

Making Everything Easier!™

VMware 2nd Special Edition

Hyper-Converged Infrastructure

FOR
DUMMIES®
A Wiley Brand

Learn to:

- Use HCI to eliminate IT complexity and reduce costs
- Achieve new levels of IT agility, control, efficiency, and security
- Dynamically control modern infrastructure services
- Evolve to a cloud-ready, software-defined data center

Brought to you by

vmware®

Michael Haag

Group Product Marketing Manager



About VMware

VMware (NYSE: VMW), a global leader in cloud infrastructure and business mobility, helps customers accelerate their digital transformation. VMware enables enterprises to master a software-defined approach to business and IT with VMware Cross-Cloud Architecture™ and solutions for the data center, mobility, and security. With 2016 revenues of \$7.09 billion, VMware is headquartered in Palo Alto, California, and has over 500,000 customers and 75,000 partners worldwide.

Industry Award Highlights

CRN Best Cloud Platform

CRN Product of the Year

Software-Defined Technology 2016



Storage Magazine Product of the Year: Gold Winner
for Server-based Storage 2016



StorageReview Editor's Choice Winner - 2016



Hyper-Converged Infrastructure

FOR
DUMMIES[®]
A Wiley Brand

VMware 2nd Special Edition

Hyper-Converged Infrastructure

FOR
DUMMIES®
A Wiley Brand

VMware 2nd Special Edition

by Michael Haag

VMware – Storage & Availability
Group Product Marketing Manager

FOR
DUMMIES®
A Wiley Brand

Hyper-Converged Infrastructure For Dummies®, VMware 2nd Special Edition

Published by
John Wiley & Sons, Inc.
111 River St.
Hoboken, NJ 07030-5774
www.wiley.com

Copyright © 2018 by John Wiley & Sons, Inc., Hoboken, New Jersey

No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning or otherwise, except as permitted under Sections 107 or 108 of the 1976 United States Copyright Act, without the prior written permission of the Publisher. Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008, or online at <http://www.wiley.com/go/permissions>.

Trademarks: Wiley, For Dummies, the Dummies Man logo, The Dummies Way, Dummies.com, Making Everything Easier, and related trade dress are trademarks or registered trademarks of John Wiley & Sons, Inc. and/or its affiliates in the United States and other countries, and may not be used without written permission. VMware, NSX, vSphere, and vRealize, are registered trademarks of VMware, Inc. vSphere Storage DRS, vSphere Virtual Volumes, vSphere Replication, vSphere Thin Provisioning, vCenter Server, vRealize Air Automation, vRealize Log Insight, vRealize Operations, vRealize Operations Manager, vRealize Automation and Horizon Air Hybrid, vSAN, and vSAN ReadyNodes are trademarks of VMware, Inc. All other trademarks are the property of their respective owners. John Wiley & Sons, Inc., is not associated with any product or vendor mentioned in this book.

LIMIT OF LIABILITY/DISCLAIMER OF WARRANTY: THE PUBLISHER AND THE AUTHOR MAKE NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE ACCURACY OR COMPLETENESS OF THE CONTENTS OF THIS WORK AND SPECIFICALLY DISCLAIM ALL WARRANTIES, INCLUDING WITHOUT LIMITATION WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE. NO WARRANTY MAY BE CREATED OR EXTENDED BY SALES OR PROMOTIONAL MATERIALS. THE ADVICE AND STRATEGIES CONTAINED HEREIN MAY NOT BE SUITABLE FOR EVERY SITUATION. THIS WORK IS SOLD WITH THE UNDERSTANDING THAT THE PUBLISHER IS NOT ENGAGED IN RENDERING LEGAL, ACCOUNTING, OR OTHER PROFESSIONAL SERVICES. IF PROFESSIONAL ASSISTANCE IS REQUIRED, THE SERVICES OF A COMPETENT PROFESSIONAL PERSON SHOULD BE SOUGHT. NEITHER THE PUBLISHER NOR THE AUTHOR SHALL BE LIABLE FOR DAMAGES ARISING HEREFROM. THE FACT THAT AN ORGANIZATION OR WEBSITE IS REFERRED TO IN THIS WORK AS A CITATION AND/OR A POTENTIAL SOURCE OF FURTHER INFORMATION DOES NOT MEAN THAT THE AUTHOR OR THE PUBLISHER ENDORSES THE INFORMATION THE ORGANIZATION OR WEBSITE MAY PROVIDE OR RECOMMENDATIONS IT MAY MAKE. FURTHER, READERS SHOULD BE AWARE THAT INTERNET WEBSITES LISTED IN THIS WORK MAY HAVE CHANGED OR DISAPPEARED BETWEEN WHEN THIS WORK WAS WRITTEN AND WHEN IT IS READ.

ISBN 978-1-119-46064-0 (pbk); ISBN 978-1-119-46066-4 (ebk)

Manufactured in the United States of America

10 9 8 7 6 5 4 3 2 1

For general information on our other products and services, or how to create a custom *For Dummies* book for your business or organization, please contact our Business Development Department in the U.S. at 877-409-4177, contact info@dummies.biz, or visit www.wiley.com/go/custompub. For information about licensing the *For Dummies* brand for products or services, contact BrandedRights&Licenses@Wiley.com.

Publisher's Acknowledgments

Some of the people who helped bring this book to market include the following:

Development Editor: Elizabeth Kuball

Copy Editor: Elizabeth Kuball

Acquisitions Editor: Katie Mohr

Editorial Manager: Rev Mengle

Business Development Representative:

Karen Hattan

Production Editor:

Selvakumaran Rajendiran

Table of Contents

Introduction1

About This Book	1
Foolish Assumptions	2
Icons Used in This Book.....	2
Where to Go from Here	2

Chapter 1: The Data Center Has Evolved — Has Your Infrastructure Kept Up?3

New Requirements for Your Data Center	4
The Rise of the Software-Defined Data Center	5
Hyper-Converged Infrastructure: Natural Evolution to a Modern Data Center	6
Traditional infrastructure.....	6
Converged infrastructure	7
Hyper-converged infrastructure	8

Chapter 2: A New Approach: Hyper-Converged Infrastructure11

Defining Hyper-Converged Infrastructure	11
Identifying Trends Driving Hyper-Convergence	13
Higher-density flash technologies	13
More powerful servers	13
Prevalence of server virtualization	14
Cloud principles and economics	15
Assembling the Ingredients for Success	15
A proven hypervisor	16
Simple, hyper-converged storage	16
Unified management.....	17
Flexible deployment choices.....	17
Looking at Key Use Cases for Hyper-Converged Infrastructure.....	18
Business-critical applications	18
Virtual desktop infrastructure/ end-user computing.....	19
Distributed IT and remote office/ branch offices.....	19
Disaster recovery.....	20
Management clusters	20

The Big Payoff: The Benefits of Hyper-Converged Infrastructure.....	21
Simplicity	21
Cost.....	22
Security	22
Agility	22
Performance	23
Availability.....	23

Chapter 3: Extending Virtualization to Storage with Hyper-Converged Infrastructure 25

The Problems with Your Grandfather's Storage Model	25
Reinventing the Storage Model	27
Understanding the Storage DNA of HCI.....	27
Driving Storage Innovation through the Hypervisor	28
The Hypervisor: The Ideal Place to Deliver Software-Defined Storage	29
The Evolution to x86 Hardware	30
A New Way to Manage Your Storage	30
Toward a Software-Defined Everything.....	32

Chapter 4: The VMware Approach to Hyper-Converged Infrastructure 33

Two Different Routes to Hyper-Converged Infrastructure.....	33
VMware-Powered HCI.....	35
Powered by VMware vSAN	36
Native integration	37
Flash-optimized performance	37
Native HCI security.....	38
Efficiency advantages.....	38
Operational advantages.....	39
Hardware choice.....	40
Elastic, nondisruptive scaling.....	40

Chapter 5: Transforming the Operational Model with Unified Management 43

Single-Pane-of-Glass Management.....	43
Management at Scale.....	44
Taking Operations Down to the Virtual Machine Level	44
Automation Driven by Policies.....	45
Dynamic Control of Storage Services	46

The VMware Implementation: vSphere Storage	
Policy-Based Management	47
Programmable via Application Programming	
Interfaces.....	47
Renewing the Friendship between the Virtual	
Infrastructure Admin and the Storage Admin	48
Chapter 6: Getting Started with Hyper-Converged	
Infrastructure	49
Implementing VMware-Powered HCI:	
Deployment Choices	49
Certified Solutions: vSAN ReadyNodes	50
Looking at the benefits of a vSAN ReadyNode.....	51
Choosing the right vSAN ReadyNode.....	52
Implementing your vSAN ReadyNode	52
Integrated Systems: Dell EMC VxRail HCI Appliances	53
Storage area network power in just two racks	53
A familiar experience	54
Chapter 7: Ten Reasons to Love	
Hyper-Converged Infrastructure	55
Improving Cost Efficiency	55
Improving Operational Efficiency	56
Enabling Dynamic Responsiveness	56
Improving Precision and Granularity	56
Delivering Native Security	57
Scaling Elastically.....	57
Preparing for Future Applications	58
Providing Consistent Performance for Every	
Application.....	58
Providing Enterprise-Class Availability.....	59
Providing a Building Block toward the Hybrid Cloud	59
Appendix: Resources	63

Introduction



Welcome to *Hyper-Converged Infrastructure For Dummies*, your guide to catching the hyper-convergence wave that's sweeping through today's data centers.

Why should you care about catching the hyper-convergence wave? Well, as Stephen Covey once said, "You can't change the fruit without changing the root."

In this case, the fruit is the return on your data center infrastructure investments. Are you getting all you can get from your investments? Probably not, assuming you're using conventional approaches.

To get more fruitful returns on your investments, you have to change the root — your data center architecture — so you put less capital and staff time into operating and managing your infrastructure.

Hyper-converged infrastructure (HCI) does just that. HCI evolves the way that compute, storage, and management are delivered and provisioned to help you cut operational and capital costs, increase information technology (IT) and business agility, and improve application performance.

How do you get there? The first step is to immerse yourself in the concepts of this new approach to the data center. That's what this book is about.

About This Book

Don't let this book's small size fool you. *Hyper-Converged Infrastructure For Dummies* is loaded with information that can help you understand and capitalize on HCI. In plain and simple language, this book tells you

- ✓ What HCI is all about
- ✓ Why it's such a hot topic

- ✓ How you can get started
- ✓ Where you'll get the biggest bang for your HCI buck

Foolish Assumptions

This book makes a few assumptions about you. If you're reading this book, I assume the following:

- ✓ You work in an IT shop.
- ✓ You're familiar with data center terminology.
- ✓ You understand the concept of virtualization.

Icons Used in This Book

To make it even easier to see the most useful information, *For Dummies* books use the following eye-catching icons.



This book is designed to work as a reference book that you don't need to memorize. But information marked with the Remember icon is so valuable that it's worth remembering, even if you don't memorize the whole book.



Check passages marked with the Technical Stuff icon for a detailed technical explanation. If you're short on time, you can skip these passages without missing the main point.



Follow the target for advice that can save you time and effort.



Watch out for these potential pitfalls on the road ahead.

Where to Go from Here

For more information on HCI, check out the VMware Hyper-Converged Infrastructure site at www.vmware.com/products/hyper-converged-infrastructure.html.

Chapter 1

The Data Center Has Evolved — Has Your Infrastructure Kept Up?



In This Chapter

- ▶ Highlighting today's infrastructure challenges
- ▶ Exploring the software-defined data center
- ▶ Introducing hyper-converged infrastructure



Have you seen an information technology (IT) pro in pain over infrastructure issues? Just look around your data center. Maybe you can look in the mirror.

In the enterprise IT landscape, maintaining an agile data center infrastructure tends to be a source of headaches for IT leaders and administrators. Without fundamental changes, the pain will only get worse, as business moves further into the world of digital everything. That's because the demands on infrastructure are exploding.

A big part of the problem stems from runaway data growth. How fast is data growing? IDC forecasts that by 2025, the global datasphere will grow to 163 zettabytes (a trillion gigabytes). That's ten times the 16.1ZB of data generated in 2016.

This problem affects more than one part of a business. The coin has two sides:

- ✓ **On one side, virtually every part of every organization is pushing the limits.** They're generating more information, demanding new kinds of access, and planning to keep it forever (or nearly so). In some cases, the need to acquire and harness information drives entire business models.
- ✓ **On the flip side, cloud-savvy end users are increasing their expectations.** They expect ever-better performance for their applications, lower-cost infrastructure, and ever-faster responses from the IT organization.

This new era of heightened expectation creates new requirements for your data center. In this chapter, I cover some of these requirements. I also explain the rise of the software-defined data center (SDDC) and what it means for you. Finally, I wrap up the chapter by explaining how hyper-converged infrastructure (HCI) helps you clear a path to both the SDDC and public cloud of your choice.

New Requirements for Your Data Center



Data storage capacity is growing like crazy. IDC estimates that 19ZB of storage capacity must ship across all media types from 2017 to 2025 to keep up with storage demands.

That capacity growth comes with good news — and bad news:

- ✓ **The good news:** The cost of storage hardware continues to shrink.
- ✓ **The bad news:** The costs associated with increased capacity, performance, and management complexity often exceed the cost savings on storage hardware.

For many environments, storage now is the lion's share of IT spend. Given that reality, it's no surprise that as data sets grow from terabytes to exabytes, storage efficiency is attracting more scrutiny from the business.

Additionally, end-user expectations are increasing because of the widespread use of server virtualization, the rise of cloud-based services, and the emergence of scale-out applications. End users now expect better application performance and faster responsiveness from the IT services organization.

These expectations put more pressure on your IT team to evolve to a modern infrastructure that simplifies compute, storage, networking, and management to deliver higher efficiency, lower costs, and greater agility.

The Rise of the Software-Defined Data Center

The SDDC promises to change how IT services are delivered. What was once static, inflexible, and inefficient becomes dynamic, agile, and optimized. In other words, the SDDC builds on the success of server virtualization to evolve the data center from the past to the future.

In this new, software-defined world, all IT infrastructure elements (including compute, storage, management, and networking) are virtualized and delivered as a service on industry-standard servers and components. Resources are automatically deployed, with little (or no) human involvement. Everything is highly automated, controlled by software, and governed by policies that incorporate the logic of business requirements for IT.

In an SDDC, you don't spend weeks provisioning the infrastructure to support a new application. You can get an application running in minutes. That means

- ✓ Super-fast time to value
- ✓ Really happy business executives



For perspective, consider this: In many ways, the SDDC is the natural extension of server virtualization. Just as server virtualization helps you squeeze more value out of your computing systems, the SDDC helps you squeeze more value out of all the resources you use to host an application, especially storage.

The software-defined approach is a much-needed framework for greater IT agility and more responsive IT service delivery, all at a lower cost. It's the key to the data center of the future.

Hyper-Converged Infrastructure: Natural Evolution to a Modern Data Center

Okay, we know that the SDDC helps IT pros overcome many common challenges stemming from legacy issues. So, how do you get there? Many roads will move you forward, but the fastest, most direct, and most popular route to the SDDC is HCI. Figure 1-1 shows how the SDDC provides an ideal architecture for private, public, and hybrid clouds, extending virtualization concepts to all data center resources and services.

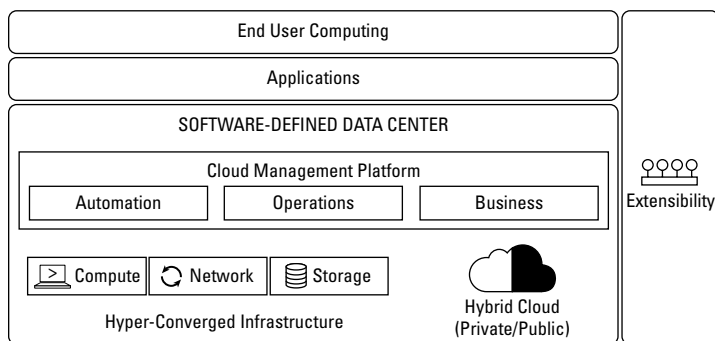


Figure 1-1: The software-defined data center.

HCI is the natural evolution of data center architectures. This ongoing evolution first moved us from traditional silo-based infrastructure to converged infrastructure. And now it's moving us to HCI. In the following sections, I walk you through each of these types of infrastructure.

Traditional infrastructure

The traditional infrastructure model relies on proprietary, purpose-built hardware for storage and networking. These

components form separate silos with their own management software from numerous vendors. They work best when optimized and managed by dedicated specialists. Furthermore, because performance is set at the hardware layer, resources are not properly optimized and overprovisioning often occurs.

Figure 1-2 shows the traditional approach as an expensive solution to a general-purpose IT need. It results in an increased footprint, increased complexity, and increased staffing and specialization. Worse, today's dynamic applications and virtualized workloads require provisioning flexibility that hardware-centric approaches aren't designed to deliver. It's the opposite of simple and streamlined.

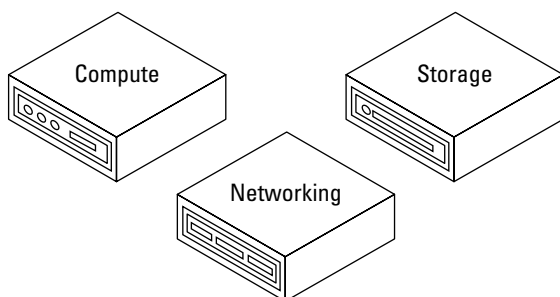


Figure 1-2: Traditional silo-based infrastructure.

Converged infrastructure

A converged infrastructure improves on the traditional model by bringing compute, storage, management, and networking into a single rack, as shown in Figure 1-3. Different specialty vendors typically still provide these elements. The overall management may be integrated and optimized, but separate systems, workflows, and management platforms are still required for many operations and troubleshooting tasks.

In addition, the hardware bundles are preconfigured to run specific workloads and can't be easily altered — resulting in a loss of flexibility. The physical boundaries may have been eliminated, but provisioning and operational challenges remain.

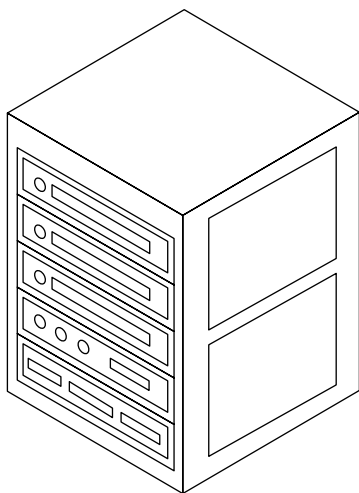


Figure 1-3: Converged infrastructure.

Hyper-converged infrastructure

Hyper-converged solutions take the next step. Hyper-converged infrastructure (HCI) converges traditional IT infrastructure silos onto industry-standard servers and virtualizes physical infrastructure. HCI originally included just virtual compute and virtual storage, but it can now be extended with full virtualized network solutions for a complete software-defined data center. This flexible, software-based approach is well suited for today's IT challenges.

The secret sauce of HCI lies in the hypervisor (the source of the “hyper” in *hyper-convergence*). As shown in Figure 1-4, key data center functions — compute, storage, storage networking, and management — are now running as software on the hypervisor, enabling efficient operations, streamlined and speedy provisioning, and cost-effective growth.

HCI is the IT building block that enables a differentiated, competitive business through the software-defined, cloud-enabled data center of the future. Given the benefits of HCI, and the challenges IT faces today, it should come as no surprise that the HCI market is expected to grow at a staggering compound annual rate of 48 percent through 2022. (That's according to *Hyper-Converged Infrastructure (HCI) – Global Market Outlook [2016–2022]*.)

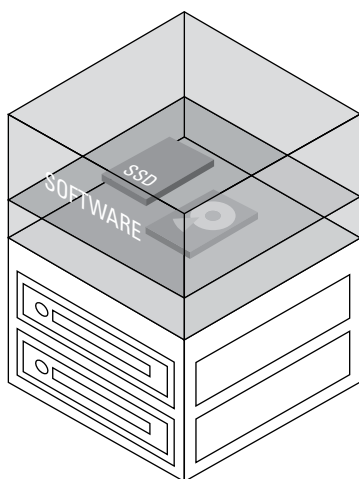


Figure 1-4: A hyper-converged infrastructure software stack.

When you deploy HCI, you're clearing your path to the SDDC. HCI natively integrates compute, storage, and storage networking functions, running them all in software on a virtualized platform along with common management tools. You can then build on your HCI foundation by adding automation and complete network virtualization capabilities to create your full SDDC.

Even better, you can extend your hyper-converged environment to your existing external storage arrays supported by vSphere to protect your current investments. Arrays that support VMware vSphere Virtual Volumes can be managed under the same storage policy-based management framework. Virtual Volumes is an industry-wide initiative supported by all major storage vendors that can coexist with VMware vSphere-based HCI solutions. This initiative allows you to leverage the unique capabilities of your current storage investments in a software-defined storage (SDS) environment or to simplify the modernization of your data center with non-disruptive migration based on proven features like VMware vSphere vMotion and Storage vMotion.



vSphere Virtual Volumes is an API integration framework that exposes virtual machine (VM) disks as native storage objects. This enables array-based operations at the virtual disk level. In other words, Virtual Volumes makes storage area network (SAN) and network-attached storage (NAS) devices VM-aware.

The Virtual Volumes framework also allows your storage arrays to integrate with the VMware SDS control plane, known as VMware Storage Policy-Based Management (SPBM). Through vSphere Virtual Volumes, you can then control your existing storage arrays via the VM-level policy mechanism. This means you can now transition easily, without disruption, to a simpler and more efficient operational model that's optimized for virtual environments and works across all storage types.

You can get a deeper understanding of Virtual Volumes by visiting the VMware website at www.vmware.com/products/vsphere/features/virtual-volumes.html.



A gap is growing between traditional data center architectures and the requirements of the SDDC. Your organization needs a new approach to your architecture.

Chapter 2

A New Approach: Hyper-Converged Infrastructure

.....

In This Chapter

- ▶ Exploring the trends driving hyper-converged infrastructure
 - ▶ Interpreting the role of the hypervisor
 - ▶ Highlighting success factors and use cases
-

This chapter explores some of the reasons hyper-converged infrastructure (HCI) is such a hot topic in information technology (IT) circles. You get a basic definition of HCI, explanation of the traits of a full-bodied solution, a walk-through of common use cases, and a list of the key benefits that stem from hyper-convergence.

Defining Hyper-Converged Infrastructure

First, let's lay out a basic definition. *Hyper-converged infrastructure*, as shown in Figure 2-1, collapses compute, storage (including storage networking), and management onto virtualized, standard hardware, enabling a building-block approach to infrastructure with scale-out capabilities. HCI originally included just virtual compute and virtual storage, but it can now be extended with full virtualized network resources for a complete software-defined data center.

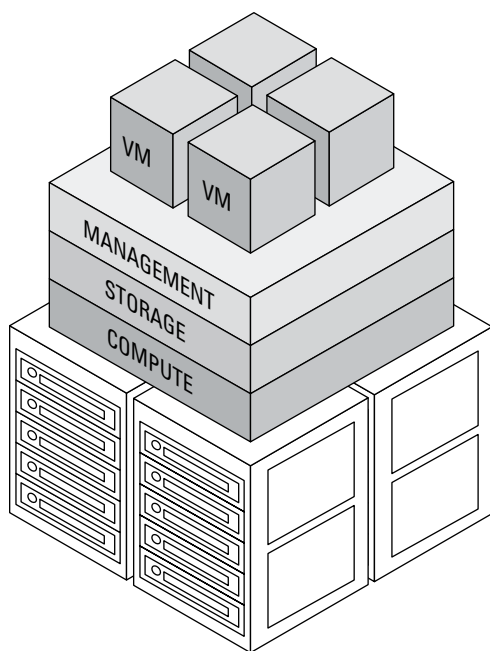


Figure 2-1: Hyper-converged infrastructure.

In HCI, all key data center functions run as software on the hypervisor in a tightly integrated software layer. HCI is fundamentally about this final architecture; as a result, there are different paths to the same end — from turnkey appliances to flexible hardware platforms installed with the hyper-converged infrastructure software.



In an HCI environment, compute, storage, and management resources are delivered through industry-standard x86 architectures. The server platform runs a hypervisor and pools direct attached storage devices — either flash devices like SSDs or hard disk drives — together from across multiple servers in the cluster to create shared storage, which acts like that provided by traditional storage area network (SAN) or network-attached storage (NAS) devices. Sometimes overlooked, a key here is that HCI does not virtualize or pool together storage from external storage systems like some traditional storage virtualizations solutions do. The shared storage is only composed of the direct attached storage devices in the server.

Identifying Trends Driving Hyper-Convergence

The hyper-converged engine is fueled by a number of key technology trends:

- ✓ Higher-density flash technologies that deliver higher performance at lower costs
- ✓ More powerful servers, thanks to advances in central processing unit (CPU) and memory densities
- ✓ Widespread adoption of server virtualization for most workloads
- ✓ Influence of cloud principles, economics, and cloud-native applications demanding an updated approach to IT

Hyper-convergence harnesses all these trends to deliver modern infrastructure with more performance and simplicity for less total cost.

Higher-density flash technologies

High-density flash and nonvolatile memory technologies are rapidly evolving. These technologies can accelerate storage performance and reduce read-and-write latency.

But there's a catch: To fully realize the potential performance gains of these new memory technologies, you must eliminate the *network hop* where data passes through bridges, routers, or gateways. The goal is to bring the data much closer to the CPUs — onto the same server. This is the hyper-converged approach, which gets a big boost from flash technologies.

As the cost of flash devices continues to decrease, the price per IOPs becomes more attractive — and leads to more adoption of HCI.

More powerful servers

With new multicore CPUs, industry-standard x86 servers keep getting more powerful. They're now so powerful that they can handle the workload requirements of high-performance storage in enterprise environments. With HCI, you can take

advantage of those increases immediately as a software solution can easily be updated or expanded to run on the latest, off-the-shelf standard servers.

Here's where things get really good: The cost of x86 hardware, including flash memory, is usually a bargain compared to purpose-built storage arrays. As a result, HCI delivers considerable cost savings compared to deploying siloed servers, storage networking, and external storage solutions.

Given its advantages, widespread adoption of HCI is inevitable. In the coming months and years, you'll see HCI solutions in data centers everywhere.

Prevalence of server virtualization

The hypervisor breaks the ties that bind an application to a particular piece of hardware. It allows a physical server to act as a host for multiple guest operating systems, or virtual machines (VMs). Each VM acts like its own system and runs its own applications. In the background, the hypervisor controls how the underlying server resources are accessed by the VMs.

With the widespread adoption of server virtualization, the hypervisor is everywhere in today's data centers. It has emerged as the standard platform for enterprise applications. Consider these findings:

- ✓ Fueling the server virtualization growth is an increased demand for hyper-converged integrated systems and software-defined data center solutions. According to the "Server Virtualization Market Research Report – Global Forecast 2023," the server virtualization market is estimated to grow by approximately \$8 billion by 2023. Because of this widespread use, the hypervisor is the obvious foundation for expanding on the benefits of server.
- ✓ IDC predicts that storage for virtual environments will grow at a 5.8 percent of CAGR to \$40.6 billion in storage hardware and software spend by 2020. This new reality makes server virtualization and VMs the primary workhorses for the storage infrastructure.

Because of this widespread use, the hypervisor is the obvious foundation for expanding on the benefits of server virtualization to cover storage, networking, and unified management — enabling a clear path to HCI and ultimately the SDDC without requiring forklift changes to current infrastructure and expertise.

Cloud principles and economics

The growth of on-demand, cloud-based services is being felt in the data center with administrators looking for simple and affordable ways to deliver business results. This is especially true for smaller companies or individual departments that are looking to architect a simple solution to meet their key IT needs.

This desire for cloud-type consumption is directly driving the adoption of HCI, which provides a much higher level of flexibility, simplicity, and on-demand growth than traditional data center infrastructure while delivering the on-premise benefits of high-performance, security, and control.

In addition, next-generation HCI solutions deliver strong support for deploying a hybrid cloud model, whether through integration with OpenStack technologies or supporting next-generation workloads, like cloud-native applications and containers.

Administrators want a way to leverage on-premises resources as well as their choice of public clouds. The right HCI solution provides a seamless path to and from the public cloud while delivering a common operating environment and experience.

Assembling the Ingredients for Success

Building an HCI environment has a lot in common with making a mouthwatering meal: Start with the best ingredients, combine carefully, and use proven techniques for making everything work together as a unified whole. The four key ingredients for HCI success are:

- ✓ A proven hypervisor
- ✓ Simple, hyper-converged storage

- ✓ A unified management platform
- ✓ Flexible deployment choices

A proven hypervisor

In an HCI solution, the hypervisor forms your foundation — it's the “hyper” in hyper-converged, and plays a key role in ensuring data availability, storage efficiency, application performance, and flexible scalability.

Given that the benefits of virtualization — from operational efficiency to increased availability — all stem from the hypervisor, choosing the right hypervisor is critical. The more capable and feature-rich your hypervisor, the better your results.



VMware is recognized as the leader in the Server Virtualization Software products quadrant by G2 Crowd (2017). In fact, more than 500,000 enterprises — including 100 percent of the Fortune 100 — trust VMware as their virtualization infrastructure platform.

Simple, hyper-converged storage

In a hyper-converged solution, storage and storage networking are collapsed into the server and virtualized. This streamlines operations, costs, and overall physical footprint. However, not all approaches to software-defined storage in an HCI environment are created equal. Next-generation HCI solutions deliver extremely tight integration between the server and storage virtualization software. The tight integration eliminates the need for a separate virtual storage appliance deployed on each server, which leads to lower resource utilization and lower VM densities.

Unlike hardware-centric solutions, hyper-converged infrastructure software pools server-attached storage to create high-performance, resilient, shared storage that's optimized for VMs. What was previously complicated and expensive becomes just the opposite: simple, powerful, streamlined, and intelligent.

The right storage solution can lower operational expenditures (OpEx) by streamlining routine tasks, enabling better and more predictable performance, and allowing your organization and IT infrastructure to grow affordably without the need for large capital investments. Capital expenditure (CapEx) costs are greatly reduced by eliminating the need for purpose-built hardware and storage networking silos.

Unified management

You're now at the point in the recipe where you've virtualized your infrastructure (compute, storage, and storage networking) — which means you're halfway there! Next, you need a way to manage it. When selecting a management solution, you'll want to avoid creating a learning curve for users, or worse, multiple management silos that you have to juggle when managing or monitoring the different layers in the HCI.

What you do want is a familiar interface, one you already know how to use. And because simplicity and ease are also vital, look for a unified platform that manages the entire stack and seamlessly integrates all your workflows.

Flexible deployment choices

Software can't run on software — you need to put it on something. To ease your path forward, look for an HCI platform that gives you the broadest possible choices for the hardware platform. This flexibility helps you build an HCI environment that matches your needs and preferences exactly. It allows you to leverage the x86 infrastructure you already know — cost-effective, industry-standard, networking and storage products from a wide variety of computer manufacturers. This means no new hardware to learn, no new purchasing process, and no new support model to navigate.



A word to the wise: Don't scrimp

Scrimping on your ingredients by settling for less than the best can yield unsatisfactory results. Opting for initial cost savings or accepting performance limits will be a decision you'll likely regret sooner rather than later. It's important to consider the impact of your selection beyond the HCI solution.

To that end, ask yourself the following questions:

- ✓ How will it integrate with your existing environment?

- ✓ What are the operational impacts?

- ✓ Can the solution efficiently and cost-effectively grow when, where, and how you need it?

Choosing the best quality of your ingredients can help you avoid a half-baked solution that leaves you with silos, vendor lock-in, expensive upgrade and expansion paths, and unpredictable performance.

Looking at Key Use Cases for Hyper-Converged Infrastructure

Although not limited to these use cases, the benefits of HCI are especially evident across these common use cases:

- ✓ Business-critical applications (BCAs)
- ✓ Virtual desktop infrastructure (VDI)/end-user computing
- ✓ Edge computing and remote offices/branch offices
- ✓ Disaster recovery
- ✓ Management clusters

Business-critical applications

Traditional infrastructure makes BCAs slow to provision and complicated to manage. Tasks like database processing, email server management, and Web 2.0 workloads require high levels of performance, availability, and reliability. Older

architectures simply can't deliver without overprovisioned storage, expensive purpose-built hardware, and siloed management tools.

Hyper-converged infrastructure overcomes these challenges with a simple, distributed scale-out architecture, often optimized for high-performance flash devices, that puts IT back in charge of the applications that are so important to the business.

Virtual desktop infrastructure/ end-user computing

With so many end-user devices in play, the need for VDI has grown, but legacy systems make deployment a challenge. VDI requires a combination of high IOPs and low latency to ensure a “just-like-physical” user experience. It also needs to maintain low capital and operational costs to justify the return on investment (ROI).

Using traditional infrastructure, VDI is expensive to deploy and maintain, with high upfront capital requirements, as well as the high maintenance costs necessary to provide adequate performance and scale for virtual desktops and applications.

HCI delivers the perfect solution to these VDI challenges. It provides a high-performance and low-cost solution for a more consistent, predictable user experience, a lower CapEx requirement, and a simpler operational model.

Distributed IT and remote office/branch offices

Many organizations have distributed computing and remote offices/branch offices that rely on local IT infrastructure managed by IT staff at another location. This remote, distributed architecture presents a host of challenges that range from unpredictable performance to management complexity to poor reliability and availability.

IT teams need better visibility from a distance, along with tools that will make administration and management simpler

and less time-consuming. And as their businesses grow, they need the ability to scale without breaking the bank.

HCI is a perfect match for edge computing and remote office/branch office deployment: It delivers a single, low-cost infrastructure solution with compute, storage, management, and networking integrated. In addition, the right HCI solution can be easily scaled up or down, and is flexible enough to accommodate changing needs — exactly what companies with remote offices need.

Disaster recovery

The cost of a disaster recovery site can be prohibitive for many organizations. As a result, a number of businesses have an inadequate or no disaster recovery plan, which introduces considerable risk. One of the more significant costs of a disaster recovery site is the IT systems infrastructure including server hardware, storage, and replication software.

Because HCI provides a complete, natively integrated platform consisting of compute, network, and storage resources, it is an ideal solution for the disaster recovery use case. Deploy on inexpensive industry-standard x86 server components to remove large, upfront investments. Because direct attached drives are used to create the shared storage, there is no dependency on external shared storage hardware. This helps reduce the total cost of the solution while providing sufficient capacity, reliability, and performance.

Software-based replication can provide asynchronous virtual machine replication with low recovery point objectives (RPOs). Replication can be configured on a per-virtual-machine basis, enabling precise control over which workloads are protected.

Management clusters

Business-critical applications may get most of the attention, but management clusters play a critical, behind-the-scenes role in keeping the overall IT environment running smoothly. A management cluster is a dedicated group of hosts reserved for running VMs that provides management services to infrastructure environments, which can include directory services,

domain name system (DNS), Dynamic Host Configuration Protocol (DHCP), and VMware vCenter Server.

Their vital role makes it imperative that management clusters are always available and always have adequate resources. In the case of a site-wide failure, they must be brought online first, as quickly as possible. It's important to keep them in an isolated environment and sized to allow you to bring them up rapidly.

Traditionally, these clusters resided on expensive hardware to ensure high availability and high performance. If they lived on shared resources for the purpose of reducing costs, they had to compete with business workloads for compute and storage resources and made recovery more challenging.

HCI helps you manage these challenges. It enables simplified management, faster restoration, and disaster recovery, and allows you to isolate infrastructure without high capital costs.



Keep in mind that the HCI use cases cited here aren't a complete list. HCI solutions can also be used to meet a wide range of other IT needs, such as systems for hybrid cloud support, disaster recovery sites, secondary data centers, DMZ deployments, and test and development functions.

The Big Payoff: The Benefits of Hyper-Converged Infrastructure

Now let's get to the dessert — the business and IT benefits of an HCI solution that has all the right ingredients.

Simplicity

With a fully featured HCI environment, you can eliminate many of the components and hardware silos found in traditional infrastructure. In simple terms, with HCI you need a lot less stuff in your data center. This simplicity helps you reduce operational time and complexity across your data center.

To help you simplify your environment, HCI

- ✔ Provides a single, integrated software stack that runs on industry-standard servers
- ✔ Delivers ease of deployment and maintenance, with policy-driven automation
- ✔ Reduces physical components to manage, monitor, and maintain

Cost

HCI can help you greatly reduce infrastructure spending across your data center. In particular, HCI

- ✔ Generates cost and storage efficiency
- ✔ Leverages technical resources and expertise you already have
- ✔ Eliminates overprovisioning with granular grow-as-you-go scaling

Security

Modern HCI solutions offer native, software-based security, like data-at-rest encryption, to address growing customer needs to protect business-critical data. The right HCI solution

- ✔ Protects information with native data-at-rest encryption that eliminates drive disposal risks and overhead.
- ✔ Eliminates the costs and complexities of deploying specialized hardware, like self-encrypting drives.
- ✔ Meets strict compliance and security regulations for many industries, like government, finance, and healthcare.

Agility

With a data center built around HCI, your IT organization is poised to rapidly respond to changing business demands. To deliver this agility and flexibility, HCI

- ✓ Offers broad deployment choice — no hardware vendor lock-in
- ✓ Enables a future-proof IT environment, with support for today's traditional applications, as well as new cloud native applications and container technologies
- ✓ Allows you to scale up and scale out to easily meet specific application needs

Performance

HCI accelerates applications and enhances the user experience. To drive performance gains, HCI

- ✓ Delivers all-flash optimizations for application fast response times
- ✓ Enables easy scale-out and scale-up capabilities
- ✓ Ensures predictable performance to keep users happy

Availability

HCI helps you minimize risk with a proven, secure platform that

- ✓ Ensures predictable performance with quality of service (QoS)
- ✓ Delivers high availability and resiliency with no single point of failure
- ✓ Builds confidence on the foundation of a proven, industry-leading hypervisor



Ultimately, HCI is a natural evolution in your data center. If you're in a VMware vSphere environment, you are among the 500,000+ customers who know and use vSphere and all the familiar tools. For your organization, HCI will deliver major advantages with minimal change and learning.

Chapter 3

Extending Virtualization to Storage with Hyper-Converged Infrastructure

.....

In This Chapter

- ▶ Introducing modern storage infrastructure
 - ▶ Exploring the DNA of a new approach to storage
 - ▶ Explaining the value of hypervisor integration
-

This chapter explores modern storage architectures that are delivered through intelligent software, which is one of the key building blocks for hyper-converged infrastructure (HCI) and the software-defined data center (SDDC). Sometimes referred to as software-defined storage, next-generation HCI solutions abstract physical storage constructs to enable flexible and precise consumption according to application requirements. This goodness is all made possible by the hypervisor, which acts as a broker that balances the needs of a virtual machine (VM) and the applications it runs.

The Problems with Your Grandfather's Storage Model

To achieve the potential of the SDDC, all the key components of the information technology (IT) infrastructure must be virtualized, so they can be automated and controlled by software. This requirement foreshadows big changes for existing storage infrastructure that was built for the past.

In simple terms, old storage architectures have a hard time keeping up with the demands of the SDDC, let alone the demands of the digital era. But current storage infrastructure isn't all wrong. In reality, storage today is a mixed bag. There are both the very good and the very not-so-good:

- ✓ **On the upside:** Modern storage arrays offer great capabilities for storing, managing, and protecting data.
- ✓ **On the downside:** Today's storage arrays are largely worlds unto themselves, like walled cities with their own cultures and their own ways of doing things.

The enterprise storage model hasn't changed much in the last 20 years: Providing storage services means acquiring *dedicated storage arrays* and surrounding them with *dedicated operating teams*. This model sometimes worked in the terabyte world, but not in today's petabyte and exabyte world.

Yesterday's enterprise storage model has many operational shortcomings. For example:

- ✓ **Most organizations rely on purpose-built, dedicated storage arrays.** Each array has its own specialized functionality and operational procedures tied to the hardware and not the applications or VMs.
- ✓ **Application needs and storage services aren't aligned.** Application owners and virtualization administrators can't easily or precisely specify what they need and when they need it. The result is either an inability to meet service-level agreements (SLAs) for applications or over-provisioning of storage capacity and services.
- ✓ **Operational workflows are stove-piped between storage, application, and virtualization teams.** Requests are made, meetings are held, sticky notes are posted on monitors, work is scheduled — and time is lost.

Clearly, yesterday's approaches to infrastructure fall far short of today's needs. We need an all-new approach. A software-defined approach.

Reinventing the Storage Model

HCI reinvents the storage model by eliminating legacy silos and enabling the true pooling of storage resources. The hypervisor brings to storage the same operational efficiency that server virtualization brings to compute.

To enable this shift, HCI puts the application and its requirements at the top of the IT food chain, enabling storage resources to respond to the dynamic changes in application requirements. Now the application is the boss; the supporting resources are the workers who make sure the boss gets what the boss needs when the boss needs it.

This is a change from the conventional *bottom-up* hardware-centric approach. This approach usually requires your storage admins to create static pools of storage resources, and then hope for alignment between the application's needs and the preprovisioned storage services. This timeworn tactic leads to wasted resources (because of overprovisioning to ensure against future growth).

In an HCI environment, the x86 server platform runs a hypervisor and includes virtualized storage devices. HCI implements *shared storage* by pooling the storage resources distributed across multiple server nodes. You essentially end up with a storage area network (SAN) inside an x86 server system.

Understanding the Storage DNA of HCI

Thanks to the flexibility and agility of software-defined infrastructure, HCI offers a new storage DNA that differs from traditional storage. A modern infrastructure based on HCI delivers the following benefits:

- ✔ **It enables application-centric storage services.** HCI enables storage services to be tailored to the precise requirements of an application and adjusted as needed for each application, without affecting neighboring applications. Storage services become fluid — a little more for this application, a little less for that one.

- ✔ **It enables policy-driven automation.** IT admins set policies for requesting, monitoring, and adjusting storage services for specific applications. HCI then enables the storage layer to figure out how best to satisfy those requirements.
- ✔ **It enables dynamic storage services.** Most of today's storage products use a static model to deliver storage services. All classes of service are physically pre-provisioned in storage volumes or logical unit numbers (LUNs). HCI uses a dynamic model, as with virtualized compute. IT admins can precisely match demand and supply, according to specific application requirements, in the exact time the resources are needed.
- ✔ **It supports conventional storage arrays.** When IT organizations bring in new technologies, they put a premium on the ability to continue to use existing investments. And that's the case with VMware's approach to HCI. Existing SAN and network-attached storage (NAS) storage systems can coexist with server-attached storage pools or can leverage the storage-policy based management system with VMware Virtual Volumes.

Driving Storage Innovation through the Hypervisor

The hypervisor has a long track record when it comes to storage innovation. In the specific case of VMware, the hypervisor has enabled all kinds of capabilities in the VMware for vSphere environment to improve the management of storage systems.

A few examples:

- ✔ vSphere Thin Provisioning allows you to over-allocate storage capacity to increase utilization and simplify capacity management.
- ✔ vSphere Storage DRS (Distributed Resource Scheduler) continuously balances storage space usage and storage I/O load to help you prevent resource bottlenecks and meet your targeted application service levels.
- ✔ vSphere Replication enables you to replicate VMs across any kind of storage system for data protection and disaster recovery.

With HCI, VMware continues along this path of driving storage transformation through the hypervisor. The ultimate goal is to bring to storage the same level of operational efficiency that server virtualization brought to compute. And this big step forward begins with the hypervisor.

The Hypervisor: The Ideal Place to Deliver Software-Defined Storage

Given its unique position — between the physical server and the VMs that run on it — the hypervisor has a unique vantage point. It basically sees everything, including applications and the host hardware.

This privileged location in the IT stack leaves the hypervisor uniquely positioned to act as a broker that balances the needs of a VM and the applications it runs — including requirements for compute, storage, and networking. The hypervisor has the eye-in-the-sky view that's needed to make intelligent placement decisions and manage ongoing workload optimizations.



Why can the hypervisor act as a broker between applications and storage services? It's because of awareness and position:

- ✓ On one hand, the hypervisor is inherently *application-aware*. It has a direct line of sight into each application running on the VMs that are connected to the host server. It understands the application's storage requirements — that's part of its job.
- ✓ On the other hand, the hypervisor is *positioned in the I/O data path* between the host server and the hosted VMs, and it manages the underlying storage infrastructure. This coveted position allows the hypervisor to turn rock-hard physical resources into fluid pools of storage capacity and capabilities that can flow into applications as needed.

The Evolution to x86 Hardware

HCI is powered by flexible shared storage that uses industry-standard x86 hardware (not specialized, purpose-built storage hardware). Lots of good things result from this change. With the use of storage components built into industry-standard hardware, the storage environment bypasses the roadblocks that are built into conventional storage architectures.

This approach rewrites the old capital expenditure (CapEx) and operational expenditure (OpEx) rules for enterprise storage. Storage components no longer cost premium prices. Your IT shop is free to select the specific components that best meet your particular requirements for performance, cost, and capacity.

With HCI, storage components share compute and memory with the server infrastructure. This eliminates the need for separate storage arrays, controllers, memory, SANs, and more. All storage technologies are fully integrated into the virtualization cluster. It's like having a SAN tucked inside a server.



Today, there are two very different ways to implement storage for HCI on x86 hardware and direct attached storage:

- ✓ Third-party software running in VMs (sometimes referred to as the controller VM) that sit *on top of* a hypervisor (not *in* a hypervisor) to create virtual storage appliances (VSAs).
- ✓ Storage functionality integrated directly *into* the hypervisor. This architecture is called *hyper-converged storage*. It's the approach used in HCI solutions.

A New Way to Manage Your Storage

The next major advantage with a hyper-converged storage architecture is the transformation of management and provisioning to make it all about the application, not all about the hardware.



In simple terms, HCI changes the management layer to allow application requirements (not hardware resources) to drive your storage decisions.

Historically, storage-services management revolved around a rigid list of requirements for capacity, performance, protection, and other storage needs. These requirements were communicated from one team to another, then physically implemented as either LUNs or storage volumes. When they were executed, there was little room for change. The requirements were pretty much set in stone.

HCI rewrites this script. Application-centric storage policies replace this hardware-centric approach. Storage policies are associated with the VMs that run an application; these policies are automatically pushed down to the storage layer for implementation and enforcement. Here's the payoff:

- ✓ Storage policies and the service levels they control are easily and dynamically changed as an application goes through its life cycle, moving from development and testing to rollout and full production.
- ✓ It's far less wasteful than hardware-specific policies. Applications get exactly the storage services they need, when they need them, without routinely overprovisioning capacity or data services.
- ✓ HCI delivers a common standardized management approach that works and spans across different storage types and tiers. The policy-based management becomes a unified command-and-control center for your storage environment. You can manage the new hyper-converged storage architecture, plus traditional storage solutions (such as SAN and NAS), and collect all the benefits of application-centric storage policies.



Next-generation HCI solutions, like those powered by VMware, deliver a new abstraction for storage and a new control plane:

- ✓ Abstraction can be implemented on traditional storage, or you can implement an entirely new HCI architecture that abstracts storage resources attached to x86 server hardware.
- ✓ The control plane is a new dynamic way to manage storage services that is common across different types of storage.

Toward a Software-Defined Everything

Compute virtualization is a mature category that has enabled benefits in performance and scalability. Today we are seeing other critical data center components also advancing and becoming dynamic resource pools that can scale. We are seeing the rise of software-defined everything — from software-defined networking to software-defined storage and hyper-converged infrastructure to software-defined application services. These all pave the way for the software-defined data center (SDDC), which is a software abstraction of your entire data center.

VMware NSX is the network virtualization platform for the software-defined data center. NSX embeds networking and security functionality that is typically handled in hardware directly into the hypervisor. The NSX network virtualization platform fundamentally transforms the data center's network operational model like server virtualization did ten years ago, and is helping thousands of customers realize the full potential of an SDDC.

With NSX, you can reproduce in software your entire networking environment. NSX provides a complete set of logical networking elements and services, including logical switching, routing, firewalling, load balancing, VPN, QoS, and monitoring. Virtual networks are programmatically provisioned and managed independent of the underlying hardware.

Chapter 4

The VMware Approach to Hyper-Converged Infrastructure

.....

In This Chapter

- ▶ Highlighting the routes to hyper-converged infrastructure
 - ▶ Introducing VMware-powered hyper-converged infrastructure
 - ▶ Explaining the attributes of VMware vSAN
-

This chapter looks at how hyper-converged infrastructure solutions powered by VMware vSAN offer the advantages of a native architecture. This chapter also looks at the benefits of the VMware software stack and introduces the advantages of flexible deployment choices.

Two Different Routes to Hyper-Converged Infrastructure

From a storage architecture standpoint, there are two common paths to delivering HCI. Although they may seem similar, these approaches deliver fundamentally different experiences and capabilities:

- ✓ Bolting storage software *onto* a hypervisor
- ✓ Building storage software *into* the hypervisor

The common bolt-on approach to hyper-convergence runs third-party storage software in virtual machines (VMs) that sit on top of a hypervisor.

Although it enables hyper-convergence, the bolt-on architecture approach has some distinct disadvantages. These limitations stem from the creation of a separate storage layer that runs as a guest VM on each server that consumes dedicated resources from each server.

Some of the biggest disadvantages of bolt-on hyper-convergence are

- ✓ Excessive resource use
- ✓ Lower performance and longer latencies
- ✓ Limited integration with the existing management and multiple operational environments

The VMware approach to HCI is “built in.” In this innovative approach, the storage software is native, or built directly into the hypervisor. This means convergence does not happen *on* the hypervisor using a virtual appliance, but instead happens *inside* the hypervisor.

The advantages of the hyper-converged approach are compelling:

- ✓ Reduced resource use
- ✓ Better performance and lower latencies
- ✓ Tight integration enabling end-to-end management from a single tool and a simplified operational model



Here are a few examples of the advantages of built-in hyper-converged storage:

- ✓ There's no need to dedicate certain virtual central processing units (vCPUs) to a virtual storage appliance (VSA) on a per-host basis.
- ✓ CPU resources are used only when they're needed. You don't need to reserve CPUs for the worst-case scenario.
- ✓ You save CPU cycles by going through *one* stack (hypervisor), not *two* (hypervisor plus a guest operating system [OS] of the VSA). It's plain math.



With hyper-converged storage, convergence takes place *in* the hypervisor, not in a VM that runs *on* the hypervisor.

VMware-Powered HCI

To enable HCI solutions, VMware converges traditional IT infrastructure silos onto industry-standard Intel-based hardware, as shown in Figure 4-1. VMware-powered HCI solutions virtualize physical infrastructure to help customers evolve their infrastructure without risk, improve TCO over traditional resource silos, and scale to tomorrow with timely support for new hardware, applications, and cloud strategies. HCI originally included virtual compute, virtual storage (with storage networking), and unified management, but can now be optionally extended with advanced virtualized network resources for a fully software-defined data center.

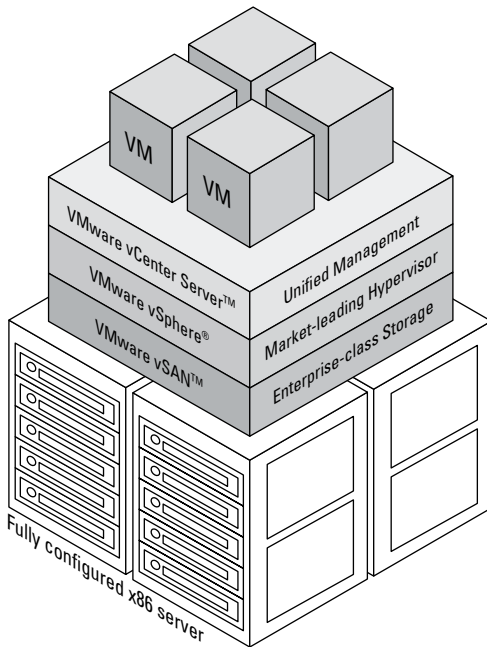


Figure 4-1: VMware-powered Hyper-Converged Infrastructure.

You can enjoy cost-effective, high-performance compute and storage powered by VMware's natively integrated software and Intel processors and solid-state drives (SSDs). It is the ideal combination of proven Intel hardware and VMware software for high performance and exceptional reliability.

The VMware Hyper-Converged Infrastructure software stack is composed of three widely trusted solutions:

- ✓ **VMware vSphere:** The hypervisor that defines the industry standard
- ✓ **VMware vSAN:** A secure, enterprise-class storage solution that is uniquely native to the hypervisor for high performance and reliability
- ✓ **VMware vCenter Server:** A unified and extensible management solution

Hyper-Converged Infrastructure solutions powered by VMware are available through a broad set of deployment options, ranging from turnkey HCI appliances to HCI-powered public cloud services to more than 250 precertified servers through the vSAN ReadyNode program.

Powered by VMware vSAN

The VMware implementation of hyper-converged storage, VMware vSAN, pools together server-attached storage (SSDs, HDDs, or other flash devices), as shown in Figure 4-2. It creates a shared datastore with advanced data services designed for virtual environments. This datastore is highly resilient with no single point of failure and optimized for the latest flash technologies.

vSAN supports both all-flash and hybrid (a mix of flash devices and HDDs) configurations with Intel-based servers to deliver enterprise-class storage for virtualized applications. This is high-performance storage with powerful software-based encryption that's built for the challenges of your business-critical applications.

Even better, vSAN seamlessly works with the rest of the VMware software stack. Management is simplified by using standard hardware and common VMware tools and interfaces across compute, storage, and networking. This makes vSAN the simplest storage platform for your VMs.

In the following sections, I walk you through the attributes of VMware vSAN.

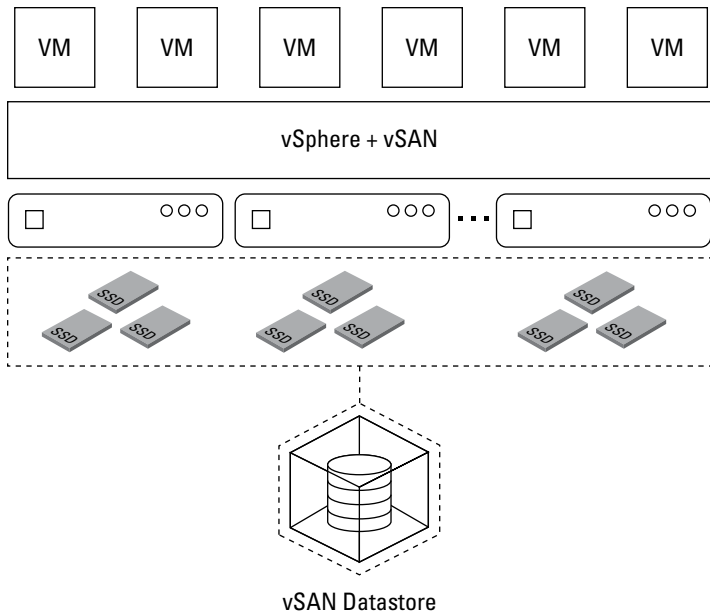


Figure 4-2: VMware vSAN.

Native integration

Hyper-converged solutions use the hypervisor to support and deliver storage functions and storage networking in software. There's no need for dedicated storage hardware, such as a storage array, or for complex storage networking, such as a Fiber Channel switch.

Because vSAN is embedded inside the vSphere kernel, vSAN can deliver the highest levels of performance without taxing the CPU with additional overhead. In addition, the native architecture simplifies management and eliminates risk associated with extra components and points of integration. This is a major difference from the many virtualized storage appliances that run separately on top of the hypervisor.

Flash-optimized performance

Because software-defined storage depends on the hypervisor, the hypervisor is like the engine that moves the load along. So top-notch hypervisor performance is key to top-notch storage performance.

In the case of the VMware vSphere virtualization environment, the ESXi hypervisor is specifically designed to offer great storage performance on flash hardware. This didn't happen by chance. The ESXi hypervisor has been optimized for more than ten years. With hyper-converged designs, the functionality that used to be implemented by the disk array moves onto the same hosts where the workloads or VMs run.

vSAN extends this performance advantage at the hypervisor layer with a distributed storage system architected from the ground up to streamline storage operations and utilize the capabilities of the latest flash technologies. As a result, applications benefit from fast response times and IT administrators enjoy higher levels of VM density.

In addition, vSAN benefits from a powerful ecosystem of hardware partners, ensuring rapid adoption of the latest flash technologies. The vSAN ReadyLabs is a dedicated vSAN engineering team that works hands-on with vSAN and the latest hardware technologies to ensure predictable hardware experience on Day 0 with tested and certified vSAN ReadyNodes.

Native HCI security

Security is becoming a top priority for all CIOs as the value of data, and the cost of a security breach, continues to increase. VMware offers the first software-defined, data-at-rest encryption solution built for HCI. Customers from financial markets to federal governments can mitigate security risks for greater peace of mind.

With vSAN Encryption, customers can deploy the storage hardware of their choice, avoiding the hefty premium charged for self-encrypting drives (SEDs). vSAN encryption is completely hardware-agnostic. In addition, key management is greatly simplified with support for all leading key management servers and simple 1-click enablement for the entire cluster.

Efficiency advantages

In addition, advanced storage efficiency features include deduplication, compression, and erasure coding. These data

efficiency and reduction technologies run inline before any data is written to the capacity tier of vSAN. These features drastically improve the storage utilization rate (meaning you need less physical storage to store the same amount of data).

And thanks to integration, those features — which can consume a significant amount of CPU and memory overhead on VSA-based HCI solutions — have minimal impact on the compute overhead. This means you can turn them on and forget them, even for mixed workload environments. No complicated planning, no tough decisions, no need to monitor or adjust the environment based on changing workloads.

Operational advantages

Operational advantages are perhaps the biggest win of the hyper-converged approach. A hyper-converged storage approach is built from the ground up to integrate and leverage all the functionality of the hypervisor, without more operational overhead or any reduction of core functionality.

If you run a vSphere environment, you probably appreciate the functionality of your virtualization layer (including such things as vSphere High Availability and vSphere vMotion). Presto! Now you can have the same functionality in vSphere-based hyper-converged storage, because it's all embedded in the hypervisor.

As customers deploy these HCI solutions at scale, vSAN offers extensive support for public APIs/SDK and PowerCLI for advanced automation and scripting. The day-to-day management and monitoring capabilities of compute and storage — including checking alerts, viewing capacity usage, upgrading controller drivers with 1-click (a new feature in vSAN 6.6), and more — can all be performed with the familiar vCenter tools. Administrators using vRealize Operations for rapid monitoring and troubleshooting of their larger environments can benefit from native vSAN integration in vRealize Operations where they can easily monitor multiple vSAN clusters, perform advanced capacity planning, and leverage customer vSAN dashboards on health and performance.

Hardware choice

To deliver the maximum value and flexibility, and ultimately a path to the complete software-defined data center (SDDC), an HCI solution shouldn't be tied to a specific hardware platform. This is where the hardware-agnostic approach to deploying VMware HCI solutions delivers differentiating choice, letting you control your infrastructure.

- ✓ **True HCI flexibility allows you to choose your x86 server platform and vendor.** All major x86 server vendors provide precertified hardware solutions ready to run vSAN. Choose from existing hardware bundles, called vSAN ReadyNodes, or pick supported components to customize your infrastructure. This flexibility puts you in the driver's seat.
- ✓ **There's a fast track to VMware-powered HCI through turnkey appliances.** These offerings are delivered as hardware appliances with more controlled configurations. It's a little less flexible, but you gain the immediate benefits of faster deployment, integrated life cycle management, and simplified purchasing.

Elastic, nondisruptive scaling

VMware vSAN is designed with a distributed architecture that allows for elastic, nondisruptive scaling. This is a key architectural advantage of using the x86 platform. You can run your data center in a modular fashion, like a cloud service provider. As business needs change, HCI solutions powered by vSAN can scale up or scale out to meet the exact needs of your applications.



This *grow-as-you-go* model helps you spread your investments over time.

There are two ways to scale, and both are pretty simple:

- ✓ **Scaling out** increases capacity and performance at the same time by adding a new host to the cluster.
- ✓ **Scaling up** increases capacity and performance independently by adding new drives to existing hosts.



vSAN can be configured as either *all-flash* or *hybrid* storage. In a hybrid storage architecture, vSAN pools server-attached HDDs and SSDs to create a distributed shared datastore.

With flash prices declining and advanced space efficiency features available, the tipping point is quickly shifting to all-flash configurations being both faster and lower cost.

The ideal storage for virtual machines

After reviewing all the characteristics of hyper-converged storage, it's apparent that this new approach offers advantages that make it the ideal storage for VMs.

Here are the most valuable advantages of hyper-converged storage:

- ✓ Better price-performance — the gains you expect with today's servers

- ✓ Integration of storage with the hypervisor and its powerful capabilities
- ✓ Flexible options for deploying and scaling your storage environment

Such benefits are the reasons that hyper-converged storage has become the ideal storage for VMs. It's the purest form of HCI and the fastest on-ramp to the SDDC.

Chapter 5

Transforming the Operational Model with Unified Management



In This Chapter

- ▶ Managing and monitoring the hyper-converged infrastructure environment
- ▶ Taking operations down to the virtual machine level
- ▶ Using policy-driven automation
- ▶ Enabling dynamic control of storage services



Ready to jump down into the information technology (IT) operations trenches? This chapter shows how hyper-converged infrastructure (HCI) transforms the operational model with simple, unified management of resources.

Single-Pane-of-Glass Management

If you're in IT operations, you know all about swivel-chair management — when you hop from one interface to another to manage different aspects of your environment. HCI helps you simplify your life with single-pane-of-glass management.

In a VMware environment, you can use your familiar vSphere tools — specifically VMware vCenter Server — to manage compute, storage, and networking from a common interface.

vCenter Server gives you simple and automated control over the virtual environment — deploy, manage, and monitor in one place with no additional tools required. You'll breathe easier when you eliminate the need for multiple tools.

But don't assume that all HCI environments offer unified management. Be on the lookout for systems that require different tools for HCI system, hypervisor, and/or storage management.

Management at Scale

When it comes to system monitoring, your HCI environment should incorporate built-in monitoring features.

For example, in a VMware environment, advanced performance and capacity monitoring are built directly into vCenter. Check capacity usage quickly. Easily verify that your hardware is running the latest, certified firmware. Ensure that performance is meeting your required levels.

If you want to enrich your VMware-powered HCI solution with proactive, sophisticated performance monitoring and analytics features — think custom dashboards and historical trends — you can use the advanced capabilities of VMware vRealize Operations and VMware vRealize LogInsight. vRealize Operations now includes native vSAN integration that delivers multicluster management, predictive analytics for performance and capacity, rapid troubleshooting, and simple monitoring — making it an ideal tool for large-scale environments.

Capabilities like these help you gain the deep operational visibility and an end-to-end picture of the software stack and environment for proactive monitoring and faster troubleshooting.

Taking Operations Down to the Virtual Machine Level

At its essence, enterprise IT is all about application delivery. That's how users see the world: through the lens of their applications. HCI is in sync with this view. With HCI, you can adjust all your storage services for specific applications and the virtual machines (VMs) where they reside.



HCI conforms to how users see the world, not how IT defines infrastructure components. This is quite different from the status quo in storage. Today's storage devices usually have poor knowledge of applications. They see the world as storage-centric logical unit numbers (LUNs) and file systems; each offers a container with a static combination of capacity, performance, and protection.

Leveraging storage abstraction at the data plane level, HCI gives you much finer control over storage services, all the way down to the VM level. This means you can create storage services driven by application requirements, not by physical storage constraints. In other words, it's all about the needs of the applications and the end users, *not* the backend hardware.

Automation Driven by Policies

To enable more efficient operations, next-generation HCI systems use storage policies to drive automation. You can set policies for an application's requirements for capacity, performance, availability, redundancy, and the like. In a VMware environment, the foundation for the policy-based control plane is called VMware vSphere Storage Policy-Based Management (SPBM).



Basically, policies are templates that spell out storage requirements for VMs and the applications they run.

The management control plane automates VM placement. It does this by identifying available datastores that meet the application's storage requirements. This allows you to avoid the tedious work that comes with provisioning VMs on a case-by-case basis.

The combination of automation and policy-based management helps you simplify storage management. Better, it helps you quickly deliver value to your customers — the people who use your IT services. For example:

- ✓ Application admins can consume storage as a service, without being slowed down by the service-fulfillment bottlenecks that come with conventional approaches to storage provisioning.

- ✓ Storage resources are provisioned to the precise requirements of an application. The application admins get just what they need, without costly overprovisioning.



After storage policies are configured, your application admins can choose their needed application or VM template. The control plane's policy engine reads the associated storage policy and then precisely provisions storage resources to match the application's requirements.

Dynamic Control of Storage Services

With today's static storage model, storage admins must estimate (or make guesstimates) about the needs of different applications well in advance of deployment. They then acquire the physical hardware and allocate it into pre-provisioned resource pools with different service levels for capacity, performance, and protection. At that point, the application is made available for consumption.

It's easy to see why this conventional model isn't ideal. Here are a few of the many problems with this approach:

- ✓ If an application's requirement doesn't precisely fit one of the preestablished storage service levels, the storage admins must make compromises.
- ✓ If an application's requirements move outside the range provided by the predefined storage resource pool, the storage admins must do more work to move the application to the appropriate pool.
- ✓ If actual aggregate storage demand doesn't line up with the preallocated buckets, resources either are wasted or don't meet demand.

HCI shatters the conventional storage mold. All hardware and software resources are presented as large pools of storage services that can be allocated to applications. When application requests come in for a specific storage service based on a given policy, HCI dynamically configures the precise mix of data services — just the right amount of capacity, performance, and protection — to meet the needs of the application.

Much as you do with virtualized compute today, HCI enables your IT team to precisely match demand and supply — without having much foreknowledge of the specific application requirements. You're prepared for whatever comes your way.

The VMware Implementation: vSphere Storage Policy-Based Management

In a VMware environment, the foundation for the policy-based control plane is called VMware vSphere Storage Policy-Based Management (SPBM).

SPBM allows you to capture your storage requirements for capacity, performance, and availability in the form of templates, called *VM storage policies*. Based on these policy templates, SPBM automates the provisioning and monitoring of storage services. As the needs of individual VMs change, SPBM gives them the storage resources they need. All this adds up to faster storage provisioning for new applications.

The use of policies also simplifies the change process. The virtual infrastructure (VI) admin can make changes to policies at any time, and the necessary infrastructure changes are configured through automation. This makes it easier to keep your applications in step with the changing needs of the business.

Programmable via Application Programming Interfaces

Application programming interfaces (APIs) are at the heart of anything that's software-defined. APIs give you the flexibility to tailor your HCI environment to different use cases.



Specifically, the policy-driven control plane provides integration points, using APIs, to enable the agile delivery of IT services in private cloud environments and self-service consumption of storage services by application owners. These APIs allow you to integrate your HCI environment with data center management tools, such as scripting and cloud automation solutions for self-service consumption of storage.

Renewing the Friendship between the Virtual Infrastructure Admin and the Storage Admin

In today's data centers, VI administrators and storage administrators are caught up in a codependent relationship. Neither can function without the other. This codependency can lead to an IT tug-of-war, with each side pulling on the other to get things done.

Using SPBM, VMware-powered HCI eliminates reasons for this tug-of-war. SPBM simplifies storage operations, automates manual tasks, and eliminates the operational dependencies between the VI admin and the storage admin. SPBM separates the provisioning of storage infrastructure from the consumption of storage by VMs.

In this software-defined world, the VI admin doesn't depend on the storage admin to fulfill infrastructure change requests:

- ✔ The storage admin is responsible for the upfront setup of the storage capacity and data services, which are published as the so-called *virtual datastore*. The storage admin is always in control of the resources that are available for consumption, so the job is more efficient.
- ✔ The VI admin uses the virtual datastore as a menu of storage items to serve the needs of VMs. The VI admin is self-sufficient — policies can be changed any time. And, like storage administration, VI administration is more efficient because the necessary infrastructure changes are configured through automation.

The VI admin and the storage admin no longer depend on each other to get things done every day. Each can be self-sufficient for many day-to-day tasks. Hey, they can be friends again!



Administrators have two basic roles in an SDS environment:

- ✔ The storage admin makes large resource pools available for dynamic consumption.
- ✔ The VI admin defines policies and monitors execution.

Chapter 6

Getting Started with Hyper-Converged Infrastructure

In This Chapter

- ▶ Introducing deployment choices for VMware-powered HCI
- ▶ Exploring certified solutions
- ▶ Explaining hyper-converged infrastructure appliances

Ready to put theory to practice? This chapter highlights resources you can leverage to implement hyper-converged infrastructure (HCI) on your terms and timelines.

Implementing VMware-Powered HCI: Deployment Choices

You have two main options for implementing VMware-based HCI, as shown in Figure 6-1:

- ✓ Certified solutions based on VMware vSAN ReadyNodes
- ✓ Integrated systems in the form of the turnkey Dell EMC VxRail HCI Appliances

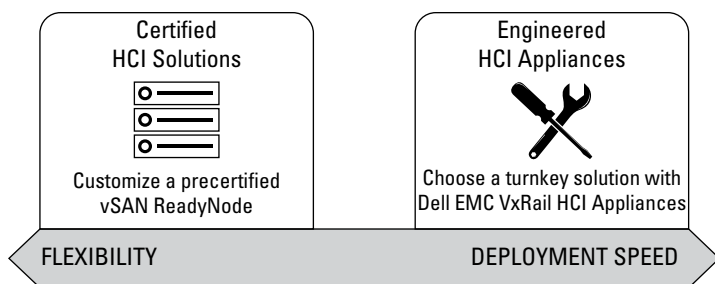


Figure 6-1: HCl deployment models.

Either of these options will help streamline your data center and deliver low-cost, high-performance compute and storage powered by VMware vSAN along with solid state drives (SSDs). The natively integrated software combines vSAN, vSphere, and vCenter with HCl deployment choices on industry-standard x86 architectures.

VMware vSAN offers proven, high-performance storage that allows you to extend your existing virtualization skill sets, reduce infrastructure and management costs, and scale to tomorrow's new hardware, application, and cloud technologies.

By being software-defined and delivered from the hypervisor, vSAN is completely hardware independent; it works with any x86 vSphere-compatible server. This means that, when you're ready to get rolling with HCl, you have a broad range of VMware and third-party components and options for configuring and deploying vSAN nodes, whether you're looking for maximum flexibility or the fastest time to market.

Regardless of the deployment model you choose, with vSAN you gain server-side economics. You can lower your storage capital expenses by taking advantage of lower-cost, industry-standard x86 architectures storage components — while gaining all the other benefits of the SDS operational model.

Certified Solutions: vSAN ReadyNodes

You can deploy vSAN with a certified hardware platform from the original equipment manufacturer (OEM) vendor

of your choice. These precertified platforms, called vSAN ReadyNodes, include a full hardware stack composed of the server, controller, and drives. VMware vSAN ReadyLabs and server OEMs have jointly validated numerous server configurations that are ready to run vSAN.

This approach allows you to build vSAN nodes that cater to different workload capacity and performance needs, by selecting the ReadyNode of your choice from the menu of options that are provided by each vendor. The ReadyNodes can be purchased as is or further customized to meet your needs — for example, including more memory, central processing units (CPUs), or drives.

In short, vSAN ReadyNodes are ideal as hyper-converged building blocks for large data center environments looking for automation and customizable hardware configurations.

Looking at the benefits of a vSAN ReadyNode

vSAN ReadyNodes help you simplify the buying decision, take control of your HCI, and accelerate time to value by providing the following benefits:

- ✓ **Choice of hardware:** Select a server OEM of your choice and choose from more than 250 precertified ReadyNodes designed for your workload needs. Each solution profile provides a different price/performance focus.
- ✓ **Elimination of silos:** Deploy your HCI environment on the x86 platforms you already know and use. This means no new hardware to learn, no new procurement process to establish, and no new support model to manage.
- ✓ **Ease of order and customization:** Purchase a single stock keeping unit (SKU) preconfigured with CPU, memory, network, I/O controller, hard disk drives (HDDs), and SSDs, and also optionally preloaded with vSphere and vSAN. Buy as is or customize to your specific needs.
- ✓ **Licensing options:** Leverage your existing enterprise license agreements or simplify procurement of licenses as a new customer.

Choosing the right vSAN ReadyNode

Here's how to choose the right vSAN ReadyNode:

1. **Refer to the vSAN Hardware Quick Reference Guide for pointers on how to identify the hardware requirements for your workload profile and the category of ReadyNode that meets your needs:** www.vmware.com/resources/compatibility/vsan_profile.html.
2. **Visit the vSAN ReadyNode Configurator for step-by-step help picking a profile and identifying the options from your vendor of choice:** <http://vsanreadynode.vmware.com/RN/RN>.

Implementing your vSAN ReadyNode

Here are some tips for implementing your vSAN ReadyNode:



- ✓ **Follow the vSphere Compatibility Guide.** Be sure to follow the guidelines and advice in the vSphere Compatibility Guide for vSAN. This online tool (available at <https://www.vmware.com/resources/compatibility/search.php?deviceCategory=vsan>) is regularly updated to provide the latest guidance from VMware. Follow it precisely.

Always verify that VMware supports any hardware components you plan to use for your vSAN deployment.
- ✓ **Create balanced configurations.** As a best practice, deploy ESXi hosts with similar or identical configurations across all cluster members, including similar or identical storage configurations. This ensures an even balance of virtual machine (VM) storage components across the disks and hosts cluster.
- ✓ **Design for the life cycle of the vSAN cluster.** For both hybrid and all-flash configurations, it's important to scale in a way that enables an adequate amount of cache and capacity for your workloads.



Consider choosing hosts that have disk slots for additional capacity and provide an easy way to install additional devices into these slots.

- ✓ **Size for capacity, maintenance, and availability.** A configuration with four nodes (or more) provides more availability options than a three-node configuration. Be sure you have enough storage capacity to not only meet your availability requirements but also allow for a rebuild of components after a failure.
- ✓ **Migrate data and VMs from existing infrastructure.** Transitioning to HCI systems powered by vSAN is also extremely easy. Once a new ReadyNodes-based vSAN cluster is brought up in your existing instance of vCenter, you can use the built-in migration capabilities that are based on proven vMotion and Storage vMotion technologies. With a few clicks through the migration wizard, both your data and workloads can be migrated without disruption from your traditional compute and storage environment to a new HCI environment.

Integrated Systems: Dell EMC VxRail HCI Appliances

The Dell EMC VxRail Appliance is a fully integrated, preconfigured, and pretested VMware HCI appliance family. Built on VMware vSphere and vSAN, VxRail delivers an all-in-one information technology (IT) infrastructure transformation solution by leveraging a known and proven building block for the software-defined data center (SDDC).

Storage area network power in just two racks

With the power of a whole storage area network (SAN) in just two rack units, these appliances provide a simple, cost-effective hyper-converged solution for a wide variety of applications and workloads. VxRail Appliances deliver features for resiliency, quality of service (QoS), and centralized management functionality, enabling faster, better, and

simpler management of consolidated workloads, virtual desktops, business-critical applications, and remote office infrastructure.

A familiar experience

Built on the foundation of VMware vSAN and managed through the familiar VMware vCenter Server, Dell EMC VxRail Appliances provide current VMware customers with a familiar experience, plus the benefits of simplified operations, life-cycle management, and additional IT services.

VxRail Appliances are fully loaded with integrated Dell EMC mission-critical data services, including replication, backup, and cloud tiering, at no additional charge. As a VMware-based solution, the appliances also integrate with VMware's cloud management platform and end-user computing solutions. VxRail is also a platform for introducing advanced SDDC offerings like VMware NSX, vRealize Air Automation, and Horizon Air Hybrid Mode.

HCI capabilities are also available in Integrated Systems from VMware. These systems are powered by VMware's hyper-converged software, vSphere for virtualization, and vSAN for storage. Integrated Systems combine VMware compute, storage, and networking with certified partner hardware into HCI appliances. The result is an all-in-one, easy-to-deploy, simple-to-manage data center systems.

Chapter 7

Ten Reasons to Love Hyper-Converged Infrastructure



In This Chapter

- ▶ Exploring operational benefits of hyper-converged infrastructure
- ▶ Highlighting business benefits of hyper-converged infrastructure
- ▶ Understanding evolving application needs



This book saves the best for last (or next to last, if you're a stickler about chapter numbers). Here's the payoff for hyper-converged infrastructure (HCI): really good outcomes for both business and information technology (IT).

Improving Cost Efficiency

With an HCI, you can cut costs by using standards-based server hardware as the basis for your storage systems. Off-the-shelf hardware can cut acquisition costs and reduce ongoing maintenance expenses, compared to the costs of buying and maintaining proprietary solutions. The result is an overall drop in capital expenditures (CapEx) and operational expenditures (OpEx).

Improving Operational Efficiency

One thing stands out when comparing HCI workflows with traditional storage workflows: There are far fewer steps, and they're usually done by far fewer people. This is intentional. HCI environments are designed to be automated from the outset, not as an afterthought.

Here's an example of how HCI improves operational efficiency: Instead of carrying out the same storage provisioning tasks over and over, you set policies and let software do the job for you. Then make any necessary adjustments in storage allocations over time. And even better, this can all be done through familiar tools you already know and trust!

Enabling Dynamic Responsiveness

Application storage service requirements change over time. An application moves from pilot to production. A heavy workload needs more storage resources. Another workload needs to be decommissioned.

In a hardware-centric world, these changes can bring a lot of heavy lifting for your IT staff — but not in the application-centric world of HCI. HCI environments are designed for agility. Change the application policy and the infrastructure responds transparently and automatically, thanks to Storage Policy-Based Management (SPBM). You gain more reliable service levels and save time and resources.

Improving Precision and Granularity

In hardware-centric conventional storage environments, overprovisioning is the norm. Admins configure static pools of storage resources according to their best guesstimates about

the maximum storage and application needs. This leads to a lot of wasted capacity.

In an HCI environment, storage services are consumed when they're needed, so there's little (or no) waste. Applications get just the performance, capacity, and protection they need — and no more. Gross approximations give way to fine adjustments, and overprovisioning becomes a relic of the past.

Delivering Native Security

With security breaches constantly grabbing the headlines, security has become a key requirement for CIOs. As you evolve to a modern data center built on HCI architectures, you need a flexible, simple security solution to protect you and your customers' mission-critical data.

A modern HCI solution must deliver native encryption that aligns with the other benefits of why you chose HCI, which includes hardware choice and flexibility, lower costs, and simplified management.

Scaling Elasticly

In HCI with vSAN, you can scale in an elastic, nondisruptive manner by taking advantage of x86 servers for storage:

- ✓ **Scale-out:** Both capacity and performance can be scaled out at the same time by adding a new host to the cluster.
- ✓ **Scale-up:** Capacity and performance can be scaled up independently merely by adding new drives to either the caching layer or the capacity layer — or both.

This grow-as-you-go model provides both linear and granular scaling in an affordable manner. Buy only what you need when you need it, and spread your investments out over time.

With the large choice of hardware platforms available for vSAN, you can also choose from the various server form factors available. Choose from traditional server design to the latest composable infrastructure from the leading vendors to best match your HCI environment with your application needs.

Preparing for Future Applications

A new style of application is becoming more common in IT environments as organizations look to deploy developer-ready infrastructure. Whether it's a mobile application, big data analytics, or new cloud-native applications, these newer applications are far more dynamic in their resource requirements than traditional enterprise applications. The rising popularity of containers and cloud applications is placing new demands on your IT infrastructure. For example, vSAN tightly integrates with Docker and Kubernetes to provide persistent storage, allowing for stateful applications and containers on proven infrastructure that is easy to manage, monitor, and maintain.

The old approach of making static upfront assumptions about an application's requirements no longer flies. Instead, the underlying infrastructure should be poised to make automatic adjustments to answer the application's changing needs. That's HCI.

Providing Consistent Performance for Every Application

Ensure that you can run any application with confidence — from business-critical applications to future cloud-native applications. Scale knowing that performance will not be compromised. And with options for all-flash, you get the most cost-efficient performance. Additionally, you can utilize space efficiency features with minimal impact on CPU and memory overhead.

Providing Enterprise-Class Availability

With HCI, you can eliminate costly downtime. Enable maximum levels of data protection and availability with built-in failure tolerance, asynchronous long-distance replication, and stretched clusters. With five-nines (99.999%) availability, you have peace of mind — even when the unexpected occurs.

Providing a Building Block toward the Hybrid Cloud

HCI, with its modular architecture, is the fundamental building block toward the hybrid cloud. And for companies wanting to move toward SDDC, the right HCI vendor will provide a path to do so with additional networking and advanced management capabilities, and enable you to utilize the same data management services across physical, virtual, and cloud environments. Achieve the next generation of hyper-convergence with VMware through the most comprehensive, integrated, and interoperable software-defined data center stack.

What is VMware Cloud Foundation?

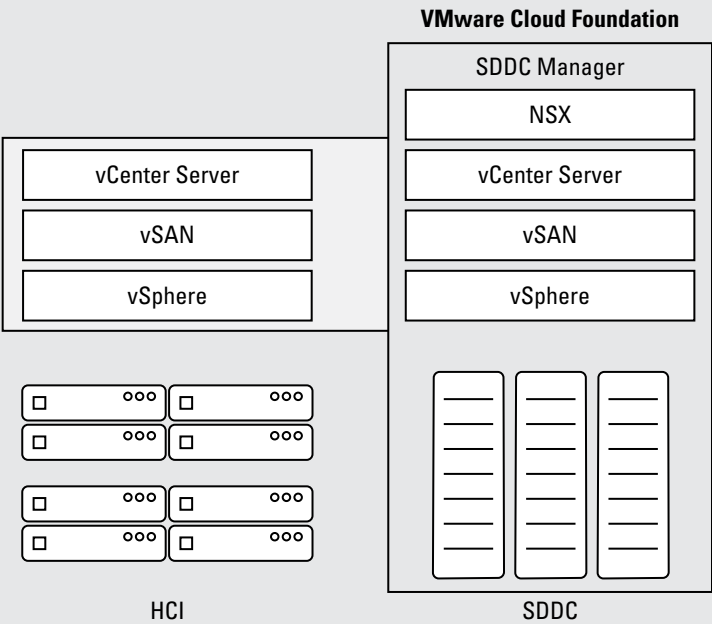
VMware Cloud Foundation is based on a modular, hyper-converged architecture, leveraging the hypervisor to deliver compute, storage, and networking in a single software layer (see the following figure).

The foundational components of VMware's HCI solution are VMware vSphere, VMware vSAN, and VMware vCenter Server, which allow the convergence of compute, storage, and management onto a single layer of software that can run on any commodity x86 infrastructure. vSphere abstracts and aggregates compute and memory resources into logical pools of compute capacity, while Virtual SAN, embedded in vSphere, pools server-attached storage to create a high-performance, shared datastore for virtual machine storage. The included SDDC Manager automates the entire system life cycle (from initial bring-up, to configuration and provisioning, to upgrades and patching) and simplifies day-to-day management and operations.

(continued)

(continued)

VMware Cloud Foundation takes HCI one step further by extending the convergence of compute and storage to include networking with VMware NSX. NSX decouples the networking functionality from the physical switches and embeds it into the hypervisor for enhanced security, greater network efficiency, and elastic scalability at data-center scale. And for organizations that want advanced automation and monitoring for their SDDC, Cloud Foundation can be enhanced with additional cloud automation and cloud operation solutions.



[illegible]

[illegible]

Appendix

Resources

Ready for a deeper dive into hyper-converged infrastructure (HCI)? Here are some top resources for your further exploration.

VMware HCI site: Explore deployment options and find resources to get you started down the path to HCI. www.vmware.com/products/hyper-converged-infrastructure.html

vSAN hands-on lab: Get hands-on HCI experience via this easy-to-use online environment. www.vmware.com/go/try-vsan-hol

vSAN free trial: Try vSAN for 60 days at no cost in your own environment. <https://my.vmware.com/web/vmware/evalcenter?p=vsan>

Self-Paced Online vSAN Training: Explore the features, benefits, and common use cases of Hyper-Converged Infrastructure powered by vSAN. https://mylearn.vmware.com/portals/www/search/results.cfm?ui=www_edu&category=catalog&searchtype=advanced&keyword=vSAN&subjectID=0&deliveryType=2&productID=0&roleID=0

VMware vSAN: Deploy and Manage: Learn how vSAN functions as an important component in the VMware software-defined data center, and gain practical experience through the completion of hands-on lab exercises in this three-day course. https://mylearn.vmware.com/mgrReg/courses.cfm?ui=www_edu&a=one&id_subject=79177

vSAN TCO and Sizing Calculator: Quantify the economic impact that vSAN can have in your environment. <https://vsantco.vmware.com/vsan/SI/SIEV>

vSAN ReadyNode Configurator: Our online tool makes selecting the right ReadyNode easy. <http://vsanreadynode.vmware.com/RN/RN>

Virtual Volumes: Learn more about the integration and management framework for external storage that provides finer control at the VM level, streamlining storage operation. www.vmware.com/products/vsphere/features/virtual-volumes.html

VMware storage blog “Virtual Blocks”: Gain insights into current trends and developments in HCI and software-defined storage (SDS). <http://blogs.vmware.com/virtual-blocks>

StorageHub Technical Resources: Technical resources and documents to help you at every stage with hyper-converged infrastructure, from evaluation to optimization. <https://storagehub.vmware.com/#!/vmware-vsant>

Catch the hyper-convergence wave!

Hyper-converged infrastructure (HCI) is the next big step in the evolution of data center architectures. This ongoing evolution moved us from traditional infrastructure dominated by IT siloes to converged infrastructure that integrates compute, storage, and networking into a single rack. Today, HCI is taking the concept of converged infrastructure to a new level.

In an HCI environment, the resource pillars are physically converged onto industry-standard servers, forming a powerful, software-defined environment designed to solve legacy IT challenges. This next step in the evolution of IT infrastructure seamlessly extends your existing virtualization capabilities to rapidly provide the simplicity, agility, and cost savings of the software-defined data center.

- **See the big picture** — learn what HCI is and how it differs from traditional and converged storage architectures
- **Measure the change** — see how HCI shifts the storage focus from hardware to applications
- **Understand the architecture** — explore the architecture of HCI and the role of the hypervisor
- **Learn how to get started** — pick up essential skills for the implementation of HCI and explore best practices and common pitfalls

Michael Haag, a veteran of the SAN storage industry, helps lead the VMware product marketing team responsible for vSAN, Virtual Volumes, and SRM. He is a published author and frequent speaker at industry-leading events including VMworld, HP Discover, SNW, and Interop. Michael holds a master's degree in electrical engineering from Rice University in Texas.



Open the book and find:

- **Guidance on upgrades with current infrastructure architectures**
- **Tips on implementing and managing hyper-converged infrastructure**
- **How to dynamically control storage services**
- **HCI deployment options**

Go to Dummies.com
for more!

WILEY END USER LICENSE AGREEMENT

Go to www.wiley.com/go/eula to access Wiley's ebook EULA.