Abstract
This document is a conceptual and architectural review of the Dell EMC VxRail system, optimized for VMware vSAN, and with Intel Inside®. The TechBook first describes how hyperconverged infrastructure drives digital transformation and then focuses on the VxRail system as a leading hyperconverged technology solution.
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# Preface

## Document Description

The Dell Technologies TechBook is a conceptual and architectural review of the Dell EMC VxRail™ system, optimized for VMware vSAN with Intel Inside. The TechBook describes how hyperconverged infrastructure drives digital transformation and focuses on the VxRail system as a leading hyperconverged technology solution.

## Audience

This TechBook is intended for Dell EMC field personnel, partners, and customers involved in designing, acquiring, managing, or operating a VxRail system solution.
IT’s transformation challenge

Overview

In the digital economy, applications are both the face and the backbone of the modern enterprise.

For the digital customer, user experience trumps all. Customer-facing applications must be available anytime, anywhere and on any device, and must provide real-time updates and intelligent interactions. For the business, the insights gleaned from the data collected from these interactions inform and drive future development needs.

Applications and the underlying infrastructure are strategic to the business. Businesses that can efficiently leverage modern data center technologies to rapidly deliver innovative capabilities to customers are positioned for real success.

The importance of applications in the modern enterprise presents a huge opportunity for IT organizations. IT can become an active enabler of the business. Traditional IT teams are faced with a massive amount of complexity when building, configuring, maintaining, and scaling applications. Organizations need to successfully deploy and operate an environment that takes full advantage of the innovation taking place across the industry – without the complexity of piecing together and supporting a wide range of patchwork tools.

IT transformation is difficult. It requires a great deal of planning, evaluation, reorganization and modernization of infrastructure technologies and applications. Multiple factors including costs, skill sets, governance, the drive to innovate and willingness to transform influence whether a business moves beyond the traditional three-tier data center structure.

Every business approaches IT transformation at a different pace and has different goals for that transformation. Not every business wants or needs to go to a full cloud service delivery model. What is needed is an approach that enables businesses to transform to a place that provides the desired transformation benefits and at a pace that makes sense for their business model.

The challenge is how to go about this transformation and what areas need to be addressed to allow for transformation of any kind to happen. Gartner\(^1\) surveyed IT staff resources on what they spend the most time on.

- 32% on troubleshooting performance and availability problems
- 15% on software and hardware change control
- 16% on developing and implementing hybrid cloud strategy

With IT staff resources spending nearly half of their time maintaining the status quo for their IT infrastructure to deliver existing services, it leaves very little opportunity to strategize, plan, and execute a plan to transform IT. Addressing the complexity of IT infrastructure will go a long way in freeing IT personnel and resources to focus more IT strategic goals that can drive modern applications and support the breakneck pace of innovation.

\(^1\) Survey results of Consumption of Staff Resources, June 2019, Gartner
Many businesses would ultimately like to automate IT service delivery through a self-service catalog via a hybrid cloud. The hybrid cloud delivers the following benefits:

- A single control point for on- and off-premises resources
- Automation streamlines delivery of IT resources, delivering them in a consistent and repeatable manner aligned with business best practices
- Metering allows the IT team to communicate the value of services while providing visibility to the business on resource cost and consumption
- Self-service empowers application owners and business users to access the resources they need, when they need them
- Capacity management allows the IT team to better manage resources across the hybrid cloud
- Monitoring and reporting provide visibility to the capacity, performance, and health of the environment
- Built-in security protects enterprise workloads
- Service-level choice aligns workloads to service levels and cost objectives
- Ability to meet the service level agreements with application level granularity

The vision of hybrid clouds is not new. Businesses have tried to deploy hybrid clouds using traditional infrastructure based on scale-up storage accessed over a storage network that is deployed and scaled in big chunks. While it is possible to build cloud capabilities on traditional three-tier infrastructure with scale-up storage, this is not the optimal solution.

If businesses want IT transformation to the cloud support their application environment, Dell EMC can modernize, automate, and transform IT operations with complete turnkey, hybrid cloud platforms built on hyperconverged infrastructure.

**Accelerating IT transformation with Dell EMC hyperconverged infrastructure**

One of the first steps a business can take in their transformation journey is to simplify infrastructure deployment and management by introducing hyperconverged infrastructure (HCI) into the environment. HCI systems essentially collapse the traditional three-tier server, network, and storage model so that the infrastructure itself is much easier to manage.

Adopting hyperconverged infrastructure solutions that natively integrate compute, storage, virtualization, management, and data services significantly reduces IT administrative tasks and create the foundation for a modern IT infrastructure. HCI solutions are optimal for reducing infrastructure costs and simplifying management, regardless of workload deployment and extent of implementation.

**Innovate rather than integrate**

Businesses have the option of building a completely customized solution. Integrating storage, networking, compute, data protection, monitoring and reporting, and then figuring out how to get all of them to work together can be time consuming, but provides the most flexibility for an organization that may want prescribed vendor components as a part of their solution. Planning, designing and building a custom solution is a complex project that
often takes months or years to come to fruition—too long if a business needs to roll out a solution to address immediate business needs and it can be costly to maintain or update over the long term.

The challenge for IT is that complexity exists at each of these layers, so building and maintaining a functional, resilient cloud can be very difficult. Many companies find that doing it themselves requires more than 70%\(^2\) of their IT resources and budget, leaving few resources to focus on innovation and projects that add real value to the business.

For most businesses, the best way to consume HCI solutions is to buy them fully integrated with lifecycle management and single source of support. Buying versus building delivers the accelerated deployment and operational simplicity with automation and orchestration of system administration tasks that can result in 5-year total cost of ownership savings of 489% over a traditional three-tier, build-your-own approach.\(^3\)

\(^2\) How IT Transformation Maturity Drives IT Agility, Innovation, and Improved Business Outcomes, April 2017, Enterprise Strategy Group

\(^3\) Delivering Efficient Business Expansion with Dell EMC VMware-based HCI, October 2018, IDC
Hyperconverged infrastructure: Building block for modern infrastructure

Introduction

Converged infrastructure platforms are fully pre-integrated server, traditional storage arrays, and networking hardware “stacks”. Hyperconverged infrastructure platforms are solutions that deliver compute, software-defined storage, and networking infrastructure services in a cluster of industry-standard servers.

Hyperconverged infrastructure extends the converged infrastructure model by incorporating the virtualization capabilities of software-defined storage (SDS). Hyperconverged infrastructure collapses the core components of traditional data center – compute and storage – into a server, effectively eliminating expensive and complex SAN environments.

Because HCI is software-defined—which means the infrastructure operations are logically separated from the physical hardware—the integration between components is much tighter than with CI. HCI manages everything as a single system through a common toolset.

Enabling technologies for HCI

The following table lists the confluence of technologies that has spurred the growth and development of hyperconverged infrastructure.

Table 1. Enabling technologies for HCI

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<th>Technology</th>
<th>Description</th>
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| Software-defined storage | Abstrats the storage intelligence from the underlying storage infrastructure. 
Virtualizes direct-attach storage into a shared pool. 
Automates provisioning and load balancing. 
Allows a business to increase available storage resources, both capacity and processing power, by adding entire nodes (e.g. a server with storage software and media) to a cluster. The resulting cluster of nodes in turn acts as a single pool of storage capacity. |
| Virtualization           | Abstrats compute and network functions. 
Enables physical resources to be shared. 
Improves utilization, mobility and security. |
| x86 servers              | High performance processors, large memory. 
Flash media delivers consistent, predictable performance. |
| Solid-state storage      | Uses solid-state drives (most frequently various types of flash memory) to store data. This storage can reside in a storage controller or in a server, but for this assessment we are considering use cases limited to tiered and All-Flash storage arrays. 
In hybrid arrays, a portion of the drives in the array are solid-state and house the most active data on the array. 
In All-Flash arrays, all drives in the array are solid-state. |
| High-speed networks      | Connects nodes together to create cluster. 
Enables HCI to deliver IOPS and reduced latencies. 
Connect applications to users |
Drivers for HCI

Customers that have transitioned or plan to transition to HCI state cost reduction, accelerated deployment, improved ability to scale, improved operational efficiencies and reduction in infrastructure tasks as top benefits they expect to realize when implementing HCI. From one IDC study of VxRail customers, they were able to provide up to 56% faster IT service delivery and improve productivity and efficiency of IT infrastructure teams by up to 60%.4

Savings in initial investments are lower, and operational expenses are also lower when compared to traditional three-tier architectures. Cost savings include power and cooling, ongoing system administration, and the elimination of disruptive updates and data migrations.

Rather than buying monolithic SAN-based infrastructure, a business can buy infrastructure that targeted for specific workloads. A main contributor to lower TCO and the increased agility of hyperconverged solutions is the ability start smaller and scale incrementally. That is not the case in traditional settings: customers either must buy more resources than they need in anticipation of scaling up, or wait until current workloads exhaust the allocated resources, then add infrastructure after the fact. Buying at the inopportune time means that resources are not optimally allocated and can even slow down customer’s business from expanding.

HCI enables a pay-as-you-grow approach—start with what is needed today and expand incrementally rather than purchasing large amount of compute and storage up front. It also addresses the typical over-provisioning and over-purchasing that occurs when technology is intended to last for multiple year cycles.

4 Delivering Efficient Business Expansion with Dell EMC VMware-based HCI, October 2018, IDC
Dell EMC VxRail

Overview

VxRail systems are jointly developed by Dell EMC and VMware and are the only fully integrated, pre-configured, and tested HCI system optimized for VMware vSAN technology for software-defined storage. Managed through the ubiquitous VMware vCenter Server interface, VxRail provides a familiar vSphere experience that enables streamlined deployment and the ability to extend the use of existing IT tools and processes.

VxRail essentials

- Fully integrated, preconfigured, and tested hyperconverged infrastructure appliance simplifies lifecycle management and extends VMware environments.
- Seamlessly integrates with existing VMware ecosystem management solutions for streamlined deployment and management in VMware environments.
- Start small, with as few as two nodes. Single node scaling, storage capacity expansion, and vSphere license independence enable growth that meets business demands.
- Backup distributed applications or workloads with integrated data protection options, including RecoverPoint for VMs.
- Single point of global 24x7 support for both the hardware and software

VxRail systems are fully loaded with integrated, mission-critical data services from Dell EMC and VMware including compression, deduplication, replication, and backup. VxRail delivers resiliency and centralized-management functionality enabling faster, better, and simpler management of consolidated workloads, virtual desktops, business-critical applications, and remote-office infrastructure. As the exclusive hyperconverged infrastructure system from Dell EMC and VMware, VxRail is the easiest and fastest way to stand up a fully virtualized VMware environment.

VxRail is the only HCI system on the market that fully integrates Intel-based Dell EMC PowerEdge Servers with VMware, vSphere, and vSAN. VxRail is jointly engineered with VMware and supported as a single product, delivered by Dell EMC. VxRail seamlessly integrates with existing (and optional) VMware ecosystem and cloud management solutions, including vRealize, NSX, Horizon, and any solution that is a part of the vast and robust vSphere ecosystem.

What’s in a VxRail system?

Dell EMC VxRail systems offer a choice of Dell EMC PowerEdge servers, powered by Intel® Scalable® or AMD EPYC™ processors, accelerated by NVIDIA data center GPUs, variable RAM, and storage capacity, allowing customers to buy what they need now. The
VxRail system uses a modular, distributed system architecture that starts with as few as two nodes and scales near linearly up to 64 nodes. 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.

Additional services that come with VxRail include RecoverPoint for VMs (RP4VM) replication and Dell EMC Remote Secure Services (SRS).

**Benefits of VMware software for HCI**

The VxRail software layers use VMware technology for server virtualization and software-defined storage. VxRail nodes are configured as ESXi hosts, and VMs and services communicate using the virtual switches for logical networking.

VxRail systems are optimized for VMware vSAN software, which is fully integrated in the kernel of vSphere and provides full-featured and cost-effective software-defined storage. vSAN implements an efficient architecture, built directly into hypervisor. This distinguishes vSAN from solutions that typically install a virtual storage appliance (VSA) that runs as a guest VM on each host. Embedding vSAN into the ESXi kernel layer has advantages in performance and memory requirements. It has little impact on CPU utilization (less than 10 percent) and self-balances based on workload and resource availability. It presents storage as a familiar data store construct and works seamlessly with other vSphere features such as VMware vSphere vMotion and Storage Policy Based Management to provide the flexibility to easily configure the appropriate level of service for each VM.

vSphere is a well-established virtualization platform, a familiar usable entity in most data centers. Dell EMC leverages vSphere for ESXi-based virtualization and VM networking in multiple product offerings, and they support a common set of VMware and Dell EMC services. This enables a VxRail implementation to integrate smoothly into VMware-centric data centers and to operate in concert with Dell EMC converged, hyperconverged, and traditional storage offerings. NSX for SDN can optionally be added to the VxRail solution. VMware NSX Data Center transforms the network in a similar way in how vSphere and vSAN transform compute and storage respectively. It provides much more flexibility, agility, and security to overcome limitations of the physical network architecture.

For more information about VMware software, see Additional resources.

**The VxRail advantage**

VxRail HCI System Software, the VxRail management software, is a strategic advantage for VxRail and further reduces operational complexity. It is the software running atop the vSAN stack and encapsulates much of the key VxRail differentiation over other vSAN Ready Nodes and other HCI solutions in the market. VxRail HCI System Software provides out-of-the-box automation and orchestration for deployment to day-to-day system-based operational tasks, which reduces the overall IT OpEx required to manage the stack. No build-it-yourself HCI solution provides this level of lifecycle management, automation, and operational simplicity.
With VxRail HCI System Software, updates are simple and can be automated with a single-click. Customers can sit back and relax knowing they are going from one known good state to the next, inclusive of all the managed software and hardware component firmware. Customers no longer have to verify hardware compatibility lists, run test and development scenarios, sequence and trial updates, and so on. The heavy lifting of sustaining and lifecycle management is already done for them. In short, VxRail creates IT certainty.

VxRail cluster management is integrated into the vCenter Service interface via the VxRail Manager plug-in to provide a fully integrated experience that is familiar to VMware users. The benefits of LCM services are extensible using RESTful APIs to position the VxRail as the platform of choice for SDDC deployments, Infrastructure as Code (IaC) cloud deployments, or for customers that prefer to manage clusters at scale through scripts or custom automation solutions.

Within VxRail HCI System Software, SaaS multi-cluster management provides global visualization, simplified health monitoring, and multi-cluster management via a cloud-based web portal. These features build upon the LCM services to increase operational efficiency, especially for customers with a large footprint of VxRail clusters and managing at scale has been challenging.

**VxRail security and compliance**

Dell EMC VxRail system is a resilient, secure, and modern hyperconverged infrastructure system that directly addresses the challenges of security and compliance in modern day environments.

VxRail system is engineered, built, configured, and maintained following the Dell EMC Secure Development Lifecycle, which follows a rigorous approach to secure product development, including executive-level risk management before products are shipped to market. Additionally, VMware vSphere—a significant part of VxRail hyperconverged infrastructure—has also been developed using a similar Security Development Lifecycle.

Everything that comprises VxRail is secure and can be seen in the figure below. Each component has security built in, with corporate security processes, unique security features, and supply chain control, so customers can feel confident that VxRail can fit into their secure IT infrastructure design. The hardware is comprised of Dell EMC PowerEdge servers and Intel processors. The virtualization and software layers are comprised of vSphere and vSAN which is integrated into the kernel of vSphere. The integrated software and management included with VxRail is comprised of VxRail HCI System Software, VMware software including vRealize Log Insight and vCenter Server, and software from Dell EMC, including RP4VM and SRS. All of this is jointly engineered with Dell EMC and VMware and delivered by and supported exclusively by Dell EMC as a single product—VxRail.
VxRail is designed to meet several standards including the Common Criteria EAL2+ certificate, USGv6 certification, making it IPv6 Ready, and has a VxRail Product Security Configuration Guide to further harden VxRail deployments. Customers can also leverage the VxRail STIG Compliance Guide and automated scripts to further harden their environments.

To learn more about VxRail's Comprehensive Security by Design, please see, Dell EMC VxRail: Comprehensive Security by Design.

VxRail provides an entry point to the software defined data center (SDDC) for most workloads. Customers of all sizes and types can benefit from VxRail, including small- and medium-sized environments, remote and branch offices (ROBO), and edge sites, as well as providing a solid infrastructure foundation for larger data centers.

Small-shop IT personnel benefit from the simplicity of the system model to expedite the application-deployment process while still taking advantage of data services only typically available in high-end systems.

Larger data centers benefit by rapid deployment where a complete vSphere environment can be installed and be ready to deploy applications within few hours of the system arriving on site. VxRail allows businesses to start small and scale non-disruptively.

Storage is configured to meet appropriate application capacity and performance requirements.

In addition, nodes are available with in a wide range of 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. Finally, because the VxRail is jointly engineered, integrated, and tested, organizations can leverage a single source of support and remote services from Dell EMC.

VxRail environments are configured as a cluster consisting of a minimum of two server nodes, with each node containing internal storage drives. VxRail systems are delivered with the software loaded, ready to attach to a customer-provided network. While most environments use 10Gb Ethernet for base connectivity for internal and external communications, 25Gb or 1Gb Ethernet connectivity is also available. Using a simple
wizard at the time of install, the system can be configured to match unique site and networking requirements.

VxRail systems enable organizations to start small and scale out as the IT organization transforms and adapts to managing converged infrastructure versus silos. With a rich set of data services, including data protection, tiering to the cloud, and active-active data center support, VxRail can be the foundational infrastructure for IT. Best of all, customers can simply add new systems into existing clusters (and decommission aging systems) to provide an evergreen HCI environment, never having to worry about costly SAN data migrations ever again. As organizations continue to transform to a cloud model, integration with the VMware vRealize Suite enables full cloud automation and service delivery capabilities.
VxRail HCI System Software

Overview

VxRail HCI System Software consists of multiple, integrated software elements that extend VMware native capabilities to deliver a seamless, automated, operational experience, keeping the infrastructure in a pre-validated configuration to ensure workloads are consistently up and running. VxRail HCI System Software is pre-installed 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: lifecycle management for predictable outcomes, management flexibility and extensibility, and simplified services and support experience.

Lifecycle management for predictable outcomes

- Automated, intelligent lifecycle management (LCM) functionality automatically updates clusters with pre-validated, pre-tested software and firmware components, ensuring the HCI stack is in a Continuously Validated State.
- The electronic compatibility matrix serves as a compliance asset providing validation of that all possible configuration and update path permutations are sound, enabling customers to 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, enabling automation and orchestration services across the entire stack for simple cluster software and firmware updates.

Management flexibility and extensibility

- VxRail Manager, natively integrated with and accessed via vCenter, is the overall management engine for all VxRail operations to deploy, manage, update, patch and add nodes to a cluster.
- SaaS multi-cluster management is designed to provide centralized multi-cluster management powered by AI-driven operations insights via a software-as-a-service delivery model. The continuous innovation and continuous delivery approach allows for frequent, incremental updates to introduce new capabilities. SaaS multi-cluster management currently provides detailed health checks, predictive analytics, and 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 EMC Secure Remote Services (SRS) for all included hardware and software within VxRail throughout the entire lifecycle of the infrastructure.
In today’s fast paced digital world, organizations that want to stay competitive require ongoing infrastructure updates and patches to ensure they’re getting the most from technology investments. Staying current with the latest software updates, updates and patches ensures the infrastructure is secure and optimized for performance while providing users with the latest features and functionality to better serve business needs.

VxRail LCM 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 automation and orchestration necessary to deliver non-disruptive, streamlined HCI stack updates. Where VxRail LCM delivers differentiated value is the ability to deliver pre-validated set of software and firmware that ensures compatibility and compliance of the HCI stack configuration while maintaining the performance and availability required of the virtualized workloads running on the clusters.

The ability to test, validate, and produce a VxRail software bundle to support every vSphere release, any-to-any version update path, and the millions of VxRail configurations is termed as Continuously Validated States. These Continuously Validated States are recorded on the Electronic Compatibility Matrix. The VxRail team’s $60 million in equipment investment with 100+ team members dedicated to testing and quality makes this possible.
Customer updateable software

VxRail software bundle is customer updateable via a fully automated and validated process. The single-click software update is initiated from VxRail Manager plug-in. It automatically downloads all software that is ready to be updated including VxRail HCI System Software, VxRail-provided vCenter Server, vSphere, and server component firmware and drivers. Customer-provided vCenter Server, vRealize Log Insight, SRS, and RecoverPoint for VMs are not part of VxRail life cycle management, and would need to be updated separately. The automated process consists of four steps.

1. Acquire VxRail software bundle. From the VxRail Manager UI, the update advisor tool lists the available update paths for the cluster. Users can select an update path to review a report on the component changes needed to complete the update. Once a decision has been made on the target version, users can initiate an internet download from the update advisor. For sites lacking internet connectivity, update bundles can also be locally uploaded to the cluster. In this scenario, users need to separately acquire the bundle and upload it from a machine in the same local network as the VxRail cluster.

2. Customers are encouraged to run the cluster readiness pre-check which can be initiated from the VxRail Manager UI. Upon completion, the pre-check report determines the readiness of the cluster to successfully complete a cluster update. If there are any reported issues, customers can address them in advance. The combination of this pre-check update, advisory report, and an estimated update time provides important information to schedule an accurate maintenance window.
3. At this point, the VxRail update bundle has been downloaded and staged on the VxRail Manager VM. At the user’s discretion, they can initiate the cluster update operation from the VxRail Manager UI. They have the option to schedule the update. To start a cluster update, user needs to provide proper credentials for vCenter, ESXi host, and VxRail Manager.

Optionaly, in the latest VxRail software releases, customers can customize the update image with additional firmware and drivers for components that are not part of the Continuously Validated State such as Fibre-Channel HBAs. Previously, updating non-VxRail-managed components required a separate update.

4. During the update operation, users can monitor the progress from the VxRail Manager UI. When the cluster update completes, the final validation step ensures the update was successful, and the VxRail system is fully functional at the new, updated version of software. A copy of the updated bundle is also stored as a recovery bundle in VxRail Manager VM.

Alternatively, there is a REST API call that can execute the update once the software has been downloaded onto the VxRail system.

The following figure shows the four automated steps of a customer executed VxRail HCI system software update.

![VxRail update workflow](image)

Figure 5. VxRail update workflow

Step 3 is performed one node at a time, where the ESXi host is placed in maintenance mode, and using vMotion, the VMs are moved to other nodes making the update process non-disruptive. Even if the cluster is not licensed to make use of DRS, VxRail’s partnership with VMware allows VxRail Manager to enable DRS during a cluster update in order to move VMs from the ESXi host that is being updated to achieve non-disruptive updates. In the latest VxRail software versions, the cluster update operation has been enhanced by pre-staging the next node with the update bundle as the current node is processed.

This improvement reduces the time to update the node, ultimately reducing the overall time to complete a cluster update.
Serviceability

VxRail has its own monitoring and event alerting system that captures VxRail management issues and hardware related issues that are manifesting on the PowerEdge server. VxRail also integrates with vCenter Server so that the events generate alarms that can be seen on the vCenter Server UI. This integration along with existing health monitoring of vSphere and vSAN on vCenter provides end-to-end visibility of the full VxRail stack. For select events, VxRail can self-determine whether it requires the attention of the Dell technical support team to resolve. In these scenarios, VxRail automatically generates an alarm on vCenter Server, collects relevant logs necessary to troubleshoot the issue, and initiates a remote service call via SRS with Dell technical support to facilitate a case creation with the supporting log materials. This self-driving feature offloads decision-making of the IT administrator and speeds problem resolution.

VxRail also leverages VMware vRealize Log Insight to monitor system events and provide ongoing holistic notifications about the state of virtual environment and system hardware. It delivers real-time automated log management for the VxRail system with log monitoring, intelligent grouping, and analytics to provide better troubleshooting at scale across VxRail physical, virtual, and cloud environments.

Dell EMC SRS is also accessible from within VxRail Manager plug-in or REST API to provide enterprise-class support and services. SRS includes online chat support and Dell EMC field-service assistance.

Lifecycle management value tiers

VxRail has innovated in different aspects of lifecycle management. The figure below provides a model to help understand where the benefits fit with respect to the customer value chain. In short, it’s the how, what, and why.

Update orchestration is the foundation, or the mechanics, to deliver lifecycle management. It’s the how. In regards to lifecycle management of an HCI solution, having an automated and orchestrated workflow to update both hardware and software together is very beneficial to a customer. This reduces the time spent dealing with individual components separately. Having pre-update comprehensive health checks reduces the risk of update failure that ultimately impacts application uptime. An end-to-end update should be non-disruptive to improve uptime. VxRail delivers this value with its tight integration of VMware software and PowerEdge server hardware.

Rather than burdening the customer with the work and risk of defining and validating the configuration required for a full stack cluster update, configuration stability is having a pre-validated configuration that a customer needs to update to in order to take advantage of the latest features and security updates. Business operations are not impacted, and the customers are leveraging the latest capabilities while the platform continues to meet security standards and compliance. VxRail delivers this configuration stability with the Continuously Validated States.

At the top of the customer value chain for lifecycle management is decision support. This is the area where HCI vendors will look to deliver in the next few years because it will help drive operational costs even further down. By using artificial intelligence (AI) to improve and enhance decision making, IT staff can further offload the burden of infrastructure management. This is an area that VxRail is starting to deliver some capabilities, most notably with SaaS multi-cluster management.
VxRail management has expanded beyond the VxRail Manager plug-in for vCenter to allow for different use cases. VxRail Manager is a plug-in on vCenter that provides a fully, integrated experience to manage VxRail clusters on a familiar interface. REST APIs extend the VxRail LCM capabilities for cloud deployment solutions or for organizations looking to deploy and manage VxRail clusters at scale where running batch scripts, configuration management tools (such as Ansible, Puppet, etc.) or custom automation for cluster operations is more efficient. SaaS multi-cluster management is a new cloud-based management option for global orchestration of all the customer’s clusters from a single web portal interface. While VxRail Manager provides the complete management capability set for VxRail clusters, managing using REST APIs and SaaS multi-cluster management have their benefits. Over time, the gaps in functionality will close to further enhance the value each brings for their respective use cases.

**VxRail Manager**

VxRail Manager features user-friendly workflows for automating VxRail deployment and configuration and monitoring the health of individual systems in the entire cluster. It also incorporates functionality for hardware serviceability and system platform lifecycle management. For instance, it guides system administrators through adding new 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 non-disruptively across VxRail nodes.

With 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 these valuable capabilities on a familiar management interface. With the VxRail Manager plug-in, the vCenter Server can manage physical hardware of the VxRail cluster.
VxRail Manager plug-in for vCenter Server

In addition to SRS-specific support, the VxRail Support page on vCenter Server links to VxRail Community pages for Dell EMC Knowledge Base articles, user forums for FAQ information, and VxRail best practices. The following figure is an example of the support view.

VxRail Manager plug-in provides access to a digital market for finding and downloading qualified software packages such as VMware Horizon Cloud, Data Domain Virtual Edition, RecoverPoint for VM, and other software options for VxRail systems.

RESTful APIs

VxRail Manager drastically simplifies operations of the virtualized IT environment. VxRail APIs take this step further, by exposing VxRail Manager functionality through standard, easy to consume public APIs, which can be integrated into a broad spectrum of existing automation solutions. This applies not only to large enterprises and service providers, but also to midsize enterprises, with limited IT staff leveraging scripts for automating IT processes and tasks.
VxRail API can be used for the following use cases:

- Infrastructure as Code (IaC) environments to execute typical administrative tasks such as monitoring, querying, reboot/shutdown, lifecycle management updates from configuration management tools like Puppet, Ansible or Chef
- VMware administrators can use PowerCLI with a VxRail API Windows PowerShell module which simplifies the learning curve
- REST APIs can be leveraged by customers looking to use batch scripts or custom automation to manage clusters at scale
- To use VxRail as an essential building block for a fully automated VMware SDDC / hybrid cloud stack. VxRail can provide native, full stack integration with VMware Cloud Foundation platform

REST APIs are easy to explore and consume by accessing the latest API documentation through the web browser using the Swagger integration.

**SaaS multi-cluster management**

As stated in the introductory section of this TechBook, the drive for digital information requires technologies that will greatly reduce the reliance on IT personnel to manage infrastructure. VxRail lifecycle manager is an example of VxRail technology that can reduce time spent managing infrastructure. To further enhance operational efficiency, AI-driven operations and multi-cluster management are areas where it can introduce more operational simplicity to cut down time needed to manage clusters at scale and operational intelligence to offload some of the decision-making burden of IT personnel for LCM and maintaining health of the clusters.

VxRail HCI System Software SaaS multi-cluster management is a centralized data collection and analytics platform that streamlines the monitoring and management of multiple VxRail clusters for a customer, improves serviceability, and helps the customer make better decisions to manage performance and capacity of their HCI. It is a cloud-based analytics platform that leverages advanced telemetry collected from the VxRail clusters for its infrastructure machine learning to provide reporting and actionable insight. Its infrastructure machine learning utilizes built-in knowledge of Dell EMC best practices and more than 700 common issues. SaaS multi-cluster management provides health
scores for the entire HCI stack to enable customers to quickly identify areas to troubleshoot and to address areas to efficiently scale based on projected growth of IT resources.

**How does it work?**

SaaS multi-cluster management is available with no additional hardware or software required for the VxRail cluster. It relies on a data collector service provided by the VxRail HCI System Software running on the VxRail nodes to aggregate metrics from the vSAN cluster as well as from the VxRail system. Officially called the Adaptive Data Collector, this service frequently transfers this aggregate bundle of data to the VxRail cloud-based platform using the same SRS conduit for dial home services. Because it uses SRS, a support account with MyService360 is required as well as configuration and enablement of SRS for data to be transferred to the VxRail data lake. This repository is housed at Dell EMC. Using Pivotal Cloud Foundry as its cloud-based service platform, SaaS multi-cluster management incorporates its infrastructure machine learning to produce reporting and insight to enable customers to improve serviceability and operational efficiencies. SaaS multi-cluster management functionality is entirely consumed via a cloud-based web portal, called MyVxRail, which provides a single global view of the customer’s VxRail environment.

There are four settings for data collection frequencies: do not collect (NONE), once a day (BASIC), once every hour (MEDIUM, which is the default setting), or once every half hour (ADVANCED). Data collection frequency is configured in the telemetry settings either using REST API commands or the VxRail Manager plug-in. The timeliness of the content shown on MyVxRail is dependent on the frequency of the data collection a user configures for their clusters. SaaS multi-cluster management uses infrastructure machine learning to model and train data to create accurate predictions. The more data it can analyze, the better the models will be.

**SaaS multi-cluster management features**

SaaS multi-cluster management is designed for continuous innovation and continuous delivery so that frequent, incremental updates can be made to introduce new capabilities. It currently provides the following capability sets:

- Cloud-based management portal – SaaS multi-cluster management is accessed from a cloud-based web portal, called MyVxRail. This web portal provides a
customer with a central point of management for all their VxRail clusters. All features of SaaS multi-cluster management are made available through MyVxRail.

• Global visualization – SaaS multi-cluster management provides a centralized topology of all VxRail clusters in one global view, instead of locally managing VxRail clusters per vCenter Server. There are two views. Clusters are organized logically by the vCenter Servers in the Logical View and physically according to the geographic location depicted on a global map in the Physical View. As the user navigates from the vCenter Server down to individual VxRail nodes, corresponding information about the selected object, its health, its resource (CPU, memory, capacity, network) usage, and underlying VM counts are shown to the user.

• Simplified health scores – Identify and assess impact of existing and potential health issues at the cluster and node levels so the user can quickly identify and troubleshoot problem areas to improve performance, availability, and IT resource planning. Infrastructure machine learning is used to learn behavior patterns of VxRail clusters and more accurately identify anomalies that may signal potential issues to address.

• Advanced metrics charting – With intelligent health reporting, the user can pinpoint problem areas using metrics charting of CPU, memory, capacity, and networking resources.

• Future capacity planning – Infrastructure machine learning is also used to project future usage so the user can have better insight into current usage and projected IT resource needs.

• Lifecycle management – SaaS multi-cluster management provides LCM planning and execution capabilities across multiple clusters with a single workflow. Perform on-demand pre-update cluster health checks (LCM pre-checks for short) to determine whether the cluster is ready to start the cluster update process and orchestrate update bundle downloads onto VxRail clusters. Once staged on the VxRail Manager VM on the cluster, a user can initiate the execution of a cluster update.

• Role-based access control – Integration with vCenter access control allows customers to regulate access and privileges to perform lifecycle management operations. MyVxRail can register to the vCenter Servers so that privileges such as: LCM pre-checks, update bundle download and staging, and cluster update can be managed using vCenter access control and enforced by MyVxRail.

• Credentials management – Credentials used to initiate a cluster update can be managed from MyVxRail to streamline cluster updates at scale. During initial setup of cluster update, credentials for vCenter Server, Platform Services Controller, and VxRail Manager are entered and saved locally on each cluster. When initiating a cluster update, MyVxRail can automatically provide the saved credentials to execute the update if the user is privileged through role-based access control. Management of the credentials can be further restricted to a smaller group of users using the ‘manage credentials’ privilege.
Use cases

The features in SaaS multi-cluster management touch upon various areas of system management. This section goes over some of the major use cases that the features were designed to address.

- Global health monitoring – the combination of global visualization and simplified health scores provide a convenient and streamlined way to assess the health of the entire VxRail footprint, along with the ability to single out clusters in need of attention. Upon login, a user can see all their clusters in a logical or physical view and be able to navigate through the topology. Health scores are integrated into the topology so that a user can see aggregate health scores. From a top-level view, a user can quickly spot poorly behaving sections of the topology and drill-down to narrow their focus for troubleshooting.

![MyVxRail Summary tab](image)

Figure 11. MyVxRail Summary tab

- Troubleshooting – SaaS multi-cluster management helps users troubleshoot issues detected from the simplified health scores. Component failures, configuration issues, and performance anomalies are reflected in the health score. Performance anomalies relies on predictive analytics that determines a normal behavioral pattern and flags occurrences when a VxRail node is behaving abnormally. A user can drill-down at the list of issues that degraded the health score to understand the reason behind the issue. For some issues, Knowledge Base articles are provided to help troubleshoot the cause. For performance
issues, the metrics charting function allows user to pinpoint the time of the issue and analyze the networking, disk, memory, and capacity activity during that time.

![MyVxRail Performance tab](image)

**Figure 12. MyVxRail Performance tab**

- On-demand LCM pre-checks – While VxRail LCM simplifies much of the update process through automation and orchestration and configuration stability, finding out that a cluster is not ready for an update during the scheduled update window can be troublesome. With LCM pre-checks, a user can run the pre-check at any time to learn whether a cluster is ready for an update. Issues can be discovered and addressed during the update planning phase versus at the time of the update. This feature is also designed to incorporate the latest health checks so that the pre-check is as accurate as possible to determine cluster update readiness.

![VxRail Pre-check report](image)

**Figure 13. VxRail Pre-check report**

- Update bundle download and staging – Downloading VxRail update bundles across multiple VxRail clusters can be challenging. Some clusters may be
individually managed because they are geographically dispersed. Some clusters may have network bandwidth issues. SaaS multi-cluster management provides the ability to orchestrate the downloads across many or all clusters in a single operation, which can offer significant time savings. This feature also can identify the delta of the current VxRail version and the target VxRail version so that only the required component installation files are packaged in the download versus downloading the entire update bundle. Bandwidth-strapped clusters can realize tremendous time savings, especially in cases where minor updates may require only a few component updates.

- Cluster update – Combined with the LCM pre-checks and update bundle download and staging, MyVxRail can provide LCM of clusters at scale. Customers can perform planning operations to gauge readiness before staging the update bundle and schedule the maintenance window. When the time comes, customers can initiate the cluster update for multiple clusters in a single workflow. Customer can customize the update path for each cluster. A time estimate, based on telemetry data gathered about the VxRail install base, is provided for each update path. Credentials manager further streamlines cluster update at scale by automating infrastructure credentials input needed to execute the operation. Cluster update requires a fee-based add-on license, SaaS active multi-cluster management for HCI System Software, that is applied each node in the cluster.

**CloudIQ**

A subset of the SaaS multi-cluster management capabilities is also available in CloudIQ. Adding VxRail visibility to CloudIQ allows users to view and monitor all their Dell infrastructure from a single web portal. In CloudIQ, users can benefit from global visualization and single-system views of their VxRail clusters from the System Health, Inventory, Capacity, and Performance sections. Simplified health scores, capacity forecasting, and performance graphs of VxRail clusters are available in CloudIQ. A virtualization view, as shown below, organizes the VxRail cluster information similar to the vCenter Server experience for easier navigation.
File-based backups of VxRail HCI System Software help to ensure business continuity in the rare event the VxRail Manager VM needs to be rebuilt.

VxRail’s service and support is backed by Dell EMC’s world-class service and support as the single point of contact for both hardware and software, by default. Dell EMC’s technical support team has in-depth VMware expertise such that 98% of cases are resolved without the need to coordinate with VMware support team to resolve. Having single vendor support ultimately speeds time to resolution by eliminating the need for the customer to coordinate between vendor support.


VxRail support includes Dell EMC SRS for call-home and proactive two-way remote connection for remote monitoring, diagnosis, and repair through the entire lifecycle 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 Dell EMC technical support has the necessary information to perform troubleshooting without extensive back-and-forth with customers.

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5 VxRail Single Source of Support, April 2020, Dell Technologies
VxRail licensing

A suite of software licenses is included with a purchase of a VxRail cluster. The software license bundle includes VxRail HCI System Software for system management, operations, and automation. The following VMware software are included:

- VMware vCenter Server
- vSphere ESXi
- vSAN
- VMware vRealize™ Log Insight™
- vSphere Replication

Additional Dell EMC software includes:

- RecoverPoint for VMs—5 VM licenses per node (for single node systems), 15 VM per chassis for the G Series

Active management capabilities for SaaS multi-cluster management requires a fee-based add-on license. In order to enable the functionality for each cluster, SaaS active multi-cluster management for HCI System Software needs to be purchased for each node in the cluster. The add-on software license is also available to clusters that have already been deployed.

VxRail system allows customers to use any existing eligible vSphere licenses with their VxRail, or the licenses can be purchased with a VxRail. This VxRail vSphere license independent model (also called “bring your own” or BYO vSphere License model) allows customers to leverage a wide variety of vSphere licenses they may have already purchased.

vSphere Enterprise Plus, Standard, and ROBO editions are supported with VxRail. vSphere Enterprise is also supported but is no longer available from VMware. vSphere Essentials and Essentials Plus are not supported. Also supported are vSphere licenses from Horizon bundles or add-ons when the system is dedicated to VDI.

If vSphere licenses need to be purchased, they should be ordered through Dell EMC, the customer’s preferred VMware channel partner, or from VMware directly. Licenses acquired through VMware ELA, VMware partners, or Dell EMC will receive single-call support from Dell EMC.

When determining the best vSphere license to use with the VxRail system, a key consideration is the effect of VxRail functionality. DRS, a significant vSphere feature, provides the greatest amount of functional variance to VxRail clusters. Customers should consider the degree of automation that DRS provides to determine if the vSphere license they desire includes this functionality.

VxRail supports flexible vSAN licensing options and requires vSAN to be ordered with VxRail or applied via a vSAN ELA from VMware. VxRail supports all license editions of vSAN including Standard, Advanced, Enterprise, and Enterprise Plus. Customers can upgrade vSAN licensing from one lower license edition to a higher license edition. vSAN ROBO licenses are supported with VxRail but customers would need to acquire the licenses through a VMware ELA.

vSphere and vSAN licenses purchased from Dell EMC expire with the node in which they are deployed, and they are not transferrable.

The vCenter Server license that is included with the VxRail cluster can only be applied to the vCenter Server that is deployed by VxRail Manager as an embedded vCenter. It is not transferrable to any customer-deployed vCenter Server. The customer must use their own vCenter Service license when using an external vCenter configuration.

For more information about VMware software, see Additional resources.
VxRail hardware

The Dell EMC VxRail family is the standard in hyperconverged infrastructure, providing extreme flexibility to granularly add capacity and performance on demand and enabling customers to easily extend use cases across the VMware virtualized environment. The system-based design allows IT centers to scale capacity and performance non-disruptively, so they can start small and grow incrementally with minimal up-front planning. VxRail environments can be designed to support a small number of virtual machines and scale to thousands.

The VxRail architecture enables a predictable pay-as-you-grow approach that aligns to changing business goals and user demand. Dell EMC and VMware are continuously innovating, and VxRail introduced new Dell EMC PowerEdge-based models that offer configuration flexibility. This flexibility allows customers to choose performance, graphics, and capacity as required for VMware environments, and supports more use cases.

The Dell EMC VxRail family of systems offers a range of platforms:

**E Series**: Low profile, cost-effective, go “everywhere” platform. 1U platform with an all NVMe option and NVIDIA Tesla T4 GPUs. Single or dual socket options powered by Intel Xeon or AMD EPYC™ processors. Ideal for remote, branch office, or edge locations where space is at a premium. Use cases include high performance computing (HPC), VDI, AI/ML, and in-memory databases.

**P Series**: Performance-intensive 2U platform configurable with 1, 2 or 4 Intel Xeon Scalable processors, or a single AMD EPYC processor with up to 64 cores. Ideal for business-critical workloads requiring high performance. Use cases include in-memory intensive database applications such as SAP HANA, HPC and AI/ML.

**V Series**: Virtualization-extended 2U platform with GPU hardware for graphics-intensive desktops and graphics-compute workloads. Ideal for specialized use cases such as high-end 2D/3D visualization leveraging NVIDIA Data Center GPU cards. Use cases include VDI, AI/ML, large/complex CAD models, computer-aided engineering (CAE), seismic exploration, complex DCC effects, 3D medical imaging, photorealistic rendering, high end virtual science, and data analytics.

**D Series**: Durable, ruggedized, short-depth platform with a filtered bezel for dust resistance. Designed to withstand extreme conditions such as intense heat and cold, shock, vibration, dust, humidity, and EMI. Available in MIL-STD and DNV-GL Maritime certified configurations. Ideal for space-constrained, remote locations with extreme conditions. Use cases include mobile command centers, retail POS systems, video surveillance, and GPS mapping on the go.

**S Series**: Storage-dense 2U platform available as single or dual-socket with hybrid storage options to deliver a maximum capacity of 96 TB per node. Ideal for dense storage workloads whose storage capacity scales faster than CPU or memory. Use cases include demanding applications such as virtualized Microsoft SharePoint, Microsoft Exchange, big data, analytics and video surveillance.

**G Series**: Compute-dense 2U/4-node platform available as single or dual-socket with up to 224 cores. Ideal for environments that require maximum processing power in small spaces. Use cases include processor-dense and general-purpose virtualized workloads.
The E, P, V, D, and S Series are single-node systems based on Dell EMC PowerEdge server technology, the number-one selling x86 server platform, with greater storage capacity, larger memory, and more powerful CPU options. The G Series is a four-node system based on Dell EMC PowerEdge server technology in a compact 2U chassis, providing a compute dense footprint.

VxRail systems are built using a distributed-cluster architecture consisting of modular blocks that scale linearly as the system grows from as small as two nodes to as large as 64 nodes. Nodes are available with different form factors, with single-node systems for use cases: low-profile systems; performance optimized; VDI optimized with GPU; and storage-optimized configurations supporting high-capacity HDD drives.

For applications that benefit from asymmetric scaling of processing power and storage capacity, customers may choose VxRail dynamic nodes which provides the ability to attach external storage resources as their primary storage. VxRail dynamic nodes decouple compute and storage scaling. As processing demand grows, customers can add dynamic nodes to the cluster. As storage capacity demand grows, customers can provision more storage from external storage resources to dynamic nodes.

Extensive compute, memory, and storage options are designed to fit multiple use cases. Customers can choose from a range of next-generation Intel and AMD processors, variable memory sizes, storage, and cache capacity to provide the right balance of compute, memory, and storage. Single-node scaling and a low-cost entry point let customers buy just the right amount of storage and compute for today’s requirements and effortlessly scale to accommodate tomorrow’s growth. Systems are available with all-flash storage configurations that deliver the industry’s most powerful HCI for applications that demand maximum performance and low latency.

The VxRail system is assembled with proven server-node hardware that has been integrated, tested, and validated as a complete solution by Dell EMC. All the nodes in the current generation of VxRail use either Intel Xeon Scalable family processors or AMD EPYC processors. The number of cores and memory capacity differ for each VxRail model.

Each node server includes the following technology:

- Single, dual, or quad Intel® Xeon® Scalable processors, each with up to 40 cores per processor. Or a single Generation AMD EPYC™ processor with up to 64 cores
- Up to 48 DDR4 DIMMs, providing memory capacity ranging from 64GB to 6,144GB per node, depending on model
- A PCIe SAS disk-drive controller supporting 12GB SAS speeds, if applicable
- A mirrored pair of BOSS SATA M.2 cards used to boot ESXi on the node
• A 10/25GbE Network Daughter Card (10GbE can auto-negotiate to 1GbE)

VxRail systems built on the latest generation Dell EMC PowerEdge server platform deliver the performance and reliability customers need for the widest range of workloads, all with full lifecycle management from a single point of support. In short, VxRail is the fastest and easiest way to transform infrastructure. It takes a lot of work and expertise to engineer a high performance and reliable HCI solution, and the work does not stop after the initial deployment. Continuous validation is needed to keep it running smoothly through software updates and node additions. As a turnkey, pre-integrated, tested, and validated HCI solution, VxRail can be quickly deployed, easily distributed, and counted on to increase the predictability, availability, and performance of the IT environment.

VxRail systems on next generation servers include multiple purpose-built platforms with build-to-order configurations that support a wide range of customer use cases, including graphics-intensive VDI, big data and analytics, high performance computing, remote office, and more. With more processor options, new NVMe drives, more additional network connectivity options, and more GPU expansion, customer can now more closely match a VxRail to their workload requirements. No over provisioning here: buy what is needed, when it is needed.

VxRail models are available to meet the requirements of a wide set of use cases. For smaller workloads, there is a low-profile system space efficient configuration that uses 1U single-node systems. A performance-optimized and a VDI-optimized configuration is available in both all-flash and hybrid configurations. For use cases requiring even greater storage, a hybrid storage-dense configuration that uses larger-capacity 3.5-inch drives is available. All models have a wide range of available memory, SSD cache, capacity storage configuration options and can start as with as few as two nodes.
Dell EMC offers the world’s most configurable HCI systems – VxRail perfectly matches any HCI requirements. The following figure shows the range of platforms designed to support multiple use cases.

<table>
<thead>
<tr>
<th>E680/F</th>
<th>E685/F/N</th>
<th>P670F</th>
<th>P675/F/N</th>
<th>V670F</th>
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**Figure 18. VxRail on latest generation Dell EMC servers**

**Standard VxRail 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 (HDDs). The nodes form a networked cluster with a minimum of two nodes or three nodes for scale-out clusters with a maximum of 64 nodes. Nodes within a cluster must be of the same storage configuration, either all hybrid or all-flash. The flexibility to mix nodes within a cluster is supported. The first three nodes must have the same compute, memory, and storage configuration, and mixing 1GbE, 10GbE, and 25GbE is not supported. From the minimum configuration to the maximum, the VxRail cluster is easily expanded one node at a time.

System models support either 25GbE, 10GbE or 1GbE network. 10Gb and 25Gb Ethernet networks are required for all-flash configurations and environments that will scale to more than eight nodes. Additional ports are available, allowing the customer to expand VM-network traffic.

**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 its primary storage. External storage resource types can be remote datastores from vSAN clusters using VMware vSAN HCI Mesh or datastores from Fibre-Channel attached storage on Dell EMC storage arrays such as PowerStore-T, PowerMax, and Unity XT. Dynamic node clusters further extends the workload types that VxRail can address. Customers can now deploy VxRail for workloads that may require enterprise storage-level data protection and resiliency or 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 VxRail’s simplified lifecycle management. For applications that may be compute-intensive or storage-intensive, VMware vSAN HCI Mesh allows customers to 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 clusters 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. There is not support for internal storage, therefore a vSAN license is not required. VxRail HCI System Software is responsible for the lifecycle management of the node. Lifecycle management of the storage array is separate. VxRail dynamic nodes are available with the E560F, P570F, and V570F VxRail models. All configuration options that come with these models are available except for cache and capacity drives.

<table>
<thead>
<tr>
<th></th>
<th>E560F</th>
<th>P570F</th>
<th>V570F</th>
</tr>
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<tbody>
<tr>
<td>Processors</td>
<td>Dual Intel® Xeon® Scalable Gen 2 8 to 56 cores, Up to 3TB of Optane PIMem, Up to two NVIDIA T4 GPUs</td>
<td>Dual Intel® Xeon® Scalable Gen 2 8 to 56 cores, Up to 3TB of Optane PIMem</td>
<td>Dual Intel® Xeon® Scalable Gen 2 8 to 56 cores, Up to six GPUs from a choice of four NVIDIA Ampere and Tesla cards</td>
</tr>
<tr>
<td>BOSS</td>
<td>BOSS with dual M.2 SATA</td>
<td>BOSS with dual M.2 SATA</td>
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<tr>
<td>R840</td>
<td>R740XD</td>
<td>R740XD</td>
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</tr>
<tr>
<td>10GbE or 25GbE networking, 16Gb or 32Gb Fibre Channel, 48V DC PSU option</td>
<td>10GbE or 25GbE networking, 16Gb or 32Gb Fibre Channel, 48V DC PSU option</td>
<td>10GbE or 25GbE networking, 16Gb or 32Gb Fibre Channel, 220V - 240V AC only</td>
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Figure 19. VxRail dynamic nodes

**Intel® Xeon® Scalable processor: Powerful processing for VxRail**

Intel® Xeon® Scalable platforms are powerful infrastructure that represents an evolutionary leap forward in agility and scalability. Disruptive by design, it sets a new benchmark in platform convergence and capabilities across compute, storage, memory, network and security. An innovative approach to platform design in Intel® Xeon® Scalable processors unlocks the power of scalable performance for today’s datacenters and communications networks—from the smallest workloads to the most mission-critical applications.
broad set of enterprise workloads while lowering costs and improving resource utilization.

Over time, evolving to a software-defined infrastructure (SDI) across all the critical domains of the datacenter (compute/storage/network) will deliver critical automation, orchestration, and telemetry capabilities to help businesses unlock the full capabilities of multi-cloud computing.

With modern, industry-standard Intel® servers and technologies that run on software-defined infrastructure, customers can seamlessly manage an environment that supports development and delivery of cloud-native applications and mission-critical workloads on secure private clouds, while also integrating with public clouds, many of which already run on Intel® architecture.

With up to 40 cores delivering highly enhanced per core performance, significant increases in memory bandwidth (eight memory channels) and I/O bandwidth (64 PCIe lanes), the most data-hungry, latency-sensitive applications such as in-memory databases and high-performance computing will see notable improvements enabled by denser compute and faster access to large data volumes.

The convergence of compute, memory, network, and storage performance combined with software ecosystem optimizations make Intel® Xeon® Scalable platforms ideal for fully virtualized, software-defined datacenters that dynamically self-provision resources—on-premises, through the network, and in the public cloud—based on workload needs.

2nd & 3rd Generation AMD EPYC™

AMD Infinity Architecture is the foundation of AMD processor technology. A thoughtful design approach to accelerate computation, access data quickly, and help protect against ever-changing security threats. AMD have brought many firsts to the market:

- First with 7nm technology enabling higher transistor density and energy efficiency
- First with PCIe 4.0 delivering 128 lanes to double the I/O performance over PCIe 3.0
First with 64 cores (128 threads) in a single socket

**AMD EPYC™ Processors on VxRail**
Built with 7nm Technology: Higher transistor density & energy efficiency

1. 3rd Gen AMD EPYC processors, 33% more IOPS, lower latency
2. Best-in-class core density - up to 64 processor cores
3. First x86 PCIe Gen 4.0 - 128 PCIe lanes
4. Eight DDR4 3200MHz memory channels

AMD EPYC™ has been engineered for data centers that rely on CPU performance. From oil and gas exploration, to in-memory databases, to big data analytics to production rendering to standard data center applications, highly parallel workloads have more cores to work with. Traditional CPUs typically must scale up to a 2-socket server to overcome an imbalance of resources. With AMD EPYC™, single-socket servers satisfy many workload needs, helping increase density and reduce capital, power, and cooling expenses.

PowerEdge servers are optimized for the AMD EPYC processors taking advantage of the additional cores, faster and additional memory channels, and of PCIe 4.0 for faster networking.
VxRail node storage disk drives

Storage capacity for the VxRail system is provided by drives that have been integrated, tested, and validated by Dell EMC. VxRail configurations use 2.5” form-factor SSDs, 2.5” NVMe drives, and mechanical HDDs. There is a VxRail configuration that uses 3.5” form-factor drives which also available for dense-storage requirements. Disks drives are logically organized into disk groups. Disk groups are configured in two ways:

- Hybrid configurations, which contain a single SSD flash-based disk for caching (the cache tier) and multiple HDD disks for capacity (the capacity tier)
- All-flash configurations, which contain a single SAS SSD or NVMe drive for caching and NVMe, SAS, or SATA SSD for capacity.

The flash drives used for caching and capacity have different endurance levels. Endurance level refers to the number of times that an entire flash disk can be written every day for a five-year period before it has to be replaced. A higher-endurance SSD is used for write caching, and capacity-optimized SSDs are used for capacity. All VxRail disk configurations use a carefully designed cache-to-capacity ratio to ensure consistent performance. Capacity SSDs are offered in both higher endurance SAS and SATA. The SATA SSDs are a lower cost option, up to 30% per drive, and great for read or moderately intensive workloads.

All-NVMe configurations are available which use either Intel Optane or NVMe drives for cache, and NVMe drives for capacity. The E560N is a cost-effective 1U platform that can support a variety of workloads including data warehousing, database, and analytical workloads with its support for Nvidia T4 GPUs. The P580N is the only 4-socket VxRail offering. Combined with all-NVMe storage, it is an ideal platform for memory-intensive and compute-heavy application workloads.

VxRail hardware options

VxRail nodes can be configured with choice of processor, memory, storage (cache and capacity drives), networking, power supply, and GPU (most but not all node types). Customers can be assured their VxRail is configured to best match their workload requirements in a very prescriptive manner, with millions of possible configuration combinations in the VxRail Series. Combine this with the numerous ways to scale on demand, and it is clear that VxRail provides the agility demanded by today’s modern IT. Upgrade options for VxRail include, memory, GPU, NIC cards, cache, and capacity drives expand workload use case possibilities.

- GPU – VxRail supports a variety of NVIDIA Data Center GPUs. Depending on the GPU model, workloads such as virtual desktop infrastructure (VDI), graphics rendering, machine learning, 3D rendering, and complex visualization computing can be suitable on a VxRail cluster.
- NIC cards – As the demand for high-bandwidth network connectivity grows, VxRail is adding higher bandwidth NIC card options. Workloads that rely on GPUs such as AI-powered business operations will drive more data transfer between nodes and clusters.
- NVMe drives – With the economics of NVMe drives becoming more favorable, NVMe cache and capacity can be a cost-effective option for high performance compute and in-memory database workloads.
**VxRail hardware**

- Fibre Channel HBA – Fibre-attached storage can be used as primary storage in VxRail dynamic node clusters. Connecting to external storage arrays as secondary storage can be a valuable use case for re-purposing existing investments while customers transition more toward VxRail clusters as their primary platform for virtualized workloads.

**Hardware delivery options**

VxRail delivers a seamless user experience to customers across a range of deployment options from appliance to fully integrated rack.

- The VxRail appliance deployment option maintains maximum flexibility. Customers are then responsible for adding networking and racking of the appliances. They are also responsible for patches/updates of non-Dell 3rd party products.

- Customers who choose the VxRail Integrated Rack deployment option chose to have Dell EMC rack and stack the VxRail appliances and customer selected networking. Depending on which hardware configuration, customers can choose from a list of fixed configurations or a customer configuration engagement. For all 3rd party products, the customer will be responsible for procuring and sending the products to a Dell EMC 2nd Touch Facility for installation.

**VxRail scaling**

VxRail scale-out clusters start with as few as two nodes and can grow in one-node increments up to 64 nodes, providing performance and capacity to meet a wide range of use cases. New systems can be added non-disruptively and different models can be mixed within a VxRail cluster. Flexible storage options also allow a node to start with a few drives and add drives as capacity requirements grow, as shown in the following figure. Single node upgrades and drive scalability protect an optimized initial investment by allowing customers to start with what they need and expand the VxRail cluster by adding nodes and/or drives to increase performance and capacity as needed. Consult the Dell EMC representative for assistance.

![Figure 20. VxRail scale on demand](image)

A few basic rules regarding scaling are worth considering for planning:

**Balance**
- At initial deployment, the first three nodes in a cluster must have identical configuration – 2-node vSAN clusters require both nodes to be identical.
- All nodes must be running the same version of software.
- Cannot mix hybrid, and all-flash or all-NVMe nodes in the same cluster.
- 1GbE, 10GbE, and 25GbE base networking cannot be mixed in the same cluster.
- 1GbE must be hybrid and single processor node type.
- For G Series, all nodes in a chassis must be identical.
- All nodes in a cluster must use the same processor vendor, either Intel or AMD. A cluster may have different generations of processors from a vendor. This is a VMware restriction.

**Flexibility**

- Systems in a cluster can be different models or series after initial deployment
- A cluster can have a varied number of drives, CPU, memory, and model types.
- A cluster can have between 2-64, but only a max of 8 if 1GbE networking is used.
- For G Series, a chassis can be partially populated.

**Upgradeable options**

With VxRail, nodes can upgrade or add memory, NIC cards, cache drives, and capacity drives. GPU can be upgraded or added in the supported node types. It is not possible to upgrade from all-flash to all-NVMe.
VxRail networking

The VxRail system is a self-contained environment with compute, storage, server virtualization, and management services that make up a hyperconverged infrastructure. The distributed cluster architecture allows independent nodes to work together as a single system. Each node contributes to and consumes system resources. This close coupling between nodes is accomplished through IP networking connectivity. IP networking also provides access to virtual machines and the services they provide.

While VxRail is a self-contained infrastructure; it is not a standalone environment. It is intended to connect and integrate with the customer’s existing data center network. A typical implementation uses one or more customer-provided 10GbE Top of Rack (ToR) switches to connect each node in the VxRail cluster. For smaller environments, an option to use 1GbE switches is available, but these lower-bandwidth networks limit performance and scale. While the network switches are typically customer provided, Dell EMC offers an Ethernet switches which can be included with the system.

The figure below shows typical network connectivity using two switches for redundancy. Single-switch implementations are also supported.

![Diagram of VxRail network connectivity](image)

Figure 21. Typical VxRail physical network connectivity for 10GbE configurations

The number of Ethernet switch ports required depends on the VxRail model. Most current generation models require two-port or four-port 10GbE connectivity for VxRail system traffic with additional options of two-port 25GbE SFP28 and four-port 1GbE available for
some models. Additional network connectivity can be accomplished by adding NIC cards. VxRail management can configure an additional PCIe NIC card for network redundancy of the VxRail system traffic. Customers would need to configure the PCIe NIC cards separately for non-VxRail system traffic, primarily VM traffic, through vCenter.

Network traffic is separated using switch-based VLAN technology and vSphere Network I/O Control (NIOC). Four types of system network traffic exist in a VxRail cluster:

**Management.** Management traffic is used for connecting to VxRail Manager plug-in on vCenter, for other management interfaces and for communications between the management components and the ESXi nodes in the cluster. Either the default VLAN or a specific management VLAN is used for management traffic.

**vSAN.** Data access for read and write activity as well as for optimization and data rebuild is performed over the vSAN network. Low network latency is critical for this traffic and a specific VLAN isolates this traffic.

**vMotion.** VMware vMotion™ allows virtual machine mobility between nodes. A separate VLAN is used to isolate this traffic.

**Virtual Machine.** Users access virtual machines and the service provided over the VM network(s). At least one VM VLAN is configured when the system is initially configured, and others may be defined as required.

Pre-installation planning includes verifying that enough physical switch ports are available and that the ports are configured for the appropriate VLANs. VLANs along with IP addresses and other network-configuration information are used when the system is configured during installation. Detailed planning and configuration information is included in the VxRail Network Guide.

When the system is initialized during installation, the configuration wizard automatically configures the required uplinks following VxRail standards and best practices. The wizard asks for the NIC configuration:

- **2x10GbE** – Management, vSAN, vMotion, and VM traffic is associated with these ports with the appropriate network teaming policy and NIOC settings.
- **4x10GbE** – Management, vSAN, vMotion, and VM traffic is associated with these ports with the appropriate network teaming policy and NIOC settings.
- **2x25GbE** – Management, vSAN, vMotion, and VM traffic is associated with these ports with the appropriate network teaming policy and NIOC settings.
- **4x25GbE** – Management, vSAN, vMotion, and VM traffic is associated with these ports with the appropriate network teaming policy and NIOC settings.
- **4x1GbE** – Only valid for systems with hybrid storage configuration with a single processor. The four (4) 10GbE ports auto-negotiate down to 1GbE. Management, vSAN, vMotion, and VM traffic is associated with these ports with the appropriate network teaming policy and NIOC settings.

During installation, port redundancy is available with active/standby and active/active NIC Teaming policies. Customers can benefit from increased network bandwidth using active/active and link aggregation network connection. Additionally, network card level redundancy can be configured for VxRail system traffic using ports from NDC and NIC.
card. If one network card fails, traffic can continue to flow through the other card. If nodes have additional physical NIC ports for non-VxRail system traffic, they can be configured after installation using standard vSphere procedures.

1GbE network option

The Ethernet network not only provides connectivity to the VMs and services, it also provides the backplane for the nodes in a hyperconverged infrastructure to aggregate and share system resources. Therefore, network bandwidth is critical to system scale and performance. Today, most data centers are built with 10Gb Ethernet connectivity, with 25GbE quickly becoming the new norm, but 1GbE still exists in some environments including smaller edge locations. To support these environments, Dell EMC also offers 1GbE VxRail models for smaller, less-demanding workloads. The following are considerations for using the 1GbE connectivity option:

1GbE is only supported for hybrid storage configurations, as it does not provide the bandwidth necessary for the ultra-high performance required by an all-flash system.

The maximum supported node count is eight nodes per cluster, because vSAN traffic increases with the number of nodes.

Only nodes with single-socket CPUs are supported.

A minimum of four ports are required per node. This increases the total number of switch ports required.

Dell EMC SmartFabric Services

Dell network switches support SmartFabric Services, which enable the configuration and operation of the switches to be controlled outside of the standard management console through a REST API interface. Certain Dell EMC switch models support initializing the switches with a SmartFabric personality profile, which then forms a unified network fabric. The SmartFabric personality profile enables VxRail to become the source for the automated configuration and administration of the Dell switches.

In this profile setting, VxRail uses the SmartFabric feature to discover VxRail nodes and Dell EMC switches on the network, perform zero-touch configuration of the switch fabric to support VxRail deployment, and then create a unified hyperconverged infrastructure of the VxRail cluster and Dell EMC switch network fabric.

Figure 22. VxRail with SmartFabric Services
For ongoing VxRail cluster network management after initial deployment, the Dell EMC OMNI (Open Manage Network Interface) vCenter plug-in is provided free of charge. The Dell EMC OMNI plug-in enables the integration and orchestration of the physical and virtual networking components in the VxRail-SmartFabric HCI stack, providing deep visibility from the vClient for ease of overall management and troubleshooting. The Dell EMC OMNI plug-in serves as the centralized point of administration for SmartFabric-enabled networks in the data center, with a user interface eliminating the need to manage the switches individually at the console level.

The orchestration of SmartFabric Services with the VxRail cluster means that state changes to the virtual network settings on the vCenter instance will be synchronized to the switch fabric using REST API. In this scenario, there is no need to manually reconfigure the switches that are connected to the VxRail nodes when an update such as a new VLAN, port group, or virtual switch, is made using the vClient.

The SmartFabric-enabled networking infrastructure can start as small as a pair of Dell EMC Ethernet switches, and can expand to support a leaf-spine topology across multiple racks. A VxLAN-based tunnel is automatically configured across the leaf and spine switches, which enable the VxRail nodes to be discovered and absorbed into a VxRail cluster from any rack within the switch fabric.

**VxRail ecosystem**

**Introduction**

VxRail is engineered as an HCI platform that extends its value beyond integration of software-defined components of compute and storage with the physical server. An ecosystem of solutions can build onto the VxRail platform to provide even more benefit for customers. External storage can be appended to VxRail solutions as secondary storage to the vSAN storage running on the VxRail cluster. Data services such as data protection are critical capabilities for virtualized production workloads. The management of virtual infrastructure can be complex and far-reaching. Integration with existing management solutions can provide VxRail awareness that can ease troubleshooting and allow for better insight on resource utilization, investment planning, and infrastructure monitoring.

**External storage**

The vSAN presents a robust, secure, and efficient shared datastore to all nodes within a VxRail cluster. External SAN storage is typically not part of a VxRail environment. However, often a requirement exists to access external storage in order to move virtual machines and data into a VxRail environment or move data between environments. Fibre Channel SAN connectivity is supported, and so is IP-based storage. An important distinction is that data in the Fibre Channel, iSCSI or NFS datastore is self-contained and is not distributed to the disk groups within the VxRail cluster. External storage can be used to provide additional capacity to the VxRail environment but, external storage is typically not used to meet capacity requirements. Virtual Machine File Systems (VMFS) can be configured over Fibre Channel and iSCSI. Network file system (NFS) is available over IP. Virtual Volumes (vVols) are available via Fibre Channel and IP.

**Fibre Channel with VxRail**

Customers can order Fibre Channel (FC) host bus adaptors (HBA) with their VxRail for external storage. FC storage can be configured to complement local VxRail cluster storage or as primary storage for VxRail dynamic node clusters.

For customers who stress the criticality to run application workloads on enterprise storage arrays typically value the data resiliency and data protection services that these storage platforms offer. There are applications that fall into this criterion in many industries including healthcare and financial. By attaching external storage to VxRail dynamic node clusters, customers can meet this requirement while also benefiting from simplified LCM experience in their vSphere clusters. When used with FC-attached external storage as primary storage, VxRail dynamic nodes only support Dell EMC storage arrays (specifically PowerStore-T, PowerMax, and Unity XT).

For FC-attached external storage as secondary storage, common use cases are customer’s desire to continue to use their existing storage array as a secondary storage to VxRail, or they are looking for a method to migrate data from their FC storage to VxRail vSAN datastores. Customers can connect to storage arrays that are supported by the HBA card and validated by VMware. However, Dell EMC only provides support for connection of the HBA to a Dell EMC storage array (i.e. PowerStore, SC, Unity, Symmetrix VMAX/PowerMAX, and XtremIO) that is qualified by eLab.

When configuring external storage via the FC HBA, customer is allowed to install VM/VIB/drivers to operationalize the use of the external storage as required. VxRail does not include the firmware and drivers of the FC HBA in its Continuously Validated States.
The customer is responsible for maintaining and updating it. Customers can install multiple HBAs if there are slots available on the PCIe bus.

**iSCSI with VxRail**

iSCSI can be used to provide mobility for VMs and associated data onto and between VxRail environments. The figure below shows a VxRail environment that includes iSCSI storage in addition to the vSAN datastore.

![Figure 24. Data mobility into and between VxRail environments](image)

Data on the iSCSI storage is easily moved into the VxRail vSAN environment or between VxRail environments.

iSCSI provides block-level storage using the SCSI protocol over an IP network. SCSI uses a client-server, initiator-target model where initiators issue read/write operations to target devices, and targets either return the requested read data or persistently save write data. iSCSI in a VMware environment is standard functionality. A software adapter using the NIC on an ESXi host is configured as an initiator, and targets on an external storage system present LUNs to the initiators. The external LUNs are configured as VMFS datastores. (Refer to vSphere documentation for more information: *Using ESXi with iSCSI SAN*.)

iSCSI configuration is performed using the vSphere web client. The steps involve creating a port group on the VDS, creating a VMkernel Network Adapter and associating it with the port group, and assigning an IP address. Then, from the vCenter Manage Storage Adapters view, the Add iSCSI Software Adapter dialog is used to create the software adapter. The last step is to bind the iSCSI software adapter with VMkernel adapter. Once this is complete, iSCSI targets and LUNs can be discovered and used to create new datastores and map them to the hosts in the cluster.

iSCSI works best in a network environment that provides consistent and predictable performance, and a separate VLAN is usually implemented. iSCSI network requirements should be considered when planning the network requirements for VxRail environment to make sure connectivity to the external iSCSI storage system exists, and the additional network traffic will not impact other applications.

**NFS with VxRail**

NFS is a network filesystem that provides file-level storage using the NFS protocol over an IP network. It can work in use cases similar to iSCSI—the difference being that NFS devices are presented as file systems rather than block devices. The figure below shows an NFS file system that has been exported from a network-attached server and mounted by the ESXi nodes in the VxRail environment.
This enables data mobility into and between VxRail environments as well as enabling additional storage capacity.

The external NFS server can be an open system host, typically Unix or Linux, or a specially built system. The NFS server takes physical storage and creates a file system. The file system is exported and client systems, in this example ESXi hosts in a VxRail system, mount the file system and access it over the IP network.

Similar to iSCSI, NFS is a standard vSphere feature and is configured using the vCenter web client. This is done in the Hosts and Clusters view under Related Objects and the New Datastore dialog. Select NFS as datastore type, the NFS version, the name of the datastore, the IP address or hostname of the NFS server that exported the filesystem, and the host that will mount it. The NFS filesystem will appear like the vSAN datastore. VMs, templates, OVA files, and other storage objects can be easily moved between the NFS filesystem and the vSAN datastore using vMotion.

As with iSCSI, NFS works best in network environments that provide consistent and predictable performance. The network requirements for NFS should be considered when initially planning the network requirements for VxRail environment.

### Data protection

Protecting VM workloads on VxRail clusters can be achieved with various options. Given the various requirements customers may have for their virtualized workloads, there are several data protection options to ensure the appropriate protection level is available. The figure below organizes different data protection options according to the service level objective that needs to be met, from continuously availability to archival.
Data protection options for every protection level of need

Stretched clusters is a native vSAN software feature that allows customers to have site level protection with zero data loss and near instantaneous recovery. This setup has automated failover in case of site failures. For customers looking for disaster avoidance and zero recovery point objective (RPO), stretched clusters is the appropriate data protection option. As a native vSAN software feature, VxRail LCM features supports stretched cluster deployments. Refer to the VxRail Planning Guide vSAN Stretched Cluster for more details: https://infohub.delltechnologies.com/t/planning-guide-dell-emc-vxrail-7-0-vsan-stretched-cluster-1/

Dell EMC RecoverPoint for VMs (RP4VM) provides a flexible replication solution for virtual workloads running on VxRail clusters. It can provide synchronous replication between sites to mitigate site loss events. With its point-in-time and asynchronous, local replication capability, replicated copies or snapshots can be re-purposed for test/development, operational recovery, and short-term backup and long-term backup use cases. RP4VM is managed directly vCenter Server. It is storage agnostic so that VMs on VxRail clusters can be replicated to other storage options including cloud service providers for cloud disaster recovery solutions.

VMware vSphere Replication is a hypervisor-based, asynchronous replication for VMs. It is fully integrated with vCenter Server and the vSphere Web Client. vSphere Replication can provide local data protection and can be an appropriate disaster recovery solution between sites for environments that can tolerate some data loss. It can be combined with VMware Site Recovery Manager to deliver automated failover and failback to minimize downtime.

Local backup and recovery solutions include PowerProtect software and Data Domain Virtual Edition (VE), PowerProtect appliance or IDPA (Independent Data Protection Appliance) as backup repositories. The PowerProtect software provides comprehensive backup and point-in-time recovery. Data Domain VE can be deployed on a VxRail cluster for a consolidated environment. The PowerProtect appliance and IDPA are purpose-built data protection appliance designed as a backup target where capacity and balanced performance are priorities.
Cloud replication, backup, and archive options are also available with VxRail clusters. RP4VM can replicate VMs to VMware Multi-Cloud deployed on AWS for a hybrid cloud site recovery solution. RP4VM and PowerProtect can also replicate and copy backups to AWS S3 for more cost-efficient backup or archive solutions.

### VxRail Management Pack for vRealize Operations

For those not familiar with what vRealize Operations is, it is VMware’s operations management software tool that provides its customers the ability to maintain and tune their virtual application infrastructure with the aid of AI and machine learning. It connects to the vCenter Server and collects metrics, events, configurations, and logs about the vSAN clusters and virtual workloads running on them. vRealize Operations also understands the topology and object relationships of the virtual application infrastructure. With all these features, it is capable of driving intelligent remediation, ensuring configuration compliance, monitoring capacity and cost optimization, and maintaining performance optimization. It is an outcome-based tool designed to self-drive according to user-defined intents powered by its AI/ML engine.

The VxRail Management Pack is an additional free-of-charge software pack that can be installed onto vRealize Operations to provide VxRail cluster awareness. Without this Management Pack, vRealize Operations can still detect vSAN clusters but cannot discern that they are VxRail clusters. The Management Pack consists of an adapter that collects distinct VxRail events, analytics logic specific to VxRail, and three custom dashboards. These VxRail events are translated into VxRail alerts on vRealize Operations so that users have helpful information to understand health issues along with recommended course of resolution. With custom dashboards, users can easily go to VxRail-specific views to troubleshoot issues and make use of existing vRealize Operations capabilities in the context of VxRail clusters.

The VxRail Management Pack is not for every VxRail user because it requires a vRealize Operations Advanced or Enterprise license. For enterprise customers or customers who have already invested in VMware’s vRealize Operations suite, it can be an easy add-on to help manage their VxRail clusters.
**VxRail solutions**

Dell EMC offers a full range of flexible consumption models that make it faster and easier for businesses to use VxRail to fuel digital transformation. These consumption models include both the technology itself and how businesses pay for this technology.

VMware Cloud Foundation on VxRail delivers an experience that customers won’t find on any other infrastructure running VMware Cloud Foundation. VMware Cloud Foundation on VxRail builds upon native VxRail and Cloud Foundation capabilities with additional unique Dell Technologies and VMware jointly engineered integration features to help simplify, streamline, and automate the operations of their entire SDDC from before and on Day 0 all the way through Day 2 operations.

As part of the Dell Technologies Cloud Platform, VMware Cloud Foundation on VxRail delivers a simple and direct path to the hybrid cloud and Kubernetes at cloud scale with one, complete, automated platform. This means customers get both the HCI infrastructure and cloud platform software stack in one, complete, automated lifecycle, 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 vRealize Suite), End User Computing Services (with VMware Horizon and App Volumes), and container-based cloud native platform services (with VMware vSphere 7 with Kubernetes and Tanzu Kubernetes Grid (TKG)) in both private or public environments making it the operational hub for their hybrid cloud. To accelerate their move to containers and a hybrid cloud operating model, Dell Technologies offers unique integration between VMware Cloud Foundation and VxRail that supports simultaneous VM and container-based workloads on industry-leading Dell EMC PowerEdge server and Dell EMC Storage across multiple cloud environments.

VMware Cloud Foundation on VxRail makes operating the data center fundamentally simpler by bringing the ease and automation of the public cloud in-house by deploying a standardized and validated network flexible architecture with built in full stack lifecycle automation for the entire cloud infrastructure stack including hardware. This level of deep integration with VCF is what gives customers a truly unique turnkey hybrid cloud experience not available on any other infrastructure.

An important aspect of the offering is the introduction of a standardized architecture for how these SDDC components are deployed together with the introduction of Cloud Foundation, an integrated cloud software platform that is based on VMware Validated Design. Having a standardized design incorporated as part of the platform provides them with a guarantee that these components have been certified with each other and are backed by Dell Technologies. Customers can then be assured that there is an automated and validated path forward to get from one Continuously Validated State to the next across the end-to-end stack.
VMware Cloud on Dell EMC is cloud infrastructure installed on-premises in a customer’s core and edge data centers and consumed as a cloud service. This new construct removes the friction of day-to-day tasks and frees their entire organization to focus on driving business value. VMware Cloud on Dell EMC seamlessly extends public cloud benefits to workloads in their core data center and edge locations alike. This extension is significant because requirements for integrating security, networking and policy management at the edge are just as stringent as those in their data center—if not more so. Yet, the VMware hybrid cloud control pane makes it as easy to configure and monitor edge workloads at scale as it is with data center workloads. This offers distinct advantages not only for industries like banking, healthcare, and oil and gas, but also for other industries including retail, grocery and manufacturing, and more.
Tanzu Architecture for VxRail, formerly known as Pivotal Ready Architecture, is a tested and validated reference architecture for deploying Pivotal Cloud Foundry on VxRail. With configurations for high availability, comprehensive product support, and options for object storage, Tanzu Architecture for VxRail is the best way to deploy Pivotal Cloud Foundry on-premises.

Cloud-native patterns are a modern approach to application architecture, development and delivery that has emerged as a natural response to the changes in business needs and infrastructure capabilities. This new model directly increases the speed and agility of application delivery for IT organizations and has proven its benefits for startups and established enterprises alike. Tanzu Architecture for VxRail is the fastest way to get Pivotal Cloud Foundry up and running in a customer’s data center. Accelerate their transformation with an “it just works” experience. This reference architecture supports Pivotal Application Service (PAS) and Pivotal Container Service (PKS).

Business benefits derived from Tanzu Architecture for VxRail include:

- **Reliable Deployment**: This reference architecture is a proven hardware and software solution.
- **Ready Infrastructure**: It is built on the only fully integrated, pre-configured, and pre-tested VMware hyperconverged infrastructure system family on the market.
- **Resilient Architecture**: It offers multi-site, multi-foundation, and multiple availability zone configuration options that deliver maximum uptime, geographic coverage, and resiliency.

Tanzu Architecture for VxRail provides a tested, validated reference architecture on which to deploy a highly available enterprise-grade developer platform. Built on hyperconverged VxRail, this reference architecture delivers automated lifecycle management of the infrastructure, a critical element in accelerating their transformation into a digital business.

- PAS and PKS reference architectures on VxRail
- Fully software-defined infrastructure
- “Always on” highly available configurations
- A central management console
VxRail solutions

- Modular design that scales with the customer
- Integrated backup & disaster recovery options

For more information, visit: https://tanzu.vmware.com/architecture-for-vxrail

2-Node vSAN cluster configuration

VxRail supports a 2-node vSAN cluster configuration. With its small footprint, it can be an appropriate, cost-effective solution for locations with limited space and workload requirements. The support requires that the configuration to be a brand-new deployment which means existing clusters cannot utilize node removal to convert into a 2-node cluster configuration. However a 2-node cluster configuration can be expanded through the addition of new nodes, up to the 64-node cluster limit. Users can still benefit from VxRail automated lifecycle management.

VCenter and Witness are external to the 2-node cluster

Management and Witness Traffic

Ports 1 & 2: Management, VM Network and Witness Traffic

Ports 3 & 4: vSAN & vMotion

2-node cluster

Figure 28. Network configuration for a 2-node vSAN cluster deployed with direct-connect option

The 2-node vSAN cluster on VxRail can be deployed in a switch configuration or a direct-connect configuration. In a switch configuration, all ports are connected to the switch. In a direct-connect configuration, the ports for vSAN and vMotion traffic are directly connected. A witness provides quorum for the cluster. The Witness is a virtual appliance installed on an ESXi host which must reside outside of the 2-node cluster, i.e. in another data center or a physical host in the same rack/location. The Witness has individual connections to both nodes which requires VLANs to separate Witness management traffic from vSAN traffic. The configuration only supports mirroring (FTT=1). Witness host is used as the tiebreaker. Each node and the Witness are an individual fault domain for a total three in the cluster.

A special workflow in the First Run experience is used to deploy the 2-node cluster. The workflow includes the setup of the Witness appliance and Witness traffic separation. The configuration must use a customer-supplied vCenter for management. With only two data nodes in the cluster, users need be cognizant of the cluster load to prevent data
VxRail solutions

unavailability in case of a node failure and a single node servicing the entire cluster workload.

For more information, see the planning guide, vSAN 2-Node Cluster on VxRail.

**VMware Horizon**

VMware Horizon is VMware's VDI and desktop management environment. Horizon provisions user desktops using a flexible and secure delivery model. The desktop environments are accessed by the user from almost any device, including mobile devices, with the security and resiliency of the data center. Because the application software and data components reside in the data center, traditional security, backup, and disaster recovery approaches may be applied. If a user's device is lost or the hardware fails, the recovery is straightforward. The user simply restores the environment by logging in using another device. With no data saved on the user's device, if the device is lost or stolen, there is much less chance that critical data could be retrieved and compromised.

The following figure shows how Horizon View encapsulates the OS, applications, profiles, and user data into isolated layers and dynamically assembles desktops on demand to provide users with a personalized view of their individual environments.

![Figure 29. Highly available and secure desktops](image)

Availability, security, ease of management, and support, are compelling reasons for moving from traditional physical desktops and laptops to VDI.

VMware Horizon is a comprehensive desktop management environment that runs in a vSphere environment. The environment is managed through vCenter centralized management and can leverage advanced capabilities including, Snapshots, vMotion, DRS, and vSAN storage.

The user’s desktop environment runs as a View Desktop VM on an ESXi server, and is accessed via the View Client that uses either Remote Desktop Protocol (RDP) or PC over IP protocols. The View Client can be an application running on a physical desktop, laptop, mobile device, or a web browser using the View Portal. The user's desktop environment can be either a dedicated VM or a floating VM (a VM assigned from a pool when the user logs in). Using the optional View Composer, rather than full images, linked clones can reduce the disk space required. Horizon View includes additional components used to manage the connection, provisioning the environment, authenticate users, and other applications and services.
VMware Horizon with VxRail

The VxRail system is a self-contained compute, storage, and vSphere virtualization, and management environment that is ideally suited for VMware Horizon. VxRail accelerates the Horizon infrastructure deployment, and an environment can be up in running in hours rather than days.

VxRail hyperconverged infrastructure is available in configurations that support hundreds to thousands of virtual desktops. The number of desktops supported is based on the user-workload profile.

Dell EMC has developed tools which provide the ability to model the number of VDI environments and the expected workload profiles to determine appropriate configuration that will meet the immediate and longer-term requirements. As demand increases, VxRail non-disruptively scales-up by adding additional systems and nodes while providing the users with expected performance and consistent user experience.

When deploying Horizon on VxRail systems, there are two general approaches: dedicating the VxRail environment to VDI or mixing VDI with other workloads. Horizon Editions or Horizon Add-on Editions are offered exclusively for use with VxRail. VMware or Dell EMC sales representatives can provide more details for the best customer-specific option.

In summary, VxRail with VMware Horizon allows an organization to quickly implement Desktops-as-a-Service (DaaS) and overcome the traditional capital expenditure (CAPEX) barriers of desktop virtualization. The environment can start small and easily scale up as needed. This lowers the initial startup investment. VxRail hyperconverged infrastructure is not only quick to setup, its integrated compute, storage, virtualization, and single-vendor support model eliminate the complexity of traditional infrastructure.

More information about VMware Horizon on VxRail can be found at: https://infohub.delltechnologies.com/t/vdi/.

APEX Dell Flex on Demand

APEX Flex on Demand by Dell Financial Services (DFS) allows a customer to acquire technology they need to support their changing business with payments that scale to match their actual usage. This model helps align their cost with usage and avoid paying for buffer capacity that is not used. It improves agility by providing instant deployment of capacity for usage when spikes occur in business operations. It improves budget agility and power by delivering better operational economics.

DFS works with customers to establish the “committed capacity” presently needed and the “buffer capacity” required in the future.

Buffer capacity is measured using automated tools with their equipment. Each payment is comprised of the fixed committed capacity and variable buffer capacity amount.

If their usage consistently consumes most of the buffer capacity, they have the option to receive additional buffer capacity. Once installed, their level of committed capacity and related payment will increase.
VxRail solutions

Figure 30. **Relationship between technology usage and Flex on Demand payment**


**SAP HANA certification with VxRail**

VxRail is one of the first HCI platforms, and the first VMware-based HCI to achieve certification to run SAP HANA, SAP’s in-memory database management system. SAP will leverage VxRail’s persistent memory to support the application and its use cases.

Customers will benefit from running SAP HANA on VxRail because of the system’s automation to get implementations up and running quickly, flexibility to offer the right mix of components to support the application from day one, and scalability to ensure future requirements are met. Start fast with automation and full lifecycle management to quickly and effectively support their HANA implementation using VxRail P Series nodes. VxRail is fully certified as a part of the Dell EMC Ready Solution for SAP v1.5 release.

VxRail is best for SAP HANA as it is fast, flexible, powerful, and scalable:

**Fast**: automation, ease of deployment / management ensure they are up and running quickly

**Flexible**: configure a system to meet specific needs with build-to-order VxRail on PowerEdge

**Powerful**: a rich mix of components deliver performance, density, and power efficiency for both transactional process and analytics

**Scalable**: increase power and performance without rip-and-replace system upgrades

For more information, see the following documents:

- [The benefits of deploying SAP HANA on Dell EMC VxRail](https://www.dellemc.com/en-us/flexibleconsumption/cloud-flex-for-hci.htm)
- [SAP HANA on Dell EMC VxRail Hyperconverged Infrastructure Validation Guide](https://www.dellemc.com/en-us/flexibleconsumption/cloud-flex-for-hci.htm)

**Reference architecture for Splunk**
Splunk Enterprise is the industry-leading platform for analyzing machine-generated data to gain valuable business insights. Splunk Enterprise uses its powerful Splunk Search Processing Language (SPL™) to extract meaningful information from machine data. The insights that are generated from analyzing machine data are called operational intelligence, which has many use cases, including:

**IT Operations:** Utilization, capacity growth

**Security:** Fraud detection, real-time detection of threats, forensics

**Internet of Things (IoT):** Sensor data, machine-to-machine, human interactions

Dell EMC and Splunk have partnered to provide jointly validated reference architectures that are optimized for maximum scalability and performance. Splunk software running on Dell EMC converged infrastructure delivers the operational intelligence that is required to drive an organization’s digital transformation. When paired together, Dell EMC and Splunk combine the operational intelligence that is provided by the Splunk eco-system with the cost-effective, scalable, and flexible infrastructure of Dell EMC.

The primary benefits Dell EMC provides to customers’ Splunk Enterprise environments include:

- Optimized storage data tiering—Aligns storage to hot/warm, cold, and frozen data requirements with high retention and performance.
- Cost-effective and flexible scale-out—Provides scale-out capacity and compute, independently or as a single, converged platform.
- Powerful data services—Includes secure encryption, compression and deduplication, and fast, efficient snapshots for protection.

A reference architecture using Dell EMC VxRail system with Isilon™ for a virtualized Splunk Enterprise environment has been jointly tested and validated by Splunk and Dell EMC to meet or exceed the performance of Splunk Enterprise running on Splunk’s documented reference hardware. VxRail offers the performance and capacity required to meet the infrastructure requirements of a small or medium-sized enterprise Splunk deployment.

See [Splunk Reference Architecture on VxRail](#) for more information.
For documentation, release notes, software updates, or for information about Dell EMC products, licensing, and service, go to the Dell EMC Online Support site (registration required) at: https://support.emc.com.

Enterprises need unwavering support for hardware and software and a smart way to manage the mix of vendors in the datacenter. Dell EMC offers a single source with the expertise, know-how and capabilities to help customers support their business.

ProSupport offers highly trained experts around the clock and around the globe to address their IT needs, minimize disruptions and maintain a high level of productivity. With over 55,000+ Dell EMC & partner professionals, across 165 countries, speaking more than 55 languages, they can rest assured that with Dell EMC they will be able to:

Maximize productivity by leveraging Dell EMC scale and skill

Minimize disruptions with around the clock access to highly trained experts

Gain efficiency through a single source for all their support needs

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

Our 12 Centers of Excellence and Joint Solution Centers deliver in-house collaboration and industry-leading levels of support, leveraging Dell EMC's alliances with leading application providers such as Oracle and Microsoft. Our 87 technical support sites are comprised of 71 total Dell Tech Support Sites and 16 total EMC Customer Service Centers.

Dell EMC support is recognized with 94% customer satisfaction rating and has received multiple awards including Temkin Group CE Excellence, TSIA STAR awards, Microsoft Deployment Partner of the Year and many more.

The Dell EMC difference is clear, when it comes to their IT strategy, we allow them to fearlessly adopt new technology giving them freedom to focus on their business. Having the same enterprise class support from Dell EMC across their infrastructure gives them that freedom.

Dell EMC offers ProDeploy installation and implementation services to ensure smooth and rapid integration of VxRail systems into customer networks. The standard service, optimal for a single system, provides an expert on site to perform a pre-installation checklist with the data center team, confirm the network and Top of Rack (ToR) switch settings, conduct site validation, rack and cable, configure, and initialize the system. Finally, an on-site Dell EMC service technician will configure SRS and conduct a brief functional overview on essential VxRail system administrative tasks. A custom version of this installation and implementation service is available for larger-scale VxRail system deployments, including those with multiple systems or clustered environments. Also offered is VxRail system extended service, which is delivered remotely and provides an expert service technician to rapidly implement VxRail system pre-loaded data services (RecoverPoint for Virtual Machines).
## Additional resources

### VxRail resource list

Refer to the following items for related, supplemental documentation, technical papers, and websites.

- Dell EMC VxRail
- Dell EMC VxRail Network Planning Guide
- VxRail with SmartFabric Services Planning and Preparation Guide
- VxRail Planning Guide for vSAN Stretched Cluster
- VxRail vCenter Server Planning Guide
- VxRail Comprehensive Security by Design
- vSAN 2-Node on VxRail Cluster Planning Guide
- Dell EMC Hyperconverged Infrastructure

### VMware resource list

- VMware vSphere technical resources
- VMware vSAN technical resources
- An overview of VMware Virtual SAN Caching algorithms
- vSAN Space Efficiency Technologies
- vSphere Virtual Machine Administration Guide
- VMware vSAN Licensing Guide