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1. Getting Started

1.1 About This Guide

The purpose of this document is to support a self-guided, hands-on evaluation of VMware® vCenter™ Operations Standard. This document is intended to provide IT professionals with the necessary information to monitor and manage the performance of their virtual datacenter environment using VMware vCenter Operations Standard.

1.2 How to Use This Guide

This guide will walk users through some key use cases for VMware vCenter Operations Standard to help you conduct a successful product evaluation. The content includes an overview, installation and configuration, and key use cases of VMware vCenter Operations Standard to demonstrate how to diagnose and correct performance problems in the virtual infrastructure.

1.3 Help and Support During the Evaluation

This guide is not intended to be a substitute for product documentation. For detailed information regarding installation, configuration, administration, and usage of VMware products, refer to the online documentation. You can also consult the online Knowledge Base if you have any additional questions. If you require further assistance, contact a VMware sales representative or channel partner.

The following are some links to online resources, documentation and self-help tools:

**VMware vSphere™ and VMware vCenter Server Resources:**
- Product overview
- Product documentation
- White papers and technical papers

**VMware vCenter Operations Standard resources:**
- Product overview
- Product documentation
- VMware vCenter Operations Standard community
- Support Knowledge Base
  [http://kb.vmware.com](http://kb.vmware.com)
2. What is VMware vCenter Operations Standard?

Operations Management disciplines are converging in the cloud. Performance, capacity and configuration management are becoming inseparable due to the dynamic nature of converged infrastructure. Traditional tools and processes designed for siloed, static physical infrastructures don’t provide the automation and control needed to effectively manage highly virtualized and private cloud environments. From the leader in virtualization and cloud infrastructure, VMware vCenter Operations Standard is designed to dramatically simplify and automate Operations Management.

VMware vCenter Operations Standard is a revolution in real-time performance management for virtual environments. With VMware vCenter Operations Standard, administrators are able to diagnose and repair performance problems while effectively balancing divergent goals in managing their virtual environment, including:

- Maximizing the performance of individual virtual components to proactively ensure service levels in dynamic virtual and cloud environments
- Optimizing the performance of your entire virtual infrastructure while maintaining high VM to ESX consolidation ratio
- Forecasting and keeping capacity on hand to handle business growth and other changes

VMware vCenter Operations Standard fills the existing gap for automated performance management for VMware administrators with patented learning-based analytics and an elegant and easy-to-use web-based interface. VMware administrators no longer must rely on classic monitoring tools and techniques that provide limited insight into the performance of their virtual infrastructure. With the introduction of VMware vCenter Operations Standard, they are provided with a detailed behavioral analysis of the entire virtual environment. VMware vCenter Operations Standard collects and analyzes performance data, correlates abnormalities and identifies the root cause of building performance problems. VMware vCenter Operations Standard abstracts performance to three measures – Workload, Health and Capacity – that allow instant identification of issues from the datacenter level down to individual components.

The benefits of VMware vCenter Operations Standard include:

- Unprecedented visibility into the virtualized environment in one screen; increased ability to isolate visually problems via a HUD-like interface to VMware vCenter
- Simple interface, reducing the complexity of VMware vCenter and removing guesswork and speeds MTTR
- Massive optimization of metric data storage and analysis; patented analytics calculate health, capacity and workload for any element
- Achievement of greater density of virtual machines per ESX, as well as optimization of resource usage, ensuring consistent and maximized ESX workloads
- Immediate visibility into the impact of a change through visual correlation to the component’s health; determine if a change has a positive (expected) or negative (unexpected) effect on the virtual element

VMware vCenter Operations Standard is shipped as a virtual appliance—a preconfigured virtual machine image that contains an operating system and application software in a ready-to-use configuration—installed in the VMware vSphere environment. VMware vCenter Operations Standard is built for smaller vCenter environments (<= 1500 VMs). The virtual appliance includes the following components:

- Administrative server – provides a user interface for the VMware vCenter Operations Standard system administrator to configure and maintain the virtual appliance
- Analytics server – hosts an operating system and the VMware vCenter Operations Standard application
- Database server – stores performance data collected from objects managed in VMware vCenter
- Collector server – collects inventory and performance data
The VMware vCenter Operations Standard user interface can be accessed in two ways—from a plug-in to the vSphere Client or directly from a Web browser. No changes to your VMware vCenter setup, such as modifying the logging levels, are required. VMware vCenter Operations Standard begins collecting performance data shortly after installation, using standard vSphere APIs. Data collection remains continuous unless you stop VMware vCenter Operations Standard. VMware vCenter Operations Standard collects performance data from each object at every level of your virtual infrastructure, from individual virtual machines and disk drives to entire clusters and datacenters. It stores and analyzes the data, and uses that analysis to provide real-time information about problems, or potential problems, anywhere in your enterprise.

VMware vCenter Operations Standard works with existing VMware products to add the following functions:

- Combines key metrics related to CPU, memory, disk and network into single scores for performance, health and capacity
- Calculates the range of normal behavior for every metric, and highlights abnormalities; adjusts the dynamic thresholds as incoming data enables it to define more accurately the normal values for a metric
- Presents graphical representations of current and historical states of the entire virtual infrastructure or selected parts of it
- Displays information about changes in the hierarchy of the virtual infrastructure; for example, when a virtual machine is moved to a different ESX host, shows how these changes affect the performance of the objects involved

The next sections in this guide will detail how to conduct a successful evaluation of VMware vCenter Operations Standard.
3. System Requirements

3.1 Hardware and Software Requirements

VMware vCenter Operations Standard typically is configured in an existing environment and does not require an isolated dedicated environment for evaluation purposes. The minimum hardware requirements for a successful evaluation include the following components:

- At least one physical server running ESX 4.0.2 or higher; see the VMware ESX 4.0 hardware compatibility list for supported server models
- VMware vCenter Server 4.0.2 or higher, which can run as virtual machine on this ESX server
- One Windows workstation or laptop, which should be used to connect to the VMware vCenter Server using the locally installed VMware vSphere Client and to access VMware vCenter Operations Standard using a Web browser

NOTE: Some storage related performance metrics such as Host I/O Commands, Host Throughput (KBps) and Host Latency (ms) are available only if both the vCenter Server and the ESX host version is 4.1 or later.

The VMware vCenter Operations Standard virtual appliance has the following hardware requirements:

- 2vCPU on a 2.4GHz or faster CPU
- 8GB RAM
- 124GB HDD for VMware vSphere 4.x with thick disk provisioning (can be thin-provisioned)

The VMware vCenter Operations Standard administrator portal supports the following browsers:

- Internet Explorer 7.0.x and 8.0.x
- Mozilla Firefox 3.x


VMware offers a free 60-day evaluation for VMware vCenter Operations Standard 1.0. Follow the instructions at http://www.vmware.com/go/try-vcenter-ops to download the necessary licenses and the following binaries:

<table>
<thead>
<tr>
<th>Binary</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMware vCenter Operations Standard 1.0 (.ova file)</td>
<td>Download the OVA for VMware vCenter Operations Standard 1.0 to a temporary folder. Point to this file when deploying the OVF template from VMware vSphere Client.</td>
</tr>
</tbody>
</table>

3.2 VMware vCenter Operations Standard Installation and Configuration

Before installing VMware vCenter Operations Standard, you must ensure that the prerequisites listed in the following VMware vCenter Operations Standard preinstall checklist are met. Completing this checklist will ensure that you are ready to proceed with the VMware vCenter Operations Standard setup.
# Description Yes / No

1. You are using compatible ESX and VMware vCenter versions (ESX Server 4.0.2 or higher and VMware vCenter Server 4.0.2 or higher are supported). The services for VMware vCenter Server and VMware Virtual Center Management Web services are running on the VMware vCenter Server.

2. You have the IP address and username and password credentials of the VMware vCenter Server.

3. You have opened the appropriate TCP ports that VMware vCenter Operations Standard needs.

4. You have adequate disk space and system resources for the VMware vCenter Operations Standard virtual appliance (VMware vCenter Operations Standard requires 2vCPU, 124GB of HDD, and 8,192 RAM).

5. You have downloaded the VMware vCenter Operations Standard virtual appliance (in OVF format).

6. Your vSphere environment consists of 1500 virtual machines or less.

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
<th>YES / NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>You are using compatible ESX and VMware vCenter versions (ESX Server 4.0.2 or higher and VMware vCenter Server 4.0.2 or higher are supported). The services for VMware vCenter Server and VMware Virtual Center Management Web services are running on the VMware vCenter Server.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>You have the IP address and username and password credentials of the VMware vCenter Server.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>You have opened the appropriate TCP ports that VMware vCenter Operations Standard needs.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>You have adequate disk space and system resources for the VMware vCenter Operations Standard virtual appliance (VMware vCenter Operations Standard requires 2vCPU, 124GB of HDD, and 8,192 RAM).</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>You have downloaded the VMware vCenter Operations Standard virtual appliance (in OVF format).</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Your vSphere environment consists of 1500 virtual machines or less.</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. VMware vCenter Operations Standard Preinstall Checklist.

The following table describes TCP ports that VMware vCenter Operations Standard accesses, in order to meet the TCP ports prerequisite listed in Step 3 on the checklist.

<table>
<thead>
<tr>
<th>PORT NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>Port 22 must be open to enable SSH access to the VMware vCenter Operations Standard virtual appliance</td>
</tr>
<tr>
<td>443</td>
<td>Administrator portal HTTPS server port</td>
</tr>
<tr>
<td>5480</td>
<td>HTTP server port for the VMware Studio version of the administrator portal</td>
</tr>
</tbody>
</table>

Table 2. TCP Ports Accessed by VMware vCenter Operations Standard.

VMware vCenter Operations Standard also uses the following listening ports, but it does not require an opening in your firewall.

<table>
<thead>
<tr>
<th>PORT NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>5432</td>
<td>PostgreSQL server port (listens to connections from local host only)</td>
</tr>
<tr>
<td>5488, 5489</td>
<td>Ports used by the VMware Studio version of the administrator portal</td>
</tr>
<tr>
<td>8005</td>
<td>Apache Tomcat management ports for the administrator portal</td>
</tr>
</tbody>
</table>

Table 3. Listening Ports Used by VMware vCenter Operations Standard.
The following steps provide an overview of VMware vCenter Operations Standard installation:

### 3.2.1 Deploy the Appliance

The first step is to deploy the virtual appliance containing VMware vCenter Operations Standard:

1. Download the .ova file to a local directory.
2. Start VMware vSphere Client, connected to a VMware vCenter installation, and choose a host and datastore to which the appliance will be deployed.
3. Invoke the “File/Deploy OVF Template…” menu. Navigate to the location of the .ova file above, and click “Next.”
4. Continue through the dialog. You’ll be asked to accept the EULA, and later, to select the host and datastore to deploy the appliance to (from the step preceding).
   a. When prompted for the name of the appliance, it’s generally a good idea to enter something other than the default value of “vCenter Operations Standard”; choose a meaningful name that you will remember.
   b. **NOTE:** If your datastore does not have 124GB of free disk space, you can thin-provision the appliance, but you’ll have to be careful not to fill up the datastore as the appliance grows.
5. After you click “Finish,” the appliance will be created.

### 3.2.2 Power-on the Appliance

You can now power on the appliance in vSphere Client. To view the console of the virtual machine, open the virtual machine console tab. When the appliance finishes booting up, you can see a blue screen in the virtual machine console, with a welcome message and a menu of command options at the bottom.

### 3.2.3 Configure Networking (if needed)

The default configuration of VMware vCenter Operations Standard virtual appliance will attempt to allocate an IP address using DHCP. If this is not what you desire, or the appliance is unable to assign itself an IP address using DHCP, you can change this configuration after the appliance boots up, to assign the appliance a static IP address. Using a static IP address is recommended.

From the blue console screen above, navigate to the “Configure the Network” menu item, and hit <CR>. This will give you a series of prompts. Answer “n” to add a new IPv6 address, and “n” to the question “Use a DHCP server instead of a static IPv4 address?”

You will then be asked for the static networking information (IP address, netmask, gateway, DNS server, and so on). After you enter all of this information, the appliance will reconfigure itself and go back to the blue console screen (where it will show you the newly assigned IP address), and you can test the networking by pinging the IP address shown.

Once you can ping the appliance, you can proceed to the next steps to configure the software.

**NOTE:** Logging in to the appliance gives you a shell prompt if you wish to perform any other OS-level configuration actions; the initial password for the root account is “vmware” when the appliance is first deployed. But see the following: this will be changed once you configure the appliance software for the first time.
3.2.4 Change the Time Zone
To change the time zone of the VMware vCenter Operations Standard virtual appliance:

• Open the http://<ipaddress>:5480 where “<ipaddress>” is the IP of the virtual appliance you deployed in the previous step.
• Log in with the following default credentials: root/vmware.
• Navigate to the time zone tab on this page to change the time zone.

3.2.5 Configure the Software
To configure the appliance, use a web browser (Internet Explorer 7 or 8, or Firefox 3.6.x) to visit the URL shown in the blue console screen (http://<ipaddress>). Log in as the administrative user with the default password (“admin”/“admin”).

This will take you to a screen where you will be prompted to change the administrative password. You must do this immediately, and you must enter a strong password (at least 8 characters, and a mix of letters and digits and/or special characters).

NOTE: As a one-time action, this will also set the password for the “root” account in the appliance’s operating system to the same password. (Any future changes of the administrator password will leave the root password untouched; it will be necessary to log in to the virtual machine console’s blue console screen in order to change the root password after that).

3.2.6 Register a VMware vCenter Server
After you save the new password above, you will be taken to a new screen to register a VMware vCenter Server. Enter this information when prompted:

• The name is just a convenient name for the VMware vCenter Server—this information is shown in the appliance screens.
• The host (IP) is the hostname or IP address of the VMware vCenter Server.
• The user name and password must be that of an administrative user of VMware vCenter (with full administrative rights over the root folder, so that it can register solutions).
• The Collector user name and Collector password can be the same as the administrative user, or for the sake of security, you might specify a user who has read-only access to all or a subset of the VMware vCenter Server inventory.

NOTE: If you get an error during this step, carefully check the username and password typed. Also, you might need to make sure to specify the fully qualified domain name of the VMware vCenter Server.

3.2.7 Apply License to VMware vCenter Operations Standard
You must apply a license to the VMware vCenter Operations Standard before you can start using it. The following steps enable you to do so:

• Log in using VMware vSphere Client to the VMware vCenter Server with which you have registered the VMware vCenter Operations Standard virtual appliance.
• From the home page, select the licensing tab under “Administration.”
• Select the view by “Asset” option, and you will see “vCenter Operations Standard” under this. If not, refresh the page.
• Right-click on the asset and select “change license key,” and enter the license.
• If there are no errors then your VMware vCenter Operations Standard installation has been licensed and is ready to use.

Refer to the VMware vCenter Operations Standard Installation and Administration Guide for any further details.

In the remainder of this evaluator’s guide, we will detail the suggested evaluation tasks to demonstrate the value of VMware vCenter Operations Standard.
4. VMware vCenter Operations Standard Evaluation Tasks

This section outlines the suggested evaluation tasks for VMware vCenter Operations Standard and lists the recommended steps for the tasks. The following tasks are covered:

- Review hierarchy views
- Examine workload details
- Examine health details
- Examine capacity details
- Use scorecards
- Analyze using heatmaps

4.1 Review Hierarchy Views

VMware vCenter Operations Standard analyzes the performance statistics for objects managed in the VMware infrastructure, such as ESX hosts, clusters and virtual machines, to help you monitor and diagnose performance in your virtual environment.

After login, you see the VMware vCenter Operations Standard initial page showing the Infrastructure view. VMware vCenter Operations Standard enables rich and flexible Web 2.0-like user interface loaded with features to navigate through the hierarchy views easily.

From this view, you can see the hierarchy of your VMware vCenter Server—Datacenters, clusters, ESXs, and virtual machines—through three different perspectives: Workload, Health, and Capacity, with the current perspective being Workload. Each object in the VMware vCenter hierarchy is assigned these three scores and will appear in one of the predefined colors, based on its score.
These values represent:

1. **Workload** – an assessment of the level of work being done by a virtual element, based on the four key potential constraints of CPU, memory, disk I/O, and net I/O; values range from 0 (no usage of these resource characteristics) to more than 100 (one or more of these resource characteristics are seriously constrained).

2. **Health** – an assessment of the abnormal/normal behavior of performance metrics, combined with best-practice understanding of key metrics; values range from 0 (very abnormal behavior) to 100 (very normal behavior).

3. **Capacity** – an assessment of past behavior as a means of anticipating future constraints on the four key potential constraints of CPU, memory, disk I/O, and net I/O; values range from 0 (one or more of these resource characteristics either are already constrained or will be within 30 days) to 100 (none of the four resource characteristics is expected to be constrained within the next year, under current usage patterns).

Switch to a **Health** perspective for the hierarchy by clicking the large **Health** icon in the upper left section of the page. Notice the change of values and icon shape for the hierarchy elements.
Switch to a **Capacity** perspective for the hierarchy by clicking the large **Capacity** icon in the upper left section of the page. Notice the change of values and icon shape for the hierarchy elements.
NOTE: It is not uncommon to see some gray colors until VMware vCenter Operations Standard appliance completes the first few data collection intervals. Workload score shows up immediately after initial data collection. Health scores will start showing up after few hours, however, it is recommended to have two weeks of historical data for better accuracy. Capacity scores also rely on historical data for forecasting extrapolation and require two weeks for accurate predictions.

In the next sections, we will explore each of these three perspectives in more detail. The remainder of this section will familiarize you with the key features of the VMware vCenter Operations Standard user interface. To proceed, switch back to the Workload perspective by clicking the Workload icon in the upper left section of the page.

You can expand or collapse the view for each level in the VMware vCenter hierarchy by clicking + or - icons.
Next, in the upper right corner of the screen, there are status filter options, which currently show all elements regardless of their status.

To see how this filtering works, click the icon to remove “unknown” elements, and then click the icon to remove “turned off” elements. The result is a filtered view of the environment similar to the following screenshot:

You can mouse-over each element to see its name and the three scores. In this case, we hovered over one of the red Workload icons in the ESX layer of the hierarchy to see details about the ESX host “10.135.188.119,” which shows a high workload.
Single-clicking an element shows you all related elements in its hierarchy. In this case, you can see the highlighted ESX (which is surrounded by red box annotations in the below image) and virtual machines that are running on that ESX. This is helpful in determining the associated virtual machine workloads resulting in heavy ESX workload.

Similarly, double-clicking an element takes you to the details view for the selected element. Notice the hot-link breadcrumb path in the upper left corner; it shows the hierarchical chain of elements, with the currently viewed ESX at the end of the chain:

You can also sort the elements in different ways using the “Sort By” drop-down list next to the filter options.
Example: When you select the “0–100” option, you will see a view similar to the following:

The search box at the top right enables you to search for specific elements by name.

This section explains how you can navigate the VMware vCenter Operations Standard user interface. The next sections in this evaluation guide will explain how to diagnose performance issues in your virtual infrastructure by using VMware vCenter Operations Standard.

4.2 Examine Workload Details

Workload provides a single aggregated score of the demand placed on an object. Simply put, it reflects the resources that an object needs relative to the resources that it can get for the four key potential constraints of CPU, memory, disk I/O, and net I/O. An object with a workload score of 0 is not being used. An object with a workload score of 100 or more is operating at maximum capacity and might require you to allocate additional resources or to move some tasks to other objects.

To diagnose an object showing high workload, you must display the Workload details page for the object. You can do so in two ways: either double-click the Workload icon for the object or click the details link when you single-click the mouse over the specific object.
There is a tremendous amount of information on this one screen, providing a complete view of what is affecting the workload of this element.

NOTE: Because this detailed view began from a workload perspective at the hierarchy view, the details on this page are workload related. We will see later how detailed views themselves have different perspectives for Workload/Health/Capacity).

When diagnosing workload problems, you should also look at the health score. If the health score is good, the high workload might be normal for the object. If it is not, you should also diagnose the health problem, either before or after diagnosing the high workload.

Notice the summary section in the upper left corner, showing the element’s last “6 hours” of workload level—it clearly shot up to its current 127 value (by the way, the “6-hour” timeline is adjustable through a configuration setting). A quick assessment of this section suggests that this ESX is operating under very heavy constraint (Workload = 127) with a bound by indication of Disk I/O. This constraint is unusual for this ESX, given that its normal workload range is 32–100. Perhaps this is a reason why the health score has also degraded (Health = 65); from a long-term trending perspective, there is not yet a worry about the capacity of this ESX (Capacity = 100). Therefore, we do have an unusual situation worth investigating.
If the workload increased recently, you should scroll down to expand the **Events and Workload** section to see a graph of recent workload values and any change events that might have affected this object. In case the workload increased immediately following an event, you can mouse over the event icon to see the description of the event that might have caused or contributed to the increased workload.

The section following this summary shows us how the four critical resource considerations are performing. Clearly, **Disk I/O** is seriously constrained, and this constraint is also out of range from normal behavior (the normal range of behavior for these four resource characteristics can be seen by the small blue band (e.g., ”**”)) that is situated above the associated color bar).

When the object workload is constrained due to CPU or memory, refer to the **CPU and Memory** section for more details. When workload is high due to disk or network I/O, scroll down to expand the **Storage and Network Resources** pane for further analysis.

The **ESX Resources** section shows additional confirmation and usage data, including the ESX version. You can mouse-over each of the numeric entries to see a detailed sparkline view of that value over the previous six hours.
In the top right-hand section called **Key Metrics** is a series of sparkline graphs with selection buttons. The metrics appear in this order: KPI that is violating its threshold; non-KPI that is violating its threshold; other KPI; and other metrics. In this case, we click the **Disk I/O** button to reveal the important metrics associated with disk workload for this ESX. Notice that all disk I/O-related KPI—**Workload %**, **Commands per Second**, and **Command Latency**—shot up significantly.

<table>
<thead>
<tr>
<th>ESX RESOURCES</th>
<th>More Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number Of Running VMs:</td>
<td>11</td>
</tr>
<tr>
<td>Total CPU Capacity:</td>
<td>40 GHz</td>
</tr>
<tr>
<td>Total Memory Capacity:</td>
<td>64 GB</td>
</tr>
<tr>
<td>Total CPU Use:</td>
<td>17 %</td>
</tr>
<tr>
<td>Total Memory Use:</td>
<td>89 %</td>
</tr>
<tr>
<td>ESX Version:</td>
<td>4.1.0-260247</td>
</tr>
</tbody>
</table>

In the section following the **Key Metrics**, you will see a graphic breakdown of how the CPU and memory are allocated and utilized by the object and, if applicable, by its child objects (in this case, ESX and various virtual machines running on this host). Mouse-over any of the color-bar sections to see a floating pop-up with details about that section of the color bar—see how an individual virtual machine is using CPU (or memory) and that virtual machine’s workload/health/capacity.
In the case of a virtual machine, the CPU usage graph in the middle of the page shows the total CPU entitlement, usage and demand for the virtual machine. The virtual machine memory graph shows memory entitlement and use by the guest operating system on the virtual machine, while the ESX memory graph shows demand and actual physical memory used on the ESX host for this virtual machine. Memory pressure and page sharing on the ESX host might cause the two memory graphs to show different usage by the virtual machine.
The VMware vCenter Operations Standard tracks virtual machine CPU and memory in different categories:

- **Configured capacity** – this is the CPU or memory configured for a virtual machine.
- **Entitlement** – this is the CPU or memory capacity that the virtual machine is entitled to based on resource allocation resulting from shares, reservations and limits, as well as on resource contention on a busy ESX server. The entitlement cannot be more than configured capacity.
- **Usage** – this indicates the CPU or memory resources that a virtual machine is actually using or getting. The usage cannot be more than the entitlement for the specific resource.
- **Demand** – this indicates the CPU or memory resources that a virtual machine really needs. Demand metric takes into account resource contention on a busy system in addition to the actual resource utilization. Example: CPU demand includes CPU usage and any CPU ready time experienced. Consequently, demand can be greater than usage or entitlement.

If demand is greater than usage, first check if the virtual machine is constrained because of shares or limits. If other virtual machines on the same parent ESX server also show higher demand compared to usage, it is likely due to contention resulting from virtual machine population. Check the parent ESX server workload details to see whether more usable CPU or memory is available. If yes, you can reconfigure the virtual machine with additional resources. If no, you might need to move virtual machines around using VMware vMotion™ or add more resources to the ESX server.

Scroll down the details view to reveal the **Related Objects** and **Events and Workload** sections.
The **Related Objects** section shows the workload values for the elements directly tied to the object being examined. Notice the workload for the parent of this ESX (the CIQDataCenter datacenter), the workload for the peers of this ESX (the five other ESX servers), and the workload for the children of this ESX (the 14 virtual machines).

The **Related Objects** section helps you diagnose performance issues in several ways:

- Review the parent object to see if it is also showing excessive workload. Excessive workload on the parent object might indicate a wider problem. If so, double-click the icon for the parent object to display its details page and to troubleshoot further.
- If one or more child objects show high workload, you can mouse-over the children objects to see their performance scores. You can double-click a child object to display its details page to troubleshoot further.
- If no child objects show high workload, and yet the object is experiencing a heavy workload, the problem likely might be due to hosting too many virtual machines. Possible resolutions might involve allocating more resources to the object or removing and/or reconfiguring one or more child objects from it.

The **Events and Workload** section shows the recent values for workload. In case the workload increased immediately following an event, you can mouse-over the event icon to see the description of the event that might have caused or contributed to the increased workload. You can also look at related parent, peer or child events, as applicable. Make sure to select appropriate time frame, and zoom in as needed in the event graph.
The Storage and Network section will help diagnose disk and network I/O-related issues if the workload is constrained on disk or net I/O. Click the “+” icon next to Storage and Network to see the corresponding details.

Click the “+” icon next to the ESX Attached Disk Subsystems section title in order to expand the section to reveal the current behavior of the LUNs attached to the ESX being examined.
Click on the **LUNs** button to toggle to a view of LUN detail. Notice the ability to click through to each LUN (in this case, there are 19 different LUNs attached to the ESX).

The **ESX Used Network Interface** section provides detailed information about the network I/O traffic, by default showing the total aggregate. Click the **pNics** button to show a per-network adaptor view of the metrics, with the ability to click through to each one (in this case, there are four different physical network adaptors attached to the ESX).
All of these sparkline graphs include gray bands around the metric graphs. These bands represent a very sophisticated analysis of the normal behavior of that metric, taking into consideration the entire history of that metric's measurement and adjusting for time of day, day of week, or any other cyclical patterns that might be exhibited by that metric (e.g., “end of month” differences, and so on).

4.3 Examine Health Details

The health rating gives you a quick overview of the current state of any object, from an individual virtual machine to the entire virtual infrastructure. VMware vCenter Operations Standard calculates health by using the performance of the KPI for the object, the number of abnormally behaving metrics for the object, and other aspects of the object performance. The overall health score for an object ranges from 0 to 100. A high health score indicates that an object is performing in accordance with its established historical parameters—most or all of its metrics are behaving normally. Because changes in behavior often indicate developing problems, if the metrics of an object behave abnormally, the health score for the resource decreases. As more metrics behave abnormally, health score continues to decrease.

To access the Detail view for health of an object, toggle the view from the hierarchy page, or from this Detail page directly. To view the health perspective for the entire hierarchy, you must click the Home link at the top left of the page to return to the initial landing page.

Click the vcops-qa-vc breadcrumb link at the top left of the page. This will return the focus to the entire hierarchy, not just the one element you had been reviewing.
Click the **Health** icon in the upper left section, and notice the before and after difference with this section:

Click the **Health** icon in the upper left section, and notice the before and after difference with this section:

**Before:**

![Before Image]

- Normal: 5-100
- Bound by: Net I/O
- Up since: Dec 1, 2010 10:26:04 AM

**After:**

![After Image]

A similar layout, but now **Health** is the primary icon and the 3D graph shows the past six hours of the health score.

Most of the other sections are unchanged when toggling to the **Health** (or **Capacity**) perspectives. The sections – Workload, ESX Resources, Key Metrics, ESX Attached Disk Subsystems and ESX Used Network Interfaces – all are unchanged.

The **Related Objects** section still shows the various parent/pier/children elements but now shows their **Health** values (not their **Workload** values), hence the change in icon shape to represent **Health**.
The major change in the Health view is in the central panel. Notice its default layout:

- **HOST SYSTEM** (14 OUT OF 44 SYMPTOMS)
  - NETWORK (1 OF 1)
  - DISK (1 OF 1)
  - SYSTEM (1 OF 1)
  - SUMMARY (1 OF 1)
- **DATASSTORE** (6 OUT OF 21 SYMPTOMS)
  - CAPACITY (2 OF 19)
  - DEVICES (1 OF 19)
- **VIRTUAL MACHINE** (7 SYMPTOMS)
  - MEMORY (2 OF 6)
  - CPU Usage (1 OF 6)

This section now shows an automatic assessment of which metrics within this element’s ecosystem (i.e., the parent, children and datastores) are performing abnormally, with these metrics grouped by element type.

Click the expansion icon ( ) next to the currently collapsed element types, Datastore and Virtual Machine, to reveal this view:

- **HOST SYSTEM** (14 OUT OF 44 SYMPTOMS)
  - NETWORK (1 OF 1)
  - DISK (1 OF 1)
  - SYSTEM (1 OF 1)
  - SUMMARY (1 OF 1)
- **DATASSTORE** (6 OUT OF 21 SYMPTOMS)
  - CAPACITY (2 OF 19)
  - DEVICES (1 OF 19)
- **VIRTUAL MACHINE** (7 SYMPTOMS)
  - MEMORY (2 OF 6)
  - CPU Usage (1 OF 6)

Notice the icon, indicating that the metric is “above” its historically normal value (given the time of day, day of week and so on). Or you can mouse-over the icon to see the “Over dynamic threshold” text.
Double-click any of the blue bars to see the actual elements reporting that abnormality. Close the pop-up window when you complete this step.

4.4 Examine Capacity Details

This section of the lab will focus on the Capacity perspective of VMware vCenter Operations Standard. The capacity score indicates how close an object is to exhausting the computing resources that are available to it. These computing resources include disk space, memory size, network capacity, and so on. To calculate the capacity score, VMware vCenter Operations Standard combines applicable metrics from the monitored VMware vCenter Server and applies its analytics algorithms to these metrics to determine long-term cycles and trends. VMware vCenter Operations Standard can use these results to calculate when an object is likely to run out of a type of resource; for example, when an object will run out of disk space. Unlike Workload, which represents the short-term condition of a monitored object, Capacity represents a longer-term characteristic. It is calculated in the context of time remaining until the resources of an object are exhausted. Therefore, an object might have very high workload and, at the same time, normal capacity levels.

To begin, click the Home link at the top left of the page to return to the initial landing page.

Click the vcops-qa-vc breadcrumb link at the top left of the page. This will return the focus to the entire hierarchy, not just the one element you had been reviewing.

Click the large Capacity icon in the top left to pivot to the Capacity view.
Your view should be similar to the following:

Notice that the changed icon shape for the elements in the hierarchy denotes the **Capacity** perspective. Similar mouse-over pop-ups and filtering are possible in this perspective, as with the **Workload** and **Health** perspectives.

Double-click this virtual machine to drill into its details. Notice again how much of the content of this detailed view is common whether viewed from the **Capacity**, **Health** or **Workload** perspective.
You will see, however, that the upper right section shows the three large icons, with **Capacity** being the largest focus and the six-hour view showing the recent history of the capacity score. Notice how you see in this view that the capacity score is “0,” meaning that you will be running out of a resource within the next 30 days, as opposed to “100,” which would mean no anticipated capacity issues for the next year. Yet the workload is not currently very high (**Workload = 78**) and the **Health** score of **100** indicates that this virtual machine is operating as it normally does.

But focus on the center section, which is specific to the current **Capacity** perspective. It is showing that **Memory|Overall Workload (%)** is expected to breach capacity and specifically is anticipated in four days (**4d**). The chart shows a visual depiction of the cycles and what patterns exist, suggesting the future breach. Notice also that there is another breach that would cause concern (**CPU Usage| Workload(%)**) in eight days (**8d**). The **Disk|Workload (%)** is also expected to breach, though it is not anticipated to breach for 136 days.
As with Workload and Health detailed views, you can scroll down the Capacity details view to reveal the Related Objects and Events and Workload sections.

Double-clicking on the parent object shows you capacity details for the parent ESX host. You can see that in this case, Memory|Overall Workload (%) is expected to breach capacity in 68 days (68d), CPU Usage|Workload(%) in 76 days (76d) and Disk|Workload (%) in 148 days (148d).
Click the **CPU Usage|Workload (%)** link in the center section to switch the graph to the projected behavior (and potential breach) of any of these **Capacity** metrics.

Scroll down to see the familiar section showing **Related Objects, Events and Capacity**, and **Virtual Machine Attached Disk Subsystems**.
You can now take appropriate action based on which type of resource is expected to be exhausted. This might involve ordering more resources, increasing resources for the ESX host and one or more virtual machines on the ESX host, moving virtual machines to another ESX host or other actions as appropriate.

### 4.5 Use Scorecard

You can use the Scoreboard page to determine stressed or underused hosts and clusters in your virtual infrastructure. This can also help you decide which resources can best accommodate any new virtual machine that you plan to provision for upcoming projects. To monitor available resources in a cluster or ESX host, click the scoreboard in the pop-up window for the object, to open the Scoreboard page.

In this case, we are looking at the Scorecard page for the Workload perspective. The **Scoreboard** page displays the workload scores for all child objects in the selected object. By default, it emphasizes the objects with high workload, meaning the objects that are constrained for resources. Notice that the object icon sizes reflect the relative performance score of the object, suggesting that the larger, red objects are more stressed, compared to the smaller, green objects.
Objects with low workload are the most likely candidates for hosting more virtual machines. To make the icons larger for ESX hosts with low workload, click the Reverse large and small button at the upper right.

You can double-click the icon of a possible candidate host or cluster to open its Details page.

Similarly, you can switch from Workload to Health to Capacity views to see the respective Scorecard pages. For example, you review the Capacity Scorecard page to show which objects are likely to exceed their capacity limits. In such cases, you might not want to add a new virtual machine to the ESX host or cluster.
4.6 Analyze Using Heatmaps

You can use the heatmaps available in the Analysis view to compare the performance of objects across the virtual infrastructure in real time. More than 20 predefined heatmaps compare commonly used metrics. You can define an unlimited number of custom heatmaps to display exactly the metrics that you need. Heatmaps can help you in several ways:

- You can use the heatmaps available in the Analysis view to compare performance of selected metrics across the virtual infrastructure. You can use this information to balance the load across ESX hosts and virtual machines.
- You can use the Analysis view to find the objects with the highest or lowest values for a particular metric.
- You can use the Analysis view to analyze the operation of different object types within or outside the desired range for each metric. Usually, you prefer objects to operate within a specific range of values. High metric values might mean an overload, which can lead to performance problems. Low metric values indicate inefficiency or waste of resources.

Click Analysis to access the heatmaps available in VMware vCenter Operations Standard. From the focus area drop-down menu, select the metric to compare, or select All. Next, select the object type, or select All Configurations from the Smallest Box drop-down menu. The heatmaps that match your selections appear in the list. To display, click the heatmap you are interested in.

Each heatmap is a collection of differently colored and sized rectangles. Each rectangle represents a resource. The color of the rectangle represents the value of one metric; the size represents the value of another. For example, one heatmap shows the total memory and percentage of memory usage for each virtual machine. Larger rectangles are virtual machines with more total memory; green indicates low memory use and red indicates high use. The display is updated in real time as new values are collected from each resource.

The bar below the heatmap is the legend. It shows what values are represented by the endpoints and midpoint of the color range. The objects shown on the heatmap are grouped by their parents. Example: A heatmap that shows virtual machine performance will group virtual machines by the ESX hosts they belong to.
You can click the column header for the metric in order to sort the **Details** section by the metric value. Sorting by a metric column enables you to see the highest and lowest values for that metric. To reverse the sort order, click the column header again. Similarly, double-clicking a rectangle in the heatmap will take you to the **Details** page for the object.

If no predefined heatmap shows the information that you want to see, you can define a custom heatmap. You can select every aspect of a heatmap: the objects and metrics it tracks, the colors it uses, and the endpoints for its value range. When defining the custom heatmap, set the **Max Value** and **Min Value** fields to the top and bottom of the desired range for this metric. Because you have set the endpoints for the graphed colors, any object showing the endpoint color, either green and red or orange and blue, is outside the desired range. Objects operating within the desired range will show intermediate colors. In this case, we create a new heatmap to show virtual machine I/O contention based on disk latency.
The following screenshot shows the output produced by this custom heatmap.

Heatmaps can serve as “single pane,” at-a-glance performance dashboards for your virtual infrastructure that can help you prioritize performance troubleshooting efforts.

5. Next Steps

In this guide, we have presented the key evaluation tasks for VMware vCenter Operations Standard. Refer to the VMware vCenter Operations Standard Installation and Administration Guide for any further details.

5.1 VMware Contact Information

For additional information, or to purchase VMware vCenter Operations Standard, the global network of VMware solutions providers is ready to assist. If you would like to contact VMware directly, you can reach a sales representative at 1-877-4VMWARE (650-475-5000 outside North America) or email sales@vmware.com. When emailing, include the state, country and company name from which you are inquiring.

5.2 Providing Feedback

VMware appreciates your feedback on the material included in this guide—in particular, any guidance on the following topics:

• How useful was the information in this guide?
• Which other specific topics would you like to see covered?
• Overall, how would you rate this guide?

Send your feedback to the following address: tmdocfeedback@vmware.com, with “VMware vCenter Operations Standard 1.0 Evaluator’s Guide” in the subject line. Thank you for your help in making this guide a valuable resource.