1 on VxRail 7.0, customers can upgrade specific clusters within a workload domain. This provides administrators with more flexibility in planning maintenance windows. VMware Cloud Foundation also supports NSX Edge cluster-level and parallel upgrades that offer more flexibility and efficiency in updating this critical component of the platform and better alignment with maintenance windows. VMware Cloud Foundation skip levels are also supported and can be performed from the SDDC Manager web-based UI. This provides additional efficiency by eliminating the requirement to install intermediate stepwise upgrades for customers who are performing LCM operations of the platform less often. The updated SDDC Manager LCM Manifest architecture also allows VMware and customers to respond more quickly to potential changes introduced in upgrade sequencing to provide more agility and further reduce risks related to software and hardware firmware upgrades.

To avoid any potential issues during LCM activities, VMware Cloud Foundation administrators can run SDDC Manager prechecks to weed out any issues before any LCM operation is run. VMware Cloud Foundation on VxRail includes an extensive set of integrated SDDC and VxRail specific health prechecks that have been integrated with the native SDDC Manager precheck workflows to identify many of the common system states that could cause LCM operations issues. Prechecks include password validity (including expired passwords), file system permissions, file system capacity, CPU reservation for NSX Managers, hosts in maintenance mode, and DRS configuration mode, among others. The following figure illustrates some examples of what these prechecks look like from the SDDC Manager UI.

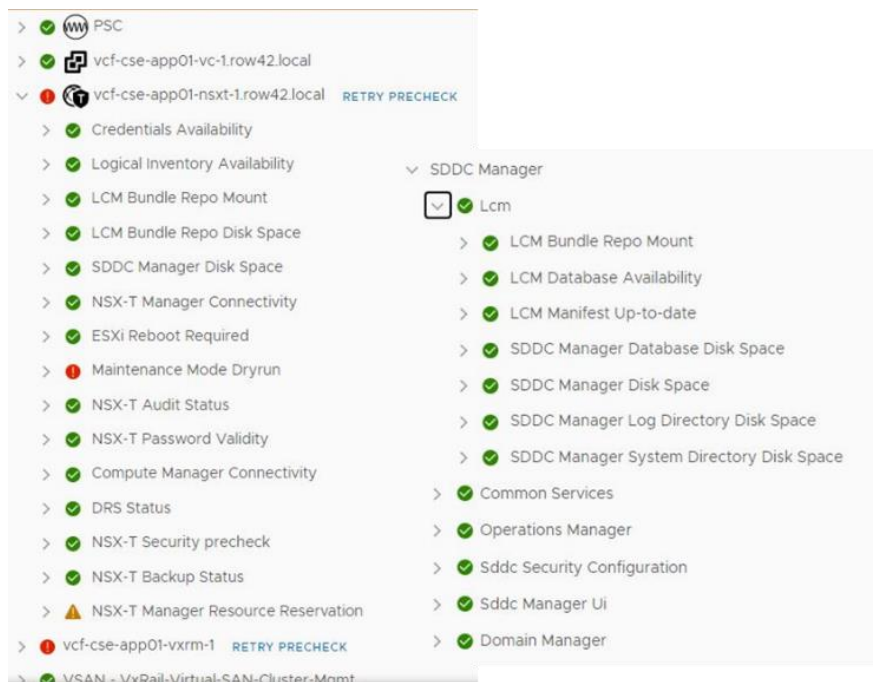


Figure 15. SDDC Manager prechecks

Recent VMware Cloud Foundation enhancements include the concept of flexible cloud management LCM operations. In VMware Cloud Foundation 4.4 and later, Aria Suite component updating and upgrading operations are managed independently from VMware Cloud Foundation using vRealize Suite Lifecycle Manager (vRSLCM) directly. Thus, administrators can upgrade Aria products independently from the core VMware Cloud Foundation upgrade to better align with business requirements. This functionality also helps simplify the core VMware Cloud Foundation upgrade process. Aria Suite upgrades do not have to be performed for a VMware Cloud Foundation upgrade if existing components are still compatible with the version being upgraded to. Thus, administrators have more flexibility on which Aria Suite components are updated and when they are updated.

Reducing maintenance window timelines is always a design goal for VMware Cloud Foundation on VxRail engineering teams to deliver on for IT teams. This is especially true in circumstances where an LCM operation has not fully completed for all hosts in a cluster. It would be inefficient, adding unnecessary time to maintenance windows, to have to start an LCM process from the beginning on hosts where an update was already successful. To avoid this situation, VMware Cloud Foundation on VxRail implements a jointly engineered LCM method that is available through the VxRail Retry API and is fully integrated with SDDC Manager. It adds logic that allows the new cluster LCM update retry function to target only the failed nodes. This enhancement drastically reduces LCM upgrade times and helps IT teams meet their maintenance windows, especially for VMware Cloud Foundation on VxRail deployments with many large workload domain clusters. It also demonstrates close collaboration and commitment from Dell and VMware engineering teams for continuous improvements of the platform based on customer feedback, and deep integration between VMware Cloud Foundation software and VxRail engineered system.

### **VMware Cloud Foundation Async Patch Tool support**

The VMware Cloud Foundation Async Patch Tool is a CLI-based tool that allows cloud administrators to apply individual component out-of-band security patches to their VMware Cloud Foundation on VxRail environment, separate from an official VMware Cloud Foundation LCM update release. This enables organizations to address security vulnerabilities faster without having to wait for a full VMware Cloud Foundation release update. It also gives administrators control to install these patches without requiring the engagement of support resources.

VMware Cloud Foundation on VxRail supports the ability to use the VMware Cloud Foundation Async Patch Tool for ESXi, vCenter, NSX, and VxRail Manager security patch updates. Once patches have been applied and a new VMware Cloud Foundation BOM update that includes the security fixes is available, administrators can use the tool to download the latest VMware Cloud Foundation LCM release bundles. They can then upgrade their environment to an official in-band VMware Cloud Foundation release BOM. Administrators can then continue to use the native SDDC Manager LCM workflow process to apply additional VMware Cloud Foundation on VxRail upgrades.

For information and interactive demonstrations on the LCM process and more, see [Interactive Demo: VMware Cloud Foundation on Dell VxRail](#).



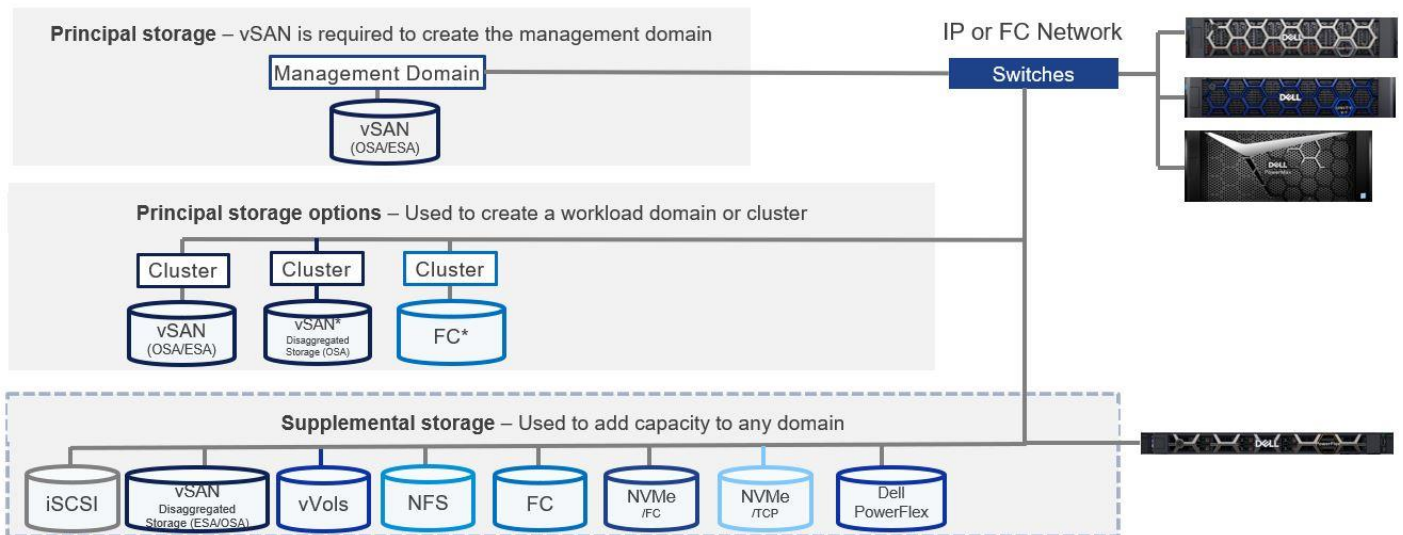
**External storage for VMware Cloud Foundation on VxRail**

VMware Cloud Foundation on VxRail supports the use of external storage to complement the use of vSAN storage that can be included with VxRail as principal storage. This is important for customers who have investments that are already made in existing external storage systems or have a use case in which external storage systems are required.

VMFS on FC external storage (such as Dell PowerMax, VMAX, PowerStore-T, and Unity XT) is supported as principal storage for VxRail VI workload domains. This capability has been integrated with SDDC Manager as part of VI WLD provisioning workflows allowing customers a choice in storage type that they would like to use when deploying VxRail dynamic node-based clusters into VI WLDs.

Customers can leverage their existing investments in IP, FC, or vVol based external storage and extend VMware Cloud Foundation on VxRail with additional capacity for use cases such as:

- Storage for applications that require particular data services that an external storage array can provide to meet workload requirements
- Data protection (file/image backups)
- Data at rest (templates, backups, archives)
- Workload and data migrations to VMware Cloud Foundation on VxRail from legacy environments
- General-purpose application storage



Note: Lifecycle management, patching, and upgrades of non vSAN-based external storage are not managed by SDDC Manager or VxRail Manager  
 \*Requires the use of VxRail dynamic node-based clusters



**Figure 16. VMware Cloud Foundation on VxRail supported storage**

The use of VMFS on FC Principal Storage (which includes FC-NVMe when using PowerMax and PowerStore-T systems) for VI workload domains is supported as of VMware Cloud Foundation 4.3.1 on VxRail 7.0.241 and higher. It supports PowerStore-T, PowerMax, VMAX, and Unity XT Primary FC storage systems only. Since this feature leverages FC, VxRail nodes must be configured with Dell VxRail qualified FC HBAs. Check the E-Lab Support Matrix and VxRail hardware compatibility documentation for the

latest supported firmware and software versions and supported VxRail hardware available.

The external storage as principal storage for VMware Cloud Foundation on VxRail feature is currently supported only with VxRail dynamic node-based clusters. Administrators can use IP, FC, and vVol external storage as supplemental cluster storage in all VMware Cloud Foundation domains to complement vSAN principal or VMFS on FC principal storage. In this case, VxRail dynamic node-based clusters or VxRail HCI node-based clusters can be leveraged.

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**Note:** Use of third-party FC storage systems for VMFS over FC Principal Storage in VMware Cloud Foundation on VxRail is not supported. However, third-party FC Storage Systems can be used as Supplemental storage. In all cases when FC storage systems are used, life cycle management of those systems is the responsibility of the administrator. It is not performed or managed by SDDC Manager or VxRail Manager.

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### VxRail flexible hardware configurations

VxRail nodes are available with different compute power, memory, and cache configurations to closely match the requirements of new and expanding use cases. As requirements grow, the system easily scales out and scales up in granular increments.

Dell delivers top of the line HCI portfolio purpose-built for HCI with the newest Dell PowerEdge server platform. This portfolio delivers tailor-made performance and reliability powerful enough for any workload, which is combined with an advanced approach to intelligent deployment and operations that simplify and accelerates IT. Dell HCI on next-generation PowerEdge servers provides the ideal foundation for software-defined data center initiatives.

With up to 150 integrated customer HCI requirements, PowerEdge servers are designed for and tailored to HCI workloads that depend on servers and storage. This results in a more consistent, predictable, and reliable high-performing HCI that can meet any use case. With a comprehensive portfolio, Dell can deliver the best fit for organization-specific HCI needs—from workload requirements, to customer environment, to deployment preferences.

Dell Technologies leads in hyperconverged sales with over 30 percent market share according to IDC.<sup>2</sup>

VxRail environments are configured as a cluster, with each node containing internal storage drives (VxRail with vSAN node cluster) or connected to an external storage (VxRail dynamic node cluster). VxRail systems are delivered with the software loaded, ready to attach to a customer-provided network. The system can be configured to match unique site and networking requirements by using a simple wizard at the time of install.

#### **VxRail with vSAN node cluster**

VxRail nodes are enclosed in a one-node, single-server system, with each node having one, two, or four multi-core processors and either all-flash solid-state disks (SSDs) or a hybrid mix of flash SSDs and hard disk drives. The nodes form a networked cluster with a minimum of two or three nodes for scale-out clusters with a maximum of 64 nodes.

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<sup>2</sup> Based on IDC converged Tracker Q1 2018, June 2018

**VxRail dynamic node cluster**

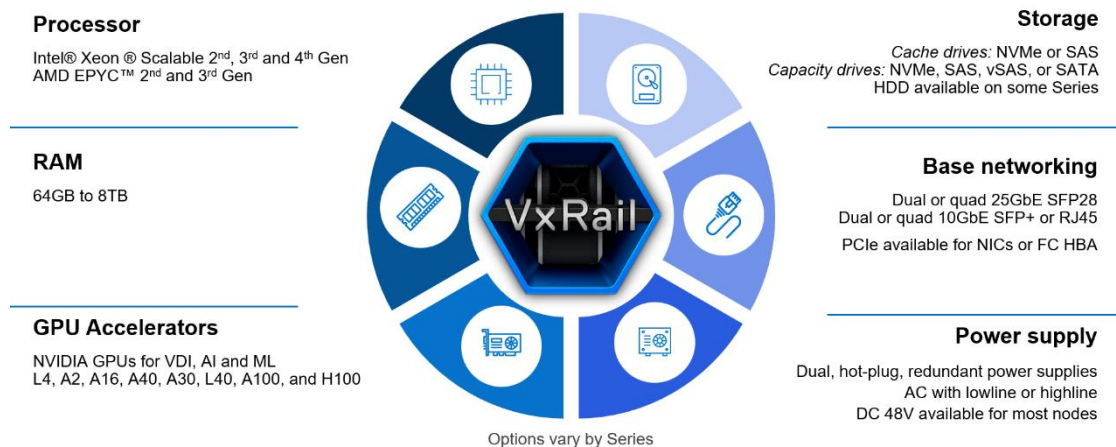
VxRail dynamic nodes are VxRail systems that are compute-only nodes used to form a vSphere cluster. Dynamic node clusters rely on external storage resources for their primary storage. External storage resource types can be remote datastores from vSAN clusters using VMware vSAN HCI Mesh or datastores from storage on Dell storage arrays such as PowerStore-T, PowerMax, Unity XT, and PowerFlex.

Dynamic node clusters further extend the workload types that VxRail can address. Customers can deploy VxRail for workloads that might require enterprise storage-level data protection and resiliency or that can benefit from independent scaling of compute and storage for better cost economics. Customers can continue to store the workloads on an enterprise array while benefitting from the VxRail simplified LCM. For applications that might be compute-intensive or storage-intensive, with VMware vSAN HCI Mesh, customers can use a mix of compute clusters and vSAN clusters that can result in better resource utilization and optimized license costs. When VxRail is used to form vSphere and vSAN clusters, customers can benefit from a common operating model with VxRail HCI System Software.

VxRail dynamic nodes are compute-only nodes running ESXi. Internal storage is not supported, so a vSAN license is not required. VxRail HCI System Software is responsible for the LCM of the node. LCM of the storage array is separate. VxRail dynamic nodes are available with the E660F, P670F, and V670F VxRail models. All configuration options that come with these models, except for cache and capacity drives, are available.

All Dell VxRail systems offer a choice of Dell PowerEdge servers, powered by new Intel® Xeon® Scalable and AMD EPYC processors, variable RAM, and storage capacity, allowing customers to make immediate purchases based on their specific needs. Single-node scaling and storage capacity expansion provide a predictable, “pay-as-you-grow” approach for future scale up and out as business and user requirements evolve.

Figure 17 shows the comprehensive set of options available across the PowerEdge family. Customers can be assured that their VxRail system is configured to best match their workload requirements, with millions of possible configuration combinations in the VxRail model series family. Available configuration options are different between standard VxRail nodes and VxRail dynamic nodes. For more information about VxRail hardware configurations, see the [Dell VxRail System TechBook](#).



**Figure 17. Component options available across the VxRail System**

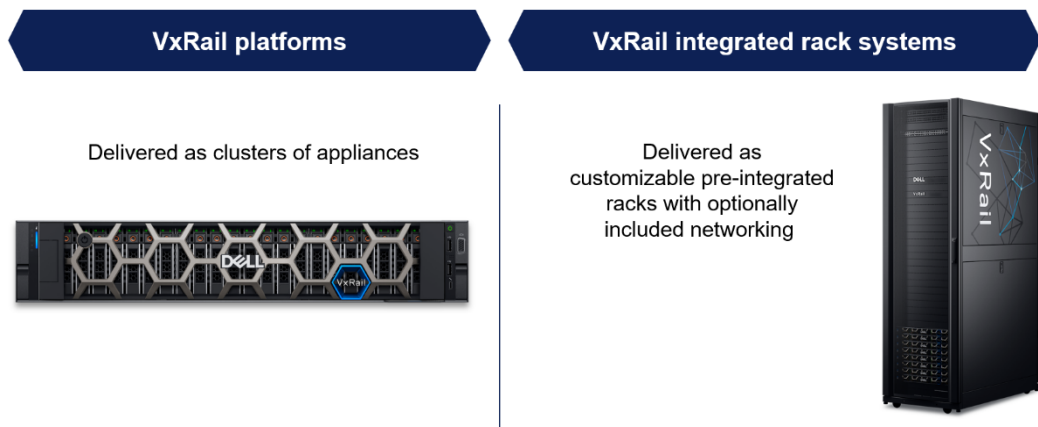


VxRail automated life cycle management enables scale out where new nodes can be added nondisruptively and different models can be mixed within a VxRail cluster. By adding the latest technology nodes into existing clusters and decommissioning aging nodes, an evergreen HCI environment can be obtained which removes necessity of costly SAN data migrations. Flexible storage options also allow a node to start with a few drives and add drives as capacity requirements grow. Nodes may also be scaled-up where the VxRail nodes can be nondisruptively upgraded with additional memory, GPU, NIC cards, cache SSD, and capacity drives to meet changing requirements.

## VxRail delivery options

VMware Cloud Foundation on VxRail can be delivered as either a cluster of nodes (platform) that leverages the customer's existing network infrastructure, or an integrated rack system with optionally included networking as shown in Figure 18.

These delivery packaging options can be used for all different customer use cases such as VxRail with vSAN HCI, VMware Cloud Foundation on VxRail, or VxRail edge use cases.



**Figure 18. VxRail delivery options**

### VxRail integrated rack delivery services options

Custom rack design configuration and integration services for VxRail integrated deployments are available for all customers looking to adopt any of the VxRail solution use cases and who need flexibility in rack design configurations to meet their needs. These services support customers using Dell or third-party networking hardware vendor equipment, or no networking at all. These services also support customers using Dell or third-party-supplied rack hardware.

Flexible Dell Technologies 2nd Touch Facility factory services give customers options on the rack and networking components they would like used. Customers can purchase from Dell Technologies, a rack from our Dell Technologies partner, APC, or supply their own consigned third-party rack. Customers also have a choice of network switches. Customers can purchase Dell PowerSwitch with OS10 EE switches from Dell Technologies or supply their own third-party switches. Any third-party consigned items supplied by the customer must be purchased separately by the customer outside of Dell Technologies. Support for those components would be provided by the component vendor. Depending on which components are used for the system, customers can choose the specific support experiences for their infrastructure.

## VxRail integrated rack delivery options

Custom rack integration factory services to meet a wide range of delivery needs



### Custom Rack Configuration and Integration Factory Service delivery options

- Customers looking to adopt any of the VxRail solution use cases and who need flexibility in rack design configurations to meet their needs.
- Supports customers using Dell or 3rd party networking hardware vendor equipment, or no networking at all
- Supports customers using Dell or non-Dell supplied rack hardware

Note: All VCF on VxRail deployments require professional services to deploy, install, and configure the entire VCF on VxRail HW/SW stack at the customer site

Rack Assembly Performed at 2<sup>nd</sup> Touch Facilities  
Fully Customized Configurations

**Figure 19. VxRail integrated rack delivery options**

Customers who choose the VxRail nodes deployment option maintain the responsibility for defining the networking and rack configuration as well as performing the work of physically racking and cabling the nodes and non-Dell, third-party product. In this option, VxRail nodes are shipped directly to the customer who will perform further rack integration work in their own data center.

A custom VxRail rack integration service option is available for customers who want a factory-integrated rack configuration delivery engagement in which they can define the networking and rack components in addition to VxRail node hardware and rack design configuration. This includes the use of third-party products performed in a Dell Technologies 2nd Touch Facility before shipping it to the customer.

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**Note:** For third-party components, the customer will be responsible for procuring and sending the products to a Dell Technologies 2nd Touch Facility for racking. This option supports all the available VxRail solution use cases.

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Customers who want specific turnkey VxRail cloud solution outcomes and who value fast delivery, within 14 days, can purchase one of the cloud solution offerings available within the APEX Cloud Services portfolio. These solutions are turnkey and are designed and packaged to provide the fastest time to value. They are delivered with prevalidated configurations and delivered in a rack whose rack components, VxRail node configurations, and rack configuration design are predefined by Dell Technologies to optimize delivery speed. For these solution offerings, customers have a choice of different pre-defined VxRail node hardware configurations that will be pre-racked as part of solution delivery. Available offerings include VMware Cloud Foundation on VxRail and VMC on Dell.

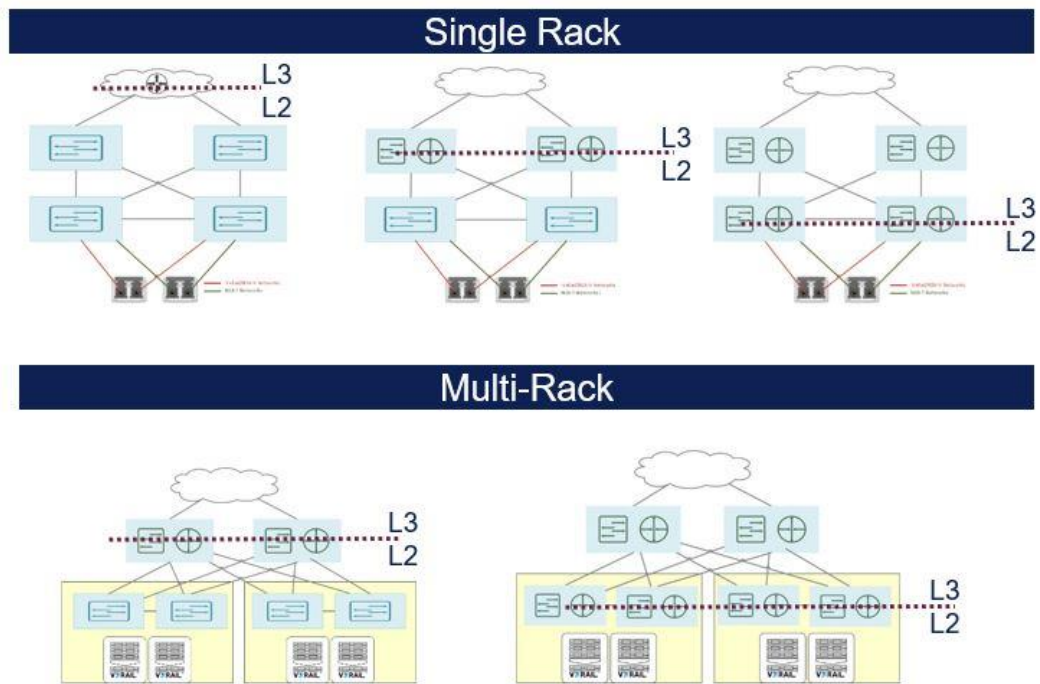
## Networking

VMware Cloud Foundation supports a network flexible architecture. Customers can choose switches that meet their organization's standard and scalability requirements. There is also increased flexibility in network configurations permitting customers to configure VLANs and other settings without fear of disrupting SDDC Manager's

automation or configuration. SDDC Manager does not require access to the physical network layer. Switches are manually configured by the customer’s network team or by the professional services engineer, if this part of implementation is also covered with a custom services engagement.

There are multiple VMware Cloud Foundation on VxRail network topology options. The choice of topology design depends on preferred outcomes. The most common network topology for VMware Cloud Foundation on VxRail follows a standard spine-leaf architecture. Decisions are required to determine where VLANs from the platform’s workload domains will terminate in the supporting physical network layer. Users must also determine the Layer 2 and Layer 3 boundary in multirack deployments.

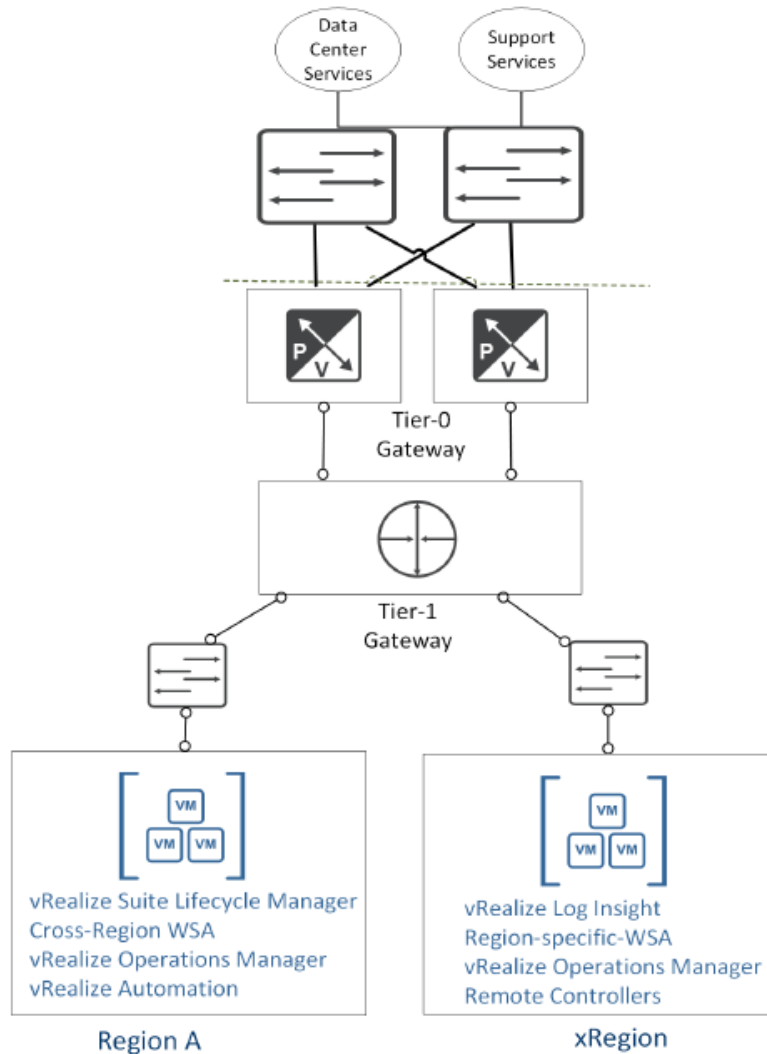
For more detailed documentation on network design options, see the VxRail Network Planning Guide and Architecture Guides and the Dell Networking Guides on the VxRail Knowledge Center and Dell support portal. For more information, see [Appendix A: References](#).



**Figure 20. VMware Cloud Foundation on VxRail example network topology options**

VxRail node networks for a cluster spanning additional racks can share same IP subnet (nonroutable) or assigned a different IP subnet (routable). This provides even more network configuration flexibility for customers.

VMware introduces Application Virtual Networks (AVN) in version 4.0 of the VMware Cloud Foundation platform. The AVN enables linkage for the Aria Suite (formerly vRealize Suite) cloud management components and enables connectivity to the upstream external network.



**Figure 21. Application Virtual Network (AVN) Overview – Regions and Logical Segments**

AVN provides the following benefits:

- The application virtual network is highly secured by using an NSX Edge device as the distributed firewall to isolate applications from each other and external users. Direct access to application virtual networks is controlled by distributed firewall rules.
- AVN prepares for future use of a single IP network address space that provides application mobility between data centers.
- AVN provides simplified future disaster recovery procedures.
- Applications that need failover support across regions now have an overlay backed subnet that spans across regions.
- During failover, applications retain their IP addresses, resulting in faster RTO.

## Network virtualization

NSX provides the foundation of the network virtualization layer for VMware Cloud Foundation on VxRail. It provides a software-defined networking approach that delivers Layer 2 to Layer 7 networking services, such as switching, routing, firewalling, and load balancing, in software. These services can be programmatically assembled in any combination, producing unique, isolated virtual networks in a matter of seconds. NSX provides native support for Kubernetes, VMware Tanzu, and cloud-native applications.

To learn more about VMware Cloud Foundation on VxRail network architecture, including NSX, see the [VMware Cloud Foundation on VxRail Architecture Guide](#).

## Multisite use cases

With flexible network architecture, VMware Cloud Foundation on VxRail systems can support multi-site use cases. Deployment in these cases is not automated. By leveraging additional guidance contained in the VMware Validated Solutions, customers can deploy VMware Cloud Foundation environments in multiple availability zones topologies to support a variety of multisite and stretched cluster use cases.

Availability zones enhance the resiliency of the SDDC and improve SLAs by:

- Allowing identification of separate fault domains within the primary region.
- Leveraging the stretch-clustering capabilities of vSAN to distribute workloads across the availability zones.

VMware Cloud Foundation supports NSX Federation. NSX Federation is the foundational building block used to support a multisite, dual-region deployment of VMware Cloud Foundation. This allows connection of two separate VMware Cloud Foundation instances deployed in data centers at two different geographically distanced regional locations. It provides centralized networking management, consistent networking data services, and centralized network security policy configuration along with enforcement and a synchronized operational state. With NSX Federation, VMware Cloud Foundation can leverage stretched networks and unified security policies across multi-region VMware Cloud Foundation deployments providing workload mobility and simplified disaster recovery. The deployment and configuration are done following the prescriptive guidance and automation scripts outlined in the VMware VVS documentation.

## Expanded platform capabilities with VMware Validated Solutions

VMware Validated Solutions (VVS) are technical validated implementations built and tested by VMware and VMware Partners. These solutions are designed to help customers solve common business problems using VMware Cloud Foundation as the foundational infrastructure.

VMware Validated Solutions are designed to help customers build secure, high-performing, resilient, and efficient infrastructure for their applications and workloads deployed on VMware Cloud Foundation. Each VMware Validated Solution comes with detailed design, with design decisions, implementation guidance consisting of manual UI-based step-by-step procedures, and, where applicable, automated steps using infrastructure-as-code. Individual VMware Validated Solutions might be supplemented with code samples and how-tos, customer success stories, and links to other published assets to provide a one-stop experience for our customers.

The benefits of VMware Validated Solutions are as follows:

- **Validated**—VMware Validated Solutions are designed by VMware architects to help customers build secure, high-performing, resilient, and efficient infrastructure.
- **Scalable**—Customers can easily scale infrastructure and applications running on VMware Cloud Foundation with technically validated, repeatable, and automated solutions.
- **Secure**—Security-centric designs offer prescriptive guidance and enhance post-deployment hardening of VMware Cloud Foundation infrastructure.
- **Lower costs**--Infrastructure as code accelerates deployments through automated workflows that reduce manual labor and rework.
- **Faster time to value**—VMware Validated Solutions help customers rapidly implement solutions on top of VMware Cloud Foundation.

Types of solutions currently available include:

- Developer Ready Infrastructure for VMware Cloud Foundation
- Site Protection and Disaster Recovery for VMware Cloud Foundation
- Advanced Load Balancing for VMware Cloud Foundation
- Private Cloud Automation for VMware Cloud Foundation
- Cloud-Based Automation for VMware Cloud Foundation

The qualification of VVS with VMware Cloud Foundation on VxRail was introduced with VMware Cloud Foundation 4.4.1 on VxRail 7.0.371; the VVS solutions qualified with VMware Cloud Foundation on VxRail are marked with a “VxRail” tag.

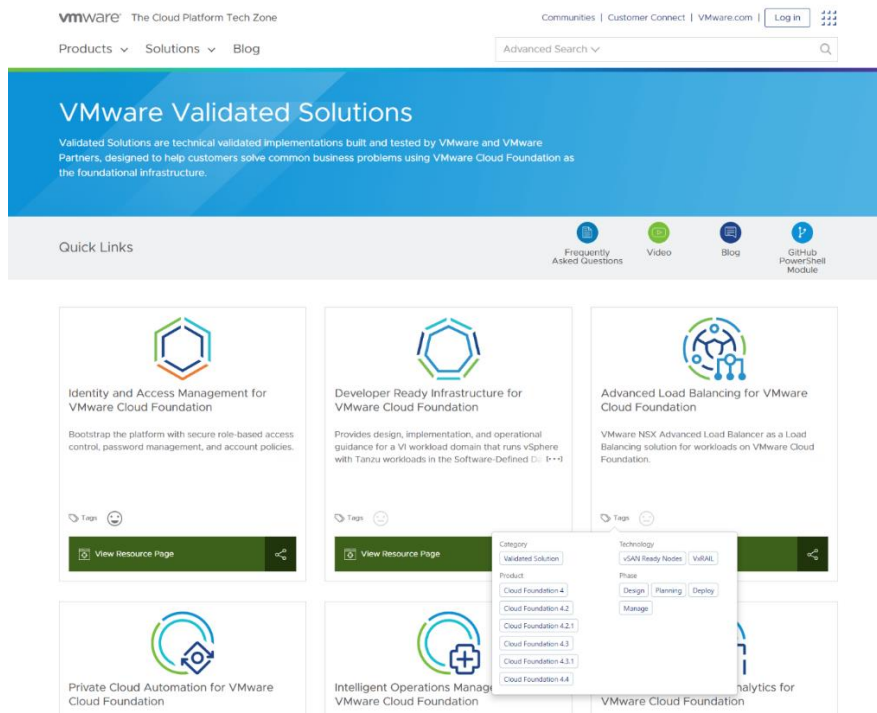


Figure 22. VMware Validated Solutions portal



These solutions get updated asynchronously from VMware Cloud Foundation releases. For the latest updates on existing solutions and to see new solutions and learn more, see the [VMware VVS portal](#).

## Services and support

### Dell Secure Connect Gateway

VxRail support includes Dell Secure Connect Gateway for call-home and proactive two-way remote connection for remote monitoring, diagnosis, and repair through the entire life cycle process to ensure maximum availability. VxRail is constantly introducing product enhancements to improve serviceability by streamlining support experience. For example, VxRail is improving the log capture and bundling to ensure that Dell technical support has the necessary information to perform troubleshooting without extensive back-and-forth with customers.

VxRail systems now use the next-generation secure remote service connectivity agent and the Secure Connect Gateway to connect to the Dell Cloud for dial-home serviceability. This new connectivity agent running within VxRail will also be used on all Dell infrastructure products.

The Secure Connect Gateway is the 5th generation gateway that acts as a centralization point for Dell products in the customer environment to manage the connection to the Dell Cloud. This remote connectivity enables bi-directional communication between the product and Dell Cloud. Products can send telemetry data and event information to the Dell Cloud. That data and information can be used to facilitate remote support by Dell services as well as to deliver cloud services such as CloudIQ, MyService360, Licensing Portal, and Service Link.

The latest-generation remote service connector is intended to provide a uniform telemetry experience across all Dell ISG products. By providing standardization, customers can reduce redundant infrastructure used to provide remote services for all their Dell products. The connectivity agent also introduces a simpler setup experience by streamlining and automating the setup process of the secure remote service for new VxRail cluster deployments.

New nodes that are shipped with VxRail 7.0.350 or later now include a unique connectivity key for the secure remote gateway. Dell manufacturing embeds this key into the iDRAC of the VxRail nodes. Users do not have to log on to the Dell Support portal to retrieve the access key to enable secure remote services. Instead, the enablement process automatically retrieves the unique connectivity key from iDRAC for the connectivity agent to enable the connection. This feature is designed to simplify and streamline the secure connect gateway serviceability setup experience.

Customers can also have a direct connection to Dell Cloud instead of having a gateway deployed. This option is available for any clusters running VxRail 7.0.350 and later.

VxRail dial-home payload improvements have been introduced to help provide Dell Support with additional key cluster information in the dial-home payload itself and capture more system error conditions. These improvements further enhance VMware Cloud Foundation on VxRail serviceability and reduce time to resolution of any VxRail related issues.

## Dell Professional Services

Dell Services must be used to successfully install VxRail and the VMware Cloud Foundation software platform. Dell networking hardware installation and multisite or stretched cluster configuration initial installation are also optionally available services. Any Day 2 customization work (for example NSX customization, vRealize Automation customization, data protection customization) that is needed would be performed using additional services engagements with VMware or Dell.

Dell Services accelerates the deployment, reduces downtime, and simplifies operations of VMware Cloud Foundation on VxRail with a full range of integration, implementation, support, and consulting services. Dell Services helps IT organizations quickly realize the value of their investment by deploying the hardware and software components of VMware Cloud Foundation on VxRail. Dell Services also helps customers achieve IaaS by integrating the cloud platform into their application portfolio, operating model, and enterprise infrastructure.



**Figure 23. Dell Services for VMware Cloud Foundation on VxRail**

Consulting services complement the platform integration with services to hasten the realization of IaaS:

- For application integration, target applications are profiled to determine their suitability and priority for VMware Cloud Foundation on VxRail deployment, and then assistance is provided to migrate these applications while minimizing downtime and risk.
- For operating model integration, help is provided to refine operational processes for more automated and agile-as-a-service operations, while also optimizing the roles and skills of customer teams for service-based operations.

## Dell Support

Customers have a choice of support and maintenance options that aligns with their business model.

Customers that purchase all components from Dell Technologies are provided with a single vendor support experience. For customers using VMware Cloud Foundation software, Dell provides the initial support levels and coordinates advanced level support from VMware. Similarly, for Dell supplied APC Racks, Dell provides the initial support and engages advanced support from APC.



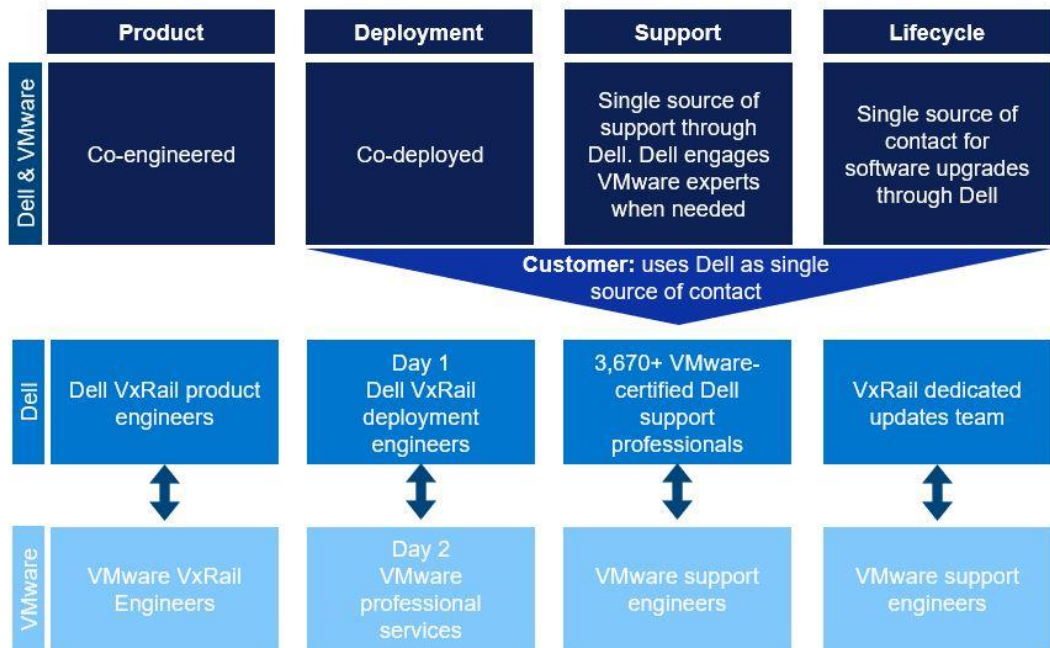
Exclusively for VMware Cloud Foundation on VxRail, Dell Technologies offers single source of support for VMware Cloud Foundation software on both ProSupport and ProSupport Plus, even if customers bring their own VMware Cloud Foundation licenses.

Remote system software code upgrades performed by Dell are also in both ProSupport and ProSupport Plus.

ProSupport	ProSupport Plus
<ul style="list-style-type: none"> <li>24X7 remote technical support</li> <li>Onsite hardware support: next business day or 4hr mission-critical</li> <li>3<sup>rd</sup> party collaborative assistance</li> <li>Automated issue detection and proactive case creation</li> <li>Self-service case initiation and management</li> <li>Access to software updates</li> <li>Support for VCF software</li> <li>System software code upgrades for VCF on VxRail*</li> </ul>	<p><b>All the features of ProSupport, as well as:</b></p> <ul style="list-style-type: none"> <li>Priority access to specialized support experts</li> <li>Eligible 3<sup>rd</sup> party software support</li> <li>Assigned Technology Services Manager</li> <li>Personalized assessments and recommendations</li> <li>Semiannual systems maintenance</li> </ul>

**Figure 24. VMware Cloud Foundation on VxRail support options**

Dell and VMware have partnered to develop and deliver VMware Cloud Foundation on VxRail, providing an optimized, premium end-user experience for customers. The following figure shows the characteristics that differentiate this offering from alternative VMware Cloud Foundation deployments:



**Figure 25. VMware Cloud Foundation on VxRail premium support experience**

- Co-engineered:** Dell VMware Cloud Foundation on VxRail is jointly engineered between Dell and VMware to deliver a market-leading, multicloud platform.
- Co-deployed:** Dell conducts day-1 deployment of the fully integrated solution; day-2 activities are performed by VMware.

- **Single source of support:** While Dell is the single source of system level support for VCF on VxRail, we work closely with VMware to resolve complex issues while Dell remains the single source of contact and project management for our customers.
- **VMware Cloud Foundation LCM software upgrades:** Dell to perform VCF on VxRail code upgrades. Dell remains the single source of contact and project management for our customers. We work closely with VMware to resolve any complex issues for customers.

Customers can choose to do their own VMware Cloud Foundation system software code upgrades. Alternatively, they can have code upgrades performed by the Dell Technologies Remote Proactive Team if they have an active ProSupport Suite for VMware Cloud Foundation on VxRail contract (ProSupport, ProSupport Plus or ProSupport One – Next Business Day or 4 hour Mission Critical). This simplifies their overall full-stack support experience.

Customers who purchase network switches or rack/PDUs from third parties are provided support for those components only from the third-party vendor.

Dell ProSupport Plus offers a single source with the expertise, know-how, and capabilities to deliver world-class support.

ProSupport Plus provides global support from highly trained experts to address IT needs, minimize disruptions, and maintain a high level of productivity. ProSupport Plus enables businesses to:

- Maximize productivity by leveraging Dell scale and skill
- Minimize disruptions with around the clock access to highly trained experts
- Gain efficiency through a single source for all support needs

Single source, 24x7 global support is provided for VxRail appliance hardware and software (including VMware Cloud Foundation software) using phone, chat, or instant message. Support also includes access to online support tools and documentation, rapid on-site parts delivery and replacement services, access to new software versions, assistance with operating environment updates, and remote monitoring, diagnostics, and repair with Dell Secure Remote Services.

Dell 12 Centers of Excellence and Joint Solution Centers deliver in-house collaboration and industry-leading levels of support, leveraging Dell's alliances with leading application providers such as Oracle and Microsoft. Dell has 87 technical support sites that include 71 Dell Technologies Support Sites and 16 Dell Technologies Customer Service Centers.

## Conclusion

VMware Cloud Foundation on VxRail provides the simplest path to the hybrid cloud through a fully integrated platform that leverages native VxRail hardware and software capabilities and other VxRail unique integrations.

Dell enables organizational IT transformation and hybrid cloud adoption by providing flexible modern cloud infrastructure solutions that can transform IT at the pace our customers are ready for. Cloud transformation is a journey. It does not happen overnight. Dell Technologies is looking to be our customers' strategic partner to help them on their journey.

IT and cloud transformation can be accomplished using a phased approach that aligns with where our customers are in their journey. First, customers can modernize their infrastructure by taking advantage of scale-out, software-defined, and cloud-enabled technologies across servers, storage, and core HCI systems, and full-stack HCI private-cloud-ready infrastructure. This helps break down infrastructure management silos to enable a more streamlined IT operations experience.

Second, customers can begin to automate their services and create a self-service experience for the business to interface with IT. This activity could happen in parallel with the third phase, which is when customers transform the way they operate and recognize the need for new roles, skills, and organizational structures to best use and optimize these new technology capabilities.

Businesses that can successfully navigate through these phases are poised for success in the new digital era.

### Adoption phases

Customers who are just getting started can look to modernize their traditional three-tiered infrastructure by adopting HCI to help simplify compute and storage operations. No longer do they have to manage compute and storage in silos, and use hardware-based infrastructure to provide compute and storage services. They can simplify their operations by consolidating compute and storage management using native VMware tools. They can leverage the power of automation and compute and storage virtualization to provide IT with more agility in provisioning infrastructure and life cycle management.

Instead of taking days or weeks to provision compute and storage infrastructure, they can now do the provision in minutes to hours by deploying VxRail HCI. VxRail includes vSphere for Compute Virtualization, vSAN for Storage Virtualization, and VxRail HCI System Software, which includes Manager software for HCI Infrastructure Lifecycle Management and Automation. If needed, VxRail can be augmented with a customer's existing external storage infrastructure so the customer can maintain investment protection for those existing assets or leverage them for specific workloads as needed.

Some customers might plan to implement hybrid or multicloud in the future for their core data centers and the edge but want to start with just the foundational pieces needed to get there over time. Those customers can start by implementing a standardized VMware full-stack HCI private-cloud-ready infrastructure architecture with VMware Cloud Foundation on VxRail that includes NSX for network security and optional network virtualization and SDDC Manager for full-stack HCI LCM and automation. Here, a customer deploys a

VMware full-stack HCI private-cloud-ready SDDC infrastructure on-premises with the benefit of automated full-stack HCI life cycle management and automation while still maintaining IT control over resource provisioning and infrastructure management.

By incorporating technologies that allow for virtualizing all their infrastructure, customers can take advantage of what a fully virtualized infrastructure can provide, such as resource utilization, workload and infrastructure configuration agility, and advanced security. With SDDC software life cycle automation provided by VMware Cloud Foundation (specifically SDDC Manager which is a part of VMware Cloud Foundation on VxRail), customers can streamline the life cycle management experience for the full-stack HCI software and hardware stack. Customers no longer need to worry about performing updates and upgrades manually using multiple tools for all the SDDC SW and HW components of the stack. These processes are streamlined through a common and integrated management toolset in SDDC Manager along with VxRail Manager.

Also at this stage, customers can begin to leverage the advanced network security that software-based networking tooling can deliver. This security goes beyond what core HCI includes without requiring a full transition to a full virtualized network implementation. For example, customers can take advantage of NSX microsegmentation and distributed firewalling, which was nearly impossible to implement using physical networking tools.

When they are ready, customers can then begin to leverage the data services benefits that a fully virtualized infrastructure can offer along with SDDC infrastructure LCM automation. For example, customers use the software-defined networking features from NSX, such as logical overlay network virtualization. Another important aspect is the introduction of VMware Cloud Foundation for deployment of these SDDC components. With this standardized design incorporated as part of the platform, customers are guaranteed that these components have been certified with each other and are backed by Dell Technologies. Customers can then be assured of an automated and validated path forward to get from one Continuously Validated State to the next across the end-to-end stack.

Also during this phase, customers can look to consolidate multiple application workloads to run on a common infrastructure platform. To help accelerate modern application transformation, customers can also optionally leverage native modern application platform runtime and control plane services. They can also take advantage of additional developer services using VMware Cloud Foundation with Tanzu and other Tanzu portfolio offerings.

As their cloud readiness grows, customers might have needs for better operational management of their newly virtualized full-stack HCI private-cloud-ready infrastructure. Here they can incorporate additional cloud infrastructure operations management capabilities into the environment—SDDC operations management capabilities provided by Aria Operations, Aria Log Insight, and Aria Network Insight. These capabilities can be added seamlessly in alignment with best practices standardized architecture guarantees. In this stage, customers can begin transforming how they operate to better manage and monitor a fully virtualized full-stack HCI private-cloud-ready infrastructure. Customers now can gain more insight into the SDDC abstractions across compute, network, and storage and their associated costs. They can use the power of integrated analytics to become smarter and more efficient when performing capacity planning or troubleshooting. These cloud infrastructure operations management tools can be automatically deployed. They can then be life cycle managed using vRSLCM, which has been natively integrated into

VMware Cloud Foundation to easily extend cloud infrastructure operations management capabilities and prepare IT teams for full cloud operating model transformation.

After attaining a comfort level in managing, operating, and automating the infrastructure, a customer might then be ready to transform how the infrastructure is delivered to the business by adopting a cloud operating model. Adoption of this model provides the business with services such as Infrastructure as a Service using IT-governed self-service portals and catalogs to business users. This stage in the cloud transformation journey would involve a combination of people and process changes within an IT organization as well as the technology to support it. Here, customers can introduce cloud management, automation, and governance with Aria Automation. At this stage, a customer would have a full private cloud with self-service catalogs.

For many customers, the target destination is a hybrid cloud and multicloud. In this stage, customers extend on the capabilities that they have built with their private cloud. They begin to incorporate public cloud and edge cloud services to enable workload mobility, portability, and location independence for deciding where workloads should run, all while leveraging a common operating model across both private and public cloud resources. Here they can leverage public cloud services such as VMware Cloud on AWS services and HCX workload mobility solutions. With these services and solutions, they can align to business priorities—whether for cost purposes or governance requirements—and build out hybrid cloud use cases. They can extend this to other VCPP powered or native public cloud providers and leverage cloud-based multicloud security with Carbon Black. Thus, they can take advantage of SaaS-based Tanzu Mission Control for multicloud K8s cluster management and Aria SaaS services to incorporate cloud native infrastructure services and applications into their strategy. All this allows IT to be a strategic business enabler for new digital transformation initiatives.

VMware Cloud Foundation on VxRail makes data center operations simpler by bringing the ease and automation of the public cloud in-house. It deploys a standardized and validated flexible network architecture with integrated life cycle automation for the entire cloud infrastructure stack including hardware. It enables a true hybrid cloud based on a common and compatible VMware Cloud Foundation platform that stretches from on-premises to off-premises. The platform combines the speed and flexibility of a public cloud with the security and control of on-premises infrastructure. It provides simplicity, consistency, and peace-of-mind to customers and empowers organizations to deliver business innovation and differentiation.

## Appendix A: References

- [Dell VxRail Hyperconverged Infrastructure](#)
- [VMware Cloud Foundation on VxRail Interactive Demo](#)
- [VMware Cloud Foundation on VxRail Architecture Guide](#)
- [VMware Cloud Foundation on VxRail Planning and Preparation Guide](#)
- [Dell VxRail Network Planning Guide](#)
- [Dell Networking Guides for VxRail](#)
- [Dell VxRail Appliance TechBook](#)
- [VMware Cloud Foundation documentation](#)
- [VMware Aria Suite \(formerly vRealize Suite\)](#)
- [VMware Tanzu](#)
- [VMware Tanzu on Dell VxRail](#)
- [Dell Technologies APEX](#)
- [Dell PowerProtect Data Manager: Protection for VMware Cloud Foundation on Dell VxRail](#)
- [VMware Validated Solutions](#)