

VMware vCloud® Architecture Toolkit™  
for Service Providers

# Architecting a VMware vRealize® Operations™ Management Solution for VMware Cloud Providers™

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## Introduction

VMware vRealize® Operations Manager™ delivers intelligent operations management across the physical, virtual, and cloud infrastructure, enabling the VMware Cloud Provider™ to efficiently operate a cloud platform and meet required customer service level agreements (SLAs).

vRealize Operations Manager correlates data from applications to storage in a unified easy-to-use management tool that provides control over performance, capacity, and configuration, with predictive analytics driving proactive action policy-based automation.

### 1.1 Document Purpose

This document is intended to help the cloud service provider design an operations management solution based on vRealize Operations Manager. It highlights key design considerations pertinent to the service provider service model. It highlights some of the common deployment models, use cases, and design considerations that VMware Cloud Providers must consider when deploying vRealize Operations Manager to support the effective operation of their cloud platform.

This document is not a replacement for product documentation. Use it as a supplementary resource when planning a VMware Cloud Provider Program implementation.

### 1.2 Glossary of Terms

**Table 1. Glossary of Terms**

Term	Description
API	Application Programming Interface
BNA	Brocade Network Advisor
CA	Certificate Authority
CIM	Common Information Model
CPU	Central Processing Unit
DCNM	Cisco Data Center Network Manager
DRS	Distributed Resource Scheduler
FC	Fibre Channel
FCoE	Fibre Channel over Ethernet
FSDB	File System Database
GB	Gigabyte
HA	High Availability
HBA	Host Bus Adapter
HIS	Historical Inventory Service



<b>Term</b>	<b>Description</b>
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
IOPS	Input Output Operations Per Second
iSCSI	Internet Small Computer Systems Interface
LDAP	Lightweight Directory Access Protocol
MB	Megabyte
NA	Not Available
NFS	Network File System
NOC	Network Operations Center
PEM	Privacy Enhanced Mail (SSL Certificate Format)
RAID	Redundant Array of Independent Disks
RC	Remote Collector
REST	Representational State Transfer
SAN	Subject Alternative Name (in the context of SSL certificates)
SAN	Storage Area Network (in the context of shared storage)
SDDC	Software Defined Data Center
SDK	Software Development Kit
SDN	Software Defined Networking
SDS	Software Defined Storage
SLA	Service Level Agreement
SMART	Self-Monitoring, Analysis and Reporting Technology
SMI-S	Storage Management Initiative Specification
SMTP	Simple Mail Transport Protocol
SNMP	Simple Network Management Protocol
SP	Service Provider





<b>Term</b>	<b>Description</b>
SSL	Secure Sockets Layer
UI	User Interface
VMware vSphere® vApp™	Virtual Appliance
vCPU	Virtual Central Processing Unit
VDC	Virtual Data Center
VM	Virtual Machine
VPC	Virtual Private Cloud
WAN	Wide Area Network



## Technology Mapping

### 2.1 vRealize Operations Manager Overview

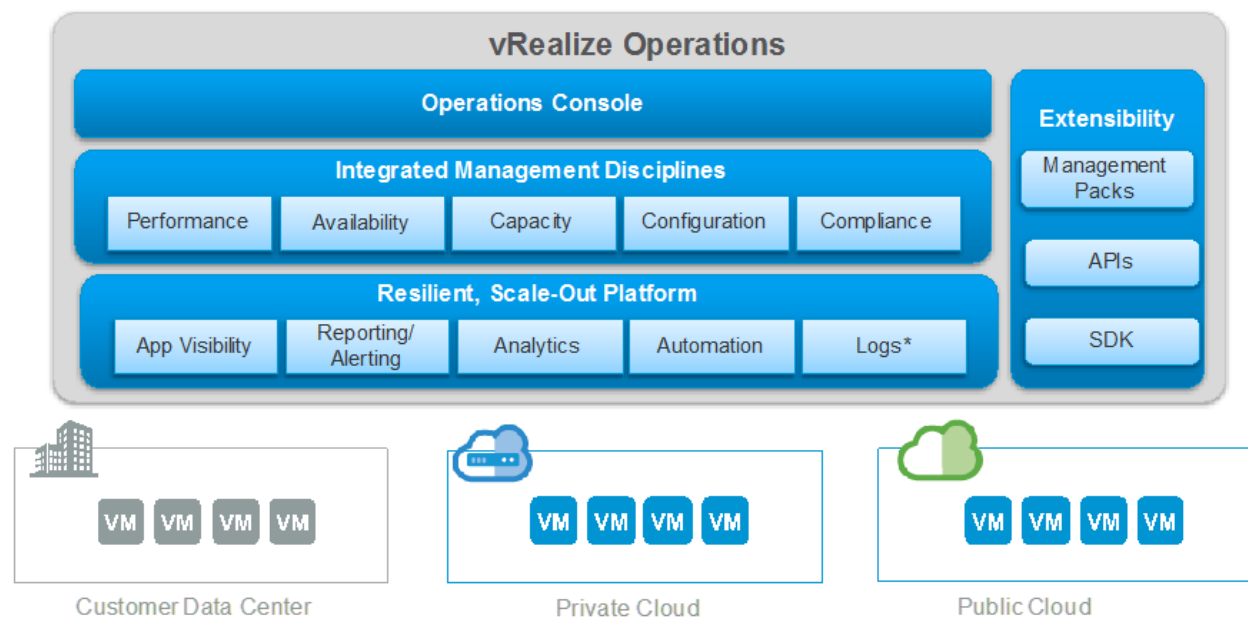
vRealize Operations Manager is the key component of a VMware Cloud Provider Program Powered Cloud service offering. It provides a simplified yet extensible approach to operations management of the cloud infrastructure.

vRealize Operations Manager collects and analyzes information from multiple data sources and uses advanced analytics algorithms to learn and recognize the “normal” behavior of every object it monitors. Through dashboard views and reports, users are able to view details so they can make informed decisions in the following areas:

- Issue resolution and root cause analysis
- Environment health and advanced warning of potential issues
- Capacity management and forecasting

vRealize Operations Manager uses management packs to collect, analyze, and present data from many VMware and third-party data sources, thereby providing a holistic view of a service provider’s cloud infrastructure and tenant-specific workloads.

**Figure 1. vRealize Operations for VMware Cloud Provider Program**





## Deployment Model Considerations

Multiple deployment models are available when deploying a vCloud, depending on the manner in which resources are provided and who consumes them. These are:

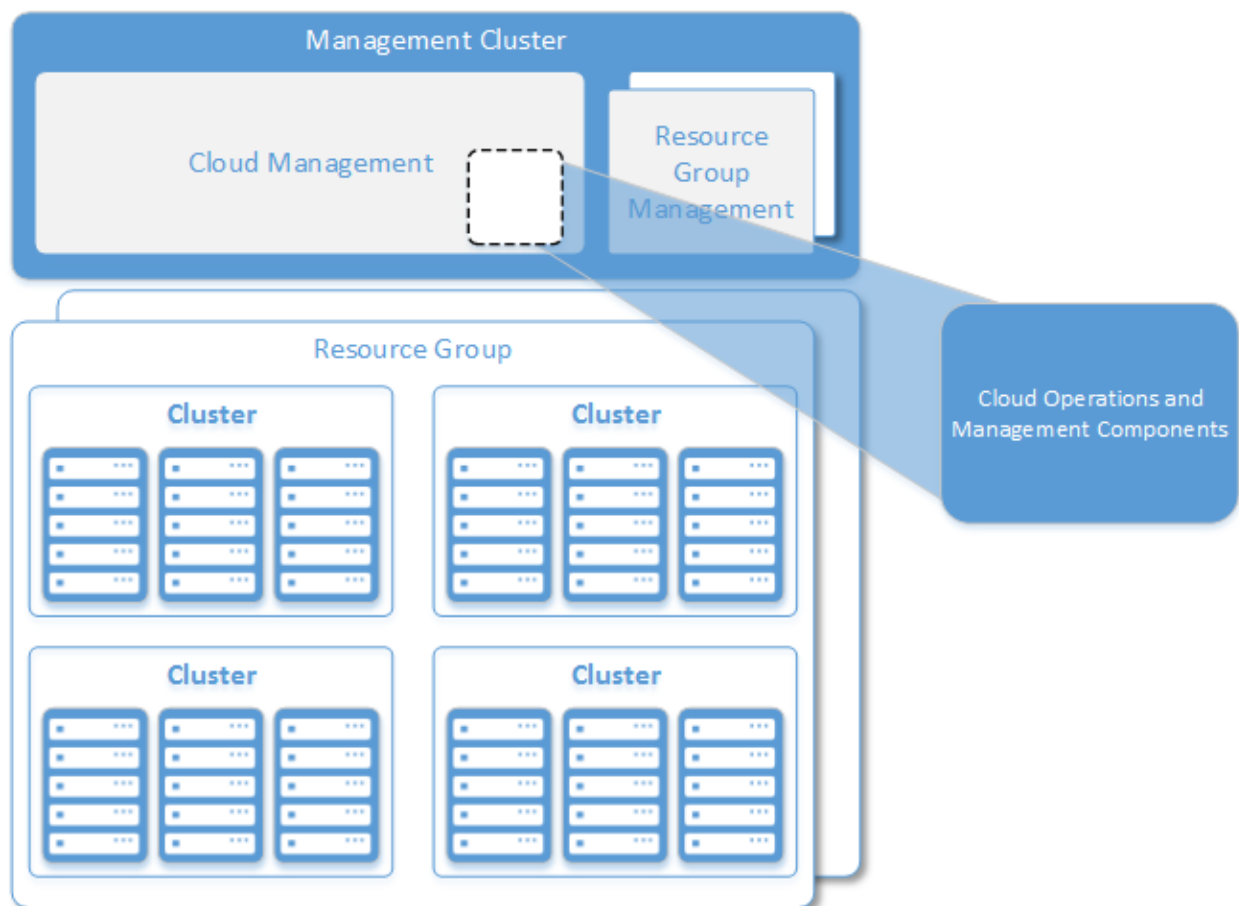
- Private cloud – Cloud infrastructure operated exclusively for an organization. Can be managed by the organization or a third party. The infrastructure can be located on-premises or off-premises.
- Public cloud – Cloud infrastructure made available to the public or to a large industry group and owned by an organization that sells cloud services.
- Hybrid cloud – Cloud infrastructure is a composite of two or more cloud instances (private and public) that are unique entities but are also bound together by standardized technology.

### 3.1 Conceptual Overview

Cloud operations and management is an important factor in any cloud design, regardless of the deployment model. Incorporate cloud operations and management components in private and public cloud designs to monitor the cloud infrastructure.

The following figure shows where cloud operations and management components are located relative to the management cluster.

**Figure 2. Cloud Operations and Management in Context**





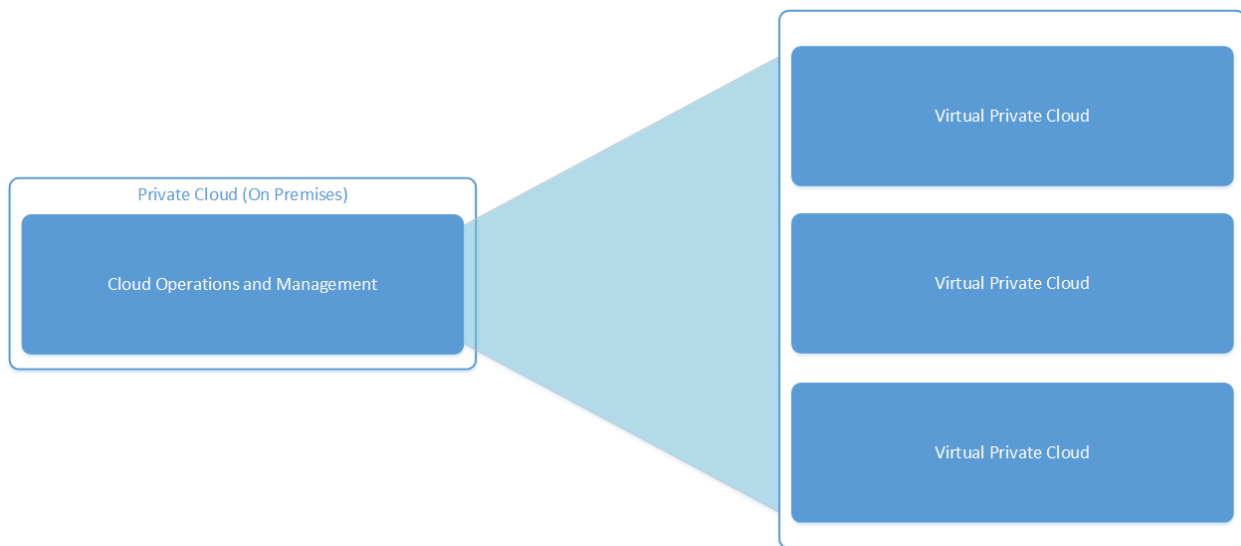
## 3.2 Deployment Models

In addition to monitoring the infrastructure where they reside, cloud operations and management components can address the following use cases:

- Enterprises managing and monitoring their own public cloud resources.
- Service providers managing and monitoring on-premises private clouds for enterprises in a Network Operations Center (NOC) context.
- Service providers managing and monitoring off-premises hosted private clouds for enterprises in a NOC context.

Enterprises can extend their existing management tools to manage their private cloud infrastructure and Virtual Private Cloud (VPC) instances purchased from a service provider. The following figure shows the deployment model.

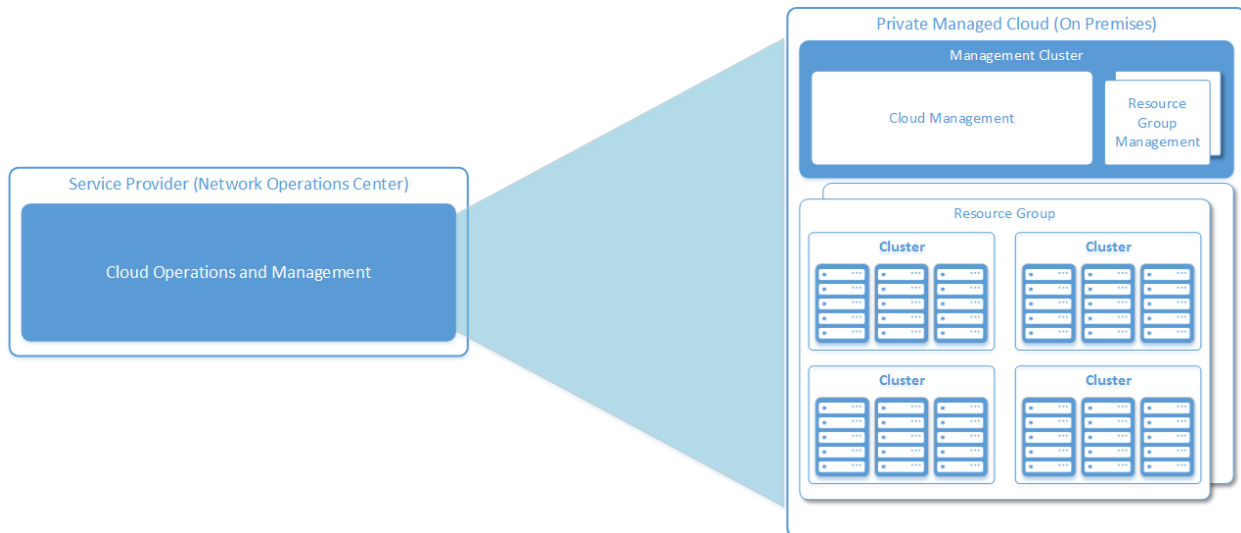
**Figure 3. Enterprises Managing and Monitoring Public Cloud Resources**





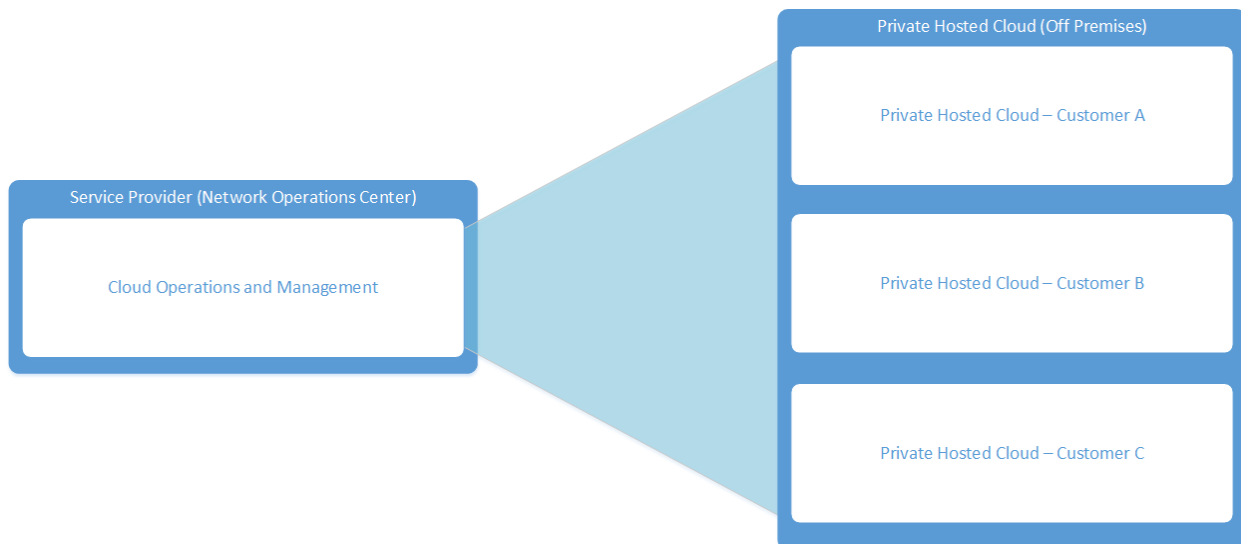
Service providers that manage on-premises private clouds for multiple customers can use centralized instances of cloud operations and management components to operate in a NOC context. The following figure shows the deployment model.

**Figure 4. Managing and Monitoring On-Premises Private Clouds for Enterprises**



Service providers that manage off-premises hosted clouds for multiple customers (potentially in the service provider's data center) can also use centralized instances of cloud operations and management components to operate in a NOC context. The following figure shows the deployment model.

**Figure 5. Managing and Monitoring Off-Premises Hosted Private Clouds for Enterprises**





## Design Considerations

This section describes the design options and considerations that must be made with regard to vRealize Operations Manager when designing a Hybrid Cloud Powered vCloud solution.

### 4.1 Architectural Overview

vRealize Operations Manager is available in two different deployment models—as a preconfigured virtual appliance (vApp) or as a Windows or Linux installable package.

The vRealize Operations Manager vApp encapsulates a VMware virtual machine. Each instance of vRealize Operations Manager can be configured to perform one of the following roles within the complete vRealize Operations Manager instance/cluster. These building block roles are:

- Master node – First node (mandatory) in a cluster or single standalone node.
- Master replica node – An optional node to provide high availability (HA) to the master node.
- Data node – Used to scale out a vRealize Operations Manager cluster.
- Remote collector node – Performs data collection only, can be used behind firewalls or across limited bandwidth connections

The following table lists the components that make up a vRealize Operations Manager node.

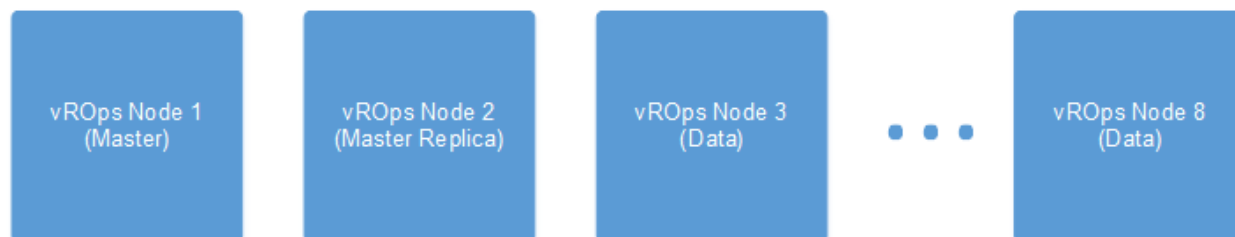
**Table 2. vRealize Operations Manager Logical Node Architecture**

Component	Description
<b>Admin / Product UI server</b>	Web application that serves as both the user interface and the administrative interface.
<b>REST API / Collector</b>	Collects data from all the components in the enterprise.
<b>Controller</b>	Handles movement of data between the UI server, Collector, and analytics engine.
<b>Analytics</b>	Tracks relationships and performs correlation and calculation of metrics and super metrics. Performs capacity planning functions and alert generation.
<b>Persistence</b>	Performs database operations across all nodes in the solution.
<b>FSDB</b>	Holds all metrics in their raw format. Each node of a vRealize Operations Manager cluster contains an FSDB as part of overall data persistence.
<b>xDB (HIS)</b>	Stores Historical Inventory Service (HIS) data. Available only on the master node/master replica.
<b>Global xDB</b>	Contains all data that cannot be spread across cluster nodes (custom dashboards and reports, policy settings, alert rules, super metric formulas). Available only on the master node and master replica.



vRealize Operations Manager can be horizontally scaled out to multiple nodes to monitor larger environments and provide high availability. Each vRealize Operations Manager installation can scale to a maximum of eight nodes. The following figure shows the vRealize Operations Manager logical cluster architecture.

**Figure 6. vRealize Operations Manager Logical Cluster Architecture**



## 4.2 Deployment Mode

vRealize Operations Manager can be deployed using a Windows installer or Linux installer. The option taken depends on what the service provider prefers to manage. The cost of operating system licenses might also be a factor with smaller environments.

### Design Considerations

The VMware Cloud Provider must choose the correct deployment model to suit manageability requirements. All models have the same scalability and performance characteristics.

## 4.3 Client Access

vRealize Operations Manager can be accessed through the user interfaces listed in the following table. Each interface is used for specific operations in vRealize Operations Manager.

**Table 3. vRealize Operations Manager User Interfaces**

User Interface	Operations
Product User Interface	<ul style="list-style-type: none"><li>• VMware vSphere summary and detailed information</li><li>• Used by the virtual infrastructure administrator and infrastructure teams</li><li>• Access to dashboard, metrics, super metrics, configuration</li><li>• Primarily used by operations teams</li></ul>
Admin User Interface	<ul style="list-style-type: none"><li>• Primarily used for initial configuration, administration and upgrades</li></ul>



vRealize Operations Manager user interfaces can be accessed through the following Web browsers:

- Google Chrome: Latest and most previous releases
- Mozilla Firefox: Latest and most previous releases
- Safari: Latest release
- Internet Explorer for Windows 10 and 11

The minimum supported resolution is 1024 x 768.





## vRealize Operations Use Cases for the VMware Cloud Provider Program

vRealize Operations Manager addresses monitoring and management use cases for VMware Cloud Providers across the following areas:

- Network and security services
- Storage services
- Logical resource monitoring
- Service level monitoring
- Capacity management and trending

### 5.1 Monitoring Network and Security Services in the Cloud

Network and security services are critical to the operations of both private and public cloud infrastructures. Physical and logical network constructs must be monitored for optimal performance and availability.

Monitoring network and security services with vRealize Operations Manager focuses on three key use cases:

- Monitoring the VMware NSX® environment through dashboards showing component health, alerts and utilization metrics
- Initial troubleshooting and problem isolation across logical and physical topologies and correlation between those topologies
- Advanced troubleshooting and visualization of object-to-object communication issues, with the ability to test communications between any two NSX endpoints

### 5.2 Monitoring Storage Services in the Cloud

Storage services in private and public cloud environments are often a mix of traditional protocols such as NFS, iSCSI, FC, FCoE and the latest software defined storage (SDS) solutions. A hybrid monitoring and management solution is required to span these technologies to unify operations touch points and reduce the number of tools required to manage an environment.

A high degree of visibility is required to maintain performance, capacity, and availability and to meet SLAs in service provider environments. vRealize Operations Manager addresses the following use cases to provide maximum visibility of storage services:

- Monitoring and troubleshooting capabilities through a complete view of the entire storage topology and data path, from virtual machine to storage volume
- Capture and analysis of throughput and latency data on HBAs and mount objects, and throughput on switch ports
- Capture of IOPS and queue depth data at on HBAs and switch ports
- Correlation of performance and capacity issues between related objects
- Identification and remediation of capacity issues before they have a business impact

### 5.3 Monitoring Public Cloud Logical Resources

VMware vCloud Director® for Service Providers provides the abstraction layer that pools SDDC resources and provides a multi-tenant platform for consuming them as a public cloud. In a service provider



environment, monitoring must extend to the abstraction layer to allow a service provider to manage performance, capacity, and availability, and to troubleshoot any issues that arise.

Monitoring public cloud logical resources with vRealize Operations Manager addresses the following use cases:

- Monitoring the health of vCloud Director entities to identify issues before the business is affected
- Showing the relationship between vCloud Director vApps and vSphere virtual machines
- Providing a global dashboard view of vCloud Director health and capacity where issues can be quickly identified and addressed
- Providing dashboards that give administrators a view of the utilization, capacity, and health of public cloud resources

## 5.4 Monitoring Private Cloud Resources

vRealize Automation provides the abstraction layer that pools SDDC resources and provides a platform for consuming them as a private cloud. Service providers that offer managed private cloud services (both on and off premise) must have a method of monitoring those environments so that SLAs are met.

Monitoring private cloud resources with vRealize Operations Manager addresses the following use cases:

- Providing visibility into the performance, health, and capacity of resources in the context of vRealize Automation constructs such as tenants, business groups, and reservations
- Providing a global dashboard view of the health and capacity of vRealize Automation entities
- Troubleshooting and visualization of workloads and underlying infrastructure
- Correlation of issues between vRealize Automation and vSphere objects
- Monitoring of multiple on-premises or off-premises private clouds from a single pane of glass

## 5.5 Monitoring Service Levels in the Cloud

Operating a public or private cloud typically requires agreed to SLAs.

Using vRealize Operations Manager to monitor service levels addresses the following use cases:

- Defining policies that can be applied to monitor objects at different service levels
- Defining thresholds to detect when monitored objects have breached or are about to breach defined service levels
- Applying different policies to different groups of objects



## 5.6 Capacity Management and Trending in the Cloud

Effective capacity management is essential for a public or private cloud to have enough capacity to satisfy demand while minimizing unutilized or underutilized resources. An understanding of consumption trends allows service providers to plan for additional capacity in a timely manner.

Monitoring capacity management and trending with vRealize Operations Manager addresses the following use cases:

- Providing information on how many virtual machines of various sizes can be accommodated with remaining capacity
- Providing service providers with information on current consumption and utilization trends, allowing service providers to maintain enough capacity to accommodate further workloads without over-provisioning resources
- A means to implement proactive capacity management based on a known pipeline of future workloads
- Ability to drive out costs through 'just in time' provisioning
- Forecast of utilization trends



## Availability

vRealize Operations Manager supports high availability (HA) by creating an additional node that is a replica of the vRealize Operations Manager master node. This node type is called a *master replica*.

When present, a master replica can take over the functions of a master node. When a problem occurs with the master node, failover to the replica node is automatic and requires only two to three minutes of vRealize Operations Manager downtime. Data stored on the master node is fully backed up on the replica node. With HA enabled, the cluster can survive the loss of a single data node without losing any data.

### 6.1 Load Balancing

The vRealize Operations Manager user interfaces can be accessed from any data node. A load balancer can be used to detect if a node is down and forward traffic to surviving nodes.

#### Design Considerations

- Design for HA by having two or more nodes in a cluster configuration with the HA option enabled.
- Use a load balancer to monitor for node failure and forward traffic to surviving nodes.

### 6.2 Clustering for High Availability

vRealize Operations Manager supports application level high availability (HA). Enabling HA has a penalty in the maximum number of objects and metrics that can be stored. With HA enabled, each piece of data contained on the master node is stored twice, halving the maximum number of supported objects and metrics and doubling the IO and disk space requirements.

**Table 4. Impact of HA on Scalability – vRealize Operations Manager 6.0.2**

	Maximum Data Nodes	Maximum Supported Objects (8 node cluster)	Maximum Supported Metrics (8 node cluster)
Without HA	8	75 K	20 m
With HA	8	37.5 K	10 m

#### Design Considerations

- To enable HA, at least one more data node must be deployed in addition to the master node. If possible when HA is enabled, deploy the replica node within the same cluster and put DRS rules in place to keep the replica separate from the master so there is physical redundancy.
- The HA feature of vRealize Operations Manager operates independently of, but complementary to VMware vSphere High Availability.



## Manageability

### 7.1 Self-Health

vRealize Operations Manager can monitor its own health and generate alerts if issues are detected. The following types of alerts are generated:

- System alert – A component of vRealize Operations Manager has failed or is experiencing an issue.
- Environment alert – vRealize Operations Manager has stopped receiving data from one or more data sources.

### 7.2 External Monitoring

If vRealize Operations Manager is not the primary monitoring solution, it can be configured to send outbound alerts to other monitoring products using the following methods:

- REST Notification
- SMTP
- SNMP
- Smart SAM

#### **Design Considerations**

Configure vRealize Operations Manager to send alerts to external monitoring platforms as required.



## Performance and Scalability

vRealize Operations Manager can be deployed as a single node, or it can be scaled out in a cluster configuration to provide the high availability and performance benefits required to process the large amounts of data found in service provider environments.

### 8.1 Clustering for Scalability

The term *cluster* in vRealize Operations Manager refers to two or more nodes taking on the roles of master node, master replica node, or data node.

Additional vRealize Operations Manager nodes can be deployed to specialize in collecting data from remote locations. These are called remote collectors (RCs).

During installation, a user can select a predefined node size based on the size of the infrastructure to be monitored. When vRealize Operations Manager outgrows the existing node size, the cluster can be expanded by adding one or more nodes of the same size.



The following table shows the predefined node sizes and corresponding capacity.

**Table 5. vRealize Operations Manager Node Size Resource Attributes and Capacity**

Characteristic/Node Size	Extra Small	Small	Medium	Large	Standard Size Remote Collectors	Large Size Remote Collectors
vCPU	2	4	8	16	2	4
Memory (GB)	8	16	32	48	4	16
IOPS	See the Sizing Guide Worksheet for details ( <a href="http://kb.vmware.com/kb/2093783">http://kb.vmware.com/kb/2093783</a> )					
Disk space	See the Sizing Guide Worksheet for details					
Single-node maximum objects	250	2,400	7,000	12,000	1,500*	12,000
Single-node maximum collected metrics**	70,000	800,000	2,000,000	3,500,000	NA	NA
Multi-node maximum objects per node***	NA	2,000	5,000	10,000	NA	NA
Multi-node maximum collected metrics per node	NA	700,000	1,500,000	2,500,000	NA	NA
Maximum objects for 8-node maximum	NA	NA	40,000	75,000	NA	NA
Maximum metrics for 8-node configuration	NA	NA	12,000,000	20,000,000	NA	NA

\* The object limit for the remote collector is based on the VMware vCenter Server® adapter.

\*\* Metric numbers reflect the total number of metrics that are collected from all adapter instances in vRealize Operations Manager.

\*\*\* In large, 8-node configurations, the reduction in maximum metrics permits some headroom.

Cluster sizing is determined using VMware sizing guidelines outlined in VMware knowledge base article *vRealize Operations Manager Sizing Guidelines (2093783)* at <http://kb.vmware.com/kb/2093783>. Sizing guidance is product version specific.



## 8.2 Load Balancing

The vRealize Operations Manager user interfaces can be accessed from any full node. VMware recommends a load balancer for even distribution of the user interface traffic and load.

The maximum number of concurrent user connections per node is four (4), based on a worst-case scenario. The load per user varies depending how many objects the user is permitted to access (in particular, if the user is running views or reports against large sets of metrics over a long time).

### Design Considerations

If vRealize Operations Manager is to be configured as a cluster, use an external load balancer to distribute the load across the cluster.

## 8.3 Remote Collectors

VMware recommends deploying remote collectors (RCs) in either of these cases:

- If a vRealize Operations Manager cluster must analyze data from remote sites connected by low-bandwidth or high-latency communication links.
- If the infrastructure to be monitored is in a secure zone and protected by a firewall.

Remote collectors can be deployed in one of two resource profiles: standard or large. The configuration for each size is shown in Table 5.

Disk space is not important to a remote collector, because collection data is stored in memory. The virtual disk can be left at the default size (thin provisioning is also acceptable).

### Design Considerations

If monitoring targets are in a secure zone or on the opposite end of a WAN link, consider deploying a remote collector to reduce the number of firewall rules required and reduce load on the WAN.

## 8.4 Performance Impact on VMware vCenter Server

vRealize Operations Manager puts the following load on a vCenter Server increasing with each vRealize Operations Manager node deployed.

**Table 6. vRealize Operations Manager Impact on vCenter Server**

Attribute	Impact
CPU	Increase by 5 to 10 percent once every 5 minutes, for approximately 30 to 60 seconds
Memory	40MB to 50MB once every 5 minutes
VMware vCenter Server Sessions	10 to 12 constant sessions, depending on inventory size

### Design Considerations

Although no noticeable impact is expected on vCenter Server, consider increasing resources for each monitored vCenter Server.





## Recoverability

### 9.1 vRealize Operations Manager Backup

The vRealize Operations Manager vApp can be backed up like any virtual machine. Choose a backup product that uses VMware vSphere Storage APIs - Data Protection. Take the cluster offline during backup and back up all nodes at the same time (or before the cluster is brought back online).

#### **Design Considerations**

Use a full, not partial, restore operation, and restore the entire cluster, not individual nodes. If vRealize Operations Manager is configured to use HA, the cluster can withstand the loss of any single node and continue to function.

### 9.2 Data Management

By default, historical data is retained for a six-month period. To alter this period, adjust the configuration setting in the vRealize Operations Manager product user interface.

#### **Design Considerations**

Retain enough data support business and capacity planning requirements.

### 9.3 Data Purging and Archiving

Data is purged on a rolling basis after the data retention period. VMware recommends purging data after six months of data collection. This is a general recommendation and subject to a service provider's own business and capacity planning requirements.

Data archiving is not supported.



## Security

### 10.1 Authorization and Authentication

The vRealize Operations Manager virtual appliance root and application administrator local accounts are set during installation, and the administrator user can be managed using the administration interface.

Both passwords can be reset using virtual machine console on each node VMs. Local passwords are encrypted and stored in the PostgreSQL metadata database.

vRealize Operations Manager can authenticate users in any of the following ways:

- LDAP database (such as Active Directory)
- vCenter Server
- Local user accounts (created in the vRealize Operations Manager product user interface)

User accounts and groups are managed through the vRealize Operations Manager user interface. Groups can be populated with locally created or LDAP user accounts, with permissions set at the group level and inherited by members of the group.

LDAP users can be imported into vRealize Operations Manager and assigned to vRealize Operations Manager groups in a single operation.

LDAP passwords are not imported into vRealize Operations Manager. Instead, the LDAP database is queried for each authentication operation. LDAP passwords cannot be changed in vRealize Operations Manager.

The use of local accounts is discouraged because the management overhead can be large. vCenter Server authentication can be useful for vRealize Operations Manager users who need only to interact with vSphere objects.

In a service provider environment, many products beyond vSphere are likely to be monitored by vRealize Operations Manager (for example, VMware vCloud Director®). For flexibility of object access and relatively low overhead of management, VMware recommends integration with LDAP and synchronization of vRealize Operations Manager local groups with existing or purpose-created LDAP global groups.

#### Design Considerations

There can be significant overhead in managing local accounts. Consider integrating vRealize Operations Manager with an LDAP directory such as Active Directory, or using vCenter Server authentication.

**Note** vCenter Server authentication allows users to interact only with vSphere objects.

### 10.2 Encryption

SSL encryption is used to secure communication with the administrator and product user interfaces. By default, vRealize Operations Manager installs a self-signed certificate. A Certificate Authority (CA) signed certificate can also be installed. The signed certificate must satisfy the following requirements:

- The certificate files contain both a valid private key and a valid certificate chain.
- The private key is generated by the RSA or the DSA algorithm.
- The private key is not encrypted by a passphrase.
- If the certificate is signed by a chain of other certificates, all other certificates are included in the certificate file.
- All the certificates and the private key included in the certificate file are in PEM format.



### Design Considerations

Consider using a CA signed certificate to further secure communications. SSL certificates are added to the first node, and copied to other nodes as they join the cluster. With this in mind, include the subject alternative names (SAN) for future nodes in a certificate request.

## 10.3 vCenter Server Adapter Instance Privileges

vRealize Operations Manager collects vSphere related data from vCenter Server instances. A user account (service account) with sufficient permissions is required for vRealize Operations Manager to communicate with each vCenter Server.

vRealize Operations Manager accesses vCenter Server data based on the permissions given to its server account. Use a read-only account for data collection purposes, and a separate account to register and maintain vSphere plug-ins in vCenter Server.

The vCenter Python Actions Adapter allows a user to execute remedial action based on a recommendation against an alert. The service account credentials provided to the vCenter Python Actions Adapter must have sufficient privileges to modify objects within the vCenter Server where the alert is triggered.

### Design Considerations

- Use a service account for each endpoint from which vRealize Operations Manager will collect data (vCenter Server, vCloud Director, and so on).
- If the vSphere data collection service account has read-only permissions, set up a separate service account with permissions to register and maintain vSphere plug-ins in vCenter Server.
- Use a separate service account for the vCenter Python Actions Adapter.
- Do not allow service account passwords to expire. If they do, vRealize Operations Manager will not be able to collect information from endpoints.



## Integration

The out-of-the-box functionality of vRealize Operations Manager can be extended with vRealize Operations management packs. With management packs, other VMware and partner products can be configured as data sources within the vRealize Operations Manager environment.

This section describes the integrations between vRealize Operations Manager and external systems commonly used in private and public cloud deployments. All management packs produced by VMware and partners can be found at the VMware Solution Exchange (<https://solutionexchange.vmware.com>).

### 11.1 VMware NSX

The vRealize Operations Management Pack for VMware NSX provides comprehensive visibility into virtual and physical topologies. Out-of-the-box dashboards developed exclusively for VMware NSX provide a quick overview of VMware NSX environment and the health of its components.

Extensive correlation between VMware NSX objects and vSphere objects enables easy troubleshooting. The management pack leverages smart alerting capabilities to provide unique alerts and recommendations to simplify VMware NSX operations.

At a glance, the user can see the health, capacity, configuration, and performance of these objects, and can take remediation actions based upon unhealthy conditions that might affect the environment.

The management pack includes VMware NSX specific configuration and health checks, providing a global view of all VMware NSX objects. The management pack extends vRealize Operations Manager to alert on VMware NSX configuration or health problems, leading to faster awareness and remediation.

#### 11.1.1 Service Accounts

A service account is required for vRealize Operations Manager to access the VMware NSX API to obtain configuration and performance data. The service account must have read-only access to VMware NSX objects at a minimum.

#### 11.1.2 Management Pack Provided Dashboards

The management pack for VMware NSX makes the following additional dashboards available in vRealize Operations Manager:

- NSX for vSphere Main dashboard
- NSX for vSphere Topology dashboard
- NSX for vSphere Object Path dashboard
- NSX for vSphere Troubleshooting dashboard

The management pack will allow visibility of VMware NSX objects and metrics. These are documented in the management pack user guide. (<https://solutionexchange.vmware.com/store/products/management-pack-for-nsx-for-vsphere-2-0>).

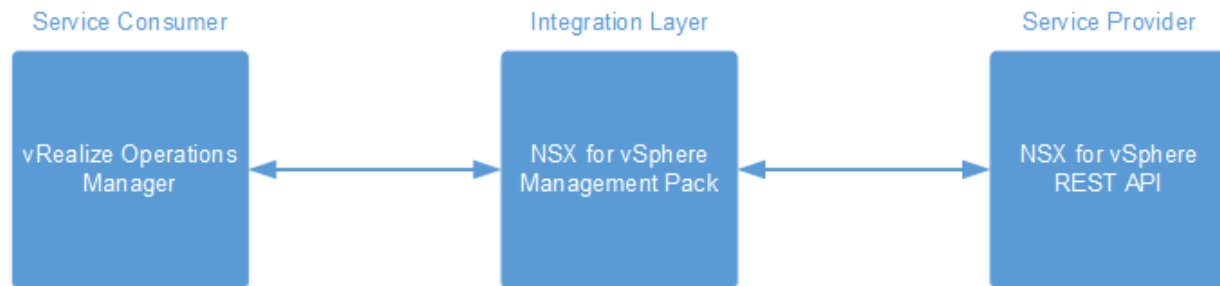


### 11.1.3 Relationship of Components and Processes

The vRealize Operations Management Pack for VMware NSX serves as the integration layer between vRealize Operations Manager and VMware NSX, as shown in the following figure.

vRealize Operations Manager uses the management pack to poll VMware NSX for configuration, performance, and support data. On behalf of vRealize Operations Manager, the Management Pack for VMware NSX translates the polling requests into REST API calls to retrieve the required data from NSX Manager.

**Figure 7. Components Relationships for VMware NSX Integration**



Installed directly as a plug-in, the vRealize Operations Management Pack for VMware NSX receives requests from vRealize Operations Manager to collect data from the configured NSX Manager. The vRealize Operations Management Pack for VMware NSX then makes REST API calls to NSX Manager by way of an authenticated HTTPS connection on behalf of vRealize Operations Manager.

## 11.2 Integration Between vRealize Operations Manager and Storage Devices Including VMware vSAN

The vRealize Operations Management Pack for Storage Devices provides a complete view of the entire storage topology, including hosts, storage network, and storage array. vRealize Operations Manager can be used to monitor and troubleshoot capacity and performance problems on different components of a storage area network.

This solution provides the following capabilities:

- An end-to-end view of topology, statistics, and events at every affected level of the storage area network
- Isolation of problems caused by elements in the physical storage stack, such as the Host Bus Adapter (HBA), storage switches, or array
- Capture and analysis of information on throughput and latency for the HBA and mount objects
- Capture of throughput on the switch ports.
- Capture of IOPS and queue depth at the HBA and switch ports for read and write components
- Storage device discovery and data collection
- Use of the Common Information Model (CIM) to exchange information with objects managed by the following fabric management systems:
  - Cisco Data Center Network Manager (DCNM)
  - Brocade Network Advisor (BNA)



### 11.2.1 Service Accounts

A service account is required for vRealize Operations Manager to access target storage systems to obtain configuration and performance data.

For VMware vSAN™, a service account with read-only permissions is required to access data for vSAN objects.

For other storage devices (arrays, switches, and so on), service accounts with permissions to read SNMP data are required for each device.

### 11.2.2 Management Pack Provided Dashboards

Installation of the Management Pack for Storage Devices will provide additional dashboards to aid with the monitoring of one or more storage devices or arrays. These additional dashboards are:

- vSAN Dashboards
  - vSAN Cluster Insights – Disk group capacity, usage dashboard
  - vSAN Device Insights – Magnetic/SSD disks, IP switch capacity/error dashboard
  - vSAN Entity Usage – Magnetic disk, SSD disk, HBA throughput and latency dashboard
  - vSAN Heat Map – vSAN datastore/component usage against predefined limits
  - vSAN Troubleshooting – vSAN end-to-end topology, alerts, metric charts
- Non-vSAN (FC, FCoE, iSCSI, and NFS) Dashboards
  - Troubleshooting
  - Component usage
  - Heat map

The management pack will allow visibility of storage device objects and metrics. These are documented in the Management pack user guide. (<https://solutionexchange.vmware.com/store/products/management-pack-for-storage-devices>).

### 11.2.3 RAID Controller Configuration Requirements

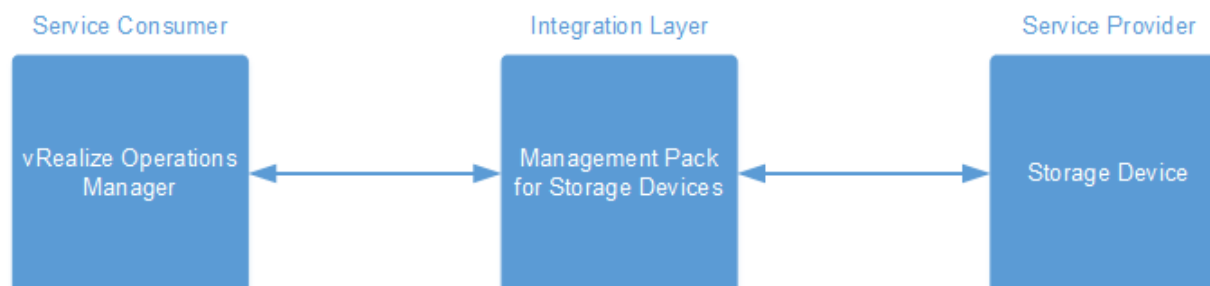
The RAID controller of the VMware ESXi™ host must be configured in pass-through mode to expose physical disk devices to ESXi storage drivers. The Management Pack for Storage Devices collects SMART data from the ESXi host's physical devices by probing storage stack drivers using SMI-S CIM subscription.



### 11.2.4 Relationship of Components and Processes

The vRealize Operations Management Pack for Storage Devices serves as the integration layer between vRealize Operations Manager and an environment's storage devices (including vSAN). The component relationship is shown in the following figure.

**Figure 8. Components Relationships for Storage Devices**



vRealize Operations Manager uses the Management Pack for Storage Devices to poll for configuration, performance and support data. On behalf of vRealize Operations Manager, the Management Pack for Storage Devices translates the polling requests into each storage device's specific format. The following table lists the access methods for each storage device or fabric manager.

**Table 7. Storage Device Access Methods**

Storage Device / Fabric Manager Type	Access Method
Physical Storage Devices	SNMP Query
Cisco Data Center Network Manager (DCNM)	HTTPS REST Query
Brocade Network Advisor (BNA)	HTTPS REST Query
VMware vSAN	HTTPS REST Query (through vCenter Server adapter)

Installed directly as a plug-in, the vRealize Operations Management Pack for Storage Devices receives requests from vRealize Operations Manager to collect data from the configured storage device or fabric manager. The vRealize Operations Management Pack for Storage Devices then makes SNMP queries or REST API calls (through an authenticated HTTPS connection) to the storage device or fabric manager on behalf of vRealize Operations Manager.

### 11.2.5 Constraints

The following are constraints of the Management Pack for Storage Devices:

- The Management Pack for Storage Devices Solution requires SMART capability to show performance metrics for hardware components.
- Some RAID controllers configured in individual RAID 0 mode might not expose all SMART statistics for physical drives. In such cases, the Management Pack for Storage Devices cannot capture and show statistics.



- The Management Pack for Storage Devices solution requires SNMP to show vSAN network performance metrics for switches.
- The Management Pack for Storage Devices can collect data from IP switches used for vSAN using SNMP only if the switches are configured with sufficient credentials to read switch SNMP data.

## 11.3 Integration Between vRealize Operations Manager and vCloud Director SP

The vRealize Operations Management Pack for vCloud Director is an embedded adapter for vRealize Operations Manager. The adapter monitors the health of supported vCloud Director SP entities and sends early warning smart alerts for monitored provider virtual data center (VDC) resources.

The Management Pack for vCloud Director collects information for provider VDC, organization, organization VDC, and vApp entities from the vCloud Director SP database and creates the corresponding resources in vRealize Operations Manager.

The Management Pack for vCloud Director maps the vApps that it imports to virtual machine resources that the vCenter Server adapter has already imported and creates resource relationships between the vApps and the virtual machines.

vRealize Operations Manager does not collect performance data from vCloud Director SP. Instead, the Management Pack for vCloud Director enables vRealize Operations Manager to present health data by mapping vCloud Director SP entities to vCenter Server objects. The vCenter Server adapter collects performance data for vCenter Server objects.

### 11.3.1 Service Accounts

Each instance of the management pack must be configured with a target user account that has sufficient privileges to read data from the target system. For a service provider to monitor the entire vCloud Director SP environment, this means an account with system administrator level privileges.

### 11.3.2 Management Pack Provided Dashboards

Installation of the Management Pack for vCloud Director will provide additional dashboards to aid with the monitoring of one or more vCloud Director SP Instances. These additional dashboards are:

- vCloud Director All Metric Selector – Visualizes all the metrics associated with a particular resource that are collected by the vCloud Director adapter at a single place.
- vCloud Director Organization VDC Utilization – Top 10 organization VDC based on the CPU usage, memory usage, storage usage.
- vCloud Director vApp Utilization – Top 10 vApps based on the CPU allocation, memory allocation, storage allocation, number of virtual machines, and number of CPUs.
- vCloud Director Mashup Charts – Health of the particular resources collected by the vCloud Director.
- vCloud Director Alerts – Shows alert resource relationships.
- vCloud Director Troubleshooting – Displays an object's health anomalies, metrics and relationships to other objects.

The management pack will allow visibility of vCloud Director objects and metrics. All of the available objects are documented in the user guide of the management pack (<https://solutionexchange.vmware.com/store/products/management-pack-for-vcloud-director>).

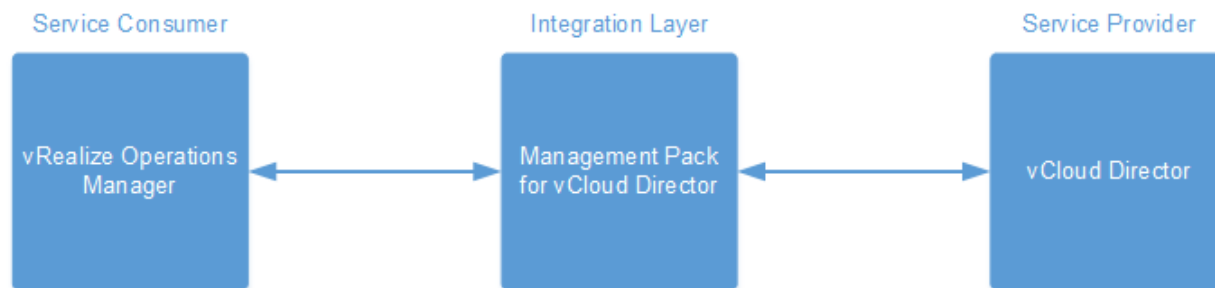




### 11.3.3 Relationship of Components and Processes

The vRealize Operations Management Pack for vCloud Director serves as the integration layer between vRealize Operations Manager and vCloud Director SP. The component relationship is shown in the following figure.

**Figure 9. Components Relationships for Storage Devices for vCloud Director**



vRealize Operations Manager uses the Management Pack for vCloud Director to poll for configuration and support data, correlating vApp constructs with vSphere virtual machines.

Installed directly as a plug-in, the vRealize Operations Management Pack for vCloud Director receives requests from vRealize Operations Manager to collect data from vCloud Director SP. The vRealize Operations Management Pack for vCloud Director then makes REST API calls (through an authenticated HTTPS connection) to vCloud Director SP on behalf of vRealize Operations Manager.



## Operational Considerations

### 12.1 Cluster Rebalance

The following table lists the types of rebalance operations that can be performed on a vRealize Operations Manager cluster.

**Table 8. vRealize Operations Manager Rebalance Operations**

Operation	Description	Implication
Rebalance adapter instances	Rebalance all adapter instances across nodes if experiencing poor collection or cluster performance.	vRealize Operations Manager will miss a few collection cycles.
Rebalance disk	Repartition all data on disk to equally distribute the disk load. Use this option if you have added new nodes, but have not deployed any new adapter instances.	This is a disruptive operation that might take hours, but it balances the system and improves performance.
Rebalance GemFire	Repartition GemFire data in memory to equally distribute the memory and network load.	

Rebalance adapter instances only if the cluster is experiencing poor performance. Perform disk and GemFire rebalancing after adding new nodes to a cluster.

The rebalance disk operation redistributes FSDB data evenly across the cluster. It can take hours to complete, because many terabytes of data might need to be distributed. As such, VMware recommends that performing disk rebalance operations during a major maintenance window.

The GemFire rebalance operation redistributes the GemFire cache across all nodes. It is far less disruptive than the disk rebalance operation.

### 12.2 Software Updates

The vRealize Operations Manager administration interface includes a central page where updates to the product software can be installed and managed.

Software updates can be downloaded from <https://my.vmware.com/> using an entitled account. Before performing a software upgrade, always read the release notes for the update process specific to that release, and for any implications, prerequisites, and management pack support.

Updates require vRealize Operations Manager to be taken offline temporarily while the update is performed.

If any content that vRealize Operations Manager provides has been customized, such as alerts, symptoms, recommendations, and policies, a best practice is to clone the content before performing the update. In this way, out-of-the-box content can be reset when installing the software update, and the update will provide new content without overwriting customized content.



## 12.3 Upgrades

An upgrade to vRealize Operations Manager 6.x from vCenter Operations Manager 5.8 is done by setting up a new vRealize Operations Manager 6.x environment and importing the previous version's configuration and data.

Migration occurs side by side and does not turn off the source. After migration, both target and source can monitor the same objects. When you turn off the earlier deployment, monitoring of the inventory and data is done solely by the new version of vRealize Operations Manager. Performing the entire process is known as a migration-based upgrade.

The high-level steps to perform a migration-based upgrade are:

- Deploy and configure a target cluster of new nodes (the same way as for a new vRealize Operations Manager installation).
- Perform a one-time connection to the previous vCenter Operations Manager source deployment to import the configuration and, optionally, data from that environment.
- Run both vRealize Operations Manager 6.x and vCenter Operations Manager side by side until the legacy environment can be shut down.

Refer to the product documentation for the detailed upgrade process.

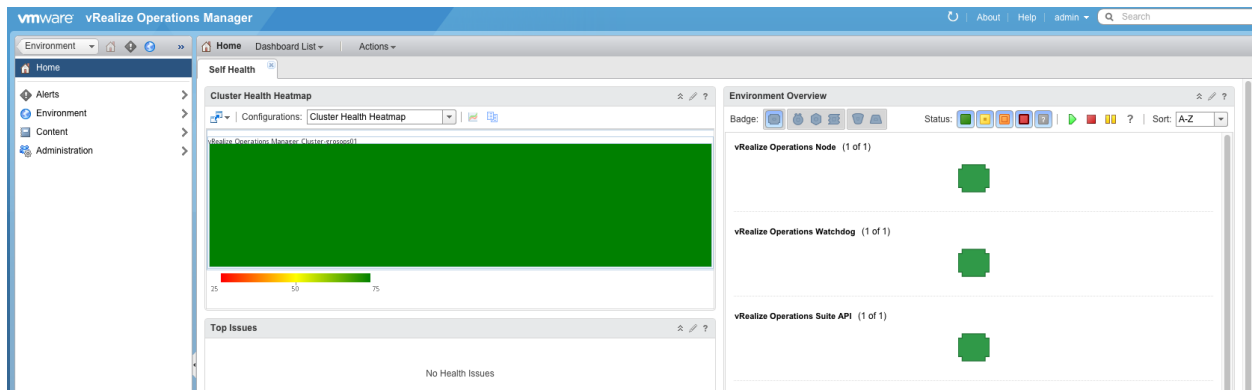
## 12.4 Monitoring

vRealize Operations Manager uses the vRealize Operations Manager adapter to collect metrics that measure its own performance. These self-monitoring metrics drive capacity models for vRealize Operations Manager objects and are useful for diagnosing problems with vRealize Operations Manager.



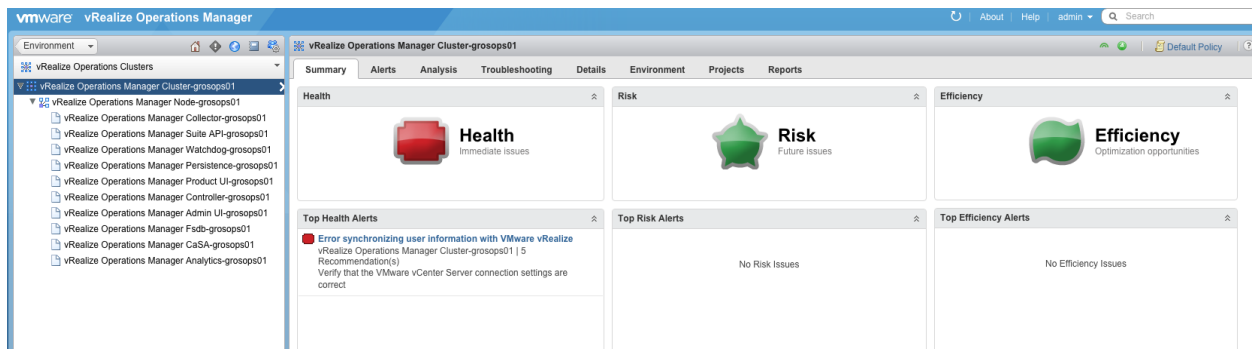
A vRealize Operations **Self Health** dashboard is provided out of the box for an at-a-glance view of cluster health. The following figure shows an example of this dashboard.

**Figure 10. vRealize Operations Manager Self Health Dashboard**



Users can view details of individual vRealize Operations Manager adapter objects in the **Environment** section.

**Figure 11. vRealize Operations Manager Self Health Environment View**





## Appendix A: vRealize Operations Port Requirements

### 13.1 vRealize Operations Manager

The following table lists the firewall ports used by vRealize Operations Manager and associated management packs.

**Table 9. vRealize Operations Manager Firewall Ports**

Source	Destination	Port	Protocol	Service Description
End-User Workstation	All Cluster Nodes	22	TCP	Enables SSH access to the vRealize Operations Manager vApp.
End-User Web Browser	All Cluster Nodes	80	TCP	Redirects to port 443.
End-User Web Browser	All Cluster Nodes	443	TCP	Used to access the vRealize Operations Manager Admin portal and the vRealize Operations Manager product user interface.
End-User Web Browser	Remote Collector	443	TCP	Remote Collector Admin user interface.
vCenter Server	All Cluster Nodes	443, 22	TCP	Used for the collection of metric data.
Remote Collector	All Cluster Nodes	443	TCP	Cluster nodes CASA.
Remote Collector	All Cluster Nodes	6061, 10000	TCP	GemFire locator and data.
Remote Collector	vCenter Server instances	443, 10443, 8443	TCP	Data collection and access to vCenter Inventory Service
Remote Collector	DNS servers	53	TCP/UDP	Name resolution.
Remote Collector	NTP servers	123	UDP	Time synchronization.
All Cluster Nodes	Remote Collector	443	TCP	Remote Collector CASA and Admin user interface.
All Cluster Nodes	SMTP	25	TCP	Alert notifications.
All Cluster Nodes	LDAP	389	TCP	Lightweight Directory Access Protocol.
All Cluster Nodes	All Cluster Nodes	*	*	All cluster nodes must be on the same LAN



## 13.2 vRealize Operations Manager – Management Pack for NSX

The information in the following table summarizes the network exchange flows required for proper interaction of the Management Pack for NSX for vSphere.

**Table 10. VMware NSX Management Pack Port Requirements**

Port	Number	Protocol	Source	Target	Description
VMware NSX API port	443	TCP	vRealize Operations Manager (all nodes within a cluster)	VMware NSX	General API port
SNMP listening agent	161	TCP/UDP	vRealize Operations Manager (all nodes within a cluster)	All physical network devices	Used for physical discovery of devices (optional)

## 13.3 vRealize Operations Manager – Management Pack for Storage Devices

The following information summarizes the network exchange flows required for proper interaction of the Management Pack for Storage Devices.

**Table 11. Management Pack for Storage Devices Port Requirements**

Port	Number	Protocol	Source	Target	Description
SNMP	162	TCP/UDP	vRealize Operations Manager vApp (all nodes within a cluster)	Storage devices and storage network devices	Used for physical discovery of devices and data collection

**Note** VMware hosted storage device information is collected from the vCenter Server adapter instance.

## 13.4 vRealize Operations Manager – Management Pack for vCloud Director

The following information summarizes the network exchange flows required for proper interaction of the Management Pack for vCloud Director.

**Table 12. Management Pack for Storage Devices Port Requirements**

Port	Number	Protocol	Source	Target	Description
HTTPS	443	TCP	vRealize Operations Manager vApp (all nodes within a cluster)	All vCloud Director SP Cells (or load balanced IP address)	vCloud Director SP API port





## Appendix B: Documentation References

### 14.1 Further Resources

All vRealize Operations Manager documentation can be found at  
<https://www.vmware.com/support/pubs/vrealize-operations-manager-pubs.html>.