vmware PRESS

VMware vCloud® Architecture Toolkit (vCAT)

Technical and Operational Guidance for Cloud Success

VMware vCAT Team

Foreword by **Pat Gelsinger**, CEO, VMware

VMware vCloud® Architecture Toolkit (vCAT)

Technical and Operational Guidance for Cloud Success

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VMware vCloud Architecture Toolkit (vCAT)

Technical and Operational Guidance for Cloud Success

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David Hill—David Hill is an experienced entrepreneur, IT consultant, and architect who has worked in the IT industry for more than 16 years on projects across the public sector and financial institutions. David joined VMware in 2010 and is a Senior Solutions Architect in the Professional Services Engineering (PSE) team. There he develops cutting-edge technology best practices, design guidelines, and intellectual property for the company and partners. David holds VCP 3/4/5 and VCAP-DCD4 certifications. David is the author and owner of the cloud technical blog www.virtual-blog.com. Find him on Twitter at @davehill99.

This book is dedicated to our families, friends, co-workers, customers, and partners. With you, we have found the time, energy, and enthusiasm to raise the bar and produce something to educate many on the concepts, technology, and operations for cloud computing and the software-defined data center.

—The vCAT Team

"Design is the fundamental soul of a human-made creation that ends up expressing itself in successive outer layers of the product or service."

—Steve Jobs

"I am constantly thinking about new and simple approaches to solving problems. As Albert Einstein said, 'Any intelligent fool can make things bigger and more complex. It takes a touch of genius to move in the opposite direction'. vCAT is a huge enabler for your service-oriented transformation efforts."

—Rupen Sheth, VCDX, ITIL, TOGAF certified

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The vCATs

Past vCAT Team members

The following are individuals who have worked on past releases of the vCloud Architecture Toolkit. This includes releases 1.6, 2.0, 2.0.1, and 3.0. Current vCAT 3.1 members have also participated in developing past releases.

As with the current vCAT team, we recognize the value in everyone's contribution, the dedication, and the sacrifices made to deliver this highly used resource.

As of pre-release, vCAT has had over 100,000 downloads used by architects, administrators, operators, consumers, customers, consultants, and vendors.

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Foreword

One thing I've learned in my career is that architecture really matters. Bad implementations can be thrown away, but architectures last a long time—sometimes forever! Having a framework and set of principles to both guide and enable innovation can determine success, and a lack thereof almost certainly signals failure. An example I'm intimately familiar with is Intel's x86 architecture. Putting the right framework in place has allowed the X86 design team to continue to create value and introduce new innovations to hundreds of millions of users to this day.

The VMware vCloud Architecture Toolkit (vCAT) serves a similar role for VMware. It provides the best of best practices that guide customers in assembling and operating a Cloud-capable, modern platform based on the Software Defined Data Center (SDDC).

The insight behind the software-defined strategy is that cloud-scale economics and agility require a radically simpler and more flexible approach to managing the hardware, network, storage, and security elements of the data center. This kind of agility requires that every technology layer be software defined and automatable. Networking, storage, compute, and security need to be abstracted, pooled, and made reconfigurable through instructions that are not bound to physical hardware. In a word, they need to be virtualized. VMware is applying its virtualization engineering capability to all the physical layers of the datacenter and extending these capabilities across multiple clouds. This gives our customers the most choice and control in how they deliver IT.

This latest vCAT release guides our customers in moving configuration management, policy management, and provisioning into the software layer. This simplifies the challenges companies increasingly face as software development and IT teams work together and the line between their roles becomes less distinct. vCAT also now supports *hybrid cloud deployments on partners' clouds or on the VMware Hybrid Cloud Service so that customers can deploy workloads on hardware they rent or own*. vCAT can also guide customers in laying the foundation for Desktop as a Service and Platform as a Service.

vCAT and other VMware reference architectures are developed as part of the VMware Validated Architecture program. Our engineering, support, and other technical teams review and validate these reference architectures in our labs and directly through our customers' deployments.

Each day, our customers and our partners come to depend more on VMware technology. This is both exciting and humbling for our company. As VMware continues to play a more central role in the IT industry, we've recognized the need to provide deep technical guidance that helps our customers realize success. We also recognize that our customers need to support existing investments and want to have the option to choose the best technology for their needs. To this end, we've created a way for other industry players to extend vCAT and integrate their products into the SDDC architecture. This also allows

partners to publish their own vCAT-compatible blueprints and design templates that guide our mutual customers in implementation and operation of solutions that incorporate those products. We believe that vCAT will continue to provide necessary and extensible architectural blueprints for the IT industry as it transitions to a software-defined approach to computing.

I heartily recommend this reference as a roadmap for anyone tasked with simplifying IT infrastructure and as an indispensable guide for those developing Software Defined Data Centers and vSphere/vCloud solutions.

Pat Gelsinger

Chief Executive Officer, VMware

Preface

"Technical skill is mastery of complexity, while creativity is mastery of simplicity."

Erik Christopher Zeeman

"What is to be sought in designs for the display of information is the clear portrayal of complexity. Not the complication of the simple; rather, the task of the designer is to give visual access to the subtle and the difficult—that is, revelation of the complex."

Edward Tufte

This book represents the work of more than 100 architects, consultants, administrators, engineers, project managers, technical editors, partners, and customers over multiple releases starting in 2010. A handful of people built the 1.x releases. For the 2.x release, approximately 72 individuals spent nearly 1,200 hours to produce 600 pages of content across eight documents. The 3.x releases saw about 42 individuals spend approximately 1,400 hours to produce 750 pages of content across nine documents. In your hands, you hold a compendium of these individual components in a single book format.

vCAT was created first as a reference architecture based on a limited set of use cases. The current release supports multiple use cases and, as such, has turned into a reference architecture toolkit that is part of a series titled VMware Validated Architectures (VVA).

The following sections present information on the owners of the product sections and a list of the contributors involved in the vCAT project since its inception. Approximately 50% of the development team holds VCDX certification. This material is thus not only a reference for SDDC and vCloud, but also a reference for those planning to achieve VCAP and VCDX certification.

You will notice our internal logo, a black cat on a white cloud. Catherine Arrasjid created this graphic to represent the project and the team of vCATs, as we are affectionately called. Our marketing team digitized it, and has become our internal team mascot.

It has been my pleasure to work on these releases—and to work with such an exceptional team of individuals, who are all recognized in the industry in their fields of specialization.

I want to call out the value of vCAT beyond just the cloud space. As you hear more about the Software Defined Data Center (SDDC) and related Software Defined components in networking, security, storage, and other areas, vCAT can provide the guidance you need. vCAT includes many of the components of SDDC—so what do you need to be aware of? We hope to include that in an addendum to vCAT that provides extensions in the SDDC area. Software Defined Networking and Security cover the areas currently represented by vCloud Networking and Security. Software Defined Storage will add relevant components on virtualization of storage. We expect a few other areas to come as the SDDC space continues to evolve.

VMware Validated Architectures, similar to vCAT, are designed to be easily integrated with third-party reference architectures. You will find references to these on the vendor sites. The goal is to allow ease of plug-and-play with other solutions, VMware, and third-party offerings.

As of publication, the vCAT site at www.vmware.com/go/vcat has more than 200,000 accesses and more than 100,000 downloads. These downloads were created by architects, administrators, operators, developers, project managers, solutions architects, and managers. The feedback has shown how vCAT is used and turned up suggestions to improve what we are producing. If you have input on improving this material, send your suggestions to IPfeedback@vmware.com. Please note that this book is printed in black and white to minimize cost and allow for wider adoption. Color versions of the original documentation in electronic and PDF format can be found at www.vmware.com/go/vcat in the Document Center tool.

We want to thank all participants on this project, with a special callout to our stakeholders who have supported this project and recognize the value it provides to our customers.

As you peruse this material, start by reading the Introduction, a guide to the material included in this book.

I wish you the best in your design and deployment of cloud and software-defined datacenters.

John Yani Arrasjid, VCDX-001

Principal Architect

VMware vCloud Architecture Toolkit R3.1 Release Notes

VMware vCloud Architecture Toolkit R3.1 Release Notes

The VMware® vCloud® Architecture Toolkit (vCAT) provides modular components so that you can design a vCloud reference architecture that supports your cloud use case. It includes design considerations and design patterns to support architects, operators, and consumers of a cloud computing solution based on VMware technologies.

For additional vCAT supporting material, visit the vCloud Architecture Toolkit page at vmware.com (www.vmware.com/go/vCAT). This is also where updates to vCAT will be posted.

vCAT 3.1 Documentation Packages

The following vCAT 3.1 packages are available:

- PDF package (~25MB)
- Documentation Center package (~50MB)

PDF Package

The PDF package is a zipped package that contains PDFs of all the documents in the toolkit. Use WinZip or a similar application to unzip the package, and use a PDF reader such as Adobe Reader to display and read the documents. You can print hard-copy documents from the PDFs.

Documentation Center Package

For a video overview on the Documentation Center packaging of vCAT, see the SME videos at www.vmware.com/go/vcat.

The documentation center package is a zipped package that contains a complete online help system that you can use to view all the documents in the toolkit from an easy-to-use interface. It offers powerful features such as the capability to search through the collection of vCAT documents, display a pregenerated PDF of a document, and, when served from a web server, access Google Translate to translate displayed pages into dozens of languages.

The vCAT 3.1 Documentation Center is also served from a website on vmware.com.

Browsers

The documentation center works with the following browsers:

- Google Chrome (preferred)
- Safari
- Internet Explorer (Search operates differently. Click the magnifying glass to search, enter a search term in the resulting text field, and press Enter or click Go).
- Firefox (works well except with Google Translate)

Installing the Documentation Center

The Documentation Center package is large, so it is recommended that you download the package over a high-speed link.

To install and display the vCAT 3.1 documentation center:

1. Download and unzip the package.
2. Double-click the index.html file to run it.
3. Allow blocked content, if prompted.

Offline Versus Online Capabilities

- If you install the Documentation Center package on your machine, you can use the toolkit offline. For example, you can install it on your laptop computer and review the documents while you are not connected to the Internet.
- If you install the Documentation Center package on a web server, the interface provides additional capabilities, such as access to Google Translate.
- The Documentation Center also optimizes the display for mobile devices. For example, using Safari on an iPad to access the documentation center works well.

Using the Documentation Center

- Click the folder icon to toggle display of the navigation pane on or off.
- Enter text in the search field and click the search icon (magnifying glass) to search for it. This is a client-side search implementation that can be used online or offline. It does not allow Boolean expressions.

If the documentation center is served from an Internet-connected web server, click the globe to display Google Translate. Select the language you want and click Translate. Each page is translated as it is displayed.

- Click a document in the navigation pane to display the sections in the document. Click a section to display content.
- Click the Page Forward or Page Back arrows to move from page to page.
- Click the Print icon to print the selected page to a printer.
- Select any document section and click the PDF icon to view a pregenerated PDF for the selected document. You can print the entire document from the PDF.
- Click the Email (envelope) icon or the link by the logo to send feedback to ipfeedback@vmware.com. The URL of the currently displayed page is automatically populated in the email Subject line.

vCAT 3.1.1 Changes and VMware Press Book Release

This book release combines all separate documents for vCAT 3.1 into one document. Each chapter in this book represents the nine separate documents. When we reference separate sections, see the associated chapter in the book format. We have not made specific updates to these release notes, to allow the material here and the material in Document Center to be synchronized.

There are several updates in this book that will apply to the updated web release.

- General
  - Updated graphics and screenshots.
  - Updated SSO material throughout.
- Chapter 1, Introduction:
  - Removed references to VMware Service Manager.
- Appendix D
  - Removed references to VMware Service Manager.

vCAT 3.1 Changes

For vCAT 3.1, most documents received additional edits, and graphics were improved for many figures. Content was updated as follows:

- *Chapter 1, Introduction:*
  - Links to brief video presentations were added for each document and topic area.
  - Figure 1.3 was updated.
- *Chapter 2, Service Definitions*:
  - The service offering examples were changed because of allocation model changes in vCloud Director 5.1.1.
  - Minor updates were made to the other service offering examples.
  - Other minor edits include the following:
    - The technology-mapping diagram was updated to show VMware vCloud Automation Center™.
    - vCloud API changed to VMware APIs.
    - VMware vCenter Operations Management Suite™ components are enumerated.
- *Chapter 3, Architecting a VMware vCloud*:
  - Information was added about vCloud Automation Center (a component of the vCloud Suite).
  - Section 3.8, "Multisite Considerations," was updated.
  - Allocation models guidance was updated.
  - Information about VMware metering was updated in Section 3.6, "vCloud Metering."
  - Hybrid vCloud considerations were updated in Section 3.9, "Hybrid vCloud Considerations."
- *Chapter 4, Operating a VMware vCloud*: Information was added about organizational structure and its evolution for vCloud in Section 4.5, "Organizing for vCloud Operations."
- *Chapter 5, Consuming a VMware vCloud*:
  - Updates were made to reflect the new network terminology in vCloud Director 5.1.
  - The text was updated to reflect new storage capabilities in vCloud Director 5.1.
  - Section 5.3.2, "vCloud Director Allocation Models," was updated to reflect changes in vCloud Director 5.1.

- Updates and clarifications were made to Section 5.4.3, "Working with Catalogs."
- Updates were made to Section 5.5.1.3, "vApp Migration," to reflect new capabilities in vCloud Director 5.1.
- Updates were made to Section 5.6.3 "What's New in the vCloud 5.1 API."

- *Chapter 6, Implementation Examples*: The following sections were extensively updated with the latest available information:
  - Section 6.3, "Organization Virtual Datacenter Examples"
  - Section 6.4.5, "VXLAN ORG Network for Disaster Recovery"
  - Section 6.7.3, "Implementing Signed Certificates from a Certificate Authority"
- *Chapter 7, Workflow Examples*: No content changes were made.
- *Chapter 8, Software Tools*: No content changes were made.
- *Chapter 9, Cloud Bursting*: No content changes were made.

Security information in Appendix B, "Security," was updated.

vCAT 3.0 Changes (Previous Release)

This section provides information on the changes that were made for the vCAT 3.0 release.

New documents were added to the toolkit, and in two cases, multiple documents were consolidated into one guide. Information about new components has been added, and information about other components has been updated.

New and Consolidated Documents

Workflow Examples, *Software Tools*, and *Cloud Bursting* are new documents with all new content.

The *vCAT 2.x Public VMware vCloud Service Definition* and *Private VMware vCloud Service Definition* have been consolidated into one *Service Definitions* document that covers public, private, and hybrid cases.

The vCAT 2.x documents, *Public VMware vCloud Implementation Examples*, *Private VMware vCloud Implementation Examples*, *and Hybrid Use Cases*, have been consolidated into one document titled *Implementation Examples* that covers public, private, and hybrid use cases. Many new implementation examples are provided.

New and Updated Components

vCAT 3.0 provided new and expanded coverage for architects, operators, and consumers.

- VMware vSphere®
- VMware vCloud Director®
- VMware vCenter™ Operations Management Suite™ (new):
  - VMware vCenter Chargeback Manager™
  - VMware vCenter Operations Manager™ (new)
  - VMware vCenter Infrastructure Navigator™ (new)
  - VMware vCenter Configuration Manager™ (new)
- VMware vCloud Networking and Security™ (formerly VMware vShield™):
  - VMware vCloud Networking and Security Edge™
  - VMware vCloud Networking and Security App™ (new)
  - VMware vCloud Networking and Security Data Security™ (new)
  - VMware vShield Endpoint™ (new)
- VMware vCloud Connector™
- VMware vCenter Orchestrator™
- VMware vSphere Service Manager™—Cloud Provisioning (new)
- VMware vCenter Site Recovery Manager™ (new)
- VMware vFabric™ RabbitMQ™ (new)
- VMware vFabric Application Director™ (new)
- VMware vFabric Application Performance Manager™ (new)
  - VMware vFabric Hyperic® (new)
  - VMware vFabric AppInsight™ (new)

VMware vCloud Networking and Security

VMware vShield has been renamed to VMware vCloud Networking and Security™. Note the following changes:

- VMware vShield Edge™ is now VMware vCloud Networking and Security Edge.
- VMware vShield App™ is now VMware vCloud Networking and Security App.
- VMware vShield Manager™ is now VMware vCloud Networking and Security Manager™.

The vCAT documents usually refer to vCloud Networking and Security, but some links to reference documents might still link to vShield documents on vmware.com. The vShield documents are being updated to reflect the new name.

Known Issues

Firefox generally works with the vCAT Documentation Center, but Google Translate does not work properly.

Providing Feedback

The usefulness of this architecture toolkit depends on feedback from customers and our network of partners. Send all feedback and IP submissions to ipfeedback@vmware.com.

From the documentation center interface, you can click the link next to the logo or click the Email (envelope) icon to send feedback.

Reader Services

Visit our website at www.informit.com/title/9780321912022 and register this book for convenient access to any updates, downloads, or errata that might be available for this book.

CHAPTER 1
Introduction

IN THIS CHAPTER

1.1 Overview

A *reference architecture* is an architecture template solution that addresses one use case in a particular domain. The VMware® vCloud® Architecture Toolkit (vCAT) provides modular components and documents to support multiple use cases, including design considerations and design patterns to support architects, operators, and consumers of cloud computing solutions based on VMware technologies.

vCAT is the first of several VMware Validated Architectures (VVA) VMware has released for customers, partners, vendors, and our internal teams. As a VVA, vCAT is supported by VMware and our support organization.

vCAT is vendor agnostic, but it does share vendor details when providing implementation examples. Vendors provide information about the use of their products with vCloud, including integration with vCAT, on the VMware Solutions Exchange (https://solutionexchange.vmware.com/store).

vCAT design guidelines cover multiple use cases. Instead of referring to *best practices* (a term subject to misinterpretation because best practices depend on use cases and are subject to many variables, including change over time), vCAT provides *design guidelines*. Architects must determine which design guidelines apply to the requirements, constraints, and characteristics of their projects and chosen technologies. When using the toolkit, consider the use case that best applies to your situation, and choose the design guidelines that support your design implementation.

This document covers the following topics:

- The vCAT documentation set
- Cloud computing and the VMware vCloud
- The journey to a mature vCloud implementation

For additional vCAT supporting material, visit the vCloud Architecture Toolkit page on vmware.com (www.vmware.com/go/vCAT). This is also where updates to vCAT are posted.

1.2 Using the vCAT Documentation Set

The vCloud Architecture Toolkit provides a set of documents to support the design of complex, integrated reference architectures for architects, operators, and consumers. Figure 1.1 shows the documents, and Table 1.1 briefly describes them.

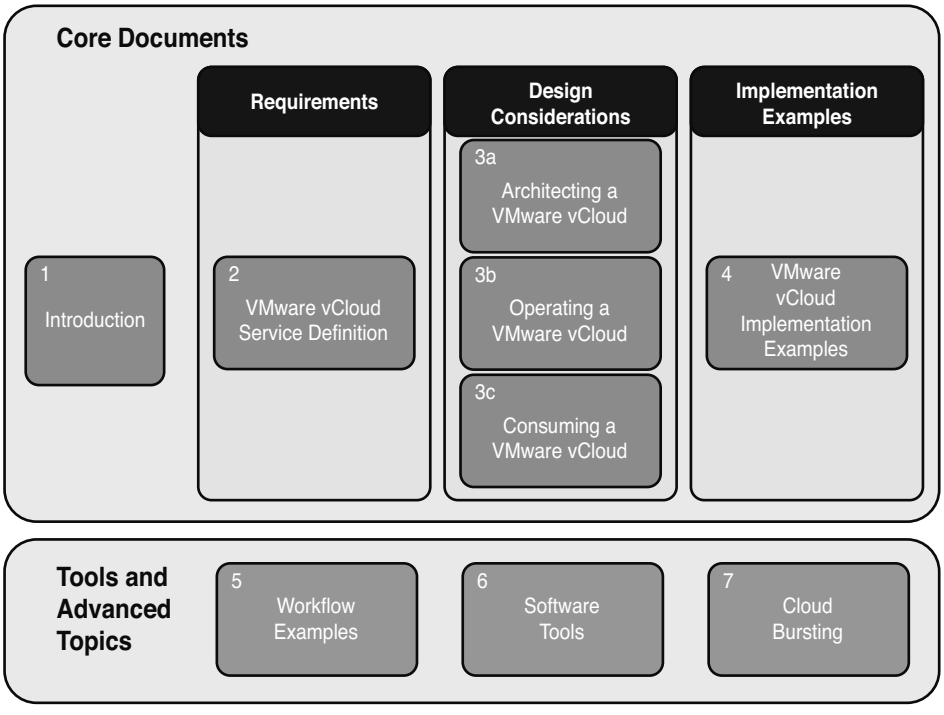

FIGURE 1.1 VMware vCloud Architecture Toolkit document map

Table 1.1 shows check marks in the first column to represent existence of an online video providing a brief presentation (<10 minutes) about a document and topic area.

TABLE 1.1 VMware vCloud Architecture Toolkit Documents

Video	Document	Description	Audience
	Release Notes	Includes information about the VMware Architecture Toolkit, toolkit packages, how to use the documentation center, and information about changes since the vCAT 3.0 release.	All
✓	*Introduction*	Covers the following topics: ▶ A brief summary of vCAT documents ▶ Suggested reading order, depending on audience or role ▶ Introduction to cloud computing and basic cloud computing requirements and definitions	All
✓	*Service Definitions*	Discusses service definition lifecycles, including specific considerations for private, public, and hybrid vCloud instances, and examples of service offerings designed to help you create service definitions that meet specific business objectives.	All
✓	*Architecting a VMware vCloud*	Details design considerations for architecting and building a VMware vCloud, including the basis for a reference architecture and guidance on requirements for implementing a VMware vCloud infrastructure.	Architects, IT operations
✓	*Operating a VMware vCloud*	Introduces high-level operational areas and discusses the evolution to support vCloud dynamics. Provides information about operational procedures, roles and responsibilities, setup, management, and monitoring of a vCloud. Also covers VMware management tools that support vCloud operations.	Architects, IT operations
✓	*Consuming a VMware vCloud*	Answers consumer questions such as the following: ▶ How do I handle the application lifecycle in a vCloud? ▶ How do I protect my workloads? ▶ How do I guarantee that workload resource requirements are met? Provides the consumer's perspective.	Architects, IT operations, consumers, end users
✓	*Implementation Examples*	Provides examples of how to build a vCloud.	Architects

Video	Document	Description	Audience
✓	*Workflow Examples*	Provides a description of useful scripts and workflows for VMware vCenter™ Orchestrator™. Other examples use technologies such as PowerCLI. Includes references to where these scripts can be found.	Architects, IT operations
✓	*Software Tools*	Includes information about software that can benefit architects and operators. Provides information about freely available technologies that have been created and used to assist in vCloud design, deployment, and operations. Also includes information about several powerful tools that are available only as part of a service engagement with VMware Professional Services or a VMware partner.	Architects, IT operations
✓	*Cloud Bursting*	Provides the theory behind autoscaling an enterprise cloud environment by using multiple cloud locations, including those owned by an enterprise and/or a service provider. This theory leverages VMware technologies but applies to other cloud technologies as well. This material is based on VMware field experience with customers and service providers.	Architects

Table 1.2 lists the typographical conventions used in all vCAT documents.

TABLE 1.2 Document Typographical Conventions

Emphasis	Emphasizes information, introduces new terms, and identifies document and workflow names.
`Command`	Identifies system commands, filenames, and Registry keys.
`Code`	Indicates code snippets and scripts.
User Interface	Identifies UI objects such as tabs, buttons, and field labels with bold text.
Hyperlink	Uses blue, underlined text to indicate an active link (URL).
Note, Caution	Notes contain information related to the topic that is of possible interest to the reader. Cautions highlight important information on potential problems or actions that might cause unexpected results. A Caution alerts the user and indicates the possibility of significant data loss.

1.2.1 Recommended Reading Order

The documents can be read in the order shown in the document map or in the order recommended for a particular audience or role, such as one of the following:

- *vCloud providers* who offer the vCloud infrastructure and services. An *architect* has overall control over how a solution is designed and implemented in the environment.
- *vCloud operators* who are responsible for operation of the cloud. *Operators* are involved with the day-to-day running and administration of the vCloud environment. They need to understand operational procedures and how the vCloud components fit together.
- *vCloud consumers* who use cloud provider resources for application deployment. A consumer (organization or individual) is someone who consumes vCloud resources. Consumers want to run their workloads in the vCloud environment without concern for the underlying infrastructure or day-to-day administration.

Table 1.3 identifies the recommended documents for each role.

TABLE 1.3 vCAT Audience Reading Guidelines

VMware vCloud Architecture Toolkit (vCAT) Reading Recommendations	Architect	Admin/ Operator	Consumer
Introduction	✓	✓	✓
Service Definitions	✓	✓	✓
Architecting a VMware vCloud	✓	✓	
Consuming a VMware vCloud	✓	✓	✓
Implementation Examples	✓		
Workflow Examples	✓	✓	
Software Tools	✓	✓	
Cloud Bursting	✓		

1.3 Cloud Computing and VMware vCloud

Cloud computing leverages the efficient pooling of an on-demand, self-managed, virtual infrastructure that is consumed as a service. VMware vCloud is the VMware solution for cloud computing that enables delivery of *Infrastructure as a Service* (IaaS). Additional "as a Service" reference architectures can be layered on top of a VMware vCloud built using vCAT.

1.3.1 VMware vCloud Requirements

According to the National Institute of Standards and Technology (NIST), the key components of a cloud are on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service. VMware aligns with the definition of *cloud* as elastic, lightweight entry and exit, available over Internet protocols, and running on a shared infrastructure.

A cloud always starts with a shared, virtual infrastructure. If any resource is dedicated to only one customer, you have a *managed hosting platform*, not a cloud infrastructure. Similarly, it is not considered a cloud if the cloud administrator or service provider must perform manual procedures to provision cloud resources following a consumer request. This is why workflow automation and orchestration are included as part of a vCloud solution.

The VMware vCloud blueprint follows these basic NIST requirements as the foundation for an IaaS cloud:

- A cloud must be built on a *pooled, virtual infrastructure*. Pools include not only CPU and memory resources, but also storage, networking, and associated services.
- The cloud should provide *application mobility between clouds,* allowing the consumer to enter and leave the cloud easily with existing workloads. The ability to use existing consumer tools to migrate workloads to or from the cloud is highly desirable. Mobility of workloads between clouds requires cross-cloud resource management.
- The cloud should be *open and interoperable*, allowing the consumption of cloud resources over open, Internet-standard protocols. Access to cloud resources does not require any other specific network protocols or clients.
- Cloud consumers should pay only for resources they consume or commit to consuming.
- The cloud should be a secure, trusted location for running cloud consumer workloads.
- Cloud consumers should have the option and capability to protect their cloud-based workloads from data loss.
- Cloud consumers are not responsible for maintaining any part of the shared infrastructure and do not need to interact with the cloud provider to maintain the infrastructure. They are not responsible for storage and network maintenance, ongoing cloud infrastructure patches, or business continuity activities. The cloud should be available to run high-availability workloads, and any faults occurring in the cloud infrastructure should be transparent to cloud consumers as a result of *built-in availability, scalability, security, and performance guarantees*.

1.3.2 VMware Alignment to Standards

VMware continues to develop technologies that align with evolving cloud standards as defined by NIST and other global standards organizations.

vCloud solutions focus on the following areas:

- **People:** People who develop solutions, architect the design, operate the implementation, and consume the resources. (See *Operating a VMware vCloud* and *Consuming a VMware vCloud*.)
- **Process:** Processes for architects, operators, and consumers.
- **Technology:** Alignment with successful design, deployment, and integration considerations. VMware technologies address the relevant areas within the standards.

Standards are still evolving for private, public, community, hybrid, and other types of clouds. vCAT focuses on the most common core design areas. The technology is the same, but operations and vCloud resource consumption vary according to the type of vCloud, the type of vCloud provider, and specific consumer requirements.

- *A private vCloud* is operated by an organization and secured behind a firewall.
- *A public vCloud* is generally accessible to users on the Internet.
- *A community vCloud* is a specific public vCloud use case in which access is limited to specified groups that share a common set of requirements.
- *A hybrid vCloud* is characterized by a connection among multiple vCloud instances. Typically, a bridge between two private vCloud instances has a dedicated and secured connection. The underlying network resides behind an Internet-facing firewall.

As cloud computing continues to evolve, many cloud definitions will arise. The information in this toolkit is a valuable aid in support of your vCloud projects, regardless of your chosen definition.

1.3.3 vCloud Definitions

vCAT uses the terms *private vCloud*, *public vCloud*, and *hybrid vCloud,* based on a specific set of definitions that NIST provides.

- Private cloud:

  A private vCloud (also known as an *internal vCloud*) operates on private networks, where a single company maintains accessible resources behind the firewall. In many cases, all the tenants share one legal entity. For example, a university might offer IaaS to its medical and business schools, or a company might do the same for various groups or business units. The private vCloud can be managed by the enterprise and hosted on-premises or operated on a dedicated infrastructure provided by a vCloud service provider or systems integrator. In any case, a private vCloud must conform to the organizational security constraints.

- Public cloud:

  A public vCloud offers IT resources as a service through external service providers and is shared across multiple organizations or the Internet. This can be viewed as a vCloud infrastructure that one organization operates and that multiple, legally separated organizations use.

  A public vCloud is provisioned for open access and might be owned, managed, and operated by one or more entities.

  A public vCloud provider might also support a private, community, or hybrid vCloud.

- Hybrid cloud:

  A hybrid vCloud combines the benefits of the private and public vCloud, with flexibility and choice of deployment methods.

  A hybrid vCloud consists of multiple, linked vCloud infrastructures. These distinct vCloud infrastructures can be private, community, or public; but they must meet a set of requirements that the providers define and the consumers agree to. Connecting these vCloud instances requires data and application mobility, as well as management.

  When load-balancing between vCloud instances (*cloud bursting*), use a consistent monitoring and management approach when migrating an application or data workload. For the theory behind cloud bursting, see the *Cloud Bursting* document.

- Community cloud:

  A community vCloud is a specific public vCloud use case in which the cloud is shared, and typically owned, by a group of organizations with a common set of requirements. In many cases, the organizations also include some level of legal separation. Community vCloud resources are shared, with some parts under central control and other parts with defined autonomy. A vCloud built for government, education, or healthcare is an example of a community vCloud.

  A community vCloud can be offered by a traditional service provider, by a member of the community, or by a third-party vendor and hosted on one or more sites. It can be placed on-premises at one or more of the organizations' sites, off-premises at a vCloud provider site, or both on- and off-premises.

1.3.4 Solution Area to Technology Mapping

When considering various technology solutions for your vCloud architecture, evaluate the solution and operational requirements to provide justification for the proposed solution. As VMware continues to develop Software Defined Data Center (SDDC) technologies, we will update the matching Infrastructure as a Service component. Figure 1.2 shows the categories of design considerations for building both a cloud and the underlying SDDC, with the related product technology that is used.

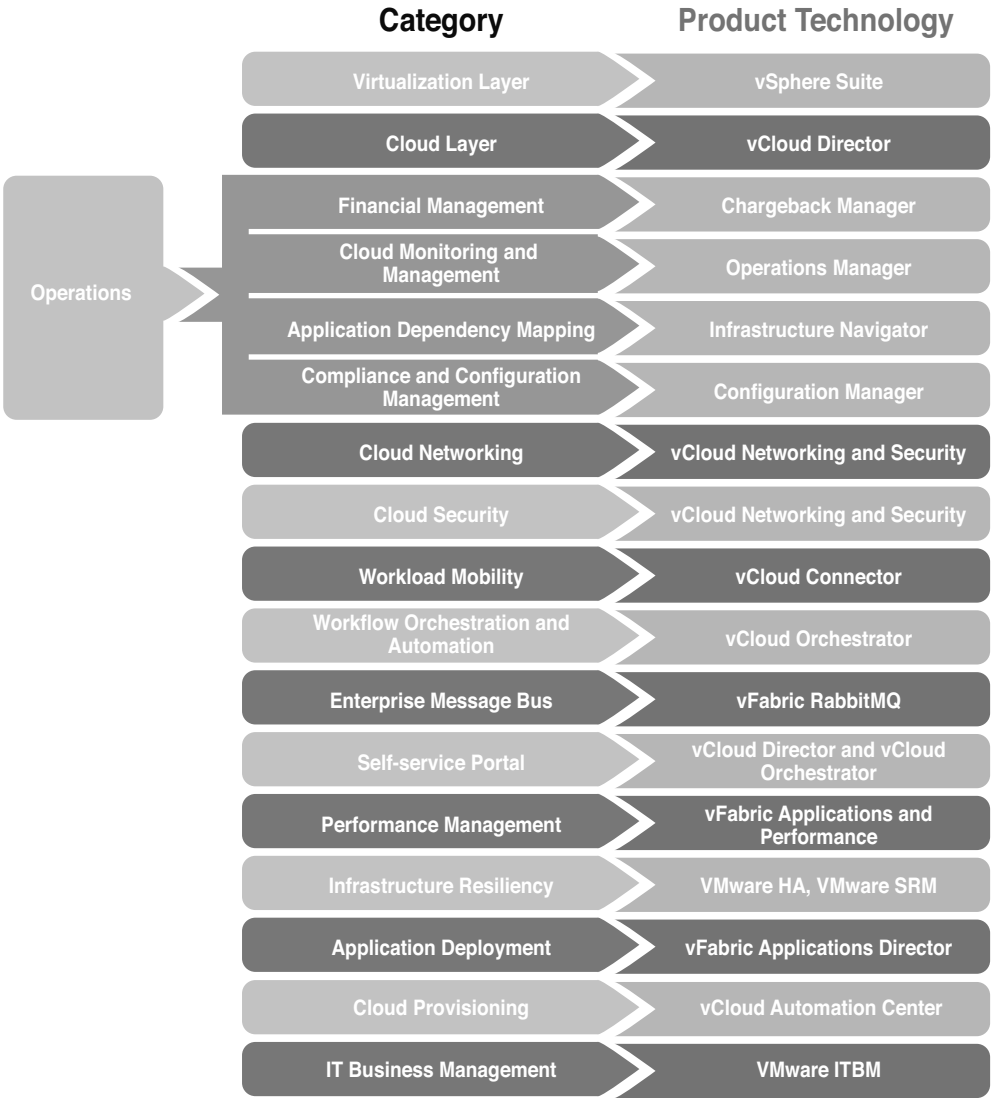

FIGURE 1.2 Technology areas

Figure 1.3 shows the technologies this vCAT release covers.

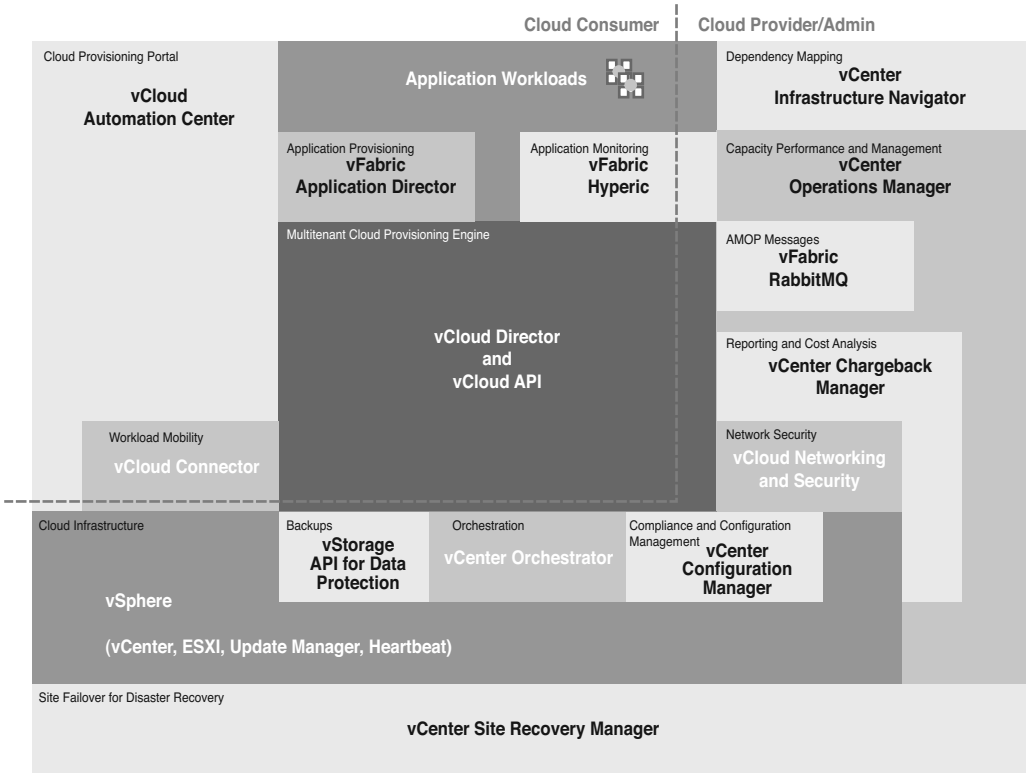

FIGURE 1.3 Technology areas in vCAT

NOTE

Except for the gray components, components that touch each other are integrated.

1.3.4.1 VMware Professional Services

VMware offers professional services that align with vCloud use cases. These range from a proof of concept (POC) that might be used as a demonstration environment, to a production deployment that requires management, workflow automation, compliance enforcement, and validation. The following services are available:

- **VMware vCloud POC Jumpstart Service:** Provides knowledge transfer workshops and hands-on product installation, configuration, and use demonstrations for the vCloud solution.

- **VMware vCloud Accelerator Service:** Rapidly delivers a functioning VMware vCloud implementation suitable for deploying applications in a limited-scale preproduction environment. If all prerequisites are met, this service engagement can be completed in fewer than 30 business days.
- **VMware vCloud Design and Deploy Service:** Provides a comprehensive architectural design for VMware vCloud that addresses the customer's unique business requirements and operational demands, helping to pave the way to vCloud computing. This service is designed for enterprises that have a well-established, vSphere-based virtualization strategy for production workloads and that are ready to take the next step toward building their production vCloud infrastructure.
- **VMware Operational Readiness for Cloud Computing Service:** Offers a four- to six-week engagement in which VMware consultants examine existing operational practices to evaluate performance across more than 150 attributes in five key areas. They uncover unknown or hidden barriers to success and highlight areas in which additional focus on people or process can deliver increased productivity, streamline operations, and improve overall vCloud solution results.

Services can be combined or customized to meet your specific requirements.

1.4 Journey to a Mature vCloud Implementation

At every stage in the processes leading to a mature vCloud implementation, financial transparency, process maturity, organizational setup, and technology implementation are critical factors for success.

VMware defines three stages on the journey to a mature vCloud: Standardize, Service Broker, and Strategic Partner. Figure 1.4 depicts these, and the following sections describe them.

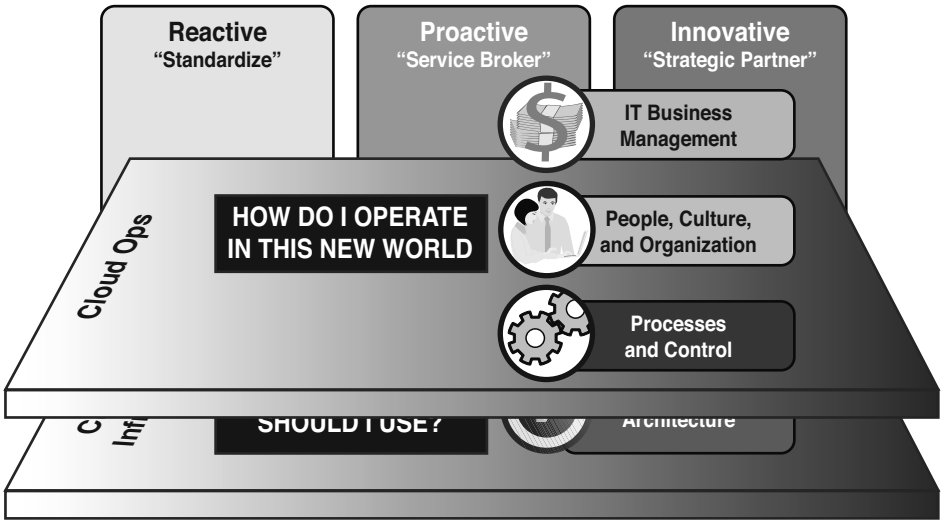

FIGURE 1.4 Journey states in vCAT

1.4.1 Stage 1: Standardize

Stage 1 often coincides with a more mature server virtualization environment, and the focus is on creating a working vCloud solution with an on-demand service catalog end users can directly access. The service catalog provides rapid deployment services for non-business-critical, development, and test environments, as well as for externally sourced applications. Implementing the service catalog promotes cloud acceptance by business users and also outlines a long-term vCloud implementation strategy with planning for operational and organizational change. The following capabilities are important for this stage:

- **Financial model and measurement:** Awareness and understanding of the costs of assets and underlying infrastructure capacity.
- **People and organization:** Specialized but shared roles for managing virtualized environments.
- No explicit virtualization Center of Excellence established.

NOTE

See "Organizing for vCloud Operations" in *Operating a VMware vCloud* for information about the Center of Excellence.

- **Process and control:**
  - IT processes are adapted for virtualization but are largely manual, with specific, customized interprocess integration.
  - The focus is on limited, continuous improvement.

- **Tools and technology:**
  - Online, self-service capability for development and test provisioning
  - Online, self-service capability for Software as a Service (SaaS)–based applications
  - Operational tools defined for virtualization environments
  - Some business workloads run in a virtualized environment, whether internal or provided by third parties

1.4.2 Stage 2: Service Broker

Stage 2 is the first service-driven stage for a vCloud. At this stage, IT has transformed from traditional models and is focused on delivering business services within a vCloud environment. This represents a cultural shift within the organization. To be successful, it requires enhanced IT operational maturity, an optimized IT organizational structure, and supporting cloud-management tools.

The term *service broker* implies that IT is organized at this stage to source internally and externally, such as adding external infrastructure capacity or providing access to vendor-based SaaS applications. The business is not necessarily aware of how the services are made available, but dramatically decreased development and provisioning times support business needs with increased quality of service and greater agility.

This stage focuses on the following goals:

- Gaining alignment and buy-in from key business stakeholders
- Creating service governance, lifecycle and service design, and development processes
- Providing service-based financial transparency
- Automating and integrating tools and technology in internal and external systems

Key capabilities for this stage include the following:

- Financial model and measurement:
  - Using usage metering and cost showback
  - Applying granular costing of underlying infrastructure assets
  - Educating IT customers about paying for services as an operating expense
  - Changing from project-based budgeting to demand-based budgeting
- People and organization: Establishing the Center of Excellence with dedicated, experienced, and knowledgeable staff
- Process and control:
  - Fully integrated IT operational processes adapted for virtualization and vCloud
  - Agile-based service design and development processes established
  - Service-level financial transparency

- Tools and technology:
  - Services defined and offered through an online consumer portal for self-service access to the service catalog
  - vCloud-level disaster recovery
  - Blueprint and policy-driven service development and provisioning
  - Purpose-built management tools for proactive vCloud operations

1.4.3 Stage 3: Strategic Differentiator

This stage is the final stage for a mature cloud. At this point, a highly efficient, scalable cloud with hybrid capability is available for an organization. IT is delivered as a service. Automated, policy-driven governance and control applies across the vCloud environment, with zero-touch operations supported by predictive and self-healing operational tool capabilities. True application mobility and device-independent access is available. The vCloud is considered to be the de facto model within the organization. The term *strategic differentiator* implies that IT has changed roles and become a business differentiator by increasing agility, resulting in faster time to market; increasing efficiency, resulting in reduced costs; and increasing reliability, resulting in dramatically increased quality of service. The following are key capabilities for this stage:

- Financial model and measurement:
  - Usage-based pricing and chargeback for services provided to business customers
  - Service demand–based budgeting
  - Priced catalog of service offerings
- People and organization: The Center of Excellence manages all elements of infrastructure, end-user, and application operations.
- Process and control:
  - Optimized, integrated, and fully automated IT processes that enhance business agility and efficiency
  - Continuous process, service, and performance improvements based on predictive capabilities
- Tools and technology:
  - Full hybrid capabilities
  - Tools that support single-pane-of-glass management across private and public vCloud environments
  - Service-level disaster recovery
  - Tools that support automated corrective actions for self-healing

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