VSPEX Private Cloud with Operations Management

Enabled with VMware® vSphere™, vRealize™ Operations Advanced™, EMC VNX, and EMC Storage Analytics

DESIGN AND IMPLEMENTATION GUIDE
# TABLE OF CONTENTS

## CHAPTER 1 .................................................................................................................. 7

- Introduction ................................................................................................................. 7
- Target Audience .......................................................................................................... 7
- Document Purpose ....................................................................................................... 7
- Business Needs ............................................................................................................ 8
- Essential Reading ........................................................................................................ 8

## CHAPTER 2 .................................................................................................................. 10

- Overview ..................................................................................................................... 10
- VMware Datacenter and Cloud Management .............................................................. 10
- Datacenter and Cloud Management with EMC and VMware ....................................... 10
  - Integrated Management ............................................................................................ 10
  - Converged Infrastructure Management ..................................................................... 10
  - Managing the Software-Defined Datacenter ............................................................. 10
  - Intelligent Operations ............................................................................................... 12
  - Policy-Based Automation ......................................................................................... 12
  - Unified Management ................................................................................................. 13
  - VMware vRealize Operations Management Packs ................................................... 13
- EMC VNX Family ......................................................................................................... 14
  - Virtual Provisioning .................................................................................................. 14
  - Fully Automated Storage Provisioning for Virtual Pools (FAST™ VP) ..................... 14
  - Unisphere ................................................................................................................. 14
- EMC Integration for VMware vSphere .......................................................................... 14
  - EMC Virtual Storage Integrator ................................................................................ 14
  - VMware vStorage APIs - Array Integration (VAI) .................................................... 14
  - VMware vSphere Storage APIs for Storage Awareness (VASA) ............................. 15
- EMC Storage Analytics ............................................................................................... 15
- Hardware and Software List ......................................................................................... 15

## CHAPTER 3 .................................................................................................................. 18

- Overview: VMware vRealize Operations Advanced Architecture ........................... 18
- Function in Overall Architecture ................................................................................. 18
- Distribution Formats ................................................................................................... 19
- vRealize Operations Manager Components ............................................................... 21
CHAPTER 5

Modifying Data Retention and Custom Parameters................................................................. 24
Security................................................................................................................................. 26
  vRealize Operations Manager Advanced.............................................................................. 26
EMC Storage Design ............................................................................................................... 28
  VNX storage tiering and FAST VP ....................................................................................... 28
  Storage Mapping ................................................................................................................ 29
  EMC Virtual Storage Integrator (VSI) .................................................................................. 29
  EMC Storage Analytics........................................................................................................ 30

CHAPTER 4 .............................................................................................................................. 32

Overview............................................................................................................................... 32
Installing and configuring vSphere with Operations Management ........................................ 32
  Deploying vRealize Operations Manager ........................................................................... 33
  vCenter Server Integrations................................................................................................. 33
Applying a vSphere with Operations Management License ................................................ 33
Updating License from vSphere with Operations Management to vRealize Operations Manager Advanced ........................................................................................................ 35
Deploying EMC Storage Analytics......................................................................................... 36

CHAPTER 5 .............................................................................................................................. 39

Overview............................................................................................................................... 39
Verifying vRealize Operations Manager Implementation .................................................... 39
Verifying the Upgrade to vRealize Operations Manager Advanced ...................................... 39
Verifying EMC Adapter Configurations ............................................................................... 40
Monitoring vRealize Operations Manager Objects .............................................................. 45
vRealize Operations Manager vSphere Dashboard ............................................................... 45
vRealize Operations Manager Badges.................................................................................. 47
Monitoring VNX Health and Resources............................................................................... 50
  Storage Topology Dashboard............................................................................................... 51
  Storage Metrics Dashboard................................................................................................ 52
  VNX Overview Dashboard................................................................................................. 55
  End-to-End VM to Storage Visibility ............................................................................... 56
Capacity Planning and Optimization.................................................................................... 58
Reporting............................................................................................................................... 64
Root Cause Analysis – Health Badge:.................................................................................. 67
  Datastore Offline................................................................................................................ 67
Root Cause Analysis – Risk Badge:..................................................................................... 71
  Raid Group capacity used (%) is high ............................................................................... 71
Root Cause Analysis – Efficiency Badge:............................................................................ 73
Raid Group capacity used (%) is low ................................................................. 73

**CHAPTER 6** ............................................................................................................. 76

Overview: vRealize Operations Manager vApp Sizing Considerations ..................... 76
Detailed Storage Capacity and I/O Considerations..................................................... 80
Interoperability Matrix ............................................................................................. 81
# FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>vRealize Operations Manager - Architecture</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>vRealize Operations scale out cluster architecture</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Web Interface administration page</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>Adding new Policy</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>EMC VNX sub-LUN tiering of production LUN data across two disk types</td>
<td>28</td>
</tr>
<tr>
<td>6</td>
<td>Organization mappings for storage service levels</td>
<td>29</td>
</tr>
<tr>
<td>7</td>
<td>EMC Storage Analytics with VMware vRealize Operations Manager Advanced</td>
<td>30</td>
</tr>
<tr>
<td>8</td>
<td>Unlicensed asset in vSphere Server</td>
<td>34</td>
</tr>
<tr>
<td>9</td>
<td>Licensed vSphere and vRealize Operations Manager after applying vSphere with Operations Management license</td>
<td>34</td>
</tr>
<tr>
<td>10</td>
<td>vRealize Operations Manager updated to Advanced Edition</td>
<td>35</td>
</tr>
<tr>
<td>11</td>
<td>Dashboards with detailed analytic information for storage</td>
<td>37</td>
</tr>
<tr>
<td>12</td>
<td>vRealize Operations Licensing Page</td>
<td>40</td>
</tr>
<tr>
<td>13</td>
<td>vRealize Operations Login Page</td>
<td>41</td>
</tr>
<tr>
<td>14</td>
<td>Adapter instance list</td>
<td>41</td>
</tr>
<tr>
<td>15</td>
<td>Verifying vCenter Server adapter instance</td>
<td>42</td>
</tr>
<tr>
<td>16</td>
<td>vCenter Server adapter successful test</td>
<td>42</td>
</tr>
<tr>
<td>17</td>
<td>vCenter Server successful entry</td>
<td>43</td>
</tr>
<tr>
<td>18</td>
<td>Verifying EMC Adapter</td>
<td>43</td>
</tr>
<tr>
<td>19</td>
<td>EMC Adapter successful test</td>
<td>44</td>
</tr>
<tr>
<td>20</td>
<td>EMC Adapter successful entry</td>
<td>44</td>
</tr>
<tr>
<td>21</td>
<td>EMC Adapter instances listed under solutions</td>
<td>45</td>
</tr>
<tr>
<td>22</td>
<td>Default Dashboard home page</td>
<td>46</td>
</tr>
<tr>
<td>23</td>
<td>Main vSphere dashboard in vRealize Operations Manager</td>
<td>46</td>
</tr>
<tr>
<td>24</td>
<td>Checking the health score for a vSphere World group</td>
<td>48</td>
</tr>
<tr>
<td>25</td>
<td>Warning for a Host in Health Weather Map</td>
<td>49</td>
</tr>
<tr>
<td>26</td>
<td>Top health alerts</td>
<td>49</td>
</tr>
<tr>
<td>27</td>
<td>Root Cause &amp; Recommendations suggested by vRealize Operations</td>
<td>50</td>
</tr>
<tr>
<td>28</td>
<td>Dashboard-to-product matrix</td>
<td>51</td>
</tr>
<tr>
<td>29</td>
<td>Storage Topology Dashboard</td>
<td>52</td>
</tr>
<tr>
<td>30</td>
<td>Storage Metrics Dashboard</td>
<td>53</td>
</tr>
<tr>
<td>31</td>
<td>Storage Metrics ESA home screen</td>
<td>54</td>
</tr>
<tr>
<td>32</td>
<td>Storage Metrics vSphere Dashboard home screen</td>
<td>54</td>
</tr>
<tr>
<td>33</td>
<td>ESA VNX overview</td>
<td>55</td>
</tr>
<tr>
<td>34</td>
<td>Details for the LUN</td>
<td>56</td>
</tr>
<tr>
<td>35</td>
<td>VM-Disks relationship in VNX topology dashboard</td>
<td>57</td>
</tr>
<tr>
<td>36</td>
<td>VM-Storage relationship in VNX Metrics dashboard</td>
<td>57</td>
</tr>
<tr>
<td>37</td>
<td>Capacity Remaining on vSphere Infrastructure</td>
<td>58</td>
</tr>
<tr>
<td>38</td>
<td>Capacity Remaining Planning with EMC Storage Analytics on Raid Group</td>
<td>59</td>
</tr>
<tr>
<td>39</td>
<td>Capacity Remaining on vSphere Infrastructure</td>
<td>60</td>
</tr>
<tr>
<td>40</td>
<td>What will fit scenarios according to the Datacenter</td>
<td>60</td>
</tr>
<tr>
<td>41</td>
<td>Creation of Projects – Planning additional Virtual Machines</td>
<td>61</td>
</tr>
<tr>
<td>42</td>
<td>Adding and combing multiple projects</td>
<td>62</td>
</tr>
<tr>
<td>43</td>
<td>Raid Group indicating less utilization</td>
<td>62</td>
</tr>
<tr>
<td>44</td>
<td>Creating project at Storage level</td>
<td>63</td>
</tr>
<tr>
<td>45</td>
<td>Combining multiple projects at Storage level</td>
<td>63</td>
</tr>
<tr>
<td>46</td>
<td>Report Template</td>
<td>64</td>
</tr>
<tr>
<td>47</td>
<td>Creating Custom report</td>
<td>65</td>
</tr>
<tr>
<td>48</td>
<td>Selecting View for custom report</td>
<td>65</td>
</tr>
<tr>
<td>49</td>
<td>Selecting Format for Custom Report</td>
<td>66</td>
</tr>
<tr>
<td>50</td>
<td>Selecting Layout Options for Custom report</td>
<td>66</td>
</tr>
<tr>
<td>51</td>
<td>Created Custom report available in Report Template</td>
<td>67</td>
</tr>
</tbody>
</table>
Figure 52. Normal “healthy” vRealize Operations Manager Dashboard 67
Figure 53. Datastore Offline 68
Figure 54. Relationship between the objects of underlying storage infrastructure 69
Figure 55. Health status of the effected object 69
Figure 56. Cause of the issue 70
Figure 57. Alert details of the datastore 70
Figure 58. vRealize Operations Manager Dashboard Risk Badge 71
Figure 59. Raid Group Utilization 72
Figure 60. Details of high utilization of a raid group 72
Figure 61. vRealize Operations Manager Dashboard Efficiency Badge 73
Figure 62. Raid Group Utilization 74
Figure 63. Details of Low utilization of raid group 74
Figure 64. Basic Version Spreadsheet for vSphere-only management pack 78
Figure 65. Advanced Version Spreadsheet for other data sources 79

TABLES

Table 1. vRealize Operations Manager vApp sizing examples. ........................................ 76
Table 2. Product Interoperability Matrix........................................................................ 81
# Table of Contents

## CHAPTER 1

- **Introduction** ................................................................. 7
- **Target Audience** ............................................................ 7
- **Document Purpose** .......................................................... 7
- **Business Needs** ............................................................. 8
- **Essential Reading** ............................................................ 8
Chapter 1

Introduction

EMC® has joined forces with the industry-leading providers of IT infrastructure to create a complete virtualization solution that accelerates the deployment of cloud infrastructures.

EMC VSPEX® validated and modular architectures are built with proven technologies comprising complete virtualization solutions that enable the administrator to make an informed decision in the hypervisor, compute, and networking layers. VSPEX® helps reduce virtualization planning and configuration burdens. When embarking on server virtualization, virtual desktop deployment or IT consolidation, VSPEX® accelerates IT transformation by enabling faster deployment, expanded choices, greater efficiency, and lower risk.

This document describes how to design and implement VMware® operational management solutions for EMC® VSPEX® Private Cloud: VMware® vSphere™ 6.0 Proven Infrastructure Guides.

Target Audience

This document is designed for partners, technical architects, and cloud solution engineers with a background in EMC and VMware solutions who want to align the daily operational tasks of management and monitoring of a private cloud. The readers of this document must have the necessary training and background to install and configure VMware vSphere 6.0, EMC VNX family of storage products and associated infrastructure as required by this implementation. External references are provided where applicable, and readers should be familiar with these documents.

The reader should also have a clear understanding of operational processes that are implemented within their own environments and recognize their end users’ general requirements to monitor and manage their private cloud. These requirements should include areas such as security, compliance, monitoring, management, data protection, and disaster recovery. Having these competencies will ensure a more relevant connection between the capabilities provided by this solution and the operational requirements of their organization, ultimately resulting in additional business value.

Document Purpose

The VSPEX® Private Cloud architecture provides customers with a modern system capable of hosting many virtual machines at a consistent performance level. This solution runs on the VMware vSphere virtualization layer backed by the highly available VNX family. The compute and network components, which are defined by the VSPEX partners, are designed to be redundant and sufficiently powerful to handle the processing and data needs of the virtual machine environment.

Private cloud architecture can be a complex undertaking to manage and monitor. This document facilitates the implementation of a managed private cloud by providing prerequisite software and hardware material lists, step-by-step sizing guidance, and verified deployment steps. After the last component has been installed, validation tests and monitoring instructions ensure that the system is running properly. This document includes several use cases for implementing
operational management for the private cloud and provides direction and enablement content for foundational capabilities and requirements.

The virtual infrastructure operational management, as described in this document, is based on VMware vRealize™ Operations and EMC Storage Analytics. This operational management solution is applicable to any of the EMC VSPEX Private Cloud: VMware vSphere 6.0 Proven Infrastructure Guides.

**Business Needs**

VSPEX solutions are built with proven technologies to create complete virtualization solutions that allow the reader to make an informed decision in the hypervisor, server, and networking layers.

Business applications are moving into consolidate compute, network, and storage environments. EMC VSPEX Private Cloud using VMware reduces the complexity of configuring every component of a traditional deployment model. The solution simplifies integration management while maintaining the application design and implementation options. It also provides unified administration while enabling adequate control and monitoring of process separation.

The challenges that infrastructure and operations management teams face most often in today's heterogeneous IT environments include:

- Performance and availability issues
- Capacity management and optimization issues
- Configuration and compliance issues
- Workload mobility and rapid changes on demand

As virtual environments continue to grow, converge, and evolve toward self-service private clouds, and merge with public clouds, IT needs new capabilities to anticipate and overcome the challenges of the next stage of the virtualization journey.

This management solution exemplifies the new cloud management approach by offering quality of service, comprehensive visibility, policy-based automation for guided troubleshooting, root-cause isolation, and remediation of even the most complex scenarios. When coupled with the EMC VSPEX validated modular architecture, the solution enables faster deployment, greater efficiency, lower risk, easier management, and faster problem resolution.

**Essential Reading**

EMC recommends reading the related documents before proceeding:

**VSPEX Proven Infrastructure Solutions**

VMware vSphere for up to 125 Virtual Machines or VMware vSphere for up to 1,000 Virtual Machines

**VMware Cloud Management**

VMware vRealize Operations documentation located [here](#).
# CHAPTER 2

Overview ...................................................................................................................... 10
VMware Datacenter and Cloud Management .......................................................... 10
Datacenter and Cloud Management with EMC and VMware ................................ 10
Integrated Management ......................................................................................... 10
Converged Infrastructure Management ................................................................. 10
Managing the Software-Defined Datacenter ....................................................... 10
VMware vRealize™ Operations with Third Party Management Pack Support .... 11
Intelligent Operations ............................................................................................. 12
Policy-Based Automation ....................................................................................... 12
Unified Management ............................................................................................... 13
VMware vRealize Operations Management Packs .............................................. 13
EMC VNX Family ..................................................................................................... 14
Virtual Provisioning ................................................................................................. 14
Fully Automated Storage Provisioning for Virtual Pools (FAST™ VP) ............... 14
Unisphere ................................................................................................................. 14
EMC Integration for VMware vSphere ................................................................. 14
   EMC Virtual Storage Integrator .............................................................................. 14
   VMware vStorage APIs - Array Integration (VAAI) ........................................... 14
   VMware vSphere Storage APIs for Storage Awareness (VASA) ...................... 15
EMC Storage Analytics ......................................................................................... 15
Hardware and Software List .................................................................................. 15
Chapter 2

Overview

VMware Datacenter and Cloud Management

In the cloud era, intelligent virtual infrastructure provides the foundation for faster, more agile and accelerated delivery of IT services and business applications. However, within virtual and cloud environments, the boundaries between operations and infrastructure management have blurred. As a result, managing these new environments using tools designed for physical environments creates operational and business problems—blocking the path to flexible, service-oriented cloud infrastructure.

Datacenter and Cloud Management with EMC and VMware

VMware’s approach to enterprise management is based on Integrated and Converged Infrastructure management.

Integrated Management

Performance issues can originate from any component, virtual machine (VM), physical host or cluster. What’s more, the rate of change of workloads has outstripped the capabilities of traditional management approaches. This requires management capabilities be tightly integrated with the virtualization and cloud platforms themselves.

Converged Infrastructure Management

Workload interdependence in virtual and cloud environments stymies the ability of specialized teams to address performance, capacity and configuration issues in isolation. Highly virtualized and cloud environments require integration of management disciplines and metrics for a holistic view of the health of virtual and physical infrastructures, and the tools to maintain it.

In operations, the disciplines of performance, capacity and configuration management are converging, necessitating greater collaboration between traditionally siloed IT teams. VMware facilitates this collaboration, for example, by providing a single dashboard that can be used by both VI and operations administrators alike to look at health, risk, and efficiency across the entire IT environment. When deployed as part of the EMC VSPEX validated architecture, the VMware management tools provide a significantly lower operational expense as well as a faster problem resolution time.

Managing the Software-Defined Datacenter

Interdependent, dynamic virtual and cloud infrastructures exceed the capabilities—and outstrip the speed—of traditional management processes and tools designed to manage physical IT assets.

Virtual and cloud infrastructures differ from the traditional physical architectures that preceded them in important ways. Traditional, siloed environments are built on tightly coupled applications and infrastructure dedicated to certain components and application tiers. The resulting rigid
vertical stack offers limited flexibility and agility, and requires a complex stack of tools and equally complex set of processes to manage it.

In contrast, highly virtualized and cloud abstracted resources, have shared capacity and fluid configurations that characterize their environments. Tools and processes designed for traditional architectures have difficulty managing this highly dynamic, constantly changing and interdependent environment. Virtual and cloud computing requires organizations to embrace a new management approach—one that is as agile, flexible and dynamic as their new IT infrastructure.

**VMware vRealize™ Operations with Third Party Management Pack Support**

vRealize Operations 6 is the latest release of VMware's integrated operations suite, converging performance, capacity, and configuration management. This release introduces the following enhancements:

- **Scale-Out Deployment Architecture** – This release provides distributed deployment with elastic scale and higher scalability.

- **Unified User Interface** – This release introduces a single user interface to manage vSphere as well as non-vSphere domains. You can create powerful, flexible custom dashboards enabling you to bring any information you want into the management console.

- **Licensing Management** – vRealize Operations Manager has an independent license-management GUI that provides enhanced administration of license keys specific to vRealize Operations. Users can now deploy mixed editions in a single vRealize Operations instance.

- **Smart Alerts** – Smart alerts combine multiple symptoms to generate a single alert that will focus on the underlying issue with clear recommendations and the option to take action for remediation.

- **Enhanced Reporting** – Enhanced reporting provides several out-of-the-box reports with the ability to generate fully customizable reports.

- **Capacity Planning and Project Management Capabilities** – New capacity planning and project management capabilities extend beyond vSphere and across physical and application level metrics. Flexible capacity models can be adjusted to meet different business needs.

- **Custom Policies** – Custom policies can applied for specific workload types, applications or clusters enabling more advanced monitoring of performance, capacity and configuration standards.

- **Automated Remediation of Problems** – Integrated action and remediation capabilities with the ability to apply actions according to the recommendation for the alerts.

- **User Access Control Management** – Improved user access control, including granular role-based access control.
Unified Storage Visibility – New storage visibility shows the correlation between the application group and the storage infrastructure supporting it, including HBA’s, Fabric and Arrays, along with the ability to trace operational issues all the way to storage.

vRealize Operations makes it easier for you to gain comprehensive visibility into the performance and health of your infrastructure and applications, reclaim over-provisioned capacity and ensure compliance with IT policies and regulatory requirements. vRealize Operations is built on an open and extensible platform so you can manage virtual and physical environments and even virtual machines running on other hypervisors and public clouds, like Amazon Web Services (AWS), with a single solution. With vRealize Operations, IT organizations of all sizes can improve performance, avoid business disruption, and become more efficient with comprehensive visibility across applications and infrastructure in one place.

vRealize Operations delivers:

Intelligent Operations

- Prebuilt and customizable dashboards, reports, and views provide real-time insight into infrastructure performance, potential problems and areas where efficiency can be improved, to enable informed and intelligent operational decisions.

- Self-learning algorithms and predictive analytics correlate monitoring data and provide intelligent alerts on underlying performance issues with clear recommendations for corrective action, enabling faster problem resolution. Dynamic thresholds adapt to your environment, significantly reducing false alerts.

- Aggregate resources and applications by business or operational logic, and apply group policies to prioritize thresholds and alerts. Map virtual infrastructure services, examine application discovery status, and analyze dependencies—to simplify root cause analysis and build reliable disaster recovery plans.

- Quickly identify and analyze performance anomalies, faults, resource constraints and bottlenecks with these in-depth views into all areas of your infrastructure.

- Performance trends, projections and extended forecasts guide you in intelligent capacity planning to address future needs. Identify over-provisioned VMs at a glance and right-size them to reclaim unused resources.

- Save “what-if” scenarios and commit capacity models to the analytics engine to influence capacity calculations and alerts. Extend capacity planning and project management capabilities beyond vSphere and across physical and application-level metrics.

Policy-Based Automation

- Visually trace degradations in health or performance back to specific configuration changes at the infrastructure and guest OS levels.

- Increase efficiency by automatically rightsizing VMs to reclaim idle resources and boost consolidation ratios. As part of capacity planning, run “what if” scenarios to develop resource optimization strategies without the need for spreadsheets or complex scripts.
• Get clear explanations and recommended solutions to performance, capacity and configuration problems. Associate workflows with Smart Alerts to automatically initiate corrective measures at critical thresholds.

• Streamline problem remediation and enforcement of configuration standards to stay in control and save time, effort and cost. Useful pre-configured actions are available out-of-the-box and can be triggered in the context of an alert or at any time.

• Prioritize critical workloads by defining thresholds, alerts and configuration settings at a group level. For even more advanced monitoring, create custom policies for specific workload types, applications or clusters.

• Grant authorization based on personas (such as VI admin and storage admin), controlling access to objects, features, actions and reports at the individual level.

• Proactively enforce configuration standards, identify changes early on and automate remediation. Correlate change events to performance degradation occurring at any level of the environment.

Unified Management
• The re-architected platform offers the scalability and resiliency — plus the capabilities for automated failover and replication — required to support highly complex environments.

• Get intuitive visibility into all levels of infrastructure and applications through a single management console spanning multiple hypervisors, plus physical and cloud environments. Integrate monitoring dashboards for Hyper-V and Amazon as well as third-party Management Packs for leading applications.

• Understand availability, performance, utilization, events, logs, and changes across every layer of your virtualized, cloud and physical infrastructure—from vSphere hypervisor to guest operating systems, middleware and applications.

• See and understand the correlations between applications and supporting storage infrastructure, including HBAs, Fabric and Arrays. Easily identify storage-related issues such as configuration errors, resource starvation and performance bottlenecks, for complete App-to-VM-to-Storage visibility.

• Monitor and manage from a single vRealize Operations console, and feed performance data into the analytics engine for correlation with other infrastructure and application metrics, to enable truly unified operations management.

VMware vRealize Operations Management Packs
vRealize Operations product extensions and third-party integrations are typically delivered as one or multiple Management Packs. These Management Packs target infrastructure and Operating Systems. VMware vRealize Operations Management Packs extend the capabilities of vRealize Operations to third-party products and technologies to enable end-to-end operations intelligence with data visualizations, dashboards, reports, alerts, and actions. An Operations Management Pack can be delivered in the form of an agent plug-in, content pack, or compliance pack. vRealize Operations Management Packs extend the power of vRealize Operations to hybrid and heterogeneous environments, providing comprehensive visibility in a single operations console across applications, storage and network devices. This document explains the management pack for EMC Storage Analytics.
EMC VNX Family

The EMC VNX storage system is a powerful, trusted, and smart storage array platform that provides a high level of performance, availability, and intelligence in organizations within the business.

VSPEX private cloud customers can leverage the advanced storage tiering features and efficiencies of the VNX storage array to deliver multiple storage service levels to their various organizations, accelerating and simplifying their as-a-service offerings in their private cloud environment.

Virtual Provisioning

EMC Virtual Provisioning™ can reduce cost, improve capacity utilization, and simplify storage management. Users can present a large amount of capacity to a host and then consume space only as needed from a shared pool, reducing initial over-allocation of storage capacity. Virtual Provisioning can reduce labor costs by simplifying data layout and reducing the steps required to accommodate capacity growth.

Fully Automated Storage Provisioning for Virtual Pools (FAST™ VP)

EMC Fully Automated Storage Provisioning for Virtual Pools (FAST™ VP) for VNX optimizes efficiency across all drive types in the array to improve system performance while reducing cost. FAST VP dynamically allocates workloads based on the configured service level and moves workloads without disruption across drive types, optimizing overall system performance. FAST VP moves the most active parts of the workload to high-performance flash disks and the least frequently accessed data to lower-cost drives, leveraging the best performance and cost characteristics of the different drive types.

Unisphere

EMC Unisphere® is an intuitive management interface that allows IT managers to dramatically reduce the time required to provision, manage, and monitor storage assets. Unisphere delivers the simplification, flexibility, and automation that accelerate the transformation to the private cloud.

EMC Integration for VMware vSphere

EMC provides tight integration points for vSphere that simplify management and provisioning of storage. vRealize Operations Advanced also provides the capability to monitor the health and performance of storage resources on the VNX array from within.

EMC Virtual Storage Integrator

EMC Virtual Storage Integrator (VSI) is the free vCenter plug-in provided by EMC that extends the vCenter user interface (UI) to include additional EMC-specific capabilities. EMC VSI provides multiple feature sets including Storage Viewer (SV), Path Management, and Unified Storage Management. Unified Storage Management simplifies the provisioning of VNX virtual pooled storage for the private cloud.

VMware vStorage APIs - Array Integration (VAAI)

EMC VNX supports VMware vStorage APIs - Array Integration (VAAI), which offloads virtual machine storage operations to the array to optimize server performance. VMware environments support the following VAAI components:
Block

- Atomic Test and Set
- XCOPY
- Write Same
- Thin Provisioning

NAS

- Full File Clone
- Native Snapshot Support
- Extended Statistics
- Reserve Space

VMware vSphere Storage APIs for Storage Awareness (VASA)

VASA allows VMware administrators to view and classify, from a single location, VNX drive types in a more sophisticated way, using the storage vendors, VASA provider to interrogate the storage and classify it in terms of its attributes and underlying technology. This analysis can range from basic disk type to the RAID level, automated tiering capabilities, and replication status.

EMC Storage Analytics

EMC Storage Analytics (ESA) can be used as a plug-in with VMware’s vRealize Operations Manager to provide a powerful management tool for VMware and storage administrators to access real-time intelligent analytics for their VNX platform. This plug-in allows users to obtain detailed statistics via customizable dashboards, heat maps, and alerts while also accessing topology mapping in a VMware environment. In addition, ESA plug-in support is available for EMC VNKe®, VMAX®, VPLEX®, XtremI®O, ScaleIO® storage and RecoverPoint® for VM.

Hardware and Software List

Hardware List

This solution is built on top of a VSPEX configuration and assumes that the required hardware is installed and set up within the business according to the configuration guidelines in the EMC VSPEX Private Cloud: VMware vSphere Proven Infrastructure Guides.
Software List

The software listed below is an addendum to the software list found in the EMC VSPEX Private Cloud: VMware vSphere Proven Infrastructure Guides.

<table>
<thead>
<tr>
<th>Software</th>
<th>Configuration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMware vRealize Operations Manager</td>
<td>6.0.1 Build 2523163</td>
<td>VMware vRealize Operations Advanced</td>
</tr>
<tr>
<td>EMC Storage Analytics</td>
<td>3.2.1</td>
<td>EMC Storage Analytics Adapter</td>
</tr>
</tbody>
</table>
CHAPTER 3 ........................................................................................................................................18

Overview: VMware vRealize Operations Advanced Architecture.............................................18
Function in Overall Architecture.................................................................................................18
Distribution Formats ....................................................................................................................19
VRealize Operations Manager Components................................................................................21
Modifying Data Retention and Custom Parameters.....................................................................24
Security .......................................................................................................................................26
  vRealize Operations Manager Advanced................................................................................26
EMC Storage Design .....................................................................................................................28
  VNX storage tiering and FAST VP ............................................................................................28
  Storage Mapping .......................................................................................................................29
  EMC Virtual Storage Integrator (VSI) .......................................................................................29
  EMC Storage Analytics...............................................................................................................30
Chapter 3

Overview: VMware vRealize Operations Advanced Architecture

Function in Overall Architecture

The vRealize Operations platform requires integrations to properly operate and provide business value. The vApp (Virtual Application) version of vRealize Operations Manager requires a connection to a VMware vCenter Server. During the initial installation, a connection to a vCenter Server must be established to provide vRealize Operations Manager as the first integration point. This provides vRealize Operations Manager with the necessary metric and event data that vCenter Server collects and produces natively.

The connections from vCenter Server to vRealize Operations Manager provide information on the status of all the VMs and the supporting vSphere environment being managed. This status information is derived from the metrics relating to the virtual hardware that the VMs use, as well as the metrics relating to the VMware ESXi™ host hardware. Additionally, resource status is also established using the vCenter Server event-related information for the Virtual Machines and ESXi hosts. See Figure 1.

System Architecture

Figure 1. vRealize Operations Manager - Architecture
vRealize Operations Manager consists of one or more nodes in a cluster. Download and deploy the vRealize Operations Manager virtual machine, once for each cluster node.

Note: Do not deploy vRealize Operations from an ESXi host. Deploy only from vCenter Server.

Use a Web browser client to configure a newly added node as the vRealize Operations Manager master node, a data node, a high availability master replica node, or a remote collector node. The master node is required first.

**Distribution Formats**

The vApp is distributed as an Open Virtualization Format (OVF) file. The vSphere C# Client or vSphere Web Client provides an import vApp workflow that guides the deployment of the vApps in OVF format.

The vRealize Operations Manager vApp is managed using the Administration Portal, which is a web console for configuration and management tasks.

**vRealize Operations Manager Nodes**

All vRealize Operations Manager clusters consist of a master node, an optional replica node for high availability, optional data nodes, and optional remote collector nodes.

- **Master Node**
  
  The initial, required node in the cluster. The master node manages all other nodes.

  In a single-node installation, the master node must also perform data collection and analysis because it is the sole node, and the only place where vRealize Operations Manager adapters are installed.

- **Data Node**
  
  In larger deployments, additional data nodes have adapters installed to perform collection and analysis. Larger deployments usually include adapters only on data nodes, not on the master node or replica node.

- **Replica Node**
  
  To enable high availability (HA), the cluster requires that you convert a data node into a replica of the master node.

- **Remote Collector Node**
  
  Distributed deployments might require a remote collector node that can navigate firewalls, interface with a remote data source, reduce bandwidth across data centers, or reduce the load on the vRealize Operations Manager analytics cluster. Remote collectors only gather objects for the inventory, without storing data or performing analysis. In addition, remote collector nodes may be installed on a different operating system than the rest of the cluster nodes.

A vRealize Operations cluster can scale out by adding new DATA NODES as shown in Figure 2. A Data Node can work as a MASTER-REPLICA to always ensure a resilient master in case of the MASTER going down due to hardware or application failure.
Figure 2. vRealize Operations scale out cluster architecture
When installing vRealize Operations Manager use the vRealize Operations Manager vApp (Linux or Windows) deployment installer to create role-less nodes. After the nodes are created and have their names and IP addresses, use an administration interface to configure according to their role as shown in Figure 3.

You can create role-less nodes all at once or as needed. A common as-needed practice might be to add nodes to scale out vRealize Operations Manager to monitor an environment as the environment grows larger.

Figure 3. Web Interface administration page

### vRealize Operations Manager Components

vRealize Operations manager is a single VM / Appliance. Figure 1 shows the vRealize Operations Manager node architecture that consists of:

- UI:Admin/Product
- Collector
- Controller
- Analytics
- Persistence
- Databases

### vApp Components
UI: Admin/Product
With vRealize Operations 6, the Admin UI, vSphere UI & the Custom UI are combined into a single UI. The Admin UI would be used for the first time setup and then cluster management activities such as adding data nodes, removing data nodes, bringing the cluster online etc.

The Product UI is used for Application access where policies, Alerts, Custom Dashboards, Management Packs and other tasks can be setup.

Collector
Collector is responsible for capturing the data coming through the adapters.

Controller
Controller is used to map the collected data to the right resources and also retrieve data for the requested queries. It also plays a vital role in keeping the remote collectors informed about the changes happening in the system and the work they need to do to ensure consistency of data for all the resources being monitored by the system.

Analytics
The role of Analytics is to ensure that all the patented algorithms within vRealize Operations are applied to the collected data and functions such as super-metrics, dynamic threshold calculation, Alerts etc are calculated and then available for viewing, providing recommendations and taking actions.

Persistence
Persistence layer gives performance required for monitoring thousands of objects for which data is collected, stored, analyzed and retrieved at the speed of light.

Databases
There is also a change in the way the databases operate.

- FSDB - The File System Database is available in all the NODES of a vRealize Operations 6 Cluster deployments. This is where all the collected metrics are stored in the raw format.

- xDB (HIS) - The xDB is where the Historical Inventory Service data is stored. This is available only on the MASTER Node or the first node of the vRealize Operations Cluster. This would also be a part of the REPLICA node which is a true copy of the MASTER node for failover purposes.

- GLOBAL xDB/Alarm Alert - This is where the user preferences, alerts & alarms are stored. This is also where all the customizations related to vRealize Operations would be stored. Like xDB this is available only on the MASTER Node or the first node of the vRealize Operations Cluster. This would also be a part of the REPLICA node which is a true copy of the MASTER node for failover purposes.

Optimizing vRealize Operations Manager vCenter

Data Collection
Metric definitions provide an overview of how the metric value is calculated or derived. vRealize Operations Manager collects data from objects in the environment. Each piece of data collected is called a metric observation or value. vRealize Operations Manager uses the vCenter adapter to
collect raw metrics. vRealize Operations Manager uses the vRealize Operations Manager adapter to collect self-monitoring metrics. In addition to the metrics it collects, vRealize Operations Manager calculates capacity metrics, badge metrics, and metrics to monitor the health of your system.

The metrics reported for the system depend on the objects in the environment. The user can use metrics to help troubleshoot problems.

Use alert and symptom definitions with actionable recommendations to generate alerts that keep the user aware of problems that occur on objects. Use customize operational policies to determine how vRealize Operations Manager analyzes the objects and displays information about them, so that the users are notified when problems occur on those objects. Use super metrics, which combine metrics into formulas, to collect combinations of data from your objects.

A policy is a set of rules that users define for vRealize Operations Manager to analyze and display information about the objects in the environment. As shown in the Figure 4 the user can create, modify, and administer policies to determine how vRealize Operations Manager displays data in dashboards, views, and reports. vRealize Operations Manager Administrators assign policies to object groups and applications to support Service Level Agreements (SLAs) and business priorities. vRealize Operations Manager includes a library of built-in active policies that are already defined. vRealize Operations Manager applies these policies in priority order.

When a policy is applied to an object group, vRealize Operations Manager collects data from the objects in the object group based on the thresholds, metrics, super metrics, attributes, properties, alert definitions, and problem definitions that are enabled in the policy.

The default policy is a set of rules that applies to the majority of the objects. The Default policy appears on the Active Policies tab, and is marked with the letter D in the Priority column. The Default policy can apply to any number of objects.

Users can customize the default policy and base policies included with vRealize Operations Manager for the environment. Users can then apply the custom policy to groups of objects, such as the objects in a cluster, or virtual machines and hosts, or to a group that users create to include unique objects and specific criteria.
Modifying Data Retention and Custom Parameters

In certain situations, specifically with large vRealize Operations Manager deployments, it is recommended that the user adjust certain values to improve the performance and data collection of the vApp. These scenarios include, but are not limited to, the following:

- High-turnover virtual machine environment such as a View/VDI environment
- Low disk space or limited storage access due to approvals or expected use cases of the system
- Specific business use case requirements that only require specific data retention, either more or less than the default values
- Deletion scheduling of resources is higher than a normal environment
- Multi-tenant environment with self-service portals with high deletion of resources/objects

The advanced properties file contains further settings for the analytics process and other system variables for specific operations. The variables in the following section can be adjusted as needed in the environment depending on customer requirements.

Note: Location = /usr/lib/vmware-vcops/user/conf/analytics/advanced.properties

After each change, the user must restart the analytics service for changes to take effect. To restart, go to the Analytics VM and access the console session by SSH or direct console mode and typing: service vmware-vcops vcpods restart analytics.
Enable the new Combined DT Plug-in

vRealize Operations Manager includes a new dynamic threshold calculation plug-in that contains an enhanced algorithm that improves DT calculations. This algorithm is not enabled by default on new installations because it is a new feature typically used for large installations. Change the value from false to true, as shown in the example below, to enable this feature.

```
# Enable the Combined DT Plugin which implements the new algorithm
useCombinedDTPlugin=true
```

Advanced Configuration Changes: controller.properties

The controller configuration file contains additional settings for the controller. The following modifications can be adjusted for environments that have higher than normal turnover, or do not require extended data retention of deleted resources or objects.

**Note:** Location = /usr/lib/vmware-vcops/user/conf/controller/controller.properties

Automatically Delete Not Existing Resources

The user can set not existing resources, those resources and objects that have already been deleted in vCenter, to automatically delete. This feature helps to keep the vApp clean of old resources and objects that are no longer needed.

```
#automatically delete not existing resources
deleteNotExisting = true
```

Adjust the Time of Not Existing State

This setting relates to the Automatically Delete Note Existing Resources setting and controls the deletion period in hours that an object must be in the not existing state before it can be deleted. In the example below, the Time of Note Existing State is set at 48 hours. This means that, after an object is deleted in vCenter, 48 hours must pass before the object is deleted out of vRealize Operations.

```
# the number of hours for a resource to stay in NOT_EXISTING state
deletionPeriodInHours=48
```

Setting the Resource Deletion Schedule

This setting configures how often the resource scheduling should run to delete resources of the vApp.

```
#the number of hours between NotExistingResourceDeletion thread scheduling
deletionSchedulePeriod = 12
```
Security

vRealize Operations Manager Advanced

There are a number of areas where, by default, security is applied to a vRealize Operations Manager Advanced installation, or can be enhanced with extra configuration. These instances include the following:

- Limiting Exposure to Internal Services
- Embedded Firewall
- Embedded Encryption
- SSL vRealize Operations to Browser Communication
- Use LDAP Authentication

Following VMware’s best practices for vApps design, vRealize Operations Manager only exposes, outside of the vApp, those services that are absolutely required. Specifically, only SSH and HTTPS are open to by default.

The administrator does not have to take action for unnecessary services to be inaccessible.

Embedded Firewall

vRealize Operations Manager has a firewall enabled to prevent external attempts to access the port probe. The vApp exposes minimal network footprints using only the following ports for inbound connections:

- 443 (https)
- 22 (ssh)
- 80 (redirected to 443)

Additionally, the vApp creates an Open VPN tunnel between the two virtual machines using port 1194.

The administrator does not have to take action to enable firewall services.

Embedded Encryption

vRealize Operations Manager uses the Blowfish encryption protocol to secure all internal user accounts and external accounts. For example, this protocol encrypts all user credentials entered into vRealize Operations Manager and used to communicate with monitoring tools.

Managing Users and Access Control in vRealize Operations Manager

Each user must have a user account to use vRealize Operations Manager. Administrators can assign each user to be a member of one or more user groups, and apply roles to assign specific privileges to each user for authorization to perform actions.
User Access Control

To ensure security of the objects in your vRealize Operations Manager instance, as a system administrator you can manage all aspects of user access control. You create user accounts, assign each user to be a member of one or more user groups, assign roles to each user or user group to set their privileges, and select the objects in your environment that each user can access.

A role is a collection of action privileges that grants a user or user group the permission to access objects. Roles do not include privileges to view or configure objects. You must assign privileges to objects separately when you add or edit a user account.

There are several methods to authenticate users in vRealize Operations Manager.

- Use LDAP to import users or user groups from an LDAP database. LDAP users can use their LDAP credentials to log in to vRealize Operations Manager.
- Use vCenter Server users. After a vCenter Server user is registered with vRealize Operations Manager, the vCenter Server user that has vCenter Server assigned vRealize Operations Manager permissions can log in to vRealize Operations Manager.
- Create local user accounts in vRealize Operations Manager.

You must have privileges to access specific features in the vRealize Operations Manager user interface. The roles associated with your user account determine the features you can access and the actions you can perform.

As a system administrator, you assign a unique user account to each user so that they can use vRealize Operations Manager. You manage user passwords and the criteria used for account lockout, password strength, and the password change policy. With role-based access, users can only perform actions that their privileges allow.

When a user has permission to take action on an object, such as to delete a virtual machine, that user has the permission to perform the same action on any virtual machine that the user can access. For example, a user cannot have read-only permission on one virtual machine, and have read and write permission on another virtual machine.

vRealize Operations Manager uses the Lightweight Directory Access Protocol (LDAP) platform-independent protocol to access distributed directory services to obtain users and user group information that resides in an LDAP user database on another machine. You can then import user accounts or user groups from that LDAP user database.
EMC Storage Design

The VNX storage array provides many features that allow provisioning of the Private Cloud. Since this solution is built on top of a VSPEX Private Cloud, it uses the same storage configuration as mentioned in the VSPEX Private Cloud proven infrastructure documents. Additional storage service levels can be created within a VNX array to achieve different levels of performance. Most effectively align resources with performance requirements.

See EMC VSPEX Private Cloud: VMware vSphere Proven Infrastructure Guides for details.

VNX storage tiering and FAST VP

As validated in the VSPEX Proven Infrastructure, this solution uses EMC’s FAST VP technology, which enables storage tiering within the storage service level. Storage tiering is the assignment of data to different types, or tiers, of storage media to reduce total storage cost. FAST VP makes automatic storage tiering possible on VNX storage arrays. FAST VP operates by periodically relocating the most active data to the highest performance storage tier, while relocating less active data to the lower performing storage tiers, as appropriate, when new data is promoted.

FAST VP uses intelligent algorithms to continuously analyze devices at the sub-LUN level. This enables it to identify and relocate the specific parts of a LUN that are most active and would benefit from being moved to higher-performing storage such as enterprise flash drives. It also identifies the least active parts of a LUN and relocates that data to higher-capacity, more cost-effective storage. Performance measurement and user-defined policies determine data movement between tiers. FAST VP moves the data automatically and non-disruptively.

The VSPEX Private Cloud uses two disk types within the storage pool with each providing a different tier of performance and capacity, as shown in Figure 5.

![EMC VNX sub-LUN tiering of production LUN data across two disk types](image)
Storage Mapping

Figure 6 shows how the storage pool and LUNs are mapped to different enterprises within the business. The following explains the storage service level’s three cloud types:

Production clouds are organizational clouds for virtual machines with maximum performance requirements.

Test/Development clouds are organization clouds for virtual machines with medium performance requirements.

Archive/Low Cost clouds are organizational clouds for virtual machines with the least performance requirements.

Figure 6. Organization mappings for storage service levels

EMC Virtual Storage Integrator (VSI)

Because VSI is modular in design, administrators can add, remove and update features independently providing a flexible, customized user experience. Features available for VSI include Storage Viewer, Path Management, Symmetrix storage replication adaptor (SRA), Unified Storage Management, AppSync Management, and EMC RecoverPoint Management.

The three features used in this solution are as follows:

- **Storage Viewer** feature extends the VMware vSphere Client to facilitate the discovery and identification of VNX storage devices that have been provisioned to ESXi hosts and virtual machines. Storage Viewer presents the underlying storage details to the vSphere administrator by merging the data of several different storage-mapping tools into a few seamless VMware vSphere Client views.
- **Path Management** feature for VMware Native Multipathing and EMC PowerPath/VE provides a mechanism for changing the multipath policy for groups of LUNs based on storage class and virtualization objects.

- **Unified Storage Management** feature provides array-based storage management and provisioning for VMAX, VNX, VNXe, CLARiiON, Celerra arrays. This feature also allows for virtual machine decompression, compression, cloning and extending datastore capacity.

**EMC Storage Analytics**

EMC Storage Analytics (ESA) links VMware vRealize Operations Manager with EMC Adapter for the VNX family. vRealize Operations Manager displays performance and capacity metrics from EMC storage systems with data that the adapter provides by:

- Connecting to, and collecting data from, block and file systems
- Converting the data into a format that vRealize Operations can process
- Passing the data to the vRealize Operations collector

vRealize Operations Manager Advanced presents the aggregated data through alerts, dashboards, and in pre-defined reports that end users can easily interpret. EMC Adapter is installed with the vRealize Operations administrative user interface. See Figure 7.
CHAPTER 4 .................................................................................................................. 32

Overview..................................................................................................................... 32
Installing and configuring vSphere with Operations Management................................. 32
  Deploying vRealize Operations Manager..................................................................... 33
  vCenter Server Integrations....................................................................................... 33
Applying a vSphere with Operations Management License............................................. 33
Updating License from vSphere with Operations Management to vRealize Operations
Manager Advanced...................................................................................................... 35
Deploying EMC Storage Analytics................................................................................ 36
Chapter 4

Overview
This chapter introduces the steps and processes involved in deploying the solution.

- Install and Configure vSphere
- Deploy vRealize Operations Manager
- Upgrade to vRealize Operations Advanced
- Deploy EMC Storage Analytics (ESA)

Installing and configuring vSphere with Operations Management

Installing VMware vSphere 6 and vCenter Server 6

Complete these tasks to install and configure VMware vSphere and vCenter Server:

1. Install ESXi 6 hypervisor on the physical servers being deployed for the solution. Refer to the vSphere Installation and Setup Guide for more detail.

2. Configure ESXi networking including NIC trunking, VMkernel ports, virtual machine port groups, and enable Jumbo Frames. Refer to the vSphere Networking document for more detail.

3. Install and configure PowerPath/VE to manage multipathing for VNX LUNs (Block Only). Refer to PowerPath/VE for VMware vSphere Installation and Administration Guide for more details (block storage only).

4. Connect the VMware datastores to the ESXi hosts deployed for the solution. Refer to the vSphere Storage Guide for more detail.

5. Set the ESXi 6 host time.

6. Download.iso installer for the VMware vCenter Server Appliance™ 6 and Client Integration Plug-in from VMware’s distribution website. For more information on installation & deployment please refer to VMware vCSA deployment guide.

7. Connect the vCenter server to the ESXi host to be managed for this solution and add the license for vCenter Server.
Deploying vRealize Operations Manager

Complete these tasks to deploy and configure vRealize Operations Manager:

1. Download the OVF for vRealize Operations Manager from VMware’s distribution website. All vRealize Operations Manager clusters consist of a master node, an optional replica node for high availability, optional data nodes, and optional remote collector nodes. For more information refer to VMware Downloads.

2. Refer to the vRealize Operations Manager vApp requirements to understand the resources required for the vApp based on the scope of the resources that will be monitored. For more information, refer to the vRealize Operations Manager vApp Deployment and Configuration Guide.

3. Use the IP pools configuration option through vSphere Web Client to assign the network base address, netmask, and default gateway that will be assigned to a network used by the vApp.

4. Deploy the vRealize Operations Manager vApp from the vSphere Web Client.

vCenter Server Integrations

Integrating vRealize Operations Manager with vCenter Server enables vRealize Operations Manager to have visibility to the vSphere resources and virtual machines.

To add vCenter Server instances to vRealize Operations Manager, refer to the vRealize Operations Manager vApp Deployment and Configuration Guide.

Applying a vSphere with Operations Management License

Note: This is not a required step but it is shown as an example of upgrading a vRealize Operations Manager license from one edition to another. vSphere and vCenter Server licenses can be installed as standalone implementations.

Obtain the vSphere with Operations Management License from https://my.vmware.com/web/vmware/login. Adding a vSphere with Management license enables both VMware vSphere as well as the vRealize Operations Manager server in Standard mode.

Figures 8 and 9 show assets listed in the vCenter server before applying the vSphere with Operations Management license and the licensed products after applying the vSphere with Operations Management license.
### VSPEX Private Cloud with Operations Management Design and Implementation Guide

#### Licenses

<table>
<thead>
<tr>
<th>License provider</th>
<th>6.0 vCenter Server instances</th>
</tr>
</thead>
</table>

#### Getting Started

- **Getting Started**
- **Licenses**
- **Products**
- **Assets**

**vCenter Server systems**

**Hosts**

**Clusters**

**Solutions**

<table>
<thead>
<tr>
<th>Asset</th>
<th>Usage</th>
<th>Product</th>
<th>License</th>
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<td>Evaluation Mode</td>
<td>Evaluation License</td>
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<tr>
<td></td>
<td>2 CPUs</td>
<td>Evaluation Mode</td>
<td>Evaluation License</td>
<td>01/12/2015</td>
</tr>
</tbody>
</table>

**Figure 8. Unlicensed asset in vSphere Server**

<table>
<thead>
<tr>
<th>Asset</th>
<th>Usage</th>
<th>Product</th>
<th>License</th>
<th>License Expiration</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td>VMware vSphere with Operations Management &amp; vCenter with Operations...</td>
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<td>12/31/2016</td>
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<tr>
<td></td>
<td>2 CPUs</td>
<td>VMware vSphere with Operations Management &amp; vCenter with Operations...</td>
<td>vSphere with Operations Management</td>
<td>12/31/2016</td>
</tr>
</tbody>
</table>

**Figure 9. Licensed vSphere and vRealize Operations Manager after applying vSphere with Operations Management license**
Updating License from vSphere with Operations Management to vRealize Operations Manager Advanced

vSphere with Operations Manager enables the standard edition of vRealize Operations Manager. vRealize Operations Manager Standard Edition enables vSphere performance and capacity optimization with predictive analytics, Smart Alerts and policy-based automation. However; vRealize Operations Manager Advanced correlates data across applications and infrastructure in a unified management tool that is easy-to-use with customizable displays and reporting tailored to each team’s needs. It provides full control over performance, capacity, and configuration with predictive analytics and Smart Alerts to drive proactive action, as well as policy-based automation.

To update vRealize Operations Manager to the Advanced edition, obtain the license key from https://my.vmware.com/web/vmware/login

Complete the following steps to update to vRealize Operations Advanced:

1. Login to the vRealize Operations Manager.
2. Click on Home -> Administration -> Licensing -> Add.
3. Copy the obtained license and paste it in the Add License box.
4. Click Validate; and then Save.
5. Confirm the license of vRealize Operations Suite 6 Advanced Edition as shown in Figure 10.

Figure 10. vRealize Operations Manager updated to Advanced Edition
vRealize Operations Advanced Suite includes the following bundled products:

1. vRealize Operations Manager Advanced
2. vRealize Configuration Manager™
3. vRealize Hyperic
4. vRealize Infrastructure Navigator™

These additional components are installed separately and use the same license that was previously installed. For information on installation and configuration, please refer to the individual Installation and Configuration documentation section found here.

https://www.vmware.com/products/vrealize-operations/resources.html

Note: This section will focus on vRealize Operations Manager rather than the other components.

Deploying EMC Storage Analytics

vRealize Operations Advanced adds support for Management Packs that extends end-to-end operational intelligence with data visualizations, dashboards, reports, alerts, and actions. An Operations Management Pack can be delivered in the form of an agent plug-in, content pack, or compliance pack. vRealize Operations Management Packs extend the power of vRealize Operations Advanced to hybrid and heterogeneous environments, providing comprehensive visibility in a single operations console across applications, storage, and network devices.

EMC Storage Analytics Management Pack for vRealize Operations Manager collects performance metrics for EMC Arrays. It uses the EMC Adapter that’s bundled along with the Management Pack to collect data.

To install the EMC Storage Analytics Management Pack, perform the below steps:

1. Download the ESA 3.2.1 .pak file from the EMC Support Zone site.
2. Login to the console of vRealize Operations Manager and install the management pack following the EMC Storage Analytics 3.2.1 Installation and User Guide.
3. Add an EMC adapter instance for vRealize Server following the EMC Storage Analytics 3.2.1 Installation and User Guide.
4. Add an EMC adapter instance for the EMC storage used in vSphere following the EMC Storage Analytics 3.2.1 Installation and User Guide.
Figure 11. Dashboards with detailed analytic information for storage
CHAPTER 5

Overview............................................................................................................. 39
Verifying vRealize Operations Manager Implementation ................................. 39
Verifying the Upgrade to vRealize Operations Manager Advanced ...................... 39
Verifying EMC Adapter Configurations .......................................................... 40
Monitoring vRealize Operations Manager Objects .......................................... 45
vRealize Operations Manager vSphere Dashboard ........................................... 45
vRealize Operations Manager Badges ............................................................. 47
Monitoring VNX Health and Resources ........................................................ 50
  Storage Topology Dashboard .......................................................................... 51
  Storage Metrics Dashboard ........................................................................... 52
  VNX Overview Dashboard ........................................................................... 55
End-to-End VM to Storage Visibility .............................................................. 56
Capacity Planning and Optimization ............................................................... 58
Reporting ........................................................................................................... 64
Root Cause Analysis – Health Badge: ............................................................ 67
  Datastore Offline .......................................................................................... 67
Root Cause Analysis – Risk Badge: ................................................................ 71
  Raid Group capacity used (%) is high .......................................................... 71
Root Cause Analysis – Efficiency Badge: ......................................................... 73
  Raid Group capacity used (%) is low ........................................................... 73
Chapter 5

Overview

This chapter shows how to verify that the vRealize Operations Manager was upgraded correctly from Standard edition to the Advance edition and that the vRealize Operations Manager is able to poll analytic data both from vCenter and EMC storage arrays to present correlative data.

Verifying vRealize Operations Manager Implementation

Upgrading to vRealize Operations Manager Advanced and installing EMC Storage Analytics (ESA) gives the ability to monitor health of a virtual infrastructure and the virtual machines running on them. This data can be used to identify the root cause for performance bottlenecks across VMs, hosts, and storage. It can also help the IT operations staff plan resources by giving predictive data about capacity.

In order to correlate captured analytic data across hosts and storage systems, vRealize Operations Manager needs to interface with vCenter Server as well as EMC Storage Arrays. vRealize Operations Manager has adapters that can interface with each subsystem to collect analytic data. The following procedure identifies the upgrade of vRealize Operations Manager to the advanced edition and verifies the correct installation of the adapter instances used for data collection.

Verifying the Upgrade to vRealize Operations Manager Advanced

Perform the following steps after upgrading vRealize Operations License

1. Login to the vRealize Operations UI at https://<ip address of vcops>/vcops-web-ent/.
2. Click on Home-> Administration -> Licensing
3. Advanced edition is listed as per Figure 12.
In order for ESA to correlate data between the EMC array and virtual machines in the vCenter Server, it needs the adapters for VNX and vCenter to be operational. The following procedure verifies that the adapters are running correctly and that they are able to collect metric data from both vCenter Server and VNX.

### Verifying EMC Adapter Configurations

After adding adapters as mentioned in Chapter 4, use the following steps to verify that the EMC adapter for vCenter Server and VNX is able to collect data.

1. Login to the vRealize Operations Manager at https://<ip address of vrops>/vcops-web-ent/ as seen in Figure 13.
2. Click on Administration -> Solutions -> Adapter Instance -> Configure (Next to Add sign)
3. Fill the details and hit the test button to see a success message.

From the Administration page, under solutions, the adaptor instances are listed. The adapter instance test runs successfully and is listed under storage system. See Figures 14-21.
Figure 13. vRealize Operations Login Page

Figure 14. Adapter instance list
Figure 15. Verifying vCenter Server adapter instance

Figure 16. vCenter Server adapter successful test
Figure 17. vCenter Server successful entry

Figure 18. Verifying EMC Adapter
Figure 19. EMC Adapter successful test

Figure 20. EMC Adapter successful entry
Management operations in cloud environments include ensuring service levels, problem solving, troubleshooting, and preventative maintenance. Successfully meeting these requirements involves the analysis of current utilization, forecasting of future needs, and the optimization of current resource consumption by reclaiming underutilized resources.

The in-depth infrastructure and operations information provided by VMware vRealize Operations Advanced eliminates time-consuming problem resolution processes through automated root cause analysis. Self-learning performance analytics and dynamic thresholds adapt to the environment to simplify operations management and eliminate false alerts. Integrated smart alerts for health, performance, and capacity degradation identify performance problems before they affect end users. Advanced capacity analytics allow administrators to optimize virtual machine density and identify capacity shortfalls before they affect end users. To manage the environment as a proactive rather than reactive administrator, monitor and respond to alerts. A generated alert notifies the administrator when objects in the environment are experiencing problems. If this can resolve the problem based on the alert before the end user notice, then service interruptions can be avoided.

vRealize Operations Manager vsphere Dashboard

Once implemented and configured the vsphere UI provides a comprehensive insight into the environment, as shown in Figures 22-23. The main dashboard is divided into three logical entities providing high-level information about the current overall health and issues of all managed resources, potential future issues and risks in the environment, and resource efficiency trends in the environment.
Figure 22. Default Dashboard home page

Figure 23. Main vSphere dashboard in vRealize Operations Manager
The three primary logical entities in vRealize Operations Manager can be explained as follows:

- **Health** calculates health scores based on patented algorithms that dynamically calculate thresholds by observing the behavior trends of the cloud environment. This information gives visibility into the red, yellow, green status of the virtual machines, datastores, and clusters. The administrator can see where the problems are, what the issue is, and if there is any pattern of abnormal behavior in the environment.

- **Risk** provides insight into the resource consumption to tell the administrator not only when the vSphere environment will run out of capacity, but also which resources will run out.

- **Efficiency** aims to help administrators proactively optimize the environment and reclaim waste.

**vRealize Operations Manager Badges**

vRealize Operations Manager uses badges to illustrate derived metrics and to provide an overview of the state of the virtual environment or an individual object. These badges serve as focus points to narrow the scope of a potential problem and provide details about the cause of the problem.

Major badges are color coded and range from a healthy green to a potentially problematic yellow, orange, or red. Badges are organized in a simple hierarchy in which these badges are defined through Alerts which are generated by vRealize Operations.

Scores might reflect a healthy state or a potential problem depending on the type of badge. For example, low scores for health, time remaining, and capacity remaining might indicate potential problems, while low scores for faults, stress, or anomalies indicate a normal state.

**Navigation and Troubleshooting**

In vCenter Operations Manager 5.x, the badge scores represent a particular Super Metric. While the shape of the badges remains the same, the scores are GONE. As the scores are no longer displayed, the badge colors are still driven by the thresholds. In fact, if user move the mouse pointer on one of the badge, user will see the score popping up (See figure 24). Digging down deeper into badges, the scores for specific objects can be seen in the inventory.

Below screenshot checking the health score for a vSphere World group in the vRealize Operations inventory.
Figure 24. Checking the health score for a vSphere World group

The vRealize Operations Manager dashboards provide a wide number of different insights into infrastructure condition and enable simple and easy analysis of the root cause of problems. For example, suppose the overall environment condition for health is represented with a green badge value. But going deeper to the analysis the administrator can get brief information about the objects. In the example used in Figure 25, the orange icon on the top row of the Health Weather Map is related to a particular Host on a VNX datastore, indicated with a Health value of 75 which indicates issues on storage sensors. vRealize Operations manager also have added feature of recommendation for the issues found which is quite helpful for understanding & solving the issue as shown in Figure 27.
Figure 25. Warning for a Host in Health Weather Map

Figure 26. Top health alerts
Monitoring VNX Health and Resources

vRealize Operations Manager integration with EMC Storage Analytics (ESA) software delivers custom analytics and visualizations that provide deep visibility into the EMC infrastructure and enable the administrator to troubleshoot, identify, and take quick action on storage performance and capacity management problems.

**Note:** vRealize Operations Manager Advanced edition or higher is required to integrate with EMC Storage Analytics

By default, EMC Storage Analytics (ESA) provides many dashboards to view metrics. It provides users with real-time information about potential problems in the enterprise. The standard dashboards are delivered as templates. The table below lists the 2 universal ESA dashboards and EMC’s product specific dashboards that are available.
Figure 28. Dashboard-to-product matrix

Storage Topology Dashboard

The Storage Topology dashboard, displayed in Figure 29, shows in this example a configured VNX arrays also referred to as adapter instances. When an array is selected from the Storage System Selector pane, the Topology and Resources panes are populated with associated underlying components. ESA pulls in all related VMware objects, making it possible to navigate end-to-end into the underlying storage array components. These components include vSphere datastore clusters, LUNs, storage pools, and storage processors. The instance in Figure 29 shows that the LUN VNX-ESA is created from the Raid group 9 and uses Storage Processor A. These details are presented graphically in the Storage Topology and Health pane and are also presented as parent and child resources in their respective panes.
Figure 29. Storage Topology Dashboard

**Storage Metrics Dashboard**

The second universal dashboard, shown in Figure 30, is for Storage Metrics. Each EMC resource has an associated set of metrics associated displayed in a graph. Navigation is driven from the top down, so after choosing the storage system and specific resources, the user can select multiple metrics to be displayed in the Metric graph.
The Storage Metric dashboard in ESA shows Performance related metrics such as Queue Length, Read/Write IOPS, and Service time. The matrices present a detailed performance overview of a dashboard. Performance analysis with these matrices can help root cause analysis of performance bottlenecks at a granular level. vRealize Operations Manager standard edition has a limited number of these matrices. Figures 31-32 show differences in matrices available for datastores in an ESA Storage metric dashboard and vSphere dashboard.
Figure 31. Storage Metrics ESA home screen

Figure 32. Storage Metrics vSphere Dashboard home screen
VNX Overview Dashboard

VNX arrays have their own specific dashboard, EMC Performance Overview, which presents details in the form of heat maps, as shown in Figure 33. This dashboard covers the main storage system resource types including Storage Processors/Data Movers, FAST Cache Performance, Storage Pools/RAID Groups, and LUNs/Filesystems. The heat map colors work on two different levels. There is a green-to-red legend for some resources types which represents either usage (i.e., Storage Pool/RAID Group allocation) or performance (i.e., latency). For any one of the objects shown, a full historical perspective is available on the Storage Metrics page.

Figure 33. ESA VNX overview

The ESA VNX overview dashboard shows the CPU utilization and health of the Storage processors along with detailed metrics on the LUNs such as LUN Utilization, Latency, IOPS, etc. Click on details to examine more information about that object, which also provides powerful tools for analyzing the resources and the performance of environment as shown in below Figure 34.
Figure 34. Details for the LUN

**End-to-End VM to Storage Visibility**

vRealize Operations Manager with ESA adapter brings in all the resources from the array and builds the right parent-child relationships from the datastores down to the component LUNs, Fast Cache, Raid Groups, Disks and Storage Processor. VNX Topology and VNX Metrics dashboard shown in Figures 35-36 provide a graphical overview of VM to Disks Parent-Child Relationship.
Figure 35. VM-Disks relationship in VNX topology dashboard

Figure 36. VM-Storage relationship in VNX Metrics dashboard
Capacity Planning and Optimization

vRealize Operations Manager continues to lead the industry with its capacity planning functionality by enhancing its capacity algorithms, providing even more flexibility, better out of the box default options and initial configuration wizards to help setting up capacity policies. New capacity planning and project management capabilities extend beyond vSphere and across physical and application level metrics. vRealize Operations Manager with ESA management pack will allow users to plan capacity more at storage resources (Raid Group, Storage Pool, LUN etc…). Figures 37-38 show differences of capacity remaining on vSphere and ESA management pack.

Figure 37. Capacity Remaining on vSphere Infrastructure
Flexible capacity models can be adjusted to meet different business needs. vRealize Operations Manager also extend its capacity planning beyond the virtual environment and into heterogeneous environments for storage, network, operating systems, applications, etc. “What-If” scenarios have also been replaced by “Capacity Projects” with new added functionalities like the ability to save multiple capacity modeling projects. They are also able to define these projects as “Planned” or “Committed” projects to visualize the impact of these projects in the UI. What these means is “Capacity Remaining” and “Time Remaining” will be reflected to include “Committed” projects in vRealize Operations. The capacity planning component of vRealize Operations Manager provides statistics on current utilization, as shown in Figure 39.

Figure 38. Capacity Remaining Planning with EMC Storage Analytics on Raid Group
Figure 39. Capacity Remaining on vSphere Infrastructure

According to the Capacity Remaining statistics in the current environment vRealize Operations Manager also provides with the number of VMs that would be fitting to the current infrastructure as per details of the VM profiles – Small, Average, Large and Medium, see Figure 40.

Figure 40. What will fit scenarios according to the Datacenter
The capacity-remaining figures are based on demand and consumption trends of the currently operating virtual machines. To plan for capacity requirements for future growth, the administrator can create Projects that contain – Add Capacity, Remove Capacity, Change Capacity, Add Demand, Remove Demand and Change demand. Virtual machine profile can be based on an existing virtual machine, or even specified manually.

The virtual machine profile can be tailored to specify not only the allocation of resources, but also their actual usage and consumption. As shown in Figure 41, adding 5 new virtual machines has been successfully run through, the details displayed for virtual machine capacity are updated to display the current actual capacity remaining as well as the potential capacity if the project was implemented.

Figure 41. Creation of Projects – Planning additional Virtual Machines

Another added advantage of latest version of vRealize Operations Manager is creating and combining multiple projects together considering future planning as shown in Figure 42.
Figure 42. Adding and combing multiple projects

Similarly vRealize Operations Manager with EMC Storage Analytics can give users ability to create and combine multiple projects at storage level. Figure 43 shows Raid Group 9 with less than 20% used of total usable capacity, but while considering future requirements and creating multiple projects and combining them together shows shortfall of capacity, see Figure 44-45.

Figure 43. Raid Group indicating less utilization
Figure 44. Creating project at Storage level

Figure 45. Combining multiple projects at Storage level
Reporting

The reports in vRealize Operations Manager allow users to keep track of current resources as well as to predict potential risks to the environment. Automated reports can be scheduled at regular intervals to increase the visibility into the health and stability of the infrastructure. vRealize Operations Manager comes with several reports out of the box, but the custom reports can also be created. User can download the report in a PDF or CSV file format for future and offline needs.

Adding ESA with the vRealize Operations Manager, reporting functions can generate a report to capture details related to current or predicted resource needs at Array Level as shown in Figure 46.

Figure 46. Report Template

Apart from existing reports templates custom report can also be created. Following are the steps to create custom reports in vRealize Operations:

1. Login to <vrops ip address>/vcops-web-ent with admin credentials.
2. Click on Home-> Content -> Reports -> Add.
3. New Window for creating a custom report will opened.
4. Mention the Name and Description as desired.
5. Expand Views and Drag the content from the left pane.
6. Expand Format and select the format of the report.
7. Finally expand the Layout option and select as required

8. Click save.

Created custom template will be available in Report Template. See Figures 47-51

Figure 47. Creating Custom report

Figure 48. Selecting View for custom report
Figure 49. Selecting Format for Custom Report

Figure 50. Selecting Layout Options for Custom report
Figure 51. Created Custom report available in Report Template

Root Cause Analysis – Health Badge:

Datstore Offline

Figure 52. Normal “healthy” vRealize Operations Manager Dashboard
vRealize Operations Manager provides root-cause analysis for alarms triggered on various resources. These analyses show the most immediate reason for an alarm. Figure 52 shows a healthy environment and Figure 53 shows datastore offline. It is not possible to determine any extra details on the problems since the storage system is offline. However, Figures 54-57 shows that, when using vRealize Operations Manager Advanced with ESA, additional information available. Like Relationship of the object in VNX topology, details of the issue i.e. the storage connectivity is lost between the host and the storage system.
Figure 54. Relationship between the objects of underlying storage infrastructure

Figure 55. Health status of the effected object
Figure 56. Cause of the issue

Figure 57. Alert details of the datastore
Root Cause Analysis – Risk Badge:

Raid Group capacity used (%) is high

Figures 58-60 explains the high utilization of Raidgroup which is beyond 90% and is recommended to extend the capacity of effected raid group. High Capacity utilization at Raidgroup level was available only because when using vRealize Operations Manager Advanced with ESA.

Figure 58. vRealize Operations Manager Dashboard Risk Badge
**Figure 59. Raid Group Utilization**

**Figure 60. Details of high utilization of a raid group**
Root Cause Analysis – Efficiency Badge:

Raid Group capacity used (%) is low

Figures 61-63 explain the low utilization of Raidgroup 9 which is less than 5%. Low Capacity utilization at Raidgroup level was available only because when using vRealize Operations Manager Advanced with ESA.

![vRealize Operations Manager Dashboard Efficiency Badge](image)

Figure 61. vRealize Operations Manager Dashboard Efficiency Badge
Figure 62. Raid Group Utilization

Figure 63. Details of Low utilization of raid group
CHAPTER 6
Overview: vRealize Operations Manager vApp Sizing Considerations .......................... 76
Detailed Storage Capacity and I/O Considerations ................................................. 80
Interoperability Matrix ......................................................................................... 81
Chapter 6

Overview: vRealize Operations Manager vApp Sizing Considerations

Prior to deploying the vRealize Operations Manager vApp, it is important to understand the size of the target environment. The vRealize Operations Manager Installation Guide defines scale in terms of virtual machine count. The following table summarizes these requirements.

Table 1. vRealize Operations Manager vApp sizing examples.

<table>
<thead>
<tr>
<th>Node Size</th>
<th>Extra Small</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
<th>Standard Size Remote Controller</th>
<th>Large Size Remote Controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>vCPU</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>16</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Memory (GB)</td>
<td>8</td>
<td>16</td>
<td>32</td>
<td>48</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>IOPS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk Space</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single-Node Maximum Objects</td>
<td>1000</td>
<td>2000</td>
<td>6000</td>
<td>10000</td>
<td>15000 (***)</td>
<td>10000 (***)</td>
</tr>
<tr>
<td>Single-Node Maximum Collected Metrics (*)</td>
<td>500000</td>
<td>1000000</td>
<td>3000000</td>
<td>5000000</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Multi-Node Maximum Objects Per Node (**)</td>
<td>NA</td>
<td>2000</td>
<td>4000</td>
<td>8000</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Multi-Node Maximum Collected Metrics Per Node (***)</td>
<td>NA</td>
<td>1000000</td>
<td>2000000</td>
<td>4000000</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Maximum Objects for B-Node Maximum (**)</td>
<td>NA</td>
<td>16000</td>
<td>32000</td>
<td>64000</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Maximum Metrics for B-Node Configuration (****)</td>
<td>NA</td>
<td>8000000</td>
<td>8000000</td>
<td>20000000</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

(*) Metric numbers reflect the total number of metrics that are collected from all adapter instances in vRealize Operations Manager. To get this number, you can go to the Cluster Management page, and view the adapter instances of each node at the bottom of the page. You can get the number of metrics collected by each adapter instance. The sum of these metrics is what is estimated here.

Note: The number shown in the overall metrics on the Cluster Management page reflects the metrics that are collected and the metrics that vRealize Operations Manager creates.

(**) In large, B-node configurations, note the reduction in maximum metrics to permit some head room.

(***) The object limit for the remote collector is based on the VMware vCenter adapter.

Note: The disk I/O requirements represent an aggregate requirement for the entire vApp; however the majority of the I/O generated is a result of the metrics collection from the VM. Furthermore the I/O is typically biased towards write operations; the exception being the daily analytics process that results in large quantities of combined reads and writes in order to update the metrics contained in the FSDB.

Detailed CPU and RAM Considerations Explained
Although the sizing guidance from the installation guide defines environment scale with respect to the quantity of virtual machines, it is important to recognize that this has been adopted to provide a familiar approach for customers to understand. The real determining factor influencing the deployment configuration, in particular for CPU and memory, is the number of metrics being collected. In fact, the previously defined VM-based sizing recommendations from the vRealize Operations Manager Installation Guide are actually derived depending on the number of Objects and Metrics and size of the nodes.

- Maximum number of remote collectors (RC) certified: 50
- Maximum number of VMware vCenter adapter instances certified: 50
- Maximum number of VMware vCenter adapter instances that were tested on a single collector: 30
- Maximum number of certified concurrent users per node (regardless of node size): 4
- If High Availability (HA) is enabled, then the number of the nodes will be two times more than in a non HA configuration - 8 nodes is the limit. User do not need to account for any HA overhead beyond that.

An object in this table represents a basic entity in vRealize Operations Manager that is characterized by properties and metrics that are collected from adapter data sources. Example of objects include a virtual machine, a host, a datastore for a VMware vCenter adapter, a storage switch port for a storage devices adapter, an Exchange server, a Microsoft SQL Server, a Hyper-V server, or Hyper-V virtual machine for a Hyperic adapter, and an AWS instance for a AWS adapter.

- The limitation of a collector per node: The object or metric limit of a collector is the same as the scaling limit of objects per node. The collector process on a node will support adapter instances where the total number of resources is not more than 2400, 5000, and 10000 respectively, on a small, medium, and large multi-node vRealize Operations Manager cluster. For example, a 4-node system of medium nodes will support a total of 20000 objects. However, if an adapter instance needs to collect 8000 objects, a collector that runs on a medium node cannot support that as a medium node can handle only 5000 objects. In this situation, you can add a large remote collector or use a configuration that uses large nodes instead of small nodes.

- If the number of objects is close to the high-end limit, dependent on the monitored environment, increase the memory on the nodes.

In the KB article 2109312 VMware has also attached a nice excel spreadsheet with sizing guidelines. It is recommended using this before installing vRealize Operations. In this spreadsheet there are two versions that can be used – Basic and Advanced.

The basic version can be used with vSphere-only management pack, hence vCenter servers can be used as the only data source. User can basically fill in the following options:

- **High Availability** = Enabled / Disabled
- **Data Retention (month)** = 6 (default and recommended)
- **Virtual Machines** = Numbers of VMs
- **Hosts** = Number of Hosts
- **Datastores** = Number of Datastores
As per the parameters it will recommend the user to choose the appropriate deployment configuration and how many appliances would be needed to deploy. It will estimate the disk capacity size and IOPS requirement, based on the input as shown in Figure 64.

![System Sizing Estimate for the vSphere Management Pack only](image)

**Recommendation Summary (options are provided for different node configurations)**

<table>
<thead>
<tr>
<th>Node form factor</th>
<th>Number of nodes</th>
<th>Data disk size per node (GB)</th>
<th>IOPs per node</th>
<th>Total vCPUs</th>
<th>Total memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra Small</td>
<td>Not supported</td>
<td>Not supported</td>
<td>Not supported</td>
<td>Not supported</td>
<td>Not supported</td>
</tr>
<tr>
<td>Small</td>
<td>2</td>
<td>423</td>
<td>563</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>Medium</td>
<td>2</td>
<td>438</td>
<td>563</td>
<td>16</td>
<td>64</td>
</tr>
<tr>
<td>Large</td>
<td>2</td>
<td>463</td>
<td>563</td>
<td>32</td>
<td>96</td>
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</tbody>
</table>

Figure 64. Basic Version Spreadsheet for vSphere-only management pack

Similarly if user configures vRealize Operations with additional data sources, there is an option to choose the advanced spreadsheet. In this spreadsheet user will be prompted for additional information, to calculate the sizing requirements for the environment, as shown in Figure 65. Based on this input it will recommend the user to choose the appropriate deployment configuration and how many appliances would be needed to deploy.
### System Sizing Estimate

#### Input

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<th>High Availability</th>
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<td>Data Retention (M)</td>
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#### vCenter Objects

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<th>Metrics 1</th>
<th>Collected Metric</th>
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<tbody>
<tr>
<td>Virtual machines</td>
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<td>88</td>
<td>176</td>
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<tr>
<td>Datacenters</td>
<td>5</td>
<td>79</td>
<td>375</td>
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<td>Clusters</td>
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<td>167</td>
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<tr>
<td>Virtual machines</td>
<td>3,000</td>
<td>450</td>
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<tr>
<td>Hosts</td>
<td>150</td>
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<tr>
<td>Datastores</td>
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<td>43,000</td>
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<tr>
<td>Total vCenter Objects</td>
<td>0.767</td>
<td>vCenter Alarms: 1,495,427</td>
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#### Hyperic Objects

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<th>Collected Metric</th>
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</thead>
<tbody>
<tr>
<td>Total Hyperic Objects</td>
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<td></td>
<td></td>
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#### Management Pack for Storage Devices Objects

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<th>Collected Metric</th>
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</thead>
<tbody>
<tr>
<td>Total MP SD</td>
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#### NSX-vSphere

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<th>Collected Metric</th>
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<td>Total NSX-vSphere</td>
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#### V4I

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<td>-</td>
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<tr>
<td>Number of RD Session</td>
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<td></td>
</tr>
<tr>
<td>View RD Session/Files</td>
<td>150</td>
<td></td>
<td></td>
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<tr>
<td>Total V4I objects</td>
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<td></td>
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</tr>
</tbody>
</table>

#### EMC VNX Array

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<th>Resource</th>
<th>Metrics 1</th>
<th>Collected Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total EMC Array</td>
<td>50</td>
<td></td>
<td>EMC VNX Array:</td>
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#### NetApp Filers

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<th>Resource</th>
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<th>Collected Metric</th>
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<tr>
<td>Total NetApp Objects</td>
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<td></td>
</tr>
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</table>

#### System Centre Operations Manager

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<th>Resource</th>
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<th>Collected Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total SCOM Objects</td>
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<td></td>
<td>SCOM Object</td>
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</tbody>
</table>

#### AWS

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<th>Resource</th>
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<th>Collected Metric</th>
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</thead>
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<tr>
<td>Total AWS Objects</td>
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<td></td>
<td>AWS Object</td>
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</tbody>
</table>

#### Other Data Sources

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<th>Resource</th>
<th>Metrics 1</th>
<th>Collected Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td>Other Object</td>
</tr>
</tbody>
</table>

#### Total

<table>
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<th>Object</th>
<th>Resource</th>
<th>Metrics 1</th>
<th>Collected Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Object</td>
<td>3,817</td>
<td></td>
<td>1,495,427</td>
</tr>
</tbody>
</table>

### Recommendation Summary (options are provided for different node configurations)

<table>
<thead>
<tr>
<th>Node form factor</th>
<th>Number of nodes</th>
<th>Data disk size per node(GB)</th>
<th>IOPS per node</th>
<th>Total vCPU</th>
<th>Total memory(GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra Small</td>
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<td>Not supported</td>
<td>Not supported</td>
<td>Not supported</td>
<td>Not supported</td>
</tr>
<tr>
<td>Small</td>
<td>Recommend using larger nodes</td>
<td>Recommend using larger</td>
<td>Recommend</td>
<td>Recommend</td>
<td>Recommend using larger</td>
</tr>
<tr>
<td>Medium</td>
<td>2</td>
<td>771</td>
<td>1,142</td>
<td>16</td>
<td>64</td>
</tr>
<tr>
<td>Large</td>
<td>2</td>
<td>798</td>
<td>1,142</td>
<td>32</td>
<td>96</td>
</tr>
</tbody>
</table>

**Note:** The sizing guidelines for vRealize Operations Manager 6.0.1 are outlined in the spreadsheet attached at [http://kb.vmware.com/kb/2109312](http://kb.vmware.com/kb/2109312)
Detailed Storage Capacity and I/O Considerations

Storage sizing considerations are again defined based on the scale of monitored environment. Although the installation guide defines scale in terms of virtual machine count, this is again aimed at achieving familiarity for customers. As with the CPU and memory sizing recommendation, the considerations for storage sizing are more accurately defined by metric count. This is true for both capacity and I/O requirements. The capacity requirements for vRealize Operations are derived from a product of the following parameters:

- Metric count
- Metric collection frequency (every 5 minutes)
- Metric retention period (default of 6 months)
- Metric storage requirement (16 bytes per metric)

Using these assumptions in conjunction with the previously defined VM-based sizing approach, it is possible to determine the amount of storage capacity required. This is calculated as follows:
# Interoperability Matrix

Table 2. Product Interoperability Matrix

<table>
<thead>
<tr>
<th>Platform</th>
<th>vRealize Operations Manager 6.0.1</th>
<th>vRealize Operations Manager 6.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMware vCenter Server 6.0</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>VMware vCenter Server 5.5 U2</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>VMware vCenter Server 5.5 U1</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>VMware vCenter Server 5.5</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>VMware vCenter Server 5.1 U3</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>VMware vCenter Server 5.1 U2</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>VMware vCenter Server 5.1 U1</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>VMware vCenter Server 5.1</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>VMware vCenter Server 5.0 U3</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>VMware vCenter Server 5.0 U2</td>
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<tr>
<td>VMware vCenter Server 5.0</td>
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<td>✔</td>
</tr>
<tr>
<td>VMware vCenter Server 4.1 U3</td>
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<td>✔</td>
</tr>
<tr>
<td>VMware vCenter Server 4.1 U2</td>
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</tr>
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</tr>
<tr>
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