



VMware vCloud® Architecture Toolkit™
for Service Providers

Introduction to the vCloud Architecture Toolkit for VMware Cloud Providers™

Version 2.9
January 2018

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Introduction to vCloud Architecture Toolkit for VMware Cloud Providers



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Introduction

The *VMware vCloud® Architecture Toolkit™ for Service Providers* (vCAT-SP) is a set of reference documents that are designed to help VMware Cloud Providers within the VMware Cloud Provider™ Program define, design, implement, and operate their VMware powered cloud platforms and services.

vCAT-SP is completely hardware vendor agnostic, although some vendors are mentioned in the implementation examples because the examples are based on implementations that VMware has performed with customers in the field.

The design guidelines and considerations highlighted in the vCAT-SP documentation are based on real-world use cases and implementation experience gained from the field. The consumer (architect) will have the opportunity to choose design considerations that are important to the success of the cloud platform, and to consider interrelated design options holistically. For example, a requirement for higher performance might influence management and operations.

1.1 Overview

vCAT-SP has been developed so that each document can stand alone and provide guidance to the architect on implementing a specific part of the solution. For example, the *Architecting VMware NSX for Service Providers* document can be used by a service provider who has already implemented a core cloud product based on VMware vSphere® or VMware vCloud Director®, understands how this component fits into a wider solution, and knows how to design based on required outcomes and use cases.

The vCAT-SP documentation is organized as follows:

- **General documents** – Document map and introduction on how to consume and leverage vCAT-SP.
- **Service definition documents** – Documents that enable the consumer to effectively define requirements for the cloud platform and determine what services to offer to their end users.
- **Architecture documents** – Documents that highlight the logical design and operational considerations within a specific architectural domain.
- **Solution architecture example documents** – Documents that provide solution architecture examples of a cloud platform.
- **Solutions and services examples** – Documents that provide architecture guidance and implementation blueprints for value-add services and solutions that can be added to the core cloud platform.

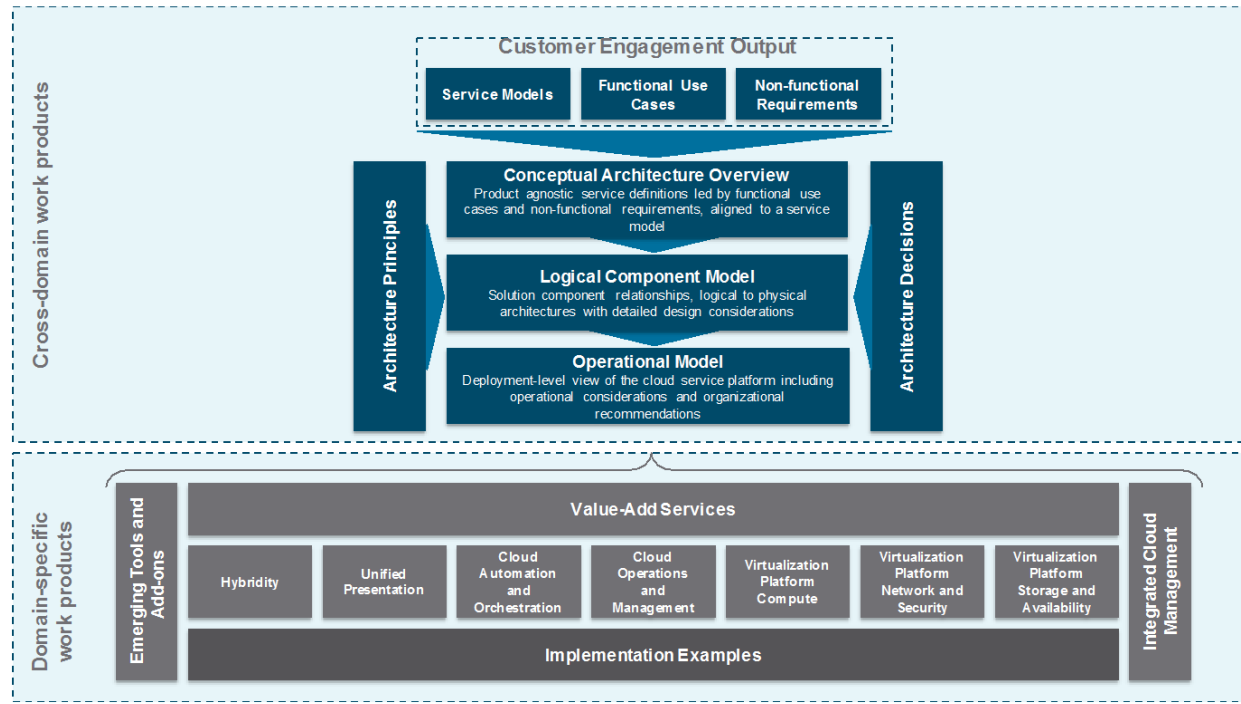
For more information and the latest news about vCAT-SP, visit: <http://www.vmware.com/go/vcat>.



1.2 Architecture Methodology

The following figure shows the architecture methodology used to develop and build vCAT-SP. VMware takes real-world service examples, use cases, functional requirements, and non-functional requirements to formulate architecture documents that present the solution and identify logical and operational design considerations.

Figure 1. Architecture Methodology





Using the vCAT-SP Documentation Set

This section describes how best to leverage vCAT-SP for the successful definition, design, and implementation of your cloud platform and services based on VMware software.

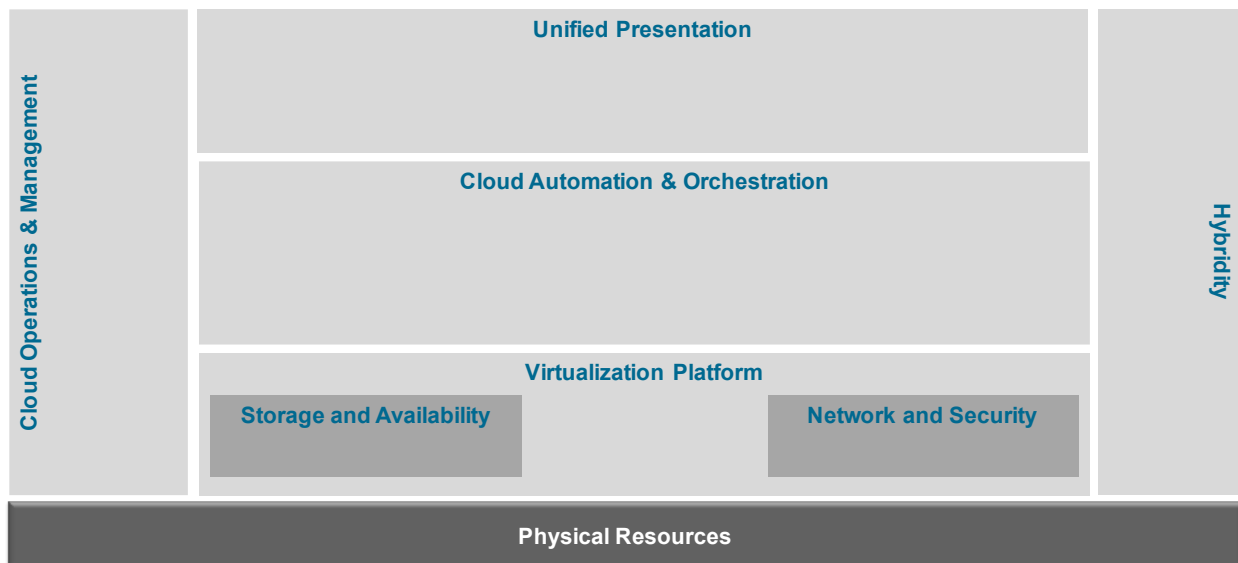
2.1 Functional Domains

vCAT-SP addresses the following functional domains:

- Unified presentation
- Hybridity
- Cloud automation and orchestration
- Cloud operations and management
- Virtualization platform
- Storage and availability
- Network and security

The following figure depicts the relationships among the functional domains.

Figure 2. Functional Domains



2.2 vCAT-SP Document Map

The following document map highlights the documents that are delivered as part of vCAT-SP. The document map is subject to change based on product direction, strategic priorities, and solution alignment.



Figure 3. vCAT-SP Document Map



2.3 vCAT-SP Document Overview

The following table describes the documents in vCAT-SP.

Table 1. vCAT-SP Documents

Document Domain	Description	Audience
Introduction Documents	Include the following: <ul style="list-style-type: none"> Brief summary of vCAT-SP documents Mapping of technology to product Introduction to vCAT-SP Instructions on how to consume vCAT-SP 	Everyone
Service Definition Documents	Provide guidance on how to define the business, technical requirements, and cloud services that the provider wants to offer: <ul style="list-style-type: none"> Platform characteristics and qualities Cloud services and applications Service and operations level agreements Compliance and security requirements Include service definitions for: <ul style="list-style-type: none"> Public cloud solution Private cloud solution Hosting solution NFVI cloud solution 	Product Manager Cloud Solution Architect
Virtualization Compute Documents	Provide architectural guidance for the virtualization platform, which includes: <ul style="list-style-type: none"> vSphere and vCenter architecture for service providers 	Cloud Solution Architect
Cloud Operations and Management Documents	Provide architectural guidance for cloud operations and management products, which include: <ul style="list-style-type: none"> VMware vRealize® Operations™ VMware vRealize Log Insight™ VMware vRealize Business™ 	Cloud Solution Architect Cloud Operations Manager

Document Domain	Description	Audience
Storage and Availability Documents	<p>Provide architectural guidance for storage and availability components, which include:</p> <ul style="list-style-type: none"> • VMware Virtual SAN™ • VMware vSphere Virtual Volumes™ • VMware Site Recovery Manager™ • VMware vSphere Data Protection™ Advanced • VMware vCloud Availability for vCloud Director 	<p>Cloud Solution Architect</p> <p>Storage Specialist</p>
Network and Security Documents	<p>Provide architectural guidance for network and security components, which include:</p> <ul style="list-style-type: none"> • VMware NSX® for vSphere 	<p>Cloud Solution Architect</p> <p>Network Specialist</p>
Cloud Automation and Orchestration Documents	<p>Provide architectural guidance for cloud automation and orchestration products, which include:</p> <ul style="list-style-type: none"> • VMware vCloud Director for Service Providers • Pivotal RabbitMQ • VMware vRealize Automation™ • VMware vRealize Orchestrator™ • VMware vRealize Code Stream™ 	<p>Cloud Solution Architect</p> <p>Cloud Automation Specialist</p>
Unified Presentation Documents	<p>Provide architectural guidance and options for VMware Cloud Providers on:</p> <ul style="list-style-type: none"> • Cloud management portals • Cloud end-user portals 	<p>Cloud Solution Architect</p> <p>Cloud Automation Specialist</p> <p>Cloud Business Manager</p>
Hybridity Documents	<p>Provide architectural guidance on:</p> <ul style="list-style-type: none"> • Hybrid cloud provisioning • Hybrid cloud management • Hybrid cloud mobility • Hybrid application design 	<p>Cloud Solution Architect</p>

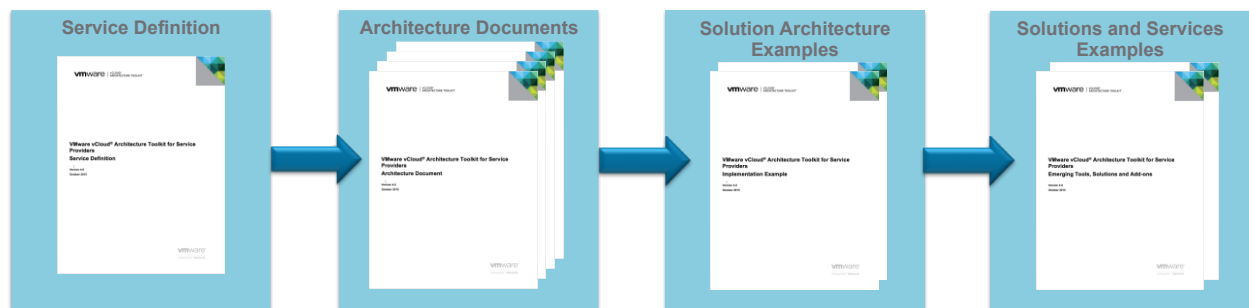
Document Domain	Description	Audience
Solution Architecture Example Documents	<p>Provide an end-to-end solution architecture for a given service model or value-add service or offering such as:</p> <ul style="list-style-type: none"> • Hosting • Private cloud • Public cloud • Database as a service • Disaster recovery as a service • Migration as a service 	Cloud Solution Architect
Solutions and Services Examples	<p>Provide architecture and example implementation blueprints for value-add services that can be added to the core cloud platform such as:</p> <ul style="list-style-type: none"> • Disaster recovery as a service • Cloud migration as a service • Database as a service 	

2.4 Recommended Reading Order

vCAT-SP has been developed as modular building blocks. It can be consumed in different ways depending on your particular focus. Start with the service definition, then continue with the architecture domains, implementation examples, and value-add and specialist modules (as required).

The following figure shows the recommended reading order for vCAT-SP. The appropriate documents for a consumer depend on the consumer’s role within the cloud project, the key features that are required, and the characteristics that the cloud platform must deliver.

Figure 4. Recommended Reading Order Example



Cloud Computing and vCAT-SP

Cloud computing leverages the efficient pooling of an on-demand, self-managed, virtual infrastructure that is consumed as a service. VMware cloud solutions offer a platform to deliver Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). VMware Cloud Providers can also build additional “as a Service” offerings on top of their vCAT-SP cloud platforms to position themselves in their respective markets.

3.1 VMware Powered Cloud 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.

A cloud platform starts with virtual infrastructure. Virtual infrastructure enables the agility and efficiency required to meet the characteristics of cloud computing. The cloud platform offers automated end-to-end delivery of services to end users, which is why workflow automation and orchestration are included as part of the VMware cloud solutions.

VMware powered cloud solutions follow these basic NIST requirements:

- The cloud platform must be built on a *pooled, virtual infrastructure*. Pools include CPU and memory resources, plus storage, networking, and associated services.
- The cloud platform must 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 platform must 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.
- The cloud platform must be a secure, trusted location for running cloud consumer workloads.
- Cloud consumers must have the option and capability to protect their cloud-based workloads from data loss.
- Cloud consumers must not be 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 must be able to run high availability workloads, and any faults occurring in the cloud infrastructure must be transparent to cloud consumers.

Note For more information, see *The NIST Definition of Cloud Computing* <http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf>.

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.

vCAT-SP focuses on the following areas:

- People – Architects who will be developing the cloud solution, engineers who will be implementing the cloud solution, and operators who will be operating the cloud solution in real-time.
- Process – Processes for architects, engineers, and operators.
- Technology – Appropriate VMware technology selection based on use cases, service models, and successful validated design, deployment, integration, and operation considerations.

NIST identifies four different types of cloud platforms:

- Private cloud – The cloud infrastructure is provisioned for the exclusive use by a single organization comprising multiple consumers (for example, business units). It can be owned, managed, and operated by the organization, a third party, or a combination of each, and it can exist on or off premises.
- Community cloud – The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations with shared concerns (for example, mission, security requirements, policy, and compliance considerations). It can be owned, managed, and operated by the organization, a third party, or a combination of each, and it can exist on or off premises.
- Public cloud – The cloud infrastructure is provisioned for open use by the general public. It can be owned, managed and operated by a business, academic, or government organization, or some combination thereof. It exists on the premises of the cloud provider.
- Hybrid cloud – The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (for example, cloud bursting for load-balancing between clouds).

3.3 VMware Powered Cloud Service Definitions

VMware service providers who are part of the VMware Cloud Provider Program deploy different cloud architectures and combinations of cloud architectures that align to the core cloud models (private, public and hybrid). The end-user experience when consuming a VMware Cloud Provider Program service is that of a unified hybrid cloud, where the customer's VMware based on-premises services can be seamlessly extended and migrated to the cloud, enabling hybrid application delivery and management and leveraging existing tools and processes.

vCAT-SP focuses on three main service models to enable VMware Cloud Providers to deliver a unified hybrid cloud experience to their customers:

- **Hosting (managed or unmanaged)** – VMware Cloud Provider Program Hosting Services offer all the benefits of a dedicated software-defined data center and are engineered on vSphere, so they are 100 percent compatible with end customers' on-premises vSphere environments. This approach offers a unified hybrid cloud experience with the same advantages of improved availability, recoverability, performance, and scalability to run business critical applications with confidence. The hosting solution can be either managed by the provider or self-managed.
- **Private Cloud (managed or unmanaged)** – VMware Cloud Provider Program Private Cloud Services are engineered on the VMware vRealize Suite, and are 100 percent compatible with end customers' on-premises vSphere environments. This unified hybrid cloud experience provides dedicated software-defined data centers, which offer the required self-service consumption, availability, performance, and scalability to run business critical applications in the cloud. The private cloud solution can either be managed by the provider or self-managed.

- Public Cloud** – VMware Cloud Provider Program Public Cloud Services are engineered on the VMware vCloud Suite®, with vSphere and vCloud Director at its core. This combination provides complete multi-level security and a multi-tenant architecture, which reduces complexity. The policy implementation can be consistent with your internal data center and VMware vCloud® Air™ yielding a unified hybrid cloud experience for your consumers.

Each cloud model can also be enhanced to offer additional “as a Service” offerings developed by the provider for strategic product differentiation.

3.4 Solution Area Technology Mappings

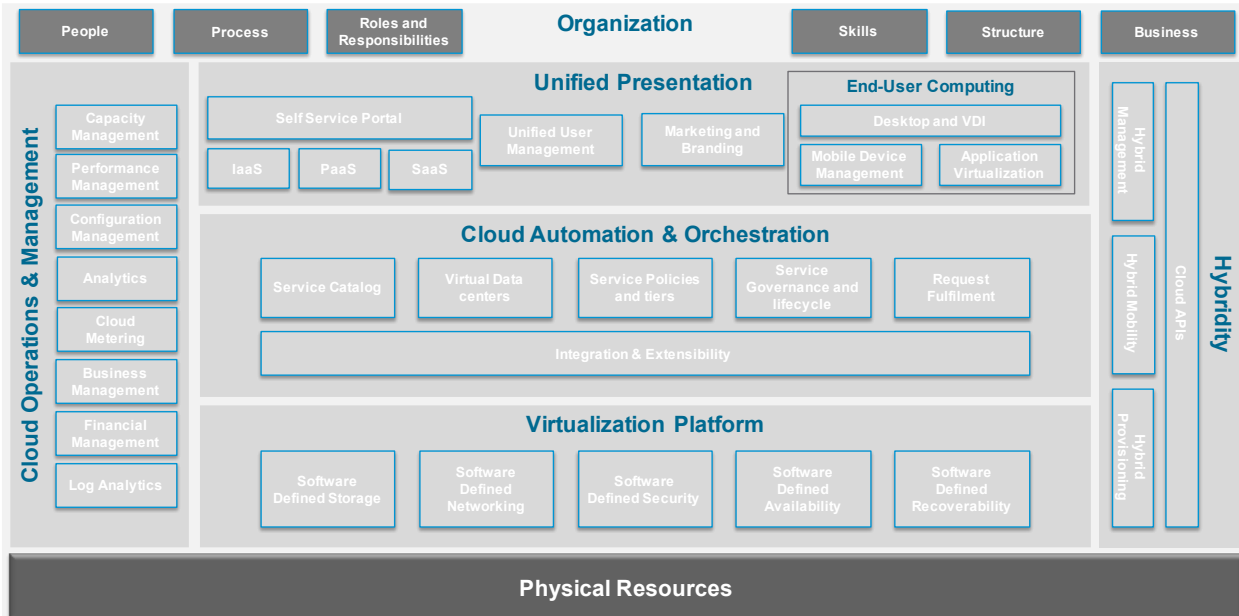
The following diagram highlights the key solution areas to consider across each cloud service model and the VMware products that align to those areas.

Figure 5. Solution Area to Technology Mapping



The following diagram shows the solution areas overlaid on top of the vCAT-SP functional areas.

Figure 6. Conceptual Solution Building Block View



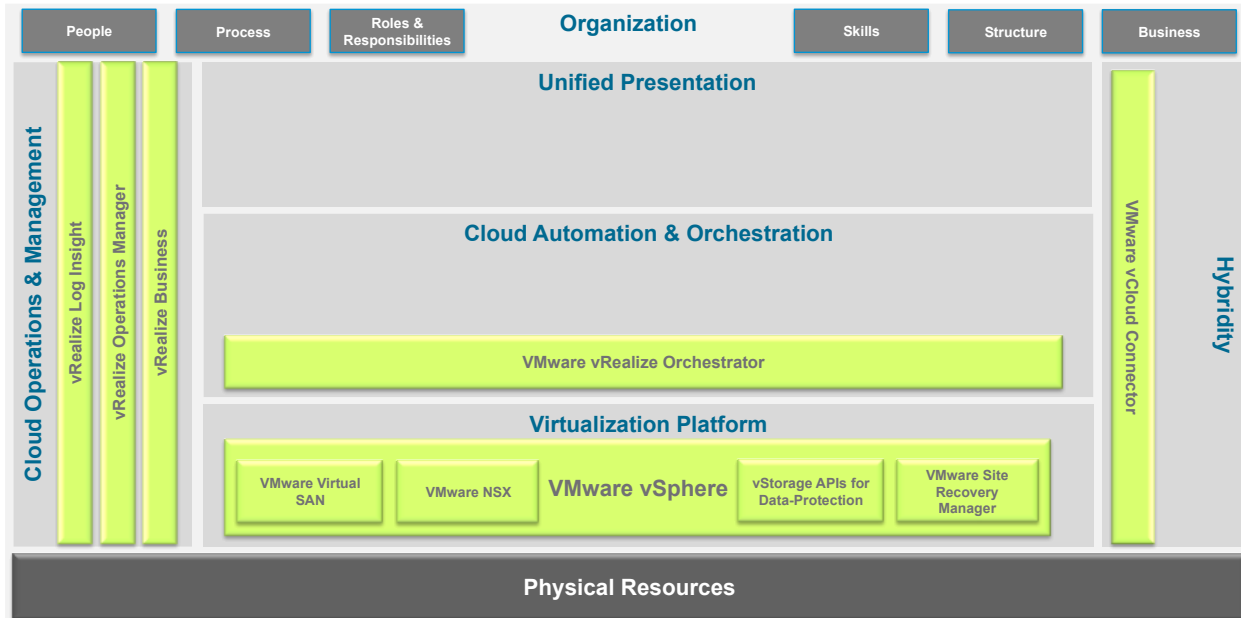
The combination of products that are required to meet each service model differs according to the functionality that the service provider wants to deliver. The following section highlights the recommended VMware products for each service model.

3.4.1 Hosting (Managed or Unmanaged) Solution Stack

- VMware vSphere
- Virtual SAN
- NSX for vSphere
- VMware vRealize Orchestrator™
- VMware vRealize Operations Manager™
- VMware vRealize Log Insight™
- VMware vRealize Business™
- VMware Site Recovery Manager™
- VMware vCloud Connector®

The following diagram depicts these products relative to the vCAT-SP functional areas.

Figure 7. Hosting (Managed or Unmanaged) Solution Stack

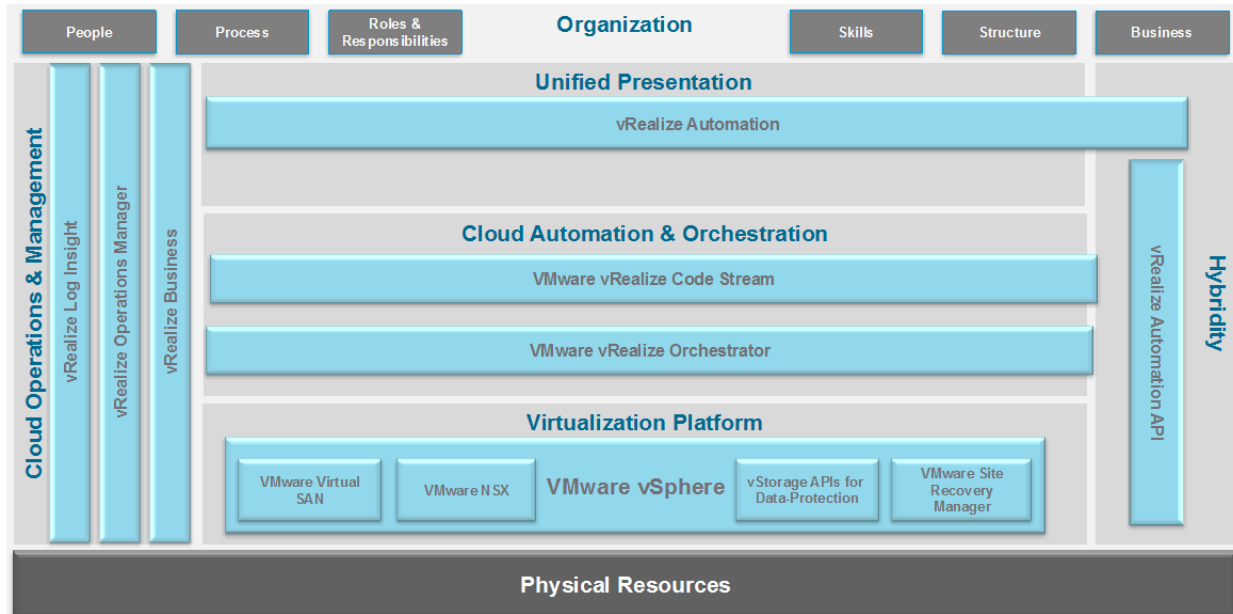


3.4.2 Private Cloud (Managed or Unmanaged) Solution Stack

- VMware vSphere
- Virtual SAN
- NSX for vSphere
- vRealize Orchestrator
- vRealize Code Stream
- vRealize Automation
- vRealize Operations Manager
- vRealize Log Insight
- vRealize Business
- Site Recovery Manager

The following diagram depicts these products relative to the vCAT-SP functional areas.

Figure 8. Private Cloud (Managed or Unmanaged) Solution Stack

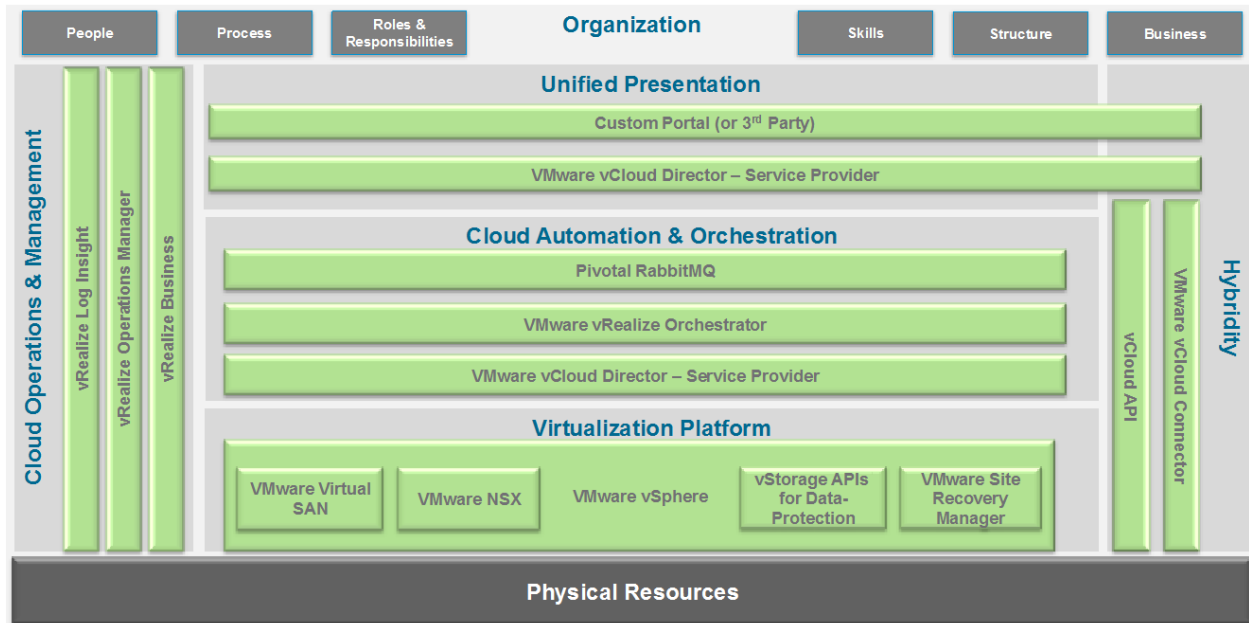


3.4.3 Public Cloud Solution Stack

- VMware vSphere
- Virtual SAN
- NSX for vSphere
- vRealize Orchestrator
- vCloud Director for Service Providers
- Custom portal or third-party
- vRealize Operations Manager
- vRealize Log Insight
- vRealize Business
- Site Recovery Manager
- vCloud Connector

The following diagram depicts these products relative to the vCAT-SP functional areas.

Figure 9. Public Cloud Solution Stack



About the Authors

VCAT-SP is an initiative that has been developed by the Global Cloud Practice within the VMware Cloud Provider Program Business Unit. This team is comprised of specialist service provider-focused architects who work with some of the most strategic VMware service providers across the globe.

Dan Gallivan – Senior Director Global Cloud Practice – VMware Cloud Provider Program

Dan is an innovative, creative, and passionate senior IT executive with a broad background in global consulting practice leadership, executive level consulting, cloud architecture and design, and business development for some of the largest and most innovative companies in the world. He has a proven track record of leading global cross-functional teams that consistently exceed sales quotas while creating competitive advantage for clients and partners through the innovative application of cloud strategies and solutions. Dan is currently responsible for managing VMware Global Cloud Practice for the VMware Cloud Provider Program (more than 4,000 partners in 110 countries). This global team of senior architects and consultants focuses on accelerating our partner's business growth through the use of the VMware portfolio of cloud services and solutions. Dan has a BS in Business Information Systems (BIS) and more than twenty years of experience running Fortune 500 data centers, global consulting teams, and business development teams.

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Adrian Roberts is a Director of the Global Cloud Architecture, VMware Cloud Provider Program IP Development Services team. Adrian has over 17 years of industry experience and has been working for VMware for more than 5 years as a technical leader and architect, specializing in cloud architecture and design for VMware strategic customers and partners. Adrian is one of a small group of people who hold a double VCDX certification in data center virtualization and cloud management and automation. Additionally, he holds other industry recognized certifications, such as TOGAF and various Microsoft certifications.

Martin Hosken – Global Cloud Architect – VMware Cloud Provider Program

Martin is a Principal Architect, Office of the CTO, Global Field, and part of the Global Cloud Sales Organization at VMware. Martin has extensive experience architecting and consulting with international customers, and serves as a trusted adviser in the design and transition of enterprise organizations and cloud service provider's legacy infrastructure onto VMware software-defined data center based cloud platforms.

Martin specializes in cloud architecture, and is predominately focused on software-defined storage technologies, such as VMware vSAN and Virtual Volumes, as well as storage related solutions for public and hybrid cloud platforms.

He is also a double VMware Certified Design Expert ([VCDX Number 117](#)) in Data Center Virtualization and Cloud Management and Automation, an established vExpert, and is the author of multiple papers, blogs and articles based on VMware and other technologies. He is also the sole author of the new Sybex publication [VMware Software-Defined Storage: A Guide to the Policy Driven, Software-Defined Storage Era](#).

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Follow Martin's blogs: <https://blogs.vmware.com/vcat/>

Follow vCAT-SP Releases at: <https://www.vmware.com/go/vcat>

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Daniel has been at VMware for six years, and is currently working as a Cloud Architect in the VMware Global Cloud Practice. Daniel's background is in the architecture and solution delivery of enterprise IT projects. His previous role was with VMware Professional Services, consulting on multi-million-dollar infrastructure projects for Australian and international companies across multiple industry verticals. Starting out in the ISP industry as a Solaris/Linux systems administrator over 17 years ago, Daniel is still a Unix geek at heart. He holds a B.Sc. in Computer Science, and certification in VCAP5-DCD, VCP5-DV, VCP5-Cloud, RHCE5, SCSA.

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Jeffrey Moore is a Cloud Architect collaborating with VMware's Cloud Providers on their software-defined data center (SDDC) architecture efforts. His areas of focus are related to multitenant cloud infrastructures (vCloud Director) as well as single-tenant cloud infrastructures (VMware vCenter Server® as a service) with a primary focus on network virtualization (NSX-v, NSX-T). He has also completed the following certifications:

AWS Certified Solutions Architect: Professional

CCIE (29735) Routing and Switching, CCIE (29735) Service Provider, CCIE (29735) Wireless, CCDE (2013::20 / Design CCIE)

Microsoft Certified Solutions Expert (MCSE): Cloud Platform

VMware Certified Professional 6: Data Center Virtualization

Harold Simon – Global Cloud Architect – VMware Cloud Provider Program

Harold Simon is a Global Cloud Architect with the VMware Cloud Provider Program Global Cloud Practice. Prior to joining the Global Cloud Practice team, Harold worked in VMware Professional Services where he consulted with multiple enterprise-level customers designing and deploying vRealize Automation solutions for private cloud implementations consuming on-premises as well as public cloud endpoints. Harold's certifications include VCDX (Data Center and Cloud), MCSE, and ITILv3.

Danilo Feroce – Global Cloud Architect – VMware Cloud Provider Program

Danilo Feroce is a Cloud Solutions Architect with the Global Cloud Practice at VMware. He has a broad experience in the high-tech industry with an international background in product development and consulting services gained working for the largest software and hardware solution players in the market over the past 20 years.

Danilo deals with virtualization concepts and products since their inception, but has sharpened his expertise to span across multiple technical domains and frameworks. He has authored many publications covering data center topics, such as performance tuning, capacity planning, sizing, scalability, availability, security and so on.

Danilo is a VMware Certified Professional and he is accredited with a range of industry certifications from recognized organizations and vendors: ISC² CISSP, ITIL, TOGAF, CompTIA, AWS, EMC, Microsoft, Dell.

Ray Heffer – Global Cloud Architect – VMware Cloud Provider Program

Ray Heffer is a Senior Cloud Solutions Architect at VMware with a deep focus on End User Computing (EUC) and Cross-Cloud technologies. Ray is a proud Ambassador to the Office of the CTO, awarded vExpert since 2011, and a Double VCDX certification holder (#122) and panelist for Desktop and Data Center Virtualization tracks (see <https://vcdx.vmware.com>).

With over 20 years of experience in the data center, infrastructure team management, architecture, design, and IT operations, Ray maintains a deep knowledge of VMware products and emerging cloud technologies. Ray has delivered many technical deep-dive sessions at industry events, such as VMworld US and Europe, VMUG (VMware User Group), and other events around the world. Ray also contributes to End User Computing publications and tools, having designed and co-developed the Horizon Sizing Estimator (<http://vmware.com/go/horizoncalc>), and has published technical white papers, blogs, and popular reference architecture designs.

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Steve Dockar – Sr. Cloud Solutions Architect – VMware Cloud Provider Program

Steve joined VMware as a Cloud Solutions Architect after a ten-year career designing hosted virtualization platforms for a global Service Provider. During that time, Steve was the infrastructure design and architecture lead for three generations of multi-tenant Cloud platforms, beginning with ESX v4.0 and ending with the introduction of NSX and the vRealize suite. As part of that role Steve was responsible for the production of solution documentation as well as the creation and delivery of internal product training.

Tomas Fojta – Global Cloud Architect – VMware Cloud Provider Program

Tomas Fojta works as a Global Cloud Architect for VMware Cloud Provider Program, where he supports the largest service provider partners worldwide who build cloud solutions utilizing VMware technologies. He is a certified virtualization and cloud architect (double VCDX, VCIX-NV, CCNA, EMCCA) as well as a project manager (PMI PMP). Specialties: public and private cloud, network virtualization.

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John Dwyer is currently a Product Manager working on vCloud Director SP at VMware. Prior to his current role, he spent time in the Global Cloud Practice as a Global Cloud Architect, where he leveraged his extensive background in software development, automation, virtualization, networking, and storage. Before joining VMware, John helped one of our VMware Cloud Provider launch an infrastructure as a service (IaaS) platform. The platform was designed from the ground up to provide a path to help enterprises move to the cloud, no matter where they were in the cloud adoption lifecycle. In 2014, his work on the IaaS platform was awarded a US Patent for providing methods and systems for managing a virtual data center with embedded roles based access control. He holds a Bachelor Degree in Information Technology from Rochester Institute of Technology and is a VMware Certified Professional.

Wade Holmes – Senior Technical Product Manager – VMware Network and Security Business Unit (Formally Global Cloud Architect – VMware Cloud Provider Program)

Wade Holmes is a Senior Technical Product Manager within the VMware Networking and Security Business Unit product team responsible for the VMware NSX platform. Wade has over 19 years of experience planning, designing, engineering, architecting, and supporting complex IT solutions and products of all scopes and sizes. Wade was a co-author and co-lead of the initial VMware vCloud Architecture Toolkit book, and helped to lead the creation of the vCloud Architecture Toolkit for Service Providers. Wade has presented and taught at multiple conferences, such as VMworld US and Europe, Gartner Security Summit, SXSW Interactive, Tech-summit, LISA, and numerous VMware User Group conferences. Wade was among the first VMware Certified Design Experts in the world, VCDX#15. Wade holds a Bachelor's degree in Information Technology and a Master's Degree in Information Assurance.

Olivier Cahagne – Global Cloud Architect – VMware Cloud Provider Program

Olivier Cahagne joined VMware as a Cloud Architect, after 14 years at Cisco Systems. Olivier is a network virtualization specialist, bridging communication between customers' R&D and VMware engineering. He works on enabling new offerings and features with Cloud Providers.

Derek Mitchell – Global Cloud Architect – VMware Cloud Provider Program

Derek has been involved in the IT industry for over 20 years, covering software engineering architecture to emerging technology, BCDR and managed services to technical sales. Currently he serves as Global Cloud Architect – VMware Cloud Provider Program for the Global Cloud Practice at VMware. Derek received his B.S. in Computer Engineering Technology from Northeastern University and his MBA from Boston University. Derek started his career in technology by developing software to extract and correlate telemetry data from the Trident II missile's MK6 guidance system. Derek then moved into roles including system administration and engineering and eventually into a presales engineering role at EMC where he designed and sold the first post 9/11 business continuity solution for the Pentagon. Throughout his career, Derek has developed multiple competencies by serving in different capacities, such as a software engineer, sales engineer, solutions architect, and product development manager responsible for developing joint solutions with system integration partners.

Derek is a published author and holds several industry certifications including VCP-Cloud, VMware AirWatch® AWTP, EMCTA – SAN Design, EMCTA – Business Continuity, and ITIL v3 Foundations.

Edward “Allen” Shortnacy – Global Cloud Architect – VMware Cloud Provider Program

Allen Shortnacy is a Global Cloud Architect in the VMware Cloud Provider Program and member of the CTO Ambassador Program. He is focused on best practices and patterns for workload migration, security, and compliance, as well as other enhancements to help VMware Cloud Provider Program Service Providers continue to bring value-added services to customers. In his prior role in Global Strategic Alliances, Allen created the Compliance Reference Architecture program, a technology partner program and documentation effort that provided guidance to achieve regulatory compliance for business-critical applications running on a VMware technology stack. He is regular speaker at VMworld, Partner Exchange, RSA Conference as well as other industry events on the subject of the software-defined data center and Hybrid Cloud.

Michael Haines – Global Cloud Architect – VMware Cloud Provider Program

Michael Haines is a Global Cloud Architect who specializes in Cloud Networking and Security at VMware. His primary role is to architect software-defined data center (SDDC) cloud, networking and security solutions, create the next-generation content for the VMware field organization, provide support for high-end and high-visibility service providers (pre and post support), and help train the experts. Michael also has extensive knowledge of VMware SDKs and APIs, and in particular, the VMware NSX for vSphere API, vCloud Networking and Security API, and vCloud API.