

# EMC<sup>®</sup> Storage Analytics

Version 3.1.1

## Installation and User Guide

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**EMC<sup>2</sup>**

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# CHAPTER 1

## Introduction

This chapter contains the following topics:

- [Overview](#)..... 10
- [References](#)..... 11
- [Terminology](#)..... 12

## Overview

VMware vRealize Operations Manager is a software product that collects performance and capacity data from monitored software and hardware resources. It provides users with real-time information about potential problems in the enterprise.

vRealize Operations Manager presents data and analysis in several ways:

- Through alerts that warn of potential or occurring problems.
- In configurable dashboards and predefined pages that show commonly needed information.
- In predefined reports.

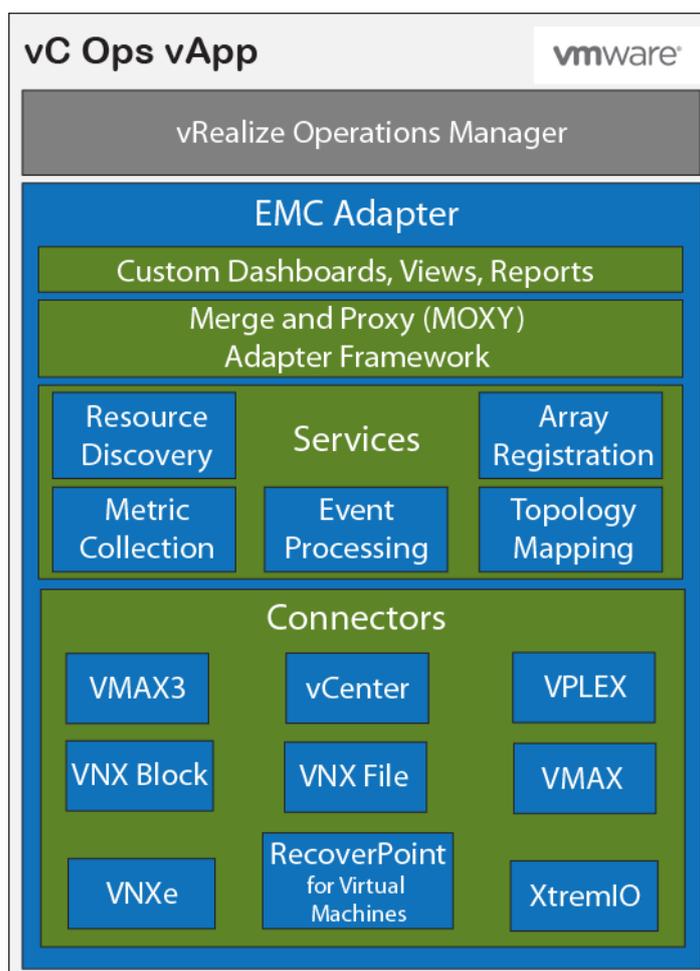
EMC<sup>®</sup> Storage Analytics links vRealize Operations Manager with an EMC adapter. The adapter is bundled with a connector that enables vRealize Operations Manager to collect performance metrics. The adapter is installed with the vRealize Operations Manager user interface.

The connector types are shown in [Figure 1 on page 11](#).

EMC Storage Analytics uses the power of existing vCenter features to aggregate data from multiple sources and process the data with proprietary analytic algorithms.

EMC Storage Analytics complies with VMware management pack certification requirements and has received the VMware Ready certification.

Figure 1 EMC adapter architecture

**Note**

Refer to the *EMC Storage Analytics Release Notes* for a list of supported product models.

## References

This topic provides a list of documentation for reference.

VMware vRealize Operations Manager documentation includes:

- *vRealize Operations Manager Release Notes* contains descriptions of known issues and workarounds.
- *vRealize Operations Manager vApp Deployment and Configuration Guide* explains installation, deployment, and management of vRealize Operations Manager.
- *vRealize Operations Manager User Guide* explains basic features and use of vRealize Operations Manager.
- *vRealize Operations Manager Customization and Administration Guide* describes how to configure and manage the vRealize Operations Manager custom interface.

VMware documentation is available at <http://www.vmware.com/support/pubs>.

EMC documentation includes:

- *EMC Storage Analytics Release Notes* provides a list of the latest supported features, licensing information, and known bugs.
- *EMC Storage Analytics Installation and User Guide* (this document) provides installation and licensing instructions, a list of resource kinds and their metrics, and information about storage topologies and dashboards.

## Terminology

This topic contains a list of commonly used terms.

### **adapter**

A vRealize Operations Manager component that collects performance metrics from an external source like a vCenter or storage system. Third-party adapters such as the EMC Adapter are installed on the vRealize Operations Manager server to enable creation of adapter instances within vRealize Operations Manager.

### **adapter instance**

A specific external source of performance metrics, such as a specific storage system. An adapter instance resource is an instance of an adapter that has a one-to-one relationship with an external source of data, such as a VNX storage system.

### **dashboard**

A tab on the home page of the vRealize Operations Manager GUI. vRealize Operations Manager ships with default dashboards. Dashboards are also fully customizable by the end user.

### **health rating**

An overview of the current state of any resource, from an individual operation to an entire enterprise. vRealize Operations Manager checks internal metrics for the resource and uses its proprietary analytics formulas to calculate an overall health score on a scale of 0 to 100.

### **icon**

A pictorial element in a widget that enables a user to perform a specific function. Hovering over an icon displays a tooltip that describes the function.

### **metric**

A category of data collected for a resource. For example, the number of read operations per second is one of the metrics collected for each LUN resource.

### **resource**

Any entity in the environment for which vRealize Operations Manager can collect data. For example, LUN 27 is a resource.

### **resource kind**

A general type of a resource, such as LUN or DISK. The resource kind dictates the type of metrics collected.

### **widget**

An area of the EMC Storage Analytics graphical user interface (GUI) that displays metrics-related information. A user can customize widgets to their own environments.

# CHAPTER 2

## Installation and Licensing

This chapter contains the following topics:

- [Installation overview](#) ..... 14
- [Installation and operating requirements](#) ..... 16
- [Installing vRealize Operations Manager](#) ..... 19
- [Installing the EMC Adapter and dashboards](#) ..... 20
- [Installing Navisphere CLI](#) ..... 20
- [Configuring a secure connection for VMAX adapters](#) ..... 21
- [Adapter instances](#) ..... 23

## Installation overview

EMC Storage Analytics consists of two installation packages that include:

- vRealize Operations Manager
- EMC Adapter

[Table 1 on page 14](#) lists the licensing requirements.

**Table 1** Licensing options for vRealize Operations Manager

| vRealize Operations Manager version                | Required license  | Notes   |
|--|---|---|
| vRealize Operations Manager Advanced or Enterprise | VMware license for vRealize Operations Manager Advanced or Enterprise<br>EMC license for your storage array | Provides a view of all vCenter-managed resources, including EMC storage arrays. |

### NOTICE

If you purchase an electronic license for EMC Storage Analytics, you will receive a letter that directs you to an electronic licensing system to activate the software to which you are entitled. Otherwise, you will receive a physical license key.

A 90-day trial license is available with EMC Storage Analytics for all supported products. The 90-day trial license provides the same features as a permanent license, but after 90 days of usage, the adapter stops collecting data. You can add a permanent license at any time.

To collect metrics from resources, you must install the EMC Adapter. The license that EMC provides for the storage array is required to add the adapter instance.

The adapter installation includes:

- Installing the EMC Adapter and dashboards.
- Adding one or more EMC adapter instances and applying license keys from EMC.

[Installing the EMC Adapter and dashboards on page 20](#) provides the installation instructions. Then you will add an EMC adapter license key for each storage instance and enter the EMC license key as described in [Adding EMC Adapter instances for your storage system on page 26](#).

[Table 2 on page 15](#) lists the installation and upgrade options for different objectives. To perform an installation or upgrade, refer to the instructions for the task that matches your objective.

**Table 2** Installation and upgrade options

| Task  | Instructions   |
|---|--|
| Install VMware vRealize Operations Manager 6.0.1 and EMC Storage Analytics 3.1.1.   | <ul style="list-style-type: none"> <li>• <a href="#">Installing vRealize Operations Manager on page 19</a></li> <li>• <a href="#">Installing the EMC Adapter and dashboards on page 20</a></li> <li>• <a href="#">Adding EMC Adapter instances for your storage system on page 26</a></li> </ul>   |
| Install EMC Storage Analytics 3.1.1 on a system running VMware vRealize Operations Manager 6.0.1.   | <ul style="list-style-type: none"> <li>• <a href="#">Installing the EMC Adapter and dashboards on page 20</a></li> <li>• <a href="#">Adding EMC Adapter instances for your storage system on page 26</a></li> </ul>  |
| Upgrade EMC Adapter 3.0.x or 2.4.1 to EMC Storage Analytics 3.1.1 on a system running VMware Operations Manager 5.8.x or vRealize Operations Manager 6.0. | <ol style="list-style-type: none"> <li>1. Install a new instance of vRealize Operations Manager 6.0.1. See <a href="#">Installing vRealize Operations Manager on page 19</a>.</li> <li>2. Install EMC Storage Analytics 3.1.1 on vRealize Operations Manager 6.0.1.</li> <li>3. Migrate the data from the old vCenter Operations Manager 6.0 or 5.8.x to the new vRealize Operations Manager 6.0.1 system.</li> </ol> <hr/> <p><b>Note</b></p> <p>Refer to the <i>vRealize Operations Manager vApp Deployment and Configuration Guide</i> for information about migration-based upgrades to vRealize Operations Manager 6.0.1.</p> |

**NOTICE**

The *EMC Storage Analytics Release Notes* provide the most recent information about supported releases.

# Installation and operating requirements

Before installing the EMC Adapter, verify that these installation and operating requirements are satisfied.

## EMC Adapter requirements

### Supported vRealize Operations Manager versions

- vRealize Operations Manager Advanced or Enterprise editions from VMware

---

#### Note

EMC Storage Analytics does not support vRealize Operations Manager Foundation and Standard editions.

---

Deploy the vApp for vRealize Operations Manager before installing the EMC Adapter. Check the *vRealize Operations Manager vApp Deployment and Configuration Guide* at <http://www.vmware.com/support/pubs> for system requirements pertaining to your version of vRealize Operations Manager.

### Supported product models

See the *EMC Storage Analytics Release Notes* for a complete list of supported product models.

### Supported web browser

See the latest vRealize Operations Manager release notes for a list of supported browsers.

### VNX Block systems

The EMC Adapter uses `naviseccli` to collect metrics from VNX Block systems. It is bundled into the EMC Adapter install file and is automatically installed along with the adapter. Storage processors require IP addresses that are reachable from the vRealize Operations Manager server. Bidirectional traffic for this connection flows through port 443 (HTTPS). Statistics logging must be enabled on each storage processor (SP) for metric collection (**System > System Properties > Statistics Logging in Unisphere**).

### VNX File systems

CLI commands issued on the Control Station direct the EMC Adapter to collect metrics from VNX File systems. The Control Station requires an IP address that is reachable from the vRealize Operations Manager server. Bidirectional Ethernet traffic flows through port 22 using Secure Shell (SSH). If you are using the EMC VNX `nas_stig` script for security (`/nas/tools/nas_stig`), do not use root in the password credentials. Setting `nas_stig On` limits direct access for root accounts, preventing the adapter instance from collecting metrics for VNX File.

### EMC SMI-S Provider for VMAX requirements

The EMC SMI-S Provider for VMAX must be on the network and accessible through secure port 5989 (default) or nonsecure port 5988 for communication. If the EMC SMI-S Provider is also used for vSphere vStorage API for Storage Awareness (VASA), follow the recommendations in the *SMI-S Provider Release Notes* to increase the number of available connections. The user configured in the EMC Adapter instance and connecting to the SMI-S instance must have the role of monitor or administrator. See [Configuring a secure connection for VMAX adapters on page 21](#) for steps to configure secure port 5989.

### VPLEX EMC adapter instance

Only one EMC adapter instance is required for VPLEX Local or VPLEX Metro. You can monitor both clusters in a VPLEX Metro by adding a single EMC adapter instance for one of the clusters. Adding an EMC adapter instance for each cluster in a VPLEX Metro introduces unnecessary stress on the system.

### VPLEX data migrations

EMC VPLEX systems are commonly used to perform non-disruptive data migrations. When monitoring a VPLEX system with EMC Storage Analytics, a primary function is to perform analytics of trends on the storage system. When swapping a back-end storage system on VPLEX, the performance and trends for the entire VPLEX storage environment are impacted. Therefore, EMC recommends that you start a new EMC Storage Analytics baseline for the VPLEX after data migration. To start a new baseline:

1. Before you begin data migration, delete all resources associated with the existing EMC Storage Analytics VPLEX adapter instance.
2. Remove the existing EMC Storage Analytics VPLEX adapter instance by using the **Manage Adapter Instances** dialog.
3. Perform the data migration.
4. Create a new EMC Storage Analytics VPLEX adapter instance to monitor the updated VPLEX system.

Optionally, you can stop the VPLEX adapter instance collects during the migration cycle. When collects are restarted after the migration, orphaned VPLEX resources will appear in EMC Storage Analytics, but those resources will be unavailable. Remove the resources manually.

### XtremIO

EMC Storage Analytics uses REST APIs to interact with XtremIO arrays. Users must specify the IP address of the XtremIO Management Server (XMS) when adding an EMC Adapter for XtremIO.

If enhanced performance is required, administrators can configure the thread count for the XtremIO adapter instance. See [Configuring the thread count for an adapter instance on page 146](#).

### Minimum OE requirements

See the *EMC Storage Analytics Release Notes* for a complete list of minimum OE requirements for supported product models.

### User accounts

To create an EMC Adapter instance for a storage array, you must have a user account that allows you to connect to the storage array or EMC SMI-S Provider. For example, to add an EMC Adapter for a VNX array, use a global account with operator or administrator role (a local account will not work).

To create an EMC Adapter instance for vCenter (where **Adapter Kind** = **EMC Adapter** and **Connection Type** = **VMware vSphere**), you must have an account that allows you access to vCenter and the objects it monitors. In this case, vCenter enforces access credentials (not the EMC Adapter). To create an EMC Adapter instance for vCenter, use, at minimum, an account assigned to the **Read-Only** role at the root of vCenter, and enable propagation of permissions to descendant objects. Depending on the size of the vCenter, wait approximately 30 seconds before testing the EMC Adapter. More information on user accounts and access rights is available in the *vSphere API/SDK Documentation* (see information about authentication and authorization for ESXi and vCenter Server).

**DNS configuration**

To use the EMC Adapter, the vRealize Operations Manager vApp requires network connectivity to the storage systems to be monitored. DNS must be correctly configured on the vRealize Operations Manager server to enable hostname resolution by the EMC Adapter.

**Time zone and synchronization settings**

Ensure time synchronization for all EMC Storage Analytics resources by using Network Time Protocol (NTP). Also, set correct time zones for EMC Storage Analytics resources (including the EMC SMI-S Provider if using an adapter for VMAX) and related systems. Failure to observe these practices may affect the collection of performance metrics and topology updates.

# Installing vRealize Operations Manager

## Before you begin

- Obtain the OVA installation package for vRealize Operations Manager from VMware.
- Obtain a copy of the *vRealize Operations Manager vApp Deployment and Configuration Guide* at <http://www.vmware.com/support/pubs>.

Refer to the *vRealize Operations Manager vApp Deployment and Configuration Guide* to deploy the vApp for vRealize Operations Manager.

## Procedure

1. Review the system requirements.
2. Follow the instructions to install vRealize Operations Manager and use the VMware license that you received when prompted to assign the vRealize Operations Manager license.
3. Conclude the installation by following instructions to verify the vRealize Operations Manager installation.

## Installing the EMC Adapter and dashboards

### Before you begin

Obtain the PAK file for the EMC Adapter.

### Note

If using Internet Explorer, the installation file downloads as a ZIP file but functions the same way as the PAK file.

### WARNING

**Upgrading EMC Storage Analytics overwrites the standard dashboards. To customize a standard dashboard, clone it, rename it, and then customize it.**

To install the EMC Adapter and dashboards:

### Procedure

1. Save the PAK file in a temporary folder.
2. Start the vRealize Operations Manager administrative user interface in your web browser and log in as an administrator.  
For example, enter `https://<vROPs_ip_address>`.
3. Select **Administration > Solutions** and then click the Add (plus) sign to upload the PAK file.

A message similar to this one displays in the **Add Solution** window:

```
The .pak file has been uploaded and is ready to install.
pak file details
Name          EMC Adapter
Description   Manages EMC systems such as VNX, VMAX...
Version       3.0.0.0
```

4. Click **Next**, read the license agreement, and check the check box to indicate agreement. Click **Next** again.

Installation begins. Depending on your system's performance, the installation can take from 5 to 15 minutes to complete.

5. When the installation completes, click the **Finish** button.  
The EMC Adapter appears in the list of installed solutions.

## Installing Navisphere CLI

For VNX Block systems, you must install the Navisphere CLI (naviseccli) in the Data Node that you assign to collect metrics for VNX.

Install the CLI before you add the EMC Adapter instance to vCenter. If the CLI is not installed, errors might occur in scaled-out vCenter environments that consist of a Master Node and multiple Data Nodes. The CLI is automatically installed on the Master Node. However, because the Data Node collects metrics, the EMC Adapter might report errors if naviseccli is not installed.

To install the CLI:

### Procedure

1. Enable Secure Shell (SSH) for both master and data nodes.  
Refer to [Connecting to vRealize Operations Manager by using SSH on page 147](#) for instructions.
2. Extract the pak file by using decompression software such as WinZip.
3. Copy the `naviseccli-bin-<version>.rpm` file (for example, `naviseccli-bin-7.33.1.0.33-x64.rpm`) to a target directory in the data node. If you are using Windows, you can use WinSCP for the copy operation.
4. Establish a secure connection to the data node and change to the target directory.
5. Run this command: `rpm -i naviseccli-bin-<version>.rpm` where *<version>* is the appropriate version of the naviseccli utility for the node.
6. Repeat this procedure to install naviseccli in other nodes, as required.

## Configuring a secure connection for VMAX adapters

You can optionally add a VMAX adapter instance on a secure connection through port 5989.

To configure a secure connection for a VMAX adapter instance, refer to the procedure below. If your deployment does not require a secure connection, you may skip this procedure.

### Procedure

1. Download the vRealize Operations Manager SSL certificate by using one of the three methods listed below:
  - If Firefox is available on a client:
    - a. Point your web browser to the vRealize Operations Manager/EMC Storage Analytics name or IP address (any node inside a cluster). The **Certificate Warning** page opens.
    - b. Click the **I Understand the Risks** link. The **Add Exception** button displays.
    - c. Click the **Add Exception** button. The **Add Security Exception** page opens.
    - d. Click the **View** button. The **Certificate View** window opens.
    - e. Click the **Details** tab, then click the **Export** button. Save the certificate as type **All Files** from the **Save as type** drop-down menu.
    - f. Close the **Certificate View** window, then click **Confirm Security Exceptions** to continue.
    - g. Use a text editor to display the certificate content, and copy the content into the clipboard.
  - If vCenter is accessible, and vRealize Operations Manager console is accessible from vCenter:
    - a. Log into vCenter through the vSphere Client.
    - b. Select **Inventory > Hosts and clusters**.
    - c. Select the vRealize Operations Manager vAppliance, and right-click to select **Open Console**.
    - d. Press the **Enter** key, then **Alt+F1** to access the command console. Login as root (using the root password).

- e. Type `cat /storage/vcops/user/conf/ssl/cacert.pem`, and copy the displayed contents into the clipboard.
  - If vRealize Operations Manager SSHD is enabled, and SSH terminal is accessible:
    - a. Log into the vApp as root (using the root password).
    - b. Type `cat /storage/vcops/user/conf/ssl/cacert.pem`, and copy the displayed contents into the clipboard.
2. Access the SMI-S Provider Ecomconfig site at `https://<ip_address>:5989/Ecomconfig`. Log in as admin/#1Password (default).
3. Click the **SSL Certificate Management** link, then select option 3 by clicking **Import CA Certificate file**.
4. Paste the content from the clipboard into the text box. Then click the **Submit the Certificate** button. The message `Successfully imported certificate` displays.
5. In the vRealize Operations Manager, click the **Test connection** button in the **EMC Adapter** window.

The message `Test was successful` displays. Secure communication is established.

### Results

A secure connection through port 5989 is established for the VMAX adapter.

## Adapter instances

The vRealize Operations Manager requires an adapter instance for each resource to be monitored. The instance specifies the type of adapter to use and the information needed to identify and access the resource.

With EMC Storage Analytics, the vRealize Operations Manager uses EMC Adapter instances to identify and access the resources. Supported adapter instances include:

- vCenter (prerequisite for other adapter instances)
- VNX File
- VNX Block
- VMAX
- VNXe
- VPLEX
- XtremIO
- RecoverPoint for Virtual Machines

See the *EMC Storage Analytics Release Notes* for a list of the supported models for each adapter instance and related OEs.

If the vCenter adapter instance is not configured, other adapter instances will function normally but will not display visible connections between the VMware objects and the array objects.

After adapter instances are created, the vRealize Operations Manager Collector requires several minutes to collect statistics, depending on the size of the storage array. Large storage array configurations require up to 45 minutes to collect metrics and resources and update dashboards. This is a one-time event; future statistical collections run quickly.

## Adding an EMC Adapter instance for vCenter

For users to traverse health trees from the virtual environment into the storage environment, EMC Storage Analytics requires you to install an EMC Adapter instance for vCenter. All storage system adapter instances require the EMC Adapter instance for vCenter, which you must add first.

To add an EMC Adapter instance for vCenter:

### Procedure

1. In a web browser, type: `https://<vROps_ip_address>/vcops-web-ent` to start the vRealize Operations Manager custom user interface log in as an administrator.
2. Select **Administration > Solutions > > EMC Adapter**, and then click the **Configure** icon.  
The **Manage Solution** dialog box appears.
3. Click the **Add** icon to add a new adapter instance.

4. Configure the following **Adapter Settings** and **Basic Settings**:

|                     |   |
|---------------------|---|
| Display Name        | Any descriptive name. For example: <b>My vCenter</b>              |
| Description         | Optional description  |
| Connection Type     | <b>VMware vSphere</b>   |
| License (optional)  | Leave blank. Not applicable for EMC Adapter instance for vCenter. |
| Management IP       | IP address of the vCenter server                                  |
| Array ID (optional) | This field must be blank for VMware vSphere connection type.      |

5. In the **Credential** field, select any previously defined credentials for this storage system; otherwise click the Add New icon and configure these settings:

|                 |  |
|-----------------|--|
| Credential name | Any descriptive name. For example: <b>My VMware Credentials</b>  |
| Username        | Username that EMC Storage Analytics uses to connect to the VMware vRealize system.<br>If a domain user is used, the format for the username is DOMAIN \USERNAME. |
| Password        | Password for the EMC Storage Analytics username  |

6. Click **OK**.

7. If required, configure the **Advanced Settings**:

|           |  |
|-----------|--|
| Collector | vRealize Operations Manager Collector  |
| Log Level | <p>Configure log levels for each adapter instance. The four levels for logging information are ERROR, WARN, INFO, and DEBUG.</p> <p><b>ERROR</b><br/>The ERROR level logs only error conditions. The ERROR level provides the smallest amount of logging information.</p> <p><b>WARN</b><br/>The WARN level logs information when an operation completes successfully but there are issues with the operation.</p> <p><b>INFO</b><br/>The INFO level logs information about workflow. It describes how an operation occurs.</p> <p><b>DEBUG</b><br/>The DEBUG level logs all details related to an operation. If logging is set to DEBUG, all other levels of logging information are displayed in the log file.</p> <p><b>TRACE</b><br/>The TRACE level provides the most detailed information and context to understand the steps leading up to errors and warnings.</p> |

The **Manage Solution** dialog box appears.

8. To test the adapter instance, click **Test Connection**.

If the connection is correctly configured, a confirmation box appears.

9. Click **OK**.

The new adapter instance polls for data every five minutes by default. At every interval, the adapter instance will collect information about the VMware vSphere datastore and virtual machines with Raw Device Mapping (RDM). Consumers of the registered VMware service can access the mapping information.

---

#### Note

To edit the polling interval, select **Administration > Environment Overview > EMC Adapter Instance**. Select the EMC Adapter instance you want to edit, and click the **Edit Object** icon.

---

## Adding EMC Adapter instances for your storage system

### Before you begin

- Install the EMC Adapter for vCenter
- Obtain the adapter license key for your storage system

Each storage system requires an adapter instance. All storage system adapter instances require the EMC Adapter instance for vCenter. Add the EMC Adapter instance for vCenter first. Then add the adapter instances for each storage system. Adapter instances are licensed per array. Observe these exceptions and requirements:

- A VNX Unified array can use the same license for VNX File and VNX Block.
- Global Scope is required for VNX Block access.
- For VPLEX Metro, add an adapter instance for only one of the clusters (either one); this action enables you to monitor both clusters with a single adapter instance.
- For RecoverPoint for Virtual Machines, get the RecoverPoint model that is required for the license.

### Procedure

1. In a web browser, type: `https://<vROps_ip_address>/vcops-web-ent` to start the vRealize Operations Manager custom user interface and log in as an administrator.
2. Select **Administration > Solutions > EMC Adapter** and click the **Configure** icon.  
The **Manage Solution** dialog box appears.
3. Click the **Add** icon to add a new adapter instance.
4. Configure the following **Adapter Settings** and **Basic Settings**:

|                    |   |
|--------------------|---|
| Display Name       | A descriptive name, such as <b>My Storage System</b> or the array ID  |
| Description        | Optional description with more details  |
| License (optional) | License key required for the array that you want to monitor (The license key for the adapter instance appears on the Right to Use Certificate that is delivered to you or through electronic licensing, depending on your order.) |

5. Configure these settings based on the adapter instance for your product:

| Supported product                                       | Field: Connection Type            | Field: Management IP  | Field: Array ID (optional) |
|---|-----------------------------------|---|----------------------------|
| VNX Block arrays  | VNX Block                         | Use the IP address of one Storage Processor (SP) in a single array. Do not add an adapter instance for each SP.                 | Not applicable             |
| VNX File and Unified models, VG2 and VG8 gateway models | VNX File                          | Use the IP address of the primary Control Station.  | Not applicable             |
| VMAX3 and VMAX families                                 | VMAX                              | Use the IP address of the configured EMC SMI-S Provider (see note).   | Required                   |
| VNXe3200  | VNXe                              | Use the IP address of the management server.  | Not applicable             |
| VPLEX Local or VPLEX Metro                              | VPLEX                             | Use the IP address of the management server. For a Metro cluster, use the IP address of either management server, but not both. | Not applicable             |
| XtremIO   | XtremIO                           | Use the IP address of the XtremIO Management Server.  | Not applicable             |
| RecoverPoint for Virtual Machines                       | RecoverPoint for Virtual Machines | Use the IP address of the RecoverPoint appliance.   | Not applicable             |

#### Note

When adding a VMAX adapter instance, EMC Storage Analytics will use a secure connection to the SMI-S Provider by using HTTPS port 5989 by default. This requires a certificate import (see [Configuring a secure connection for VMAX adapters on page 21](#)). To bypass certificate authentication and use HTTP instead of HTTPS, use `<SMI-S IP Address>:5988` in the **Management IP** field.

6. In the **Credential** field, select any previously defined credentials for this storage system; otherwise click the **Add New** icon and configure these settings:

| Field           | Value to enter   |
|-----------------|--|
| Credential name | A name for the credentials information.  |
| Username        | Username that EMC Storage Analytics uses to connect to the storage system. <ul style="list-style-type: none"> <li>For VNX File, use the credentials of the Control Station.</li> </ul> |

| Field    | Value to enter   |
|----------|--|
|          | <ul style="list-style-type: none"> <li>For VNX Block, use the credentials of the Storage Processor.</li> <li>For VMAX, use the credentials of an ECOM user with monitor or administrator privileges. The default user/password combination is admin/#1Password.</li> <li>For VNXe, use the credentials of the management server.</li> <li>For VPLEX, use the credentials of the management server (for example, the service user). The default credentials are service/Mi@Dim7T.</li> <li>For XtremIO, use the credentials of the XtremIO Management Server.</li> <li>For RecoverPoint for Virtual Machines, use the credentials of the RecoverPoint appliance.</li> </ul> |
| Password | Password for the EMC Storage Analytics username on the storage system.   |

7. Click **OK**.

The **Manage Solution** dialog reappears.

8. If required, configure the following **Advanced Settings**:

|           |  |
|-----------|--|
| Collector | Automatically select collector   |
| Log Level | <p>Configure log levels for each adapter instance. The four levels for logging information are ERROR, WARN, INFO, and DEBUG.</p> <p><b>ERROR</b><br/>The ERROR level logs only error conditions. The ERROR level provides the smallest amount of logging information.</p> <p><b>WARN</b><br/>The WARN level logs information when an operation completes successfully but there are issues with the operation.</p> <p><b>INFO</b><br/>The INFO level logs information about workflow. It describes how an operation occurs.</p> <p><b>DEBUG</b><br/>The DEBUG level logs all details related to an operation. If logging is set to DEBUG, all other levels of logging information are displayed in the log file.</p> <p><b>TRACE</b><br/>The TRACE level provides the most detailed information and context to understand the steps leading up to errors and warnings.</p> |

The **Manage Solution** dialog box appears.

9. Click **Test Connection** to validate the values you entered.

If the adapter instance is correctly configured, a confirmation box appears.

**NOTICE**

Testing an adapter instance validates the values you entered. Failure to do this step causes the adapter instance to change to the (red) warning state if you enter invalid values and do not validate them.

---

10. To finish adding the adapter instance, click **OK**.

## Editing EMC Adapter instances for your storage system

### Before you begin

- Install the EMC Adapter
- Configure the EMC Adapter instance for your storage system
- Obtain an adapter license key for your storage system

The EMC Adapter instances for storage systems require licenses. Adapter instances are licensed per storage array. A VNX Unified array can use the same license for VNX File and VNX Block.

### Procedure

1. Start the vRealize Operations Manager custom user interface and log in as administrator.

For example in a web browser, type: `https://<vROps_ip_address>/vcops-web-ent`.

2. Select **Administration > Environment Overview > EMC Adapter Instance**
3. Select the EMC adapter you want to edit and click the **Edit Object** icon.

The Edit Object dialog appears.

4. Edit the fields you need to change. See [Adding EMC Adapter instances for your storage system on page 26](#) for field descriptions.
5. To finish editing the adapter instance, click **OK**.

# CHAPTER 3

## EMC Storage Analytics Dashboards

This chapter contains the following topics:

- [Topology mapping](#).....32
- [EMC dashboards](#)..... 44

## Topology mapping

Topology mapping is viewed and traversed graphically using vRealize Operations Manager health trees. The dashboards developed for EMC Storage Analytics utilize topology mapping to display resources and metrics.

EMC Storage Analytics establishes mappings between:

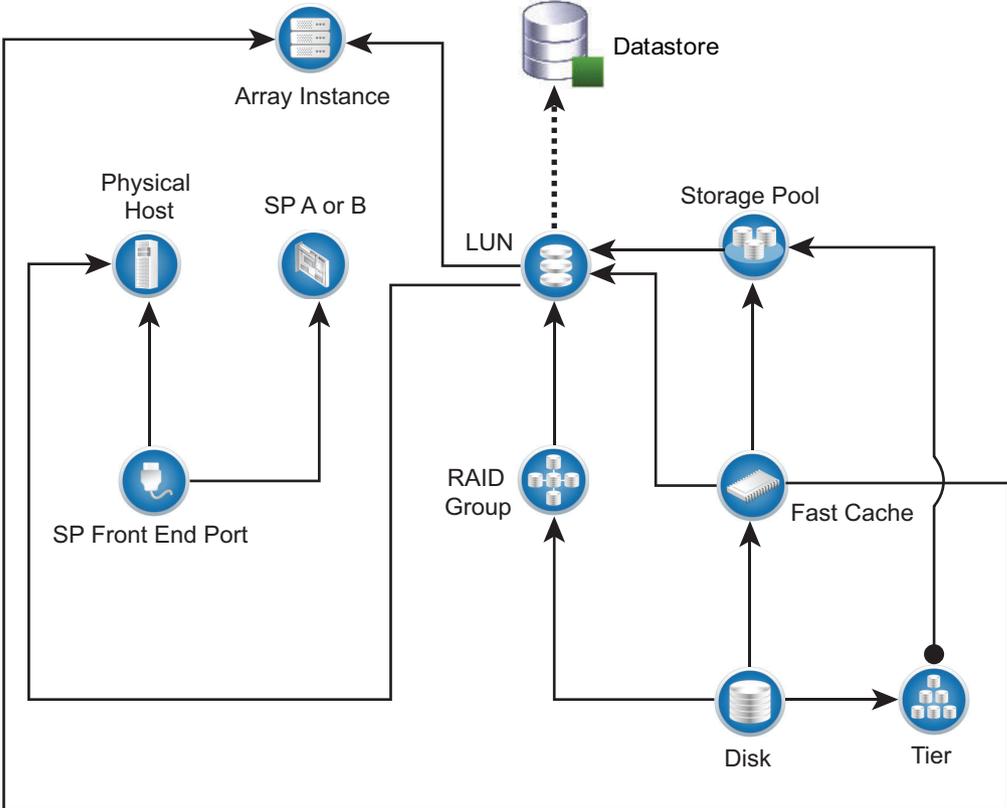
- Storage system components
- Storage system objects and vCenter objects

Topology mapping enables health scores and alerts from storage system components, such as storage processors and disks, to appear on affected vCenter objects, such as LUNs, datastores, and VMs. Topology mapping between storage system objects and vCenter objects uses a vCenter adapter instance.

# VNX Block topology

EMC Storage Analytics implements the following topology for VNX Block.

Figure 2 VNX Block topology



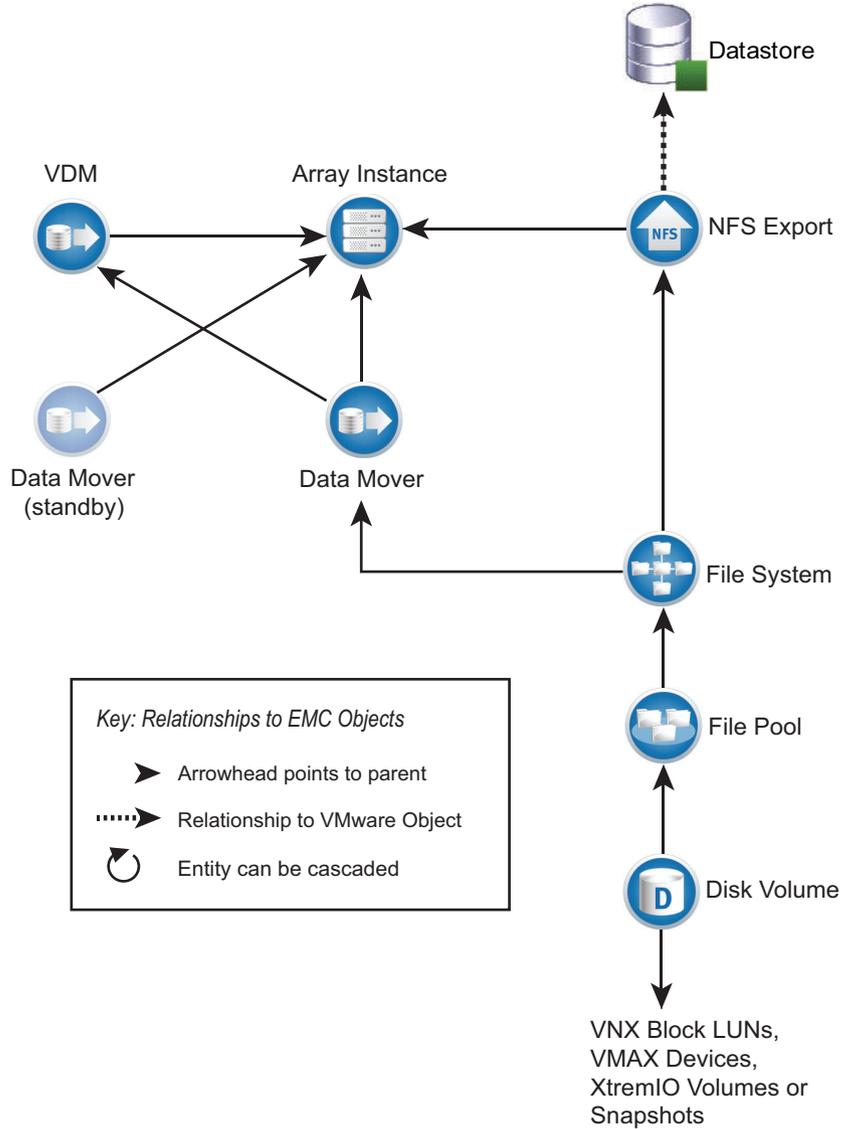
Key: Relationships to EMC Objects

- Arrowhead points to parent
- ⋯➤ Relationship to VMware Object
- ↻ Entity can be cascaded

## VNX File topology

EMC Storage Analytics implements the following topology for VNX File.

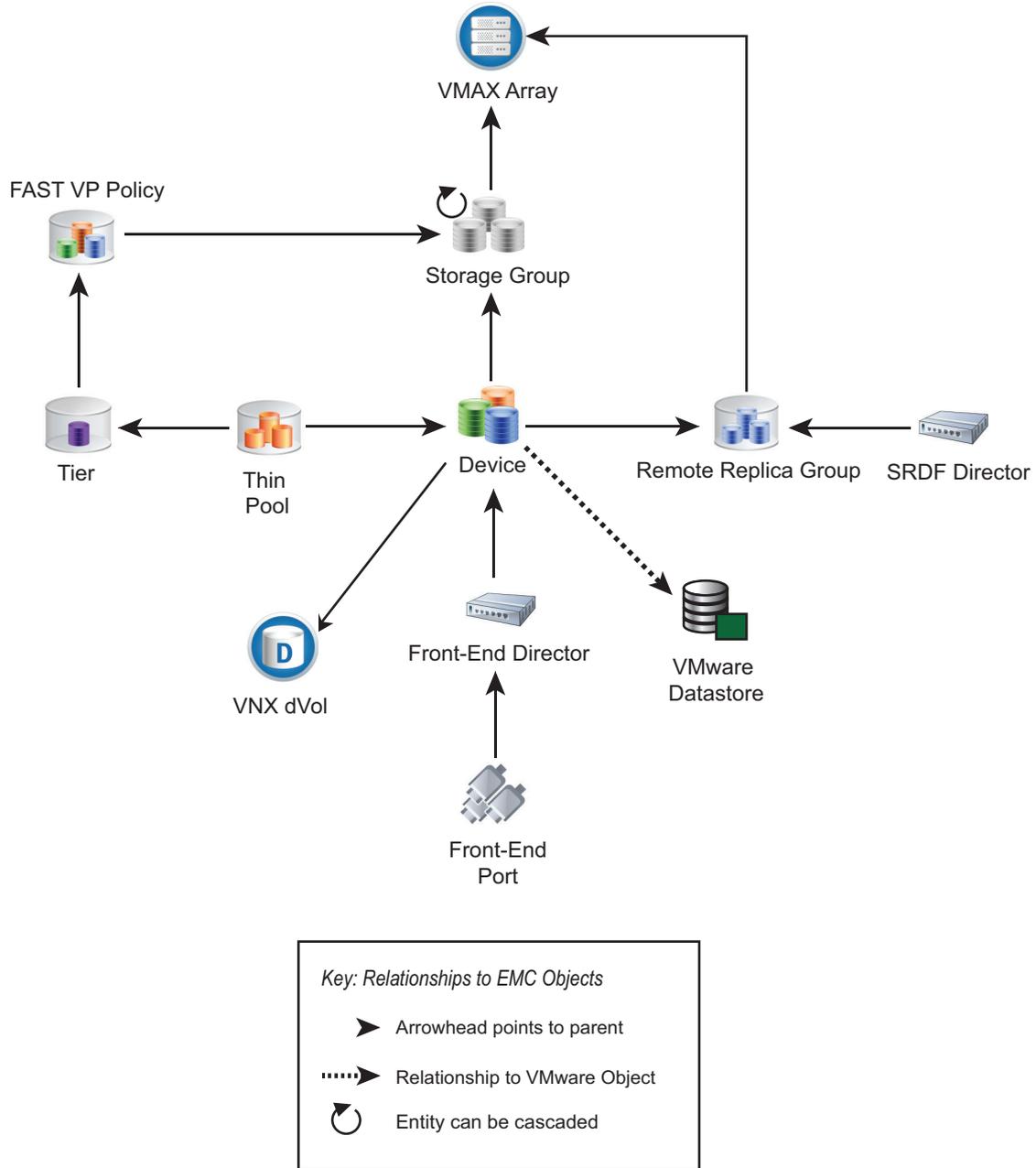
**Figure 3** VNX File topology



## VMAX topology

EMC Storage Analytics implements the following topology for VMAX.

**Figure 4** VMAX topology



## VMAX topology rules

The following rules govern how objects are displayed in the VMAX topology dashboard and which metrics are collected for them.

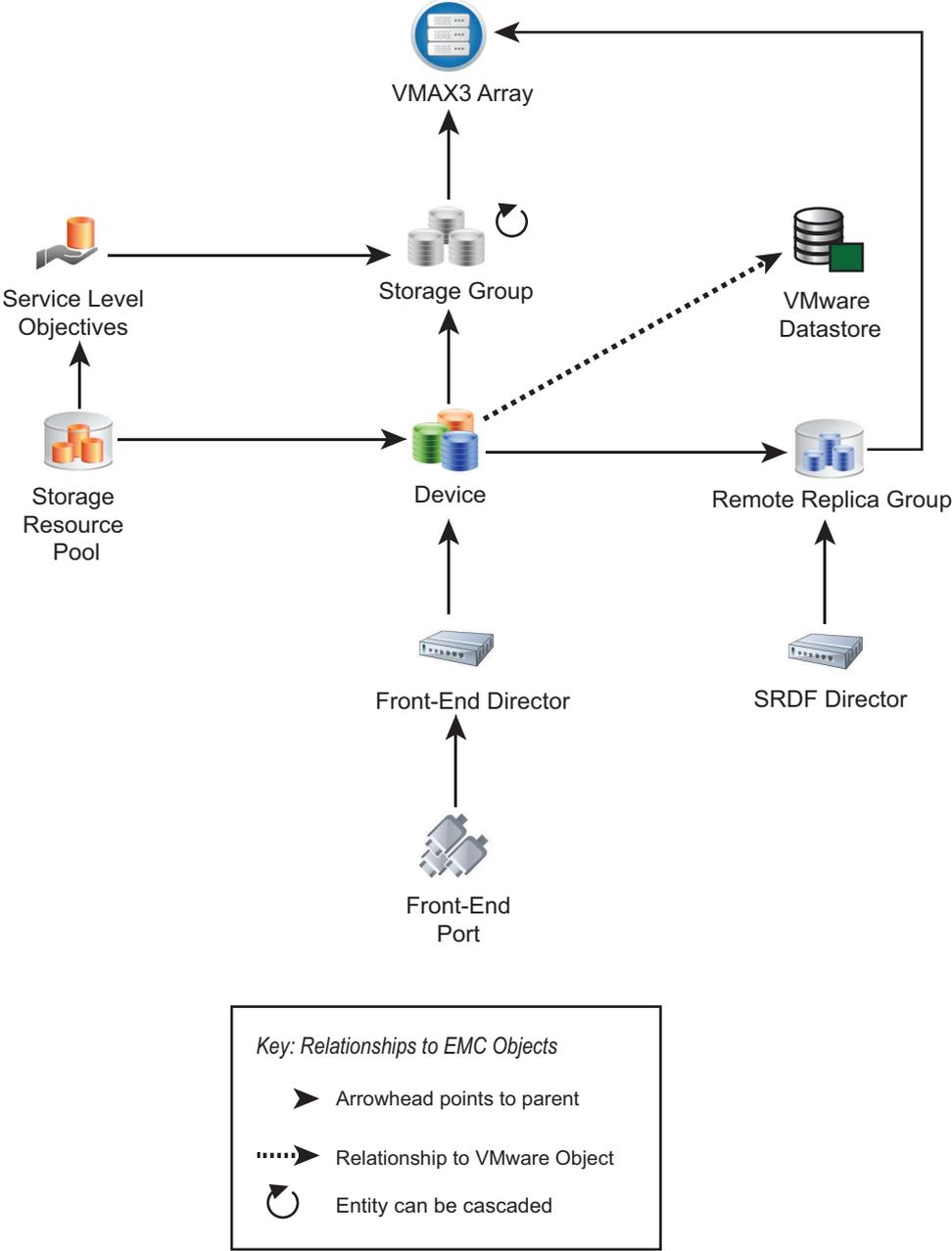
- vRealize Operations Manager does not display devices that are unmapped and unbound.

- vRealize Operations Manager does not display devices that are mapped and bound but unused by VMware, VNX, or VPLEX. Performance metrics for these devices are aggregated into the parent Storage Group performance metrics.
- If the corresponding EMC vSphere adapter instance is running on the same vRealize Operations Manager appliance, then the vRealize Operations Manager displays devices that are mapped, bound, and used by VMware datastores or RDMS.
- If the corresponding EMC VNX File adapter instance is running on the same vRealize Operations Manager appliance, then the vRealize Operations Manager displays devices that are mapped, bound, and used by VNX File Disk Volumes.
- A VMAX device will display when the corresponding VPLEX adapter instance is added.
- vRealize Operations Manager does not display Storage Groups with unmapped and unbound devices.
- vRealize Operations Manager displays Storage Groups that contain mapped and bound devices, and their metrics are aggregates of the member devices.

# VMAX3 topology

EMC Storage Analytics implements the following topology for VMAX3.

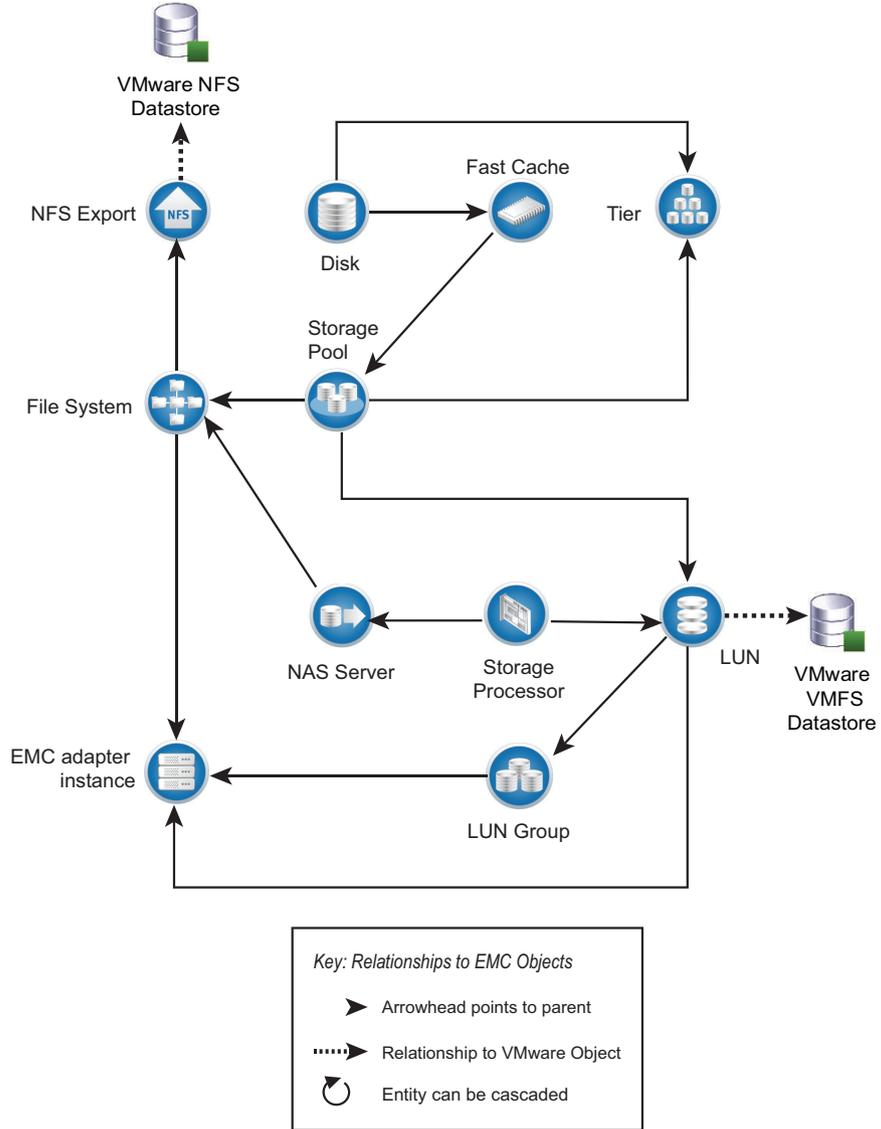
Figure 5 VMAX3 topology



## VNXe topology

EMC Storage Analytics implements the following topology for VNXe.

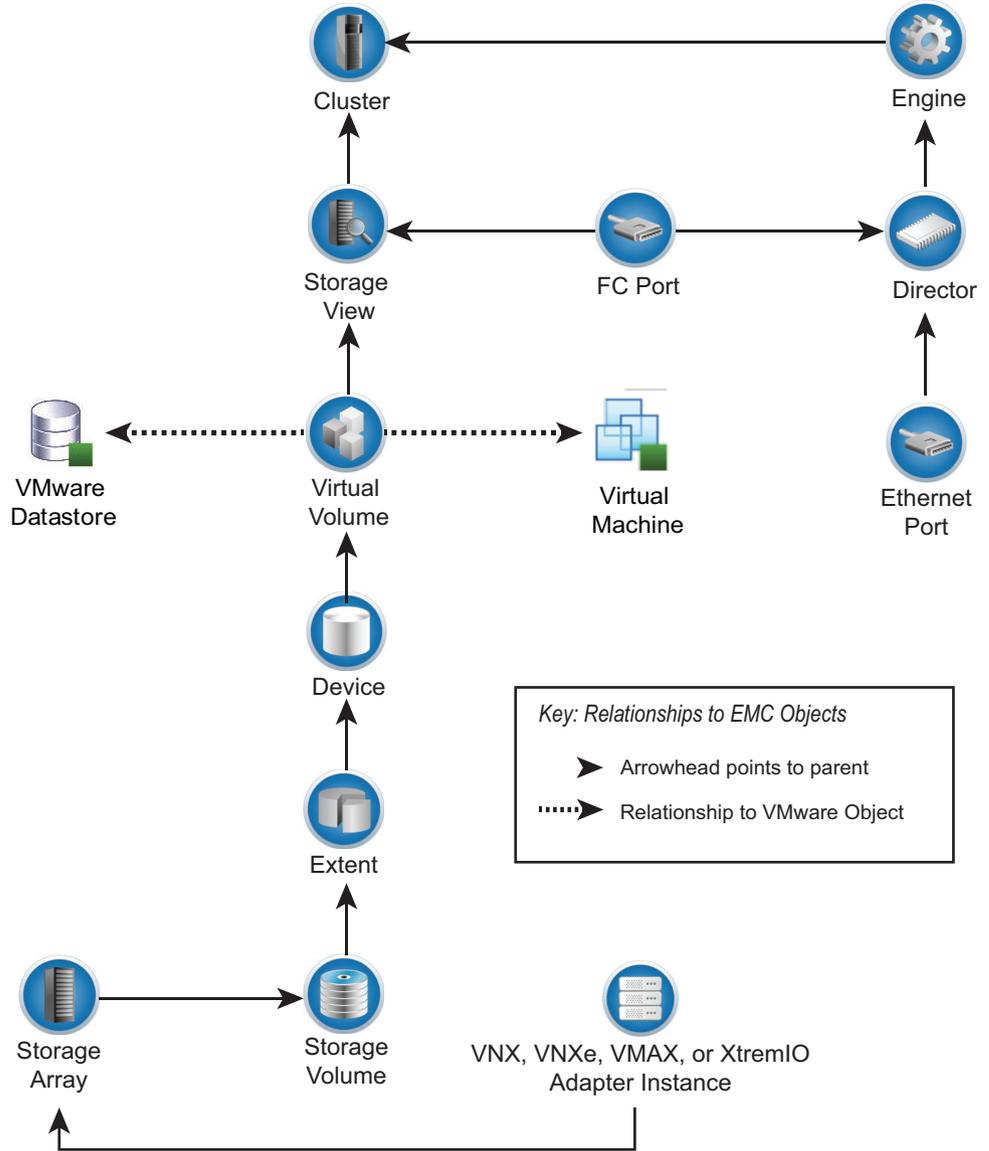
**Figure 6** VNXe topology



## VPLEX Local topology

EMC Storage Analytics implements the following topology for VPLEX Local.

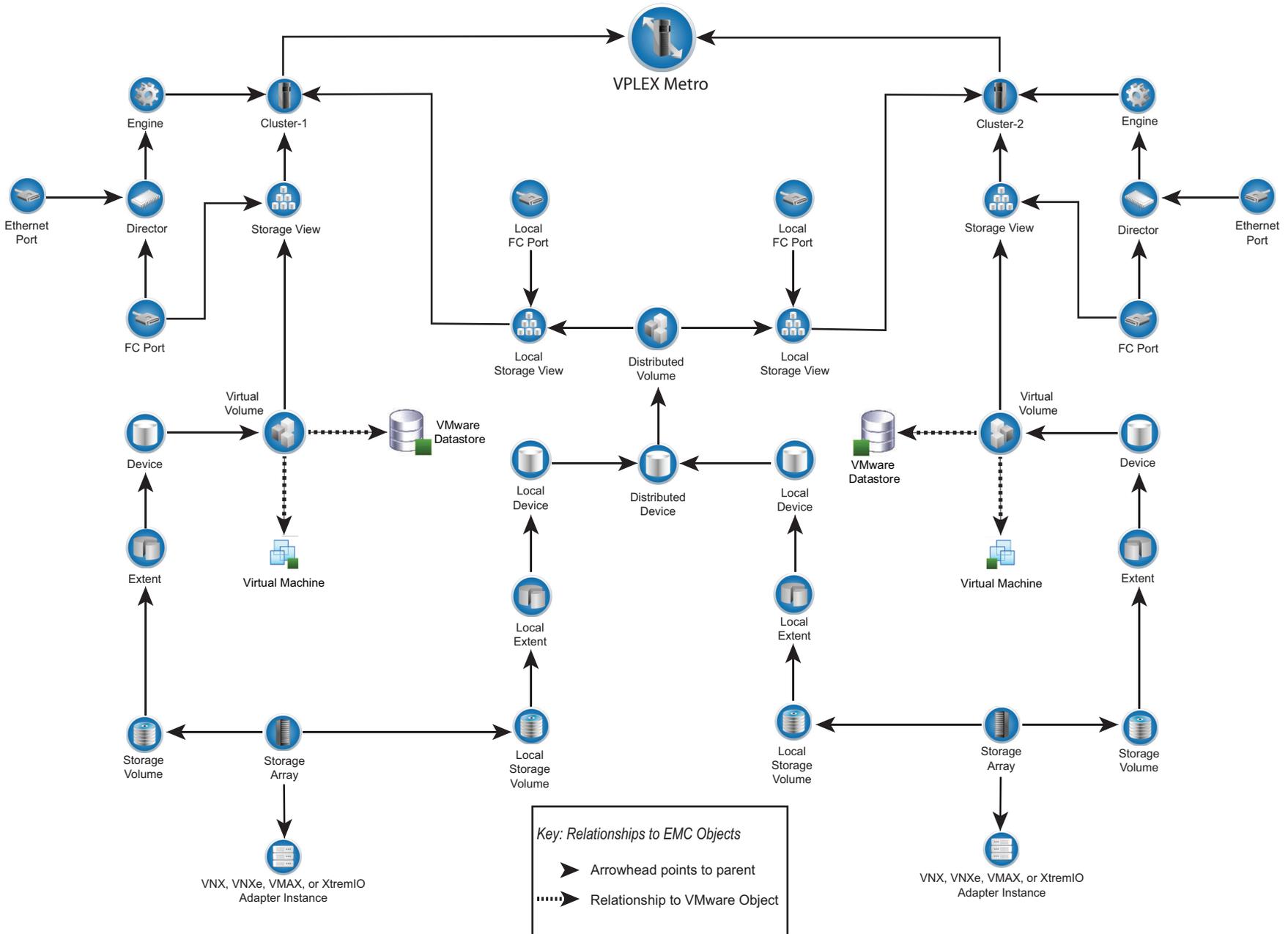
Figure 7 VPLEX Local topology



## **VPLEX Metro topology**

EMC Storage Analytics implements the following topology for VPLEX Metro.

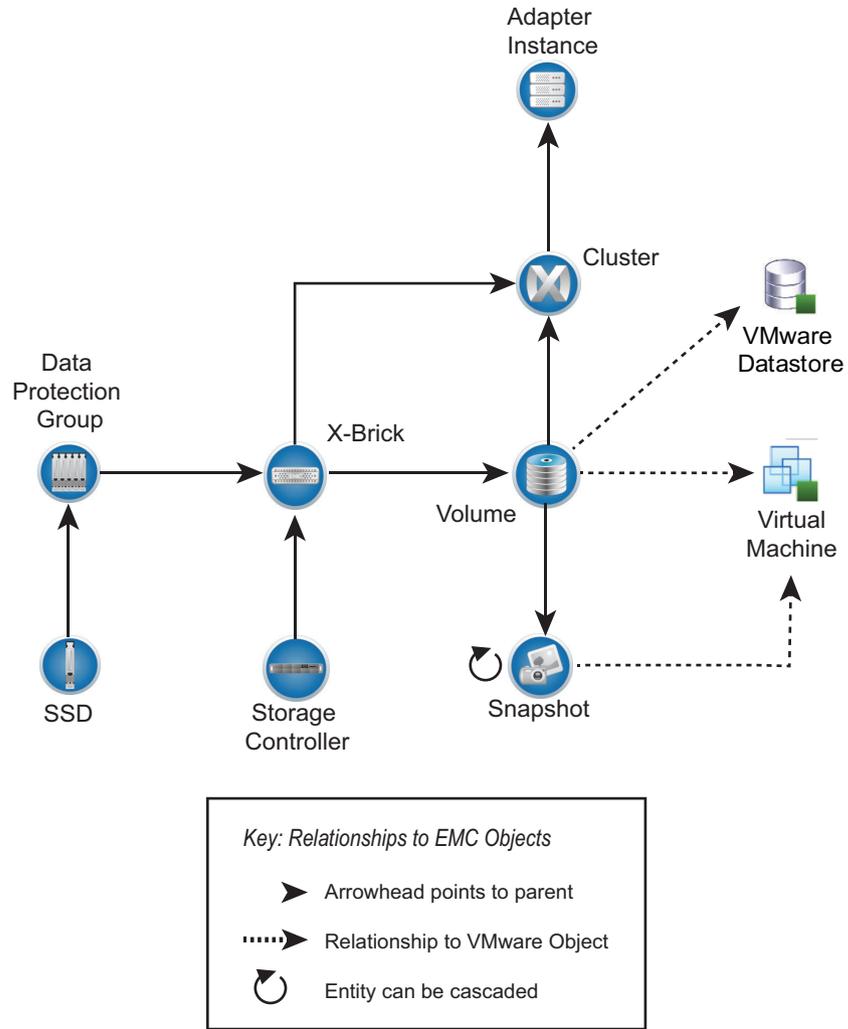
Figure 8 VPLEX Metro topology



## XtremIO topology

XtremIO implements the following topology for XtremIO.

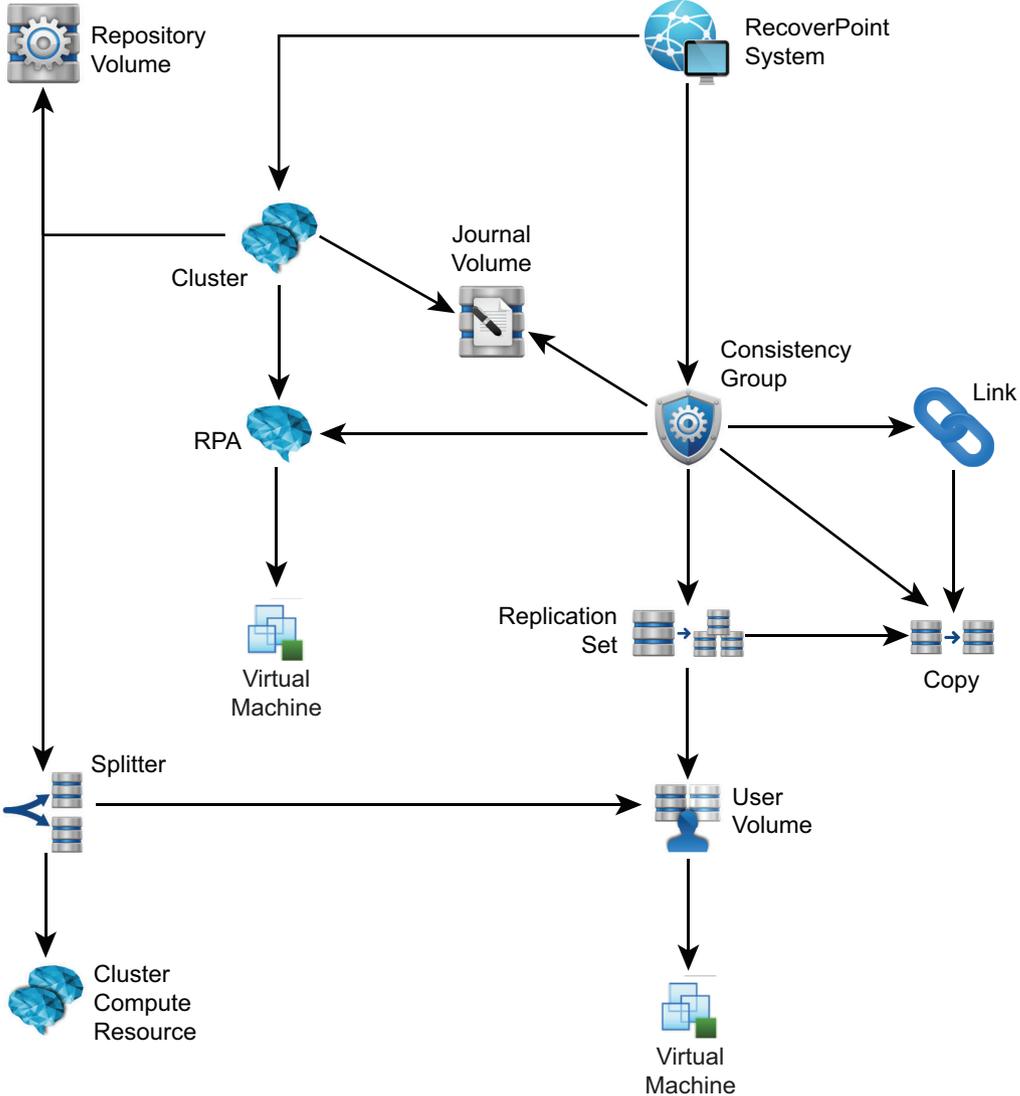
**Figure 9** XtremIO topology



# RecoverPoint for Virtual Machines topology

EMC Storage Analytics implements the following topology for RecoverPoint for Virtual Machines.

Figure 10 RecoverPoint for Virtual Machines topology



## EMC dashboards

Use dashboards to view metrics.

The standard dashboards are delivered as templates. If a dashboard is accidentally deleted or changed, you can generate a new one. [Table 3 on page 44](#) lists the EMC dashboards available for each EMC product.

**Table 3** Dashboard-to-product matrix

| Dashboard name                          | VNX | VNXe | VMAX | VPLEX | XtremIO | RecoverPoint for Virtual Machines |
|---|-----|------|------|-------|---------|-----------------------------------|
| Storage Topology                        | X   | X    | X    | X     | X       | X                                 |
| Storage Metrics                         | X   | X    | X    | X     | X       | X                                 |
| <i>&lt;product_name&gt;</i> Overview    | X   | X    | X    | X     | X       | X                                 |
| <i>&lt;product_name&gt;</i> Topology    | X   | X    | X    | X     | X       | ---                               |
| <i>&lt;product_name&gt;</i> Metrics     | X   | X    | X    | X     | X       | X                                 |
| Top-N <i>&lt;product_name&gt;</i>       | X   | X    | X    | ---   | X       | X                                 |
| <i>&lt;product_name&gt;</i> Performance | --- | ---  | ---  | X     | X       | X                                 |
| VPLEX Communication                     | --- | ---  | ---  | X     | ---     | ---                               |

You can use the standard vRealize Operations Manager dashboard customization features to create additional dashboards that are based on your site requirements (some restrictions may apply).

## Storage Topology dashboard

The Storage Topology dashboard provides an entry point for viewing resources and relationships between storage and virtual infrastructure objects.

Click the **Storage Topology** tab. Details for every object in every widget are available by selecting the object and clicking the **Object Detail** icon at the top of the widget.

The Storage Topology dashboard contains the following widgets:

### Storage System Selector

This **Resource** widget filters the EMC Adapter instances that are found in each storage system. To populate the **Storage Topology and Health** widget, select an instance name.

### Storage Topology and Health

This **Health Tree** widget provides a navigable visualization of resources and virtual infrastructure resources. Single-click to select resources, or double-click to change the navigation focus. To populate the **Parent Resources** and **Child Resources** widgets, select a resource in this widget.

### Parent resources

This widget lists the parent resources of the resource selected in the **Storage Topology and Health** widget.

**Child resources**

This widget lists the child resources of the resource selected in the **Storage Topology and Health** widget.

## Storage Metrics dashboard

Click the **Storage Metrics** tab to display resource and metrics for storage systems and view graphs of resource metrics.

The Storage Metrics dashboard contains the following widgets:

### **Storage System Selector**

This Resource widget lists all configured EMC Adapter instances. To populate the **Resource Selector** widget, select an instance name.

### **Resource Selector**

This **Health Tree** widget lists each resource associated with the adapter instance selected in the **Storage System Selector**. To populate the **Metric Picker** widget, select a resource.

### **Metric Picker**

This widget lists all the metrics that are collected for the resource selected in the **Resource Selector** widget. The search feature of this widget allows users to locate specific objects. Double-click a metric to create a graph of the metric in the **Metric Graph** widget.

### **Metric Graph**

This widget graphs the metrics selected in the **Metric Picker** widget. Display multiple metrics simultaneously in a single graph or in multiple graphs.

## VNX Overview dashboard

Click the **VNX Overview** tab to view a collection of heat maps that provide a single view of the performance and capacity for all VNX resources with configured adapter instances. Heat maps on this dashboard group the contents by adapter instance.

The VNX Overview dashboard displays the following heat maps:

### CPU performance

This heat map displays the CPU utilization of each Storage Processor and Data Mover on each configured adapter instance. The color of the heat map entries shows percentage busy:

- Green indicates 0% busy.
- Red indicates 100% busy.

### FAST cache performance

This heat map has two modes: Read Cache Hit Ratio and Write Cache Hit Ratio. To select the mode, use the Configuration menu. The Read/Write Cache Hit Ratio (%) is the number of FAST Cache read or write hits divided by the total number of read or write I/Os across all RG LUNs and Pools configured to use FAST Cache. The color of the heat map entries shows hit ratios:

- Green indicates a high FAST Cache hit ratio.
- Red indicates a low FAST Cache hit ratio. A low value on an idle array is acceptable.
- Gray indicates that there is no FAST Cache present on the VNX systems identified by the adapter instances and a `Heat Map not configured message` appears with the heat map.

### Pool capacity

This heat map has four modes: RAID Group Available Capacity, Storage Pool Capacity Utilization, Storage Pool Available Capacity, and File Pool Available Capacity.

In Capacity Utilization mode, the color of the heat map entries shows the value of the percentage full metric for all non-RAID Group storage pools:

- Green indicates 0% full.
- Red indicates 100% full.

In Available Capacity mode, the color of the heat map entries shows the value of the Available Capacity (GB) metric:

- Green indicates the largest available capacity on any storage pool for any of the configured adapter instances.
- Red indicates 0 GB available.

### LUN and file system performance

This heat map has several modes.

In LUN Utilization mode, the color of the heat map entries show the percentage busy metric for all LUNs grouped by adapter instance:

- Green indicates 0% busy.
- Red indicates 100% busy.

In LUN Latency mode, the color of the heat map entries shows the value of the Latency (ms) metric:

- Green indicates 0 ms latency.
- Red indicates 20 ms or greater latency and is configurable.

Latency values appear for RAID Group LUNs. Pool LUNs appear in white with no latency values reported.

In LUN Read IOPs mode, the color of the heat map entries shows the relative number of read I/O operations per second serviced by the LUN. The color ranges from light green to dark green. Dark green indicates the highest number of read I/O operations per second serviced by any LUN listed in the heat map.

In LUN Write IOPS mode, the color of the heat map entries shows the relative number of write I/O operations per second serviced by the LUN. The color ranges from light green to dark green. Dark green indicates the highest number of write I/O operations per second serviced by any LUN listed in the heat map.

In File System Read IOPs mode, the color of the heat map shows the relative number of read I/O operations per second serviced by the file system. The color ranges from light green to dark green. Dark green indicates the highest number of read I/O operations per second serviced by any file system listed in the heat map.

In File System Write IOPS mode, the color of the heat map entries shows the relative number of write I/O operations per second serviced by the file system. The color ranges from light green to dark green. Dark green indicates the highest number of write I/O operations per second serviced by any file system listed in the heat map.

## VMAX Overview dashboard

Click the **VMAX Overview** tab to view a collection of heat maps that provide a single view of the performance and capacity for all VMAX resources with configured adapter instances. Heat maps on this dashboard group the contents by adapter instance.

The VMAX dashboard displays the following heat maps for all applicable VMAX models. For each heat map and selected metric, the configured VMAX adapter is shown:

### Thin Pool Usage

This heat map displays the Percent Allocated metric. Percent Allocated displays the allocated capacity in each thin pool. The color of the heat map entries ranges from green to red and corresponds to the percent allocated as follows:

- Green indicates that 0% of the thin pool is allocated.
- Yellow indicates that 50% of the thin pool is allocated.
- Red indicates that 100% of the thin pool is allocated.

The VMAX dashboard displays the following heat maps for VMAX3. For each heat map and selected metric, the configured VMAX adapter is shown:

### Storage Resource Pool

This heat map displays the Percent Allocated metric. Percent Allocated displays the allocated capacity in each thin pool. The color of the heat map entries ranges from green to red and corresponds to the percent allocated as follows:

- Green indicates that 0% of the thin pool is allocated.
- Yellow indicates that 50% of the thin pool is allocated.
- Red indicates that 100% of the thin pool is allocated.

The VMAX dashboard displays the following heat maps for all supported VMAX models. For each heat map and selected metric, the configured VMAX adapter is shown:

### Storage Group

This heat map has four modes: Total Reads (IOPS), Total Writes (IOPS), Read Latency (ms), and Write Latency (ms).

Total Reads and Writes represent the aggregate reads or writes for all LUNs in the storage group. Write and Read Latency is the average write or read latency of all LUNs in the storage group.

For Total Reads and Writes, the color of the heat map entries shows the relative number of total reads or writes across all the storage groups. The color ranges from light blue to dark blue. Dark blue indicates the storage group(s) with the highest number of total reads or writes while light blue indicates the lowest. Because the range of values for total reads or writes has no lower or upper limits, the numerical difference between light and dark blue may be very small.

For Write and Read Latency, the color of the heat map entries is based on a scale of latency from 0 to 40ms. This scale is based on average customer requirements and may not represent a customer's particular requirements for latency. In such cases, EMC recommends adjusting the scale appropriately. The color of the heat map entries ranges from green to red as follows:

- Green indicates a latency of 0ms.
- Yellow indicates a latency of 20ms.
- Red indicates a latency of 40ms.

### LUN Performance

This heat map has four modes: Reads (IOPS), Writes (IOPS), Read Latency (ms), and Write Latency (ms).

Reads and Writes represent the total reads or writes for a particular LUN. Read and Write Latency is the average read or write latency of all LUNs in the storage group.

For Reads and Writes, the color of the heat map entries shows the relative number of reads or writes across all the LUNs. The color ranges from light blue to dark blue. Dark blue indicates the LUN(s) with the highest number of reads or writes while light blue indicates the lowest. Because the range of values for reads or writes has no lower or upper limits, the numerical difference between light and dark blue may be very small.

For Read and Write Latency, the color of the heat map entries ranges from green to red and is based on a scale of latency from 0 to 40ms. This scale is based on average customer requirements and may not represent a customer's particular requirements for latency. In such cases EMC recommends adjusting the scale appropriately. The color of the heat map entries range from green to red as follows:

- Green indicates a latency of 0ms.
- Yellow indicates a latency of 20ms.
- Red indicates a latency of 40ms.

### Front End Director

This heat map has two modes: Total Bandwidth (MB/s) and Total Operations (IOPS).

Total Bandwidth is the cumulative amount of data transferred over all ports of the front-end director (measured in Megabytes per second). Total Operations is the total number of operations taking place over all ports of a front-end director (measured in IOs per second).

The color of the heat map entries is the same for both metrics. It shows the relative total bandwidth or relative total number of operations, depending on the selected metric. The color ranges from light blue to dark blue. Dark blue indicates the front-end director(s) with the highest number of total operations or the greatest total bandwidth, depending on the selected metric. Light blue indicates the lowest number of operations or the least total bandwidth. Because the range of values for operations or bandwidth has no lower or upper limits, the numerical difference between light and dark blue may be very small.

### SRDF Director

This heat map has two modes: Total Bandwidth (MB/s) and Total Writes (IOPS).

Total Bandwidth is the cumulative amount of data transferred over an SRDF director (measured in Megabytes per second). Total Writes is the total number of writes over an SRDF director (measured in IOs per second).

The color of the heat map entries is the same for both metrics. It shows the relative total bandwidth or relative total number of writes, depending on the selected metric. The color ranges from light blue to dark blue. Dark blue indicates the SRDF director(s) with the highest number of total writes or the greatest total bandwidth, depending on the selected metric. Light blue indicates the lowest number of writes or the least total bandwidth. Because the range of values for bandwidth or writes has no lower or upper limits, the numerical difference between light and dark blue may be very small.

### SRDF Groups

This heat map has four modes: Devices in Session (count), Average Cycle Time (seconds), Writes (IOPS), and Writes (MB/s).

Devices in Session represents the number of devices in an SRDF session in the SRDF group. The Average Cycle Time is an SRDF/A metric that provides the average elapsed time between data transfer cycles. Writes (IOPS) represents the number of writes per second on the devices in the SRDF group. Writes (MB/s) represents the number of megabytes per second sent from the SRDF group.

The color of the heat map entries is the same for all metrics. It shows the relative devices in session, average cycle time, total bandwidth, or the relative number of writes, depending on the selected metric. The color ranges from light blue to dark blue. Dark blue indicates the SRDF group(s) with the highest number of one of these metrics and light blue indicates the lowest number of one of these metrics. Because the range of values has no lower or upper limits, the numerical difference between light and dark blue may be very small.

## VNXe Overview dashboard

Click the **VNXe Overview** tab to view a collection of heat maps that provide a single view of the performance and capacity for all VNXe resources with configured adapter instances. Heat maps on this dashboard group the contents by adapter instance.

The VNXe Overview dashboard displays the following heat maps:

### CPU Performance

This heat map displays the CPU Utilization, such as % busy, of each Storage Processor on each configured adapter instance. The color of the heat map entries shows % busy:

- Green indicates 0% busy
- Red indicates 100% busy

### Pool capacity

This heat map has two modes: Storage Pool Capacity Utilization and Storage Pool Available Capacity.

In Capacity Utilization mode, the color of the heat map entries shows the value of the % full metric for all storage pools:

- Green indicates 0% full.
- Red indicates 100% full.

In Available Capacity mode, the color of the heap map entries shows the value of the Available Capacity (GB) metric:

- Green indicates the largest available capacity on any storage pool for any of the configured adapter instances.
- Red indicates 0 GB available.

### LUN Performance

This heat map has two modes: LUN Read IOPS and LUN Write IOPS.

LUN Read IOPS and LUN Write IOPS represent the total reads or writes for a particular LUN. The color of the heat map entries shows the relative number of reads or writes across all the LUNs. The color ranges from light green to dark green. Dark green indicates the LUN(s) with the highest number of reads or writes while light green indicates the lowest. Because the range of values for reads or writes has no lower or upper limits, the numerical difference between light and dark green may be very small.

## VPLEX Overview dashboard

Click the **VPLEX Overview** tab to view a collection of scorecard widgets that provide an overview of the health for the VPLEX system.

The EMC VPLEX Overview dashboard displays the following widgets:

---

### Note

Red, yellow, and orange colors correlate with the Health State or Operational Status of the object. Any Health State or Operational Status other than those listed below will show green (good). Also note that because VMware expects numeric values, you cannot modify these widgets.

---

### CPU Health

This widget displays the CPU usage, as a percentage, for each director on the VPLEX. The color of the directors in the widget reflects the CPU usage:

- Green indicates CPU usage of 0 - 75%.
- Yellow indicates CPU usage of 75 - 85%.
- Orange indicates CPU usage of 85 - 95%.
- Red indicates CPU usage of 95 - 100%.

Generally, a director should stay below 75% CPU usage. Correct an imbalance of CPU usage across directors by adjusting the amount of I/O to the busier directors; make this adjustment by modifying existing storage view configurations. Identify busier volumes and hosts and move them to less busy directors. Alternately, add more director ports to a storage view to create a better load balance across the available directors.

### Memory Health

This widget displays the memory usage, as a percentage, of each director on the VPLEX. The color of the directors in the widget reflects the memory usage:

- Green indicates memory usage of 0 - 70%.
- Yellow indicates memory usage of 70 - 80%.
- Orange indicates memory usage of 80 - 90%.
- Red indicates memory usage of 90 - 100%.

### Front-End Latency - Read/Write

This widget displays read and write latency (in ms) for each Front-end Director.

- Green indicates latency values between 0 ms and 7 ms.
- Yellow indicates latency values of 7 ms up to 11 ms.
- Orange indicates latency values of 11 ms up to 15 ms.
- Red indicates latency values over 15 ms.

### Front-End Operations

This widget displays the active and total operations (in counts/s) for each Front-end Director.

## VPLEX Performance dashboard

Click the **VPLEX Metrics** tab to view a collection of heat maps that provide a single view of the most important performance metrics for VPLEX resources.

The EMC VPLEX Metrics dashboard displays two types of heat maps:

- Metrics with definitive measurements such as CPU usage (0-100%) or response time latency (0-15ms) are assigned color ranges from lowest (green) to highest (red).
- Metrics with varied values that cannot be assigned a range show relative values from lowest (light blue) to highest (dark blue).

### Front-end Bandwidth

This heat map has three modes: Reads (MB/s), Writes (MB/s), and Active Operations (Counts/s)

Reads and Writes represent the total reads or writes for the storage volumes across the front-end ports on a director.

For Reads and Writes, the color of the heat map entries shows the relative front-end bandwidth on a director, depending upon the selected metric.

Active Operations represents the number of active, outstanding I/O operations on the director's front-end ports.

### Back-end Bandwidth

This heat map has three modes: Reads (MB/s), Writes (MB/s), and Operations (Counts/s).

Reads and Writes represent the total reads or writes for the storage volumes across the back-end ports on a director.

For Reads and Writes, the color of the heat map entries shows the relative back-end bandwidth on a director, depending upon the selected metric.

Operations represents the number of I/O operations per second through the director's back-end ports.

### Back-end Errors

This heat map has three modes: Resets (count/s), Timeouts (count/s), and Aborts (count/s). Resets are LUN resets sent by VPLEX to a storage array LUN when it does not respond to I/O operations for over 20 seconds. Timeouts occur when an I/O from VPLEX to a storage array LUN takes longer than 10 seconds to complete. Aborts occur when an I/O from VPLEX to a storage array LUN is cancelled in transit. Resets indicate more serious problems than timeouts and aborts.

The color of the heat map entries is the same for all metrics. It shows the relative amount of resets, timeouts, or aborts, depending on the selected metric.

**Front-end Latency**

This heat map has three modes: Read Latency (ms), Write Latency (ms), and Queued Operations (Counts/s).

Write and Read Latency is the average write or read latency for all virtual volumes across all front-end ports on a director.

For Read and Write Latency, the color of the heat map entries is based on a scale of latency from 0 to 15ms, depending upon the selected metric. This scale is based on average customer requirements and may not represent a customer's particular requirements for latency. In such cases, EMC recommends adjusting the scale appropriately.

For VPLEX Metro systems consisting primarily of distributed devices, the WAN round-trip time greatly affects the front-end write latency. See the COM Latency widgets and the WAN Link Usage widget in the VPLEX Communication dashboard.

**Virtual Volumes Latency**

This heat map has three modes: Read Latency (ms), Write Latency (ms), and Total Reads & Writes (Counts/s).

Write and Read Latency is the average write or read latency for all virtual volumes on a director.

For Read and Write Latency, the color of the heat map entries is based on a scale of latency from 0 to 15ms, depending on the selected metric. This scale is based on average customer requirements and may not represent a customer's particular requirements for latency. In such cases, EMC recommends adjusting the scale appropriately.

Total Reads & Writes represents the virtual volume total reads and writes per director.

**Storage Volumes Latency**

This heat map has two modes: Read Latency (ms) and Write Latency (ms).

Write and Read Latency is the average write or read latency for all storage volumes on a director.

For Read and Write Latency, the color of the heat map entries is based on a scale of latency from 0 to 15ms, depending on the selected metric. This scale is based on average customer requirements and may not represent a customer's particular requirements for latency. In such cases, EMC recommends adjusting the scale appropriately.

## VPLEX Communication dashboard

Click the **VPLEX Communication** tab to view a collection of heat maps that provide a single view of the performance of the communication links for a VPLEX configuration.

The EMC VPLEX Communication dashboard displays two types of heat maps:

- Metrics with definitive measurements such as intra-cluster local COM latency (0-15ms) are assigned color ranges from lowest (green) to highest (red).
- Metrics with varied values that cannot be assigned a range show relative values from lowest (light blue) to highest (dark blue).

### Cluster-1 COM Latency

This heat map has one mode: Average Latency (ms).

The Cluster-1 latency statistics represent the intra-cluster local COM latency, which occurs within the rack and is typically fast (less than 1 msec).

For COM Latency, the color of the heat map entries is based on a scale of latency from 0 to 15ms, depending upon the selected metric. This scale is based on average customer requirements and may not represent a customer's particular requirements for latency. In such cases, EMC recommends adjusting the scale appropriately.

For VPLEX Metro, EMC recommends adjusting the scale based on your discovered WAN round-trip time.

### Cluster-2 COM Latency

This heat map has one mode: Average Latency (ms).

The Cluster-2 latency statistics represent the intra-cluster local COM latency, which occurs within the rack and is typically small (less than 1 msec).

For COM Latency, the color of the heat map entries is based on a scale of latency from 0 to 15ms, depending upon the selected metric. This scale is based on average customer requirements and may not represent a customer's particular requirements for latency. In such cases, EMC recommends adjusting the scale appropriately.

For VPLEX Metro, EMC recommends adjusting the scale based on your discovered WAN round-trip time.

### WAN Link Usage (VPLEX Metro only)

This heat map has four modes:

- Distributed Device Bytes Received (MB/s)
- Distributed Device Bytes Sent (MB/s)
- Distributed Device Rebuild Bytes Received (MB/s)
- Distributed Device Rebuild Bytes Sent (MB/s)

Distributed Device Bytes Received or Sent represent the total amount of traffic received or sent for all distributed devices on a director.

Distributed Device Rebuild Bytes Received or Sent represent the total amount of rebuild/migration traffic received or sent for all distributed devices on a director.

The color of the heat map entries shows the relative number of distributed device bytes transferred on a director, depending upon the selected metric.

## XtremIO Overview dashboard

Click the **XtremIO Overview** tab to view a collection of scorecard widgets that provide an overview of the health for the XtremIO system.

The XtremIO Overview dashboard displays two types of heat maps:

- Metrics with definitive measurements are assigned color ranges from lowest (green) to highest (red).
- Metrics with varied values that cannot be assigned a range show relative values from lowest (light blue) to highest (dark blue).

### Cluster Data Reduction

This widget displays the Data Deduplication Ratio and Compression Ratio of each cluster.

---

#### Note

Compression Ratio shows as blue if XtremIO version 2.4.1 is running.

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### Cluster Efficiency

This widget displays the Thin Provisioning Savings (%) and the Total Efficiency of each cluster.

### Volume

This widget displays volumes in one of two modes: Total Capacity or Consumed Capacity. Select a volume to display its sparkline charts.

### Cluster

This widget displays, for each cluster, the Total Physical and Logical Capacity; Available Physical and Logical Capacity; and Consumed Physical and Logical Capacity.

### Snapshot

This widget displays snapshots in one of two modes: Total Capacity or Consumed Capacity. Select a snapshot to display its sparkline charts.

## XtremIO Performance dashboard

The XtremIO Performance dashboard provides percent utilization of the Storage Controller CPUs, key volume, and SSD metrics and sparklines.

The XtremIO Performance dashboard displays two types of heat maps:

- Metrics with definitive measurements such as CPU usage (0-100%) are assigned color ranges from lowest (green) to highest (red).
- Metrics with varied values that cannot be assigned a range show relative values from lowest (light blue) to highest (dark blue).

### Storage Controllers CPU 1 Utilization (%)

This widget shows the percent utilization of CPU 1.

### Storage Controllers CPU 2 Utilization (%)

This widget shows the percent utilization of CPU 2.

### Volume

This widget provides five modes: Total Operations, Total Bandwidth, Total Latency, Unaligned (%), and Average Block Size. Select a volume from this widget to display sparklines for it.

### SSD

This widget provides two modes: Endurance Remaining and Disk Utilization. Select an SSD from this widget to display sparklines for it.

## RecoverPoint Overview dashboard

Click the **RecoverPoint Overview** tab to view a collection of heat maps that provide a single view of the performance and capacity for all resources of VMAX with configured adapter instances. Heat maps on this dashboard group the contents by adapter instance.

The XtremIO Overview dashboard displays heat maps for metrics with definitive measurements are assigned color ranges from lowest (green) to highest (red).

### RecoverPoint for Virtual Machines System

This widget displays the number of RecoverPoint splitters and RecoverPoint clusters. It also provides summary information about the systems and clusters.

### RecoverPoint Cluster

This widget displays the following for each RecoverPoint system, including summary information:

- The number of consistency groups and the number of clusters
- The number of protected VMDKs and the number of protected user volumes
- The number of protected virtual machines for each RecoverPoint system
- The number of RecoverPoint Appliances (RPAs) for each cluster

### Consistency Group

This widget displays all enabled RecoverPoint consistency groups.

**Splitter**

This widget displays the following for each RecoverPoint system, including summary information:

- The number of vSphere ESX Clusters, the related splitters, and the number of connected clusters
- The number of attached volumes

## RecoverPoint for Virtual Machines Performance dashboard

The RecoverPoint Virtual Machines Performance dashboard provides a single view of the most important performance metrics for the resources.

The Performance dashboard displays two types of heat maps:

- Metrics with definitive measurements such as CPU usage (0-100%) are assigned color ranges from lowest (green) to highest (red).
- Metrics with varied values that cannot be assigned a range show relative values from lowest (light blue) to highest (dark blue).

**Lag (%)**

This widget shows the percent of the current lag for the link and for protection.

**Current Protection Window (Hrs)**

This widget shows the protection window ratio in hours for consistency groups.

**CPU Utilization (%)**

This widget shows the percent utilization of virtual RecoverPoint appliance (RPA) CPUs.

**Cluster**

This widget shows the performance for incoming writes (IOPS and KB/s) to clusters.

**Consistency Group**

This widget shows the performance for incoming writes (IOPS and KB/s) to consistency groups.

**RecoverPoint Appliance (RPA)**

This widget shows the performance for incoming writes (IOPS and KB/s) to RPAs.

## Topology dashboards

The topology dashboards provide an entry point for viewing resources and relationships between storage and virtual infrastructure objects for supported adapter instances.

Depending on the EMC adapter instance you installed, click the:

- **VNX Topology** tab
- **VNXe Topology** tab
- **VMAX Topology** tab
- **VPLEX Topology** tab
- **XtremIO Topology** tab
- **RecoverPoint for Virtual Machines Topology** tab

Details for every object in every widget are available by selecting the object and clicking the **Resource Detail** icon at the top of each widget.

The topology dashboards contain the following widgets:

### **Resource Tree**

This widget shows the end-to-end topology and health of resources across vSphere and storage domains. You can configure the hierarchy that is shown by changing the widget settings; changing these settings does not alter the underlying object relationships in the database. Select any resource in this widget to view related resources in the stack.

### **Health Tree**

The **Health Tree** widget provides a navigable visualization of resources that have parent or child relationships to the resource you select in the **Resource Tree** widget. Single-click to select resources, or double-click to change the navigation focus.

### **Metric Sparklines**

This widget shows sparklines for the metrics of the resource you select in the **Resource Tree** widget.

## Metrics dashboards

The metrics dashboards display resources and metrics for storage systems and allow the user to view graphs of resource metrics.

Depending on the EMC adapter instance you installed, click the:

- **VNX Metrics** tab
- **VNXe Metrics** tab
- **VMAX Metrics** tab
- **XtremIO Metrics** tab
- **RecoverPoint for Virtual Machines Metrics** tab

Widgets for the metrics dashboards are described next.

### Resource Tree/Environment Overview

This widget shows the end-to-end topology and health of resources across vSphere and storage domains. You can configure the hierarchy that is shown by changing the widget settings; changing these settings does not alter the underlying object relationships in the database. Select any resource in this widget to view related resources in the stack.

### Metric Selector/Metric Picker

This widget lists all the metrics that are collected for the resource you select in the **Resource Tree/Environment Overview** widget. Double-click a metric to create a graph of the metric in the **Metric Graph/Metric Chart** widget.

### Metric Graph/Metric Chart

This widget graphs the metrics you select in the **Metric Selector/Metric Picker** widget. Display multiple metrics simultaneously in a single graph or in multiple graphs.

### Resource Events (VNX/VNXe only)

The resource event widget shows a graph that illustrates the health of the selected object over a period of time. Object events are labeled on the graph. When you hover over or click a label, event details appear in a message box:

```
Id: 460
Start Time: May 23, 2014 4:30:52 AM
Cancel Time: May 23, 2014 4:38:28 AM
Trigger: Notification
Resource: Pool 0 (Storage Pool)
Details: FAST VP relocation completed.
```

The message box includes the event ID, start time, cancel time, trigger, resource name, and event details.

To close the message box, click the X button at the top-right corner.

## Top-N dashboards

Click a Top-N dashboard to view your top performing devices at a glance.

The Top-N dashboards are available for:

- VNX
- VNXe
- VMAX
- XtremIO
- RecoverPoint for Virtual Machines

Top performing devices are selected based on the current value of the associated metric that you configured for each widget. You can change the time period.

You can also change the number of objects in your top performer list.

### **VNX and VNXe**

By default, a Top-N dashboard shows the top 5 devices in the following categories across your VNX or VNXe systems:

- Top-5 by Read (IOPS)
- Top-5 by Write (IOPS)
- Top-5 by Read (MB/s)
- Top-5 by Write (MB/s)
- Top-5 by Consumed Capacity

### **VMAX**

By default, a Top-N dashboard shows the top 10 devices in the following categories across your VMAX system.

- Top-10 by Read (IOPS)
- Top-10 by Write (IOPS)
- Top-10 by Read (MB/s)
- Top-10 by Write (MB/s)
- Top-10 by Read Latency (ms)
- Top-10 by Write Latency (ms)

### **XtremIO**

By default, a Top-N dashboard shows the top 10 devices in the following categories across your XtremIO system.

- Top-10 by Read (IOPS)
- Top-10 by Write (IOPS)
- Top-10 by Read Latency (usec)
- Top-10 by Write (usec)
- Top-10 by Read Block Size (KB)
- Top-10 by Write Block Size (KB)
- Top-10 by Total Capacity (GB)

### **RecoverPoint for Virtual Machines**

By default, a Top-N dashboard shows the top 10 devices in the following categories across RecoverPoint for Virtual Machine systems.

- Top-10 RPAs by Write (IOPS)
- Top-10 RPAs by Write (KB/s)
- Top-10 Clusters by Write (IOPS)
- Top-10 Clusters by Write (KB/s)
- Top-10 Consistency Groups by Write (IOPS)
- Top-10 Consistency Groups by Write (KB/s)

## Dashboard XChange

The Dashboard XChange is a user community page for users to exchange EMC Storage Analytics custom dashboards.

EMC Storage Analytics provides a set of default dashboards that provide you with a variety of functional views into your storage environment. EMC Storage Analytics also enables you to create custom dashboards that allow you to visualize collected data according to your own requirements. The Dashboard XChange is an extension of that feature that enables you to:

- Export custom dashboards to the Dashboard XChange to benefit a wider EMC Storage Analytics community
- Import custom dashboards from the Dashboard XChange to add value to your own environment

The Dashboard XChange, hosted on the EMC Community Network, will also host dashboards designed by EMC to showcase widget functions that may satisfy a particular use-case in your environment. You can import these dashboards into your existing environment to enhance the functionality offered by EMC Storage Analytics. You can also edit imported dashboards to meet the specific requirements of your own storage environment.

The Dashboard XChange provides these resources to assist you in creating custom dashboards:

- How-to video that shows how to create custom dashboards
- Best practices guide that provides detailed guidelines for dashboard creation
- Slide show that demonstrates how to import dashboards from or export them to the Dashboard XChange

The EMC Storage Analytics Dashboard XChange is available at <https://community.emc.com/community/connect/esa>. Note that there are XChange Zones for supported platforms.

# CHAPTER 4

## Resource Kinds and Metrics

This chapter contains the following topics:

- [VNX Block metrics](#)..... 66
- [VNX File metrics](#)..... 76
- [VMAX metrics](#)..... 83
- [VNXe metrics](#).....86
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- [XtremIO metrics](#)..... 107
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## VNX Block metrics

EMC Storage Analytics provides metrics for these Resource Kinds:

- [EMC Adapter Instance on page 66](#) (array)
- [Disk on page 66](#)
- [FAST Cache on page 67](#)
- [Pool LUN on page 68](#)
- [RAID Group on page 70](#)
- [RAID Group LUN on page 70](#)
- [SP Front-end Port on page 71](#)
- [Storage Pool on page 72](#)
- [Storage Processor on page 73](#)
- [Tier on page 74](#)

**Table 4** VNX Block metrics for Array

| Metric                             | Additional information                                  |
|------------------------------------|---|
| Elapsed collect time (ms)          | Time elapsed during the collection.                     |
| New metrics in each collect call   | Number of new metrics per collection.                   |
| New resources in each collect call | Number of new resources per collection.                 |
| Number of down resources           | Number of down resources for this adapter instance.     |
| Number of metrics collected        | Number of metrics collected by this adapter instance.   |
| Number of resources collected      | Number of resources collected by this adapter instance. |

**Table 5** VNX Block metrics for Disk

| Metric                    | Additional information  |
|---------------------------|---|
| Busy (%)                  | The percentage of time during which the disk is servicing any requests.   |
| Capacity (GB)             | Total capacity of the disk.   |
| Hard Read Errors (Count)  | Number of hard read errors.   |
| Hard Write Errors (Count) | Number of hard write errors.  |
| LUN Count                 | Total number of LUNs that the disk is serving.  |
| Queue Length              | The average number of requests within a polling interval that are waiting to be serviced by the disk, including the one currently in service. |
| Read Size (MB)            | Appears in the <b>Performance</b> metric group.<br>The average size of data read.   |

**Table 5** VNX Block metrics for Disk (continued)

| <b>Metric</b>           | <b>Additional information</b>  |
|-------------------------|--|
| Reads (IOPS)            | The average number of read requests from the disk per second.  |
| Reads (MB/s)            | The average amount of data read from the disk in megabytes per second.   |
| State                   | Current state of the disk.   |
| Total Latency (ms)      | The average time, in milliseconds, that it takes for one request to pass through the disk, including any waiting time. |
| Total Operations (IOPS) | The total number of read and write requests per second that pass through the disk.                                     |
| Total Bandwidth (MB/s)  | The total number of host read and write data per second that pass through the disk.                                    |
| Write Size (MB)         | Appears in the <b>Performance</b> metric group.<br>The average size of data written.                                   |
| Writes (IOPS)           | The average number of write requests to the disk per second.   |
| Writes (MB/s)           | The average amount of data written to the disk in megabytes per second.  |

**Table 6** VNX Block metrics for FAST Cache

| <b>Metric</b>                  | <b>Additional information</b>   |
|--------------------------------|---|
| Current Operation              | <b>Creating or Destroying.</b>  |
| Current Operation Status       | If there is a current FAST Cache operation in progress such as destroying or creating, this displays the percentage complete.   |
| Current Operation Complete (%) | If there is a current FAST Cache operation in progress such as destroying or creating, this displays the percentage complete.   |
| Dirty (%)                      | Appears in the <b>Performance &gt; SPA</b> and <b>Performance &gt; SPB</b> metric groups.<br>Percentage of write cache pages owned by the SP that contain data that has not yet been flushed out to the FAST Cache. |
| Flushed (MB)                   | Appears in the <b>Performance &gt; SPA</b> and <b>Performance &gt; SPB</b> metric groups.<br>The average amount of data in megabytes that was written from the write cache to the FAST Cache.                       |
| Mode                           | Read/Write  |
| RAID Type                      | The RAID Type of FAST Cache   |
| Read Cache Hit Ratio (%)       | The ratio of read requests that the FAST Cache satisfied without requiring any disk access versus the total number of read requests. The higher the ratio the better the read performance.                          |

**Table 6** VNX Block metrics for FAST Cache (continued)

| Metric                        | Additional information  |
|-------------------------------|---|
| Read Cache Hits (Hits/s)      | Average number of read requests per second that were satisfied by the FAST Cache without requiring any disk access. Read requests that are not FAST Cache hits are read misses.               |
| Read Cache Misses (Misses/s)  | Average number of read requests per second that required one or multiple disk accesses.   |
| Size (GB)                     | The capacity of FAST Cache.   |
| Write Cache Hit Ratio (%)     | The ratio of write requests that the FAST Cache satisfied without requiring any disk access versus the total number of write requests. The higher the ratio the better the write performance. |
| Write Cache Hits (Hits/s)     | Average number of write requests per second that were satisfied by the FAST Cache without requiring any disk access. Write requests that are not FAST Cache hits are write misses.            |
| Write Cache Misses (Misses/s) | Average number of write requests per second that required one or multiple disk accesses.  |

**Table 7** VNX Block metrics for Pool LUN

| Metric                                    | Additional information   |
|---|--|
| Average Busy Queue Length                 | Appears in the <b>Performance</b> metric group.<br>The average number of outstanding requests when the LUN was busy.   |
| Busy (%)                                  | Appears in the <b>Performance &gt; SPA</b> and <b>Performance &gt; SPB</b> metric groups.<br>The fraction of an observation period during which a LUN has any outstanding requests. When the LUN becomes the bottleneck, the utilization is at or near 100%. However, since the I/Os can be serviced by multiple disks, an increase in workload may still result in a higher throughput. |
| Capacity Tier Distribution (%)            | The distribution (%) of the Capacity Tier.   |
| Consumed Capacity (GB)                    | The amount of space consumed in the pool by the LUN plus overhead.   |
| Explicit trespasses (Count)               | Appears in the <b>Performance &gt; SPA</b> and <b>Performance &gt; SPB</b> metric groups.<br>Number of trespasses since the last poll. Default polling cycle is five minutes. Occurs as a result of an external command from a user or the failover software. When an SP receives this command, LUN ownership is transferred to that SP.   |
| Extreme Performance Tier Distribution (%) | The distribution (%) of the Extreme Performance Tier.  |
| Implicit trespasses (Count)               | Appears in the <b>Performance &gt; SPA</b> and <b>Performance &gt; SPB</b> metric groups.  |

**Table 7** VNX Block metrics for Pool LUN (continued)

| Metric                            | Additional information  |
|-----------------------------------|---|
|                                   | Number of trespasses since the last poll. Default polling cycle is five minutes. Occurs as a result of software controls within the storage system. An implicit trespass occurs when the amount of I/O transferred across the non-optimal path exceeds the optimal path I/O by a specified threshold. |
| Initial Tier                      | The initial tier that was used for initial placement of the new LUN.  |
| Performance Tier Distribution (%) | The distribution (%) of the Performance Tier.   |
| Queue Length                      | The length of the LUN queue.  |
| Read Cache State                  | The enabled or disabled state of the read cache.  |
| Read Size (MB)                    | Appears in the <b>Performance</b> metric group.<br>The average size of data read.   |
| Reads (IOPS)                      | The average number of host read requests that is passed through the LUN per second. Smaller requests usually result in a higher read throughput than larger requests.   |
| Reads (MB/s)                      | The average amount of host read data in megabytes that is passed through the LUN per second. Larger requests usually result in a higher bandwidth than smaller requests.  |
| Service Time (ms)                 | Appears in the <b>Performance</b> metric group.<br>Average service time for successful completion of I/O without retries and queuing delays.  |
| Tiering Policy                    | The tiering policy of this Pool LUN.  |
| Total Latency (ms)                | The average time, in milliseconds, that a request to this LUN is outstanding, including its waiting time.   |
| Total Operations (IOPS)           | The total number of read and write requests per second that pass through the LUN.   |
| Total Bandwidth (MB/s)            | The total number of host read and write data per second that pass through the LUN.  |
| User Capacity (GB)                | The amount of space consumed in the pool by the LUN.  |
| Write Cache State                 | The enabled or disabled state of the write cache.   |
| Write Size (MB)                   | Appears in the <b>Performance</b> metric group.<br>The average size of data written.  |
| Writes (IOPS)                     | The average number of host write requests that is passed through the LUN per second. Smaller requests usually result in a higher write throughput than larger requests.   |
| Writes (MB/s)                     | The average amount of host write data in megabytes that is passed through the LUN per second. Larger requests usually result in higher bandwidth than smaller requests.   |

**Table 8** VNX Block metrics for RAID Group

| Metric   | Additional information   |
|--|--|
| Available Capacity (GB)                        | The remaining free capacity of this RAID Group.  |
| Defragmented (%)                               | When a defragment operation is in progress, this displays the percentage complete.   |
| Disk Count                                     | Number of disks in this RAID Group.  |
| Free Continuous Group of Unbound Segments (GB) | Size in GB of the largest continuous span of free space in the RAID Group. LUNs must fit into a contiguous span of free space. |
| Full (%)                                       | Percentage of total capacity that is consumed.   |
| LUN Count                                      | Number of LUNs in this RAID Group.   |
| Max Disks                                      | Maximum number of disks allowed for this RAID Group.   |
| Max LUNs                                       | Maximum number of LUNs allowed for this RAID Group.  |
| Raw Capacity (GB)                              | The total amount of space available in the RAID Group prior to RAID protection.  |
| User Capacity (GB)                             | The amount of space available in the RAID Group.   |

**Table 9** VNX Block metrics for RAID Group LUN

| Metric                    | Additional information   |
|---------------------------|--|
| Average Busy Queue Length | Appears in the <b>Performance</b> metric group.<br>The average number of outstanding requests when the LUN was busy.   |
| Busy (%)                  | Appears in the <b>Performance &gt; SPA</b> and <b>Performance &gt; SPB</b> metric groups.<br><br>The fraction of an observation period during which a LUN has any outstanding requests. When the LUN becomes the bottleneck, the utilization is at or near 100%. However, since the I/Os can be serviced by multiple disks, an increase in workload may still result in a higher throughput. |
| Queue Length              | The length of the LUN queue.   |
| Read Cache State          | The enabled or disabled state of the read cache.   |
| Read Size (MB)            | Appears in the <b>Performance</b> metric group.<br>The average size of data read.  |
| Reads (IOPS)              | The average number of host read requests that is passed through the LUN per second. Smaller requests usually result in a higher read throughput than larger requests.  |
| Reads (MB/s)              | The average amount of host read data in megabytes that is passed through the LUN per second. Larger requests usually result in a higher bandwidth than smaller requests.   |
| Service Time (ms)         | Appears in the <b>Performance</b> metric group.  |

**Table 9** VNX Block metrics for RAID Group LUN (continued)

| Metric                  | Additional information   |
|-------------------------|--|
|                         | Average service time for successful completion of I/O without retries and queuing delays.  |
| Total Latency (ms)      | The average time in milliseconds, that it takes for one request to pass through the LUN, including any waiting time. The higher the queue length for a LUN, the more requests are waiting in its queue, thus increasing the average latency of a single request. For a given workload, queue length and response time are directly proportional. |
| Total Operations (IOPS) | The total number of read and write requests per second that pass through the LUN.  |
| Total Bandwidth (MB/s)  | The total number of host read and write data per second that pass through the LUN.   |
| User Capacity (GB)      | The amount of space available in the RAID Group LUN.   |
| Write Cache State       | The enabled or disabled state of the write cache.  |
| Write Size (MB)         | Appears in the <b>Performance</b> metric group.<br>The average size of data written.   |
| Writes (IOPS)           | The average number of host write requests that is passed through the LUN per second.   |
| Writes (MB/s)           | The average amount of host write data in megabytes that is passed through the LUN per second.  |

**Table 10** VNX Block metrics for SP Front-end Port

| Metric                  | Additional information   |
|-------------------------|--|
| Queue Full Count        | The number of times that a front-end port issued a queue full response to the hosts.             |
| Reads (IOPS)            | The average number of read requests per second that pass through the SP front-end port.          |
| Reads (MB/s)            | The average amount of data read from the disk in megabytes per second.                           |
| Total Operations (IOPS) | The total number of read and write requests per second that pass through the SP front-end port.  |
| Total Bandwidth (MB/s)  | The total number of host read and write data per second that pass through the SP front-end port. |
| Writes (IOPS)           | The average number of write requests per second that pass through the SP front-end port.         |
| Writes (MB/s)           | The average amount of data written to the disk in megabytes per second.                          |

**Table 11** VNX Block metrics for Storage Pool

| <b>Metric</b>                            | <b>Additional information</b>   |
|--|---|
| Available Capacity (GB)                  | Capacity available for use in this Storage Pool.  |
| Auto-Tiering                             | Shows if auto-tiering is scheduled.   |
| Auto-Tiering State                       | The enabled or disabled state of auto-tiering.  |
| Consumed Capacity (GB)                   | Capacity used in this Storage Pool.   |
| Current Operation                        | Displays the current operation in the pool.   |
| Current Operation Complete (%)           | If there is a thin pool operation in progress such as a re-balance, this displays the percentage complete.  |
| Current Operation State                  | Displays the current operation state.   |
| Current Operation Status                 | Displays additional descriptive information for the current state of the thin pool.   |
| Data Movement Completed (GB)             | Amount of data that has been moved up or down.  |
| Data to Move Down (GB)                   | Amount of data that is going to be moved down.  |
| Data to Move Up (GB)                     | Amount of data that is going to be moved up.  |
| Data to Move Within (GB)                 | Amount of data to move within tiers.  |
| Deduplicated LUNs Shared Capacity (GBs)  | Shared capacity of deduplicated LUNs.   |
| Deduplication and Snapshot Savings (GBs) | Capacity savings through deduplication and Snapshots.   |
| Deduplication Rate                       | Rate of deduplication.  |
| Deduplication State                      | The deduplication state can take any of these values:<br><br>Idle (No deduplicated LUNs)<br>Idle (No deduplicated LUNs) - Faulted<br>Pending<br>Pending - Faulted<br>Running (% complete, GB remaining)<br>Running - Faulted (% complete, GB remaining)<br>Paused<br>Paused - Faulted |
| Disk Count                               | Number of disks consumed by this Storage Pool.  |
| Disk Type                                | Type of disks in this Storage Pool.   |
| Estimated Time to Complete               | Estimated time to complete the data relocation.   |
| FAST Cache                               | The enabled or disabled state of the FAST Cache for this Storage Pool.  |
| Full (%)                                 | Percentage of total capacity that is consumed.  |
| Initial Tier                             | Initial tier can be any of the values available for Tiering Policy (above).   |
| LUN Count                                | Number of LUNs hosted by this Storage Pool.   |

**Table 11** VNX Block metrics for Storage Pool (continued)

| <b>Metric</b>               | <b>Additional information</b>   |
|-----------------------------|---|
| Oversubscribed (GB)         | How much the Storage Pool is oversubscribed.  |
| Relocation Rate             | Rate at which relocation occurs.  |
| Relocation Start Time       | Start time for the relocation.  |
| Relocation Status           | Relocation is active or inactive.   |
| Relocation Stop Time        | Stop time for the relocation.   |
| Relocation Type             | Scheduled or manual relocation.   |
| Schedule Duration Remaining | If using scheduled relocation, this displays the remaining time for the relocation.   |
| Subscribed (%)              | Percentage of total capacity that is subscribed.  |
| Threshold (%)               | Threshold as percentage of total capacity.  |
| Tiering Policy              | <p>With FAST VP enabled, tiering policy can take any of these values:</p> <ul style="list-style-type: none"> <li>Start High then Auto-Tier (recommended)</li> <li>Auto Tier</li> <li>Highest Available Tier</li> <li>Lowest Available Tier</li> <li>No Data Movement</li> </ul> <p>With FAST VP disabled, tiering policy can be:</p> <ul style="list-style-type: none"> <li>Optimize for Pool Performance (default)</li> <li>Highest Available Tier</li> <li>Lowest Available Tier</li> </ul> |

**Table 12** VNX Block metrics for Storage Processor

| <b>Metric</b>            | <b>Additional information</b>  |
|--------------------------|--|
| Busy (%)                 | The percentage of time during which the SP is serving requests. When the SP becomes the bottleneck, the utilization will be at or close to 100%. And increase in workload will have no further impact on the SP throughput, but the I/O response time will start increasing more aggressively. |
| Dirty Cache Pages (%)    | The amount of dirty cache pages by percentage. This metric is for 1st generation VNX models.   |
| Dirty Cache Pages (MB)   | The amount of dirty cache pages in megabytes. This metric is for 2nd generation VNX models.  |
| Read Cache Hit Ratio (%) | The ratio of read requests that the SP Cache satisfied without requiring any disk access versus the total number of read requests.   |
| Read Cache Size (MB)     | The size of the read cache in megabytes. This metric is only for 1st generation VNX models.  |

**Table 12** VNX Block metrics for Storage Processor (continued)

| Metric                     | Additional information  |
|----------------------------|---|
| Read Cache State           | The enabled or disabled state of the read cache.  |
| Read Size (MB)             | Appears in the <b>Disk</b> metric group.<br>The average size of data read.  |
| Reads (IOPS)               | The average number of host read requests that is passed through the SP per second. Smaller requests usually result in a higher read throughput than larger requests.    |
| Reads (MB/s)               | The average amount of host read data in megabytes that is passed through the SP per second. Larger requests usually result in a higher bandwidth than smaller requests. |
| Total Operations (IOPS)    | The total number of read and write requests per second at the time when the SP is polled.   |
| Total Bandwidth (MB/s)     | The total number of read and write requests that pass through the SP per second.  |
| Write Cache Hit Ratio (%)  | The ratio of write requests that the SP Cache satisfied without requiring any disk access versus the total number of write requests.                                    |
| Write Cache Flushes (MB/s) | The average amount of data in megabytes that was written from the write cache to the disks per second. The value is a measure of back-end activity.                     |
| Write Cache Size (MB)      | The size of the write cache in megabytes. This metric is only for 1st generation VNX models.  |
| Write Cache State          | The enabled or disabled state of the write cache.   |
| Write Size (MB)            | Appears in the <b>Disk</b> metric group.<br>The average size of data written.   |
| Writes (IOPS)              | The number of writes per second at the time when the SP is polled. Smaller requests usually result in a higher write throughput than larger requests.                   |
| Writes (MB/s)              | The average write request size in megabytes that passes through the SP per second. Larger requests usually result in higher bandwidth than smaller requests.            |

**Table 13** VNX Block metrics for Tier

| Metric                  | Additional information                    |
|-------------------------|---|
| Available Capacity (GB) | Capacity still available for use.         |
| Consumed Capacity (GB)  | Used capacity.                            |
| Disk Count              | Number of disks in the tier.              |
| Higher Tier (GB)        | Amount of data targeted for higher tiers. |
| Lower Tier (GB)         | Amount of data targeted for lower tiers.  |

**Table 13** VNX Block metrics for Tier (continued)

| <b>Metric</b>      | <b>Additional information</b>          |
|--------------------|--|
| RAID Type          | Type of RAID applied to the tier.      |
| Subscribed (%)     | Percentage of tier that is subscribed. |
| User Capacity (GB) | Free capacity for users.               |

## VNX File metrics

EMC Storage Analytics provides metrics for these Resource Kinds:

- [EMC Adapter Instance on page 76](#) (array)
- [Data Mover on page 76](#) (includes Virtual Data Mover)
- [dVol on page 80](#)
- [File Pool on page 81](#)
- [File System on page 81](#)

**Table 14** VNX File metrics for Array

| Metric                             | Additional information                                  |
|------------------------------------|---|
| Elapsed collect time (ms)          | Amount of elapsed time for the collection.              |
| New metrics in each collect call   | Number of new metrics per collection.                   |
| New resources in each collect call | Number of new resources per collection.                 |
| Number of down resources           | Number of down resources for this adapter instance.     |
| Number of metrics collected        | Number of metrics collected by this adapter instance.   |
| Number of resources collected      | Number of resources collected by this adapter instance. |

**Table 15** VNX File metrics for Data Mover

| Metric                        | Metric Group  | Description   |
|-------------------------------|---------------|---|
| Buffer Cache Hit Ratio (%)    | Cache         | Buffer Cache Hit ratio percentage.  |
| DNLC Hit Ratio (%)            | Cache         | Directory Name Lookup Cache (DNLC) hit ratio percentage used for pathname resolution logic. |
| Open File Cache Hit Ratio (%) | Cache         | Open File Cache Hit ratio percentage.   |
| Type                          | Configuration | Data Mover type. The value can be Active (for the primary Data Mover), Standby, or VDM.     |
| Busy (%)                      | CPU           | CPU utilization percentage during this interval.  |
| Reads (MB/s)                  | Disk          | Storage in megabytes per second received from all server-storage interfaces.                |
| Total Bandwidth (MB/s)        | Disk          | The total bandwidth in megabytes per second for the Data Mover.                             |
| Writes (MB/s)                 | Disk          | Storage in megabytes per second sent to all server-storage interfaces.                      |
| CIFS Average Read Size (KB)   | Network       | Average CIFS read size  |

**Table 15** VNX File metrics for Data Mover (continued)

| <b>Metric</b>                  | <b>Metric Group</b>               | <b>Description</b>  |
|--------------------------------|-----------------------------------|---|
| CIFS Average Write Size (KB)   | Network                           | Average CIFS write size   |
| CIFS Reads (IOPS)              | Network                           | IOs per second for CIFS reads   |
| CIFS Reads (MB/s)              | Network                           | Megabytes per second for CIFS reads   |
| CIFS Total Operations (IOPS)   | Network                           | The total number of CIFS read and write requests per second that pass through the Data Mover. |
| CIFS Total Bandwidth (MB/s)    | Network                           | The total number of CIFS read and write data per second that pass through the Data Mover.     |
| CIFS Writes (IOPS)             | Network                           | Input/output operations per second for CIFS writes  |
| CIFS Writes (MB/s)             | Network                           | Megabytes per second for CIFS writes  |
| NFS Average Read Size (Bytes)  | Network                           | Average size of data read.  |
| NFS Average Write Size (Bytes) | Network                           | Average size of data written.   |
| NFS Reads (IOPS)               | Network                           | NFS read operations per second.   |
| NFS Reads (MB/s)               | Network                           | NFS read data response in megabytes per second.   |
| NFS Total Bandwidth (MB/s)     | Network                           | The total number of NFS read and write data per second that pass through the Data Mover.      |
| NFS Total Operations (IOPS)    | Network                           | The total number of NFS read and write requests per second that pass through the Data Mover.  |
| NFS Writes (IOPS)              | Network                           | NFS write operations per second.  |
| NFS Writes (MB/s)              | Network                           | NFS write data response in megabytes per second.  |
| Network In Bandwidth (MB/s)    | Network                           | Network in bandwidth. megabytes received per second.  |
| Network Out Bandwidth (MB/s)   | Network                           | Network out bandwidth. megabytes sent per second.   |
| Total Network Bandwidth (MB/s) | Network                           | The total network bandwidth per second.   |
| Read Calls/s                   | Network > NFSv2, NFSv3, and NFSv4 | Read calls per second   |
| Read Errors/s                  | Network > NFSv2, NFSv3, and NFSv4 | Read errors per second  |
| Read Response Time (ms)        | Network > NFSv2, NFSv3, and NFSv4 | Total read response time  |

**Table 15** VNX File metrics for Data Mover (continued)

| Metric                           | Metric Group                      | Description                              |
|----------------------------------|-----------------------------------|--|
| Write Calls/s                    | Network › NFSv2, NFSv3, and NFSv4 | Write calls per second                   |
| Write Errors/s                   | Network › NFSv2, NFSv3, and NFSv4 | Write errors per second                  |
| Write Response Time (ms)         | Network › NFSv2, NFSv3, and NFSv4 | Total write response time                |
| Access Calls/s                   | Network › NFSv3                   | Access calls per second                  |
| Access Errors/s                  | Network › NFSv3                   | Access errors per second                 |
| Access Response Time (ms)        | Network › NFSv3                   | Total access response time               |
| GetAttr Calls/s                  | Network › NFSv3                   | Get file attributes (GetAttr) per second |
| GetAttr Errors/s                 | Network › NFSv3                   | GetAttr errors per second                |
| GetAttr Response Time (ms)       | Network › NFSv3                   | Total response time for GetAttr          |
| Lookup Calls/s                   | Network › NFSv3                   | Lookup calls per second                  |
| Lookup Errors/s                  | Network › NFSv3                   | Lookup errors per second                 |
| Lookup Response Time (ms)        | Network › NFSv3                   | Total lookup response time               |
| SetAttr Calls/s                  | Network › NFSv3                   | Set file attributes (SetAttr) per second |
| SetAttr Errors/s                 | Network › NFSv3                   | SetAttr errors per second                |
| SetAttr Response Time (ms)       | Network › NFSv3                   | Total response time for SetAttr          |
| Close Calls/s                    | Network › NFSv4                   | Close calls per second                   |
| Close Errors/s                   | Network › NFSv4                   | Close errors per second                  |
| Close Response Time (ms)         | Network › NFSv4                   | Total close response time                |
| Compound Calls/s                 | Network › NFSv4                   | Compound calls per second                |
| Compound Errors/s                | Network › NFSv4                   | Compound errors per second               |
| Compound Response Time (ms)      | Network › NFSv4                   | Total compound response time             |
| Open Calls/s                     | Network › NFSv4                   | Open calls per second                    |
| Open Errors/s                    | Network › NFSv4                   | Open errors per second                   |
| Open Response Time (ms)          | Network › NFSv4                   | Total open response time                 |
| Close Average Response Time (ms) | Network › SMB1                    | Close average response time              |

**Table 15** VNX File metrics for Data Mover (continued)

| <b>Metric</b>                         | <b>Metric Group</b> | <b>Description</b>               |
|---------------------------------------|---------------------|----------------------------------|
| Close Calls/s                         | Network > SMB1      | Close calls per second           |
| Close Max Response Time (ms)          | Network > SMB1      | Close maximum response time      |
| NTCreateX Average Response Time (ms)  | Network > SMB1      | NTCreateX average response time  |
| NTCreateX Calls/s                     | Network > SMB1      | NTCreateX calls per second       |
| NTCreateX Max Response Time (ms)      | Network > SMB1      | NTCreateX maximum response time  |
| ReadX Average Response Time (ms)      | Network > SMB1      | Average response time for ReadX  |
| ReadX Calls/s                         | Network > SMB1      | ReadX calls per second           |
| ReadX Max Response Time (ms)          | Network > SMB1      | ReadX maximum response time      |
| Trans2Prim Average Response Time (ms) | Network > SMB1      | Trans2Prim average response time |
| Trans2Prim Calls/s                    | Network > SMB1      | Trans2Prim calls per second      |
| Trans2Prim Max Response Time (ms)     | Network > SMB1      | Trans2Prim maximum response time |
| WriteX Average Response Time (ms)     | Network > SMB1      | WriteX average response time     |
| WriteX Calls/s                        | Network > SMB1      | WriteX calls per second          |
| WriteX Max Response Time (ms)         | Network > SMB1      | WriteX maximum response time     |
| Close Average Response Time (ms)      | Network > SMB2      | Close average response time      |
| Close Calls/s                         | Network > SMB2      | Close calls per second           |
| Close Max Response Time (ms)          | Network > SMB2      | Close maximum response time      |
| Flush Average Response Time (ms)      | Network > SMB2      | Flush average response time      |
| Flush Calls/s                         | Network > SMB2      | Flush calls per second           |
| Flush Max Response Time (ms)          | Network > SMB2      | Flush maximum response time      |
| Create Average Response Time (ms)     | Network > SMB2      | Create average response time     |
| Create Calls/s                        | Network > SMB2      | Create calls per second          |
| Create Max Response Time (ms)         | Network > SMB2      | Create maximum response time     |

**Table 15** VNX File metrics for Data Mover (continued)

| Metric                               | Metric Group   | Description                                   |
|--------------------------------------|----------------|---|
| IOCTL Average Response Time (ms)     | Network > SMB2 | Input/Output Control average response time    |
| IOCTL Calls/s                        | Network > SMB2 | Input/Output Control (IOCTL) calls per second |
| IOCTL Max Response Time (ms)         | Network > SMB2 | Input/Output Control maximum response time    |
| Queryinfo Average Response Time (ms) | Network > SMB2 | Query information average response time       |
| Queryinfo Calls/s                    | Network > SMB2 | Query information calls per second            |
| Queryinfo Max Response Time (ms)     | Network > SMB2 | Query information maximum response time       |
| Read Average Response Time (ms)      | Network > SMB2 | Read average response time                    |
| Read Calls/s                         | Network > SMB2 | Read calls per second                         |
| Read Max Response Time (ms)          | Network > SMB2 | Read maximum response time                    |
| Write Average Response Time (ms)     | Network > SMB2 | Write average response time                   |
| Write Calls/s                        | Network > SMB2 | Write calls per second                        |
| Write Max Response Time (ms)         | Network > SMB2 | Write maximum response time                   |

**Table 16** VNX File metrics for dVol

| Metric                                    | Additional information  |
|---|---|
| Average Read Size (Bytes)                 | Average size of data read.  |
| Average Write Size (Bytes)                | Average size of data written.   |
| Average Completion Time ( $\mu$ Sec/call) | Average time for completion of an I/O.  |
| Average Service Time ( $\mu$ Sec/call)    | Average service time for successful completion of I/O without retries and queuing delays. |
| Capacity (GB)                             | Total capacity of the disk volume.  |
| IO Retries (IOPS)                         | Number of I/O retries per second.   |
| Queue Length                              | Length of disk queue  |
| Reads (IOPS)                              | Number of read operations on the disk per second.   |
| Reads (MB/s)                              | Megabytes read from the disk per second.  |
| Total Operations (IOPS)                   | Number of I/O operations on the disk volume per second.                                   |
| Total Bandwidth (MB/s)                    | Total bandwidth of the disk volume.   |
| Utilization (%)                           | Percentage time that disk has been utilized.  |

**Table 16** VNX File metrics for dVol (continued)

| Metric        | Additional information                             |
|---------------|--|
| Writes (IOPS) | Number of write operations on the disk per second. |
| Writes (MB/s) | Mbytes written to the disk per second.             |

**Table 17** VNX File metrics for File Pool

| Metric                  | Additional information              |
|-------------------------|-------------------------------------|
| Available Capacity (GB) | Capacity still available for use.   |
| Capacity (GB)           | Total capacity of the file pool.    |
| Consumed Capacity (GB)  | Consumed capacity of the file pool. |

**Table 18** VNX File metrics for File System

| Metric                     | Additional information   |
|----------------------------|--|
| Available Capacity (GB)    | Capacity still available for use.  |
| Average Read Size (Bytes)  | Average size of data read.   |
| Average Write Size (Bytes) | Average size of data written.  |
| Capacity (GB)              | Total space available for storage of user data (does not include metadata).  |
| Consumed Capacity (GB)     | Consumed capacity of the File System.  |
| Thin Provisioning          | True indicates that the file system is enabled for virtual provisioning, an option that can only be used with automatic file system extension. Combining automatic file system extension with virtual provisioning allows growth of the file system gradually and as needed. When virtual provisioning is enabled, NFS and CIFS clients receive reports for either the virtual maximum file system size or real file system size, whichever is larger. |
| Max Capacity (GB)          | If automatic extension is enabled, the file system will automatically extend to this maximum size when the high water mark is reached. The default value for the high water mark is 90 percent.  |
| Read IO Ratio (%)          | Percentage of total I/Os that are read I/Os.   |
| Read Requests (Requests/s) | Read operations per second in the interval.  |
| Reads (IOPS)               | The average read operations per second.  |
| Reads (MB/s)               | Read data response per second.   |
| Total Bandwidth (MB/s)     | The total number of read and write data per second for the file system.  |
| Total Operations (IOPS)    | The total number of read and write data per second for the file system.  |

**Table 18** VNX File metrics for File System (continued)

| <b>Metric</b>               | <b>Additional information</b>                 |
|-----------------------------|---|
| Write IO Ratio (%)          | Percentage of total I/Os that are write I/Os. |
| Write Requests (Requests/s) | Write operations per second in the interval.  |
| Writes (IOPS)               | The average write operations per second.      |
| Writes (MB/s)               | Write data response per second.               |

## VMAX metrics

EMC Storage Analytics provides metrics for the following applicable VMAX and VMAX3 Resource Kinds:

- [Device on page 83](#)
- [Front-End Director on page 84](#)
- [Front-End Port on page 84](#)
- [Remote Replica Group on page 84](#)
- [SRDF Director on page 84](#)
- [Storage Group on page 85](#)
- [FAST VP Policy on page 83](#)
- [Thin Pool on page 85](#)
- [Storage Resource Pool on page 85](#)

**Table 19** VMAX metrics for Device

| Metric                  | Definition   |
|-------------------------|--|
| Read Latency (ms)       | The average time it took the VMAX array to serve one Read I/O for this device.           |
| Reads (IOPS)            | The number of Read operations performed each second on the device.                       |
| Reads (MB/s)            | The number of megabytes read per second from the device.                                 |
| Total Bandwidth (MB/s)  | The total number of read and write megabytes performed each second on the device.        |
| Total Capacity          | The total capacity available (in GBs) on the device.                                     |
| Total Operations (IOPS) | The total reads and writes performed each second on the device.                          |
| Used Capacity           | The capacity used (in GBs) by the device.  |
| Write Latency (ms)      | The average time it took the VMAX array to serve one Write I/O for this device.          |
| Writes (IOPS)           | The total number of Write I/O operations performed each second by the VMAX volume (LUN). |
| Writes (MB/s)           | The cumulative number of megabytes written per second to the device.                     |

**Table 20** VMAX metrics for FAST VP Policy

| Metric            | Metric group                   | Definition                          |
|-------------------|--------------------------------|-------------------------------------|
| Name              | Tier 1, Tier 2, Tier 3, Tier 4 | The name of the FAST VP policy.     |
| Percent in policy | Tier 1, Tier 2, Tier 3, Tier 4 | Percentage of tier within a policy. |

**Table 21** VMAX metrics for Front-End Director

| Metrics                 | Definition   |
|-------------------------|--|
| Reads (IOPS)            | The total read operations the front-end director processes per second.             |
| Total Bandwidth (MB/s)  | The total number of megabytes sent and received per second by the director.        |
| Total Hits (IOPS)       | The total number of requests per second that were immediately serviced from cache. |
| Total Operations (IOPS) | The total reads and writes the front-end director processes per second.            |
| Writes (IOPS)           | The total write operations the front-end director processes per second.            |

**Table 22** VMAX metrics for Front-End Port

| Metrics                 | Definition  |
|-------------------------|---|
| Total Operations (IOPS) | The total reads and writes the front-end port processes per second. |
| Total Bandwidth (MB/s)  | The number of megabytes transferred per second.                     |

**Table 23** VMAX metrics for Remote Replica Group

| Metrics                       | Definition  |
|-------------------------------|---|
| Average Cycle Time (s)        | The average time it takes for each cycle to complete.   |
| Delta Set Extension Threshold | The percent of write pendings before DSE activates.   |
| Devices in Session (count)    | The number of devices in the group.   |
| HA Repeat Writes (counts/s)   | Writes to a slot already in the active cycle. Total host adapter repeat writes, measured in write commands to SRDF/A volumes only. This counter helps estimate the cache locality of reference, i.e., how much cache is saved by the re-writes. This does not give any indication to the bandwidth locality of reference. |
| Minimum Cycle Time (s)        | The setting for the minimum number of seconds for a cycle.  |
| Writes (IOPS)                 | The number of write input/output operations coming in per second for the volumes in this session.   |
| Writes (MB/s)                 | The total number of megabytes sent per second by the group.   |

**Table 24** VMAX metrics for SRDF Director

| Metrics                 | Definition  |
|-------------------------|---|
| Reads (IOPS)            | The read operations the SRDF director processes per second.                     |
| Total Bandwidth (MB/s)  | The total number of megabytes sent and received per second by the RDF director. |
| Total Operations (IOPS) | The total reads and writes the SRDF director processes per second.              |

**Table 24** VMAX metrics for SRDF Director (continued)

| <b>Metrics</b> | <b>Definition</b>  |
|----------------|--|
| Writes (IOPS)  | The write operations the SRDF director processes per second. |

**Table 25** VMAX metrics for Storage Group

| <b>Metric</b>           | <b>Definition</b>  |
|-------------------------|--|
| Read Latency (ms)       | The average time it took the VMAX array to serve one Read I/O for this storage group.  |
| Reads (IOPS)            | The number of read operations performed each second by the storage group.              |
| Reads (MB/s)            | The cumulative number of megabytes read per second by the storage group.               |
| Total Bandwidth (MB/s)  | The total number of megabytes sent and received per second by the storage group.       |
| Total Capacity          | The total capacity available (in GBs) for the storage group.                           |
| Total Latency (ms)      | The average time it took the VMAX array to serve one I/O for this storage group.       |
| Total Operations (IOPS) | The total reads and writes performed each second by the storage group.                 |
| Used Capacity           | The capacity used (in GBs) by the the storage group.                                   |
| Write Latency (ms)      | The average time it took the VMAX array to serve one Write I/O for this storage group. |
| Writes (IOPS)           | The number of write operations performed each second by the storage group.             |
| Writes (MB/s)           | The cumulative number of megabytes written per second by the storage group.            |

**Table 26** VMAX metrics for Thin Pool

| <b>Metric</b>           | <b>Definition</b>                                     |
|-------------------------|---|
| Allocated Capacity (GB) | The allocated thin pool capacity.                     |
| Full (%)                | The percent of the thin pool that has been allocated. |
| Total Capacity (GB)     | The total thin pool capacity.                         |
| Used Capacity (GB)      | The used thin pool capacity.                          |

**Table 27** VMAX3 metrics for Storage Resource Pool

| <b>Metric</b>                | <b>Definition</b>                                |
|------------------------------|--|
| Capacity/Full (%)            | The percent of the pool that has been allocated. |
| Capacity/Total Managed Space | The capacity and total managed space.            |

## VNXe metrics

EMC Storage Analytics provides metrics for these Resource Kinds:

### Note

Only the Resource Kinds with associated metrics are shown.

- [EMC Adapter Instance on page 86](#)
- [Disk on page 86](#)
- [FAST Cache on page 87](#)
- [File System on page 87](#)
- [LUN on page 87](#)
- [Storage Pool on page 88](#)
- [Storage Processor on page 88](#)
- [Tier on page 93](#)

**Table 28** VNXe metrics for EMC Adapter Instance

| Metric                             | Additional information                                  |
|------------------------------------|---|
| Elapsed collect time (ms)          | Time elapsed during the collection.                     |
| New metrics in each collect call   | Number of new metrics per collection.                   |
| New resources in each collect call | Number of new resources per collection.                 |
| Number of down resources           | Number of down resources for this adapter instance.     |
| Number of metrics collected        | Number of metrics collected by this adapter instance.   |
| Number of resources collected      | Number of resources collected by this adapter instance. |

**Table 29** VNXe metrics for Disk

| Metric             | Metric Group  | Description  |
|--------------------|---------------|--|
| Size (GB)          | Capacity      | The total capacity of the disk.  |
| State              | Configuration | Current state of the disk.   |
| Busy (%)           | Performance   | The percentage of time during which the disk is servicing any requests.  |
| Reads ()           | Performance   | The percentage of time during which the disk is servicing any requests.  |
| Reads (MB/s)       | Performance   | The average amount of data read from the disk in megabytes per second.   |
| Total Latency (ms) | Performance   | The average time, in milliseconds, that it takes for one request to pass through the disk, including any waiting time. |

**Table 29** VNXe metrics for Disk (continued)

| Metric        | Metric Group | Description   |
|---------------|--------------|---|
| Writes (IOPS) | Performance  | The average number of write requests to the disk per second.            |
| Writes (MB/s) | Performance  | The average amount of data written to the disk in megabytes per second. |

**Table 30** VNXe metrics for Fast Cache

| Metric                  | Metric group  | Description                       |
|-------------------------|---------------|-----------------------------------|
| Available Capacity (GB) | Capacity      | Capacity still available for use. |
| Raid Type               | Configuration | The RAID Type of FAST Cache.      |

**Table 31** VNXe metrics for File System

| Metric                  | Metric group | Description   |
|-------------------------|--------------|---|
| Available Capacity (GB) | Capacity     | Capacity still available for use.   |
| Capacity (GB)           | Capacity     | Total space available for storage of user data (does not include metadata).   |
| Consumed Capacity (GB)  | Capacity     | Consumed capacity of the File System.   |
| Max Capacity (GB)       | Capacity     | If automatic extension is enabled, the file system will automatically extend to this maximum size when the high water mark is reached. The default value for the high water mark is 90 percent.   |
| Thin Provisioning       | Capacity     | <b>True</b> indicates that the file system is enabled for virtual provisioning, an option that can only be used with automatic file system extension. Combining automatic file system extension with virtual provisioning allows growth of the file system gradually and as needed. When virtual provisioning is enabled, NFS and CIFS clients receive reports for either the virtual maximum file system size or real file system size, whichever is larger. |

**Table 32** VNXe metrics for LUN

| Metric                 | Metric group | Description                |
|------------------------|--------------|----------------------------|
| Consumed Capacity (GB) | Capacity     | Capacity used in this LUN. |
| Total Capacity (GB)    | Capacity     | Total LUN capacity.        |

**Table 32** VNXe metrics for LUN (continued)

| Metric        | Metric group | Description  |
|---------------|--------------|--|
| Queue Length  | Performance  | The length of the LUN queue.   |
| Reads (IOPS)  | Performance  | The average number of host read requests that is passed through the LUN per second. Smaller requests usually result in a higher read throughput than larger requests.    |
| Reads (MB/s)  | Performance  | The average amount of host read data in megabytes that is passed through the LUN per second. Larger requests usually result in a higher bandwidth than smaller requests. |
| Writes (IOPS) | Performance  | The average number of host write requests that is passed through the LUN per second.   |
| Writes (MB/s) | Performance  | The average amount of host write data in megabytes that is passed through the LUN per second.  |

**Table 33** VNXe metrics for Storage Pool

| Metric                  | Metric group  | Description  |
|-------------------------|---------------|--|
| Available Capacity (GB) | Capacity      | Capacity available for use in this Storage Pool.                       |
| Consumed Capacity (GB)  | Capacity      | Capacity used in this Storage Pool.                                    |
| Full (%)                | Capacity      | Percentage of total capacity that is consumed.                         |
| Subscribed (%)          | Capacity      | Percentage of total capacity that is subscribed.                       |
| User Capacity (GB)      | Capacity      | The amount of space available in the Storage Pool.                     |
| Fast Cache              | Configuration | The enabled or disabled state of the FAST Cache for this Storage Pool. |

**Table 34** VNXe metrics for Storage Processor

| Metric                    | Metric group | Description  |
|---------------------------|--------------|--|
| Dirty Cache Pages (MB)    | Cache        | The amount of dirty cache pages in megabytes.  |
| Read Cache Hit Ratio (%)  | Cache        | The ratio of read requests that the SP Cache satisfied without requiring any disk access versus the total number of read requests.   |
| Write Cache Hit Ratio (%) | Cache        | The ratio of write requests that the SP Cache satisfied without requiring any disk access versus the total number of write requests. |
| CIFS Reads (IOPS)         | Network      | Input/output operations per second for CIFS reads.   |

**Table 34** VNXe metrics for Storage Processor (continued)

| <b>Metric</b>                | <b>Metric group</b> | <b>Description</b>                                    |
|------------------------------|---------------------|---|
| CIFS Reads (MB/s)            | Network             | Megabytes per second for CIFS reads.                  |
| CIFS Writes (IOPS)           | Network             | Input/output operations per second for CIFS writes.   |
| CIFS Writes (MB/s)           | Network             | Megabytes per second for CIFS writes.                 |
| Network In Bandwidth (MB/s)  | Network             | Network in bandwidth (megabytes received per second). |
| Network Out Bandwidth (MB/s) | Network             | Network out bandwidth (megabytes sent per second).    |
| NFS Reads (IOPS)             | Network             | NFS read operations per second.                       |
| NFS Reads (MB/s)             | Network             | NFS read data response in megabytes per second.       |
| NFS Writes (IOPS)            | Network             | NFS write operations per second.                      |
| NFS Writes (MB/s)            | Network             | NFS write data response in megabytes per second.      |
| <hr/>                        |                     |   |
| Read Calls/s                 | Network › NFSv2     | Read calls per second.                                |
| Read Errors/s                | Network › NFSv2     | Read errors per second.                               |
| Read Response Time (ms)      | Network › NFSv2     | Read response time.                                   |
| Reads (IOPS)                 | Network › NFSv2     | NFS V2 read operations per second.                    |
| Write Calls/s                | Network › NFSv2     | Write calls per second.                               |
| Write Errors/s               | Network › NFSv2     | Write errors per second.                              |
| Write Response Time (ms)     | Network › NFSv2     | Write average response time.                          |
| Writes (IOPS)                | Network › NFSv2     | NFS V2 write operations per second.                   |
| <hr/>                        |                     |   |
| Access Calls/s               | Network › NFSv3     | Access calls per second.                              |
| Access Errors/s              | Network › NFSv3     | Access errors per second.                             |
| Access Response Time (ms)    | Network › NFSv3     | Access average response time.                         |
| GetAttr Calls/s              | Network › NFSv3     | Get file attributes (GetAttr) per second.             |
| GetAttr Errors/s             | Network › NFSv3     | GetAttr errors per second.                            |
| GetAttr Response Time (ms)   | Network › NFSv3     | GetAttr average response time.                        |
| Lookup Calls/s               | Network › NFSv3     | Lookup calls per second.                              |
| Lookup Errors/s              | Network › NFSv3     | Lookup errors per second.                             |
| Lookup Response Time (ms)    | Network › NFSv3     | Lookup average response time.                         |
| Read Calls/s                 | Network › NFSv3     | Read calls per second.                                |
| Read Errors/s                | Network › NFSv3     | Read errors per second.                               |

**Table 34** VNXe metrics for Storage Processor (continued)

| <b>Metric</b>                         | <b>Metric group</b> | <b>Description</b>                                      |
|---------------------------------------|---------------------|---|
| Read Response Time (ms)               | Network › NFSv3     | Read average response time.                             |
| Reads (IOPS)                          | Network › NFSv3     | NFS V3 read operations per second.                      |
| SetAttr Calls/s                       | Network › NFSv3     | SetAttr per second.                                     |
| SetAttr Errors/s                      | Network › NFSv3     | SetAttr errors per second.                              |
| SetAtt Response Time (ms)             | Network › NFSv3     | Set file attributes (SetAttr) average response time.    |
| Write Calls/s                         | Network › NFSv3     | Write calls per second.                                 |
| Write Errors/s                        | Network › NFSv3     | Write errors per second.                                |
| Write Response Time (ms)              | Network › NFSv3     | Write average response time                             |
| Writes (IOPS)                         | Network › NFSv3     | NFS V3 write operations per second.                     |
| Close Average Response Time (ms)      | Network › SMB1      | Close average response time.                            |
| Close Calls/s                         | Network › SMB1      | Close calls per second.                                 |
| Close Max Response Time (ms)          | Network › SMB1      | Close maximum response time.                            |
| NTCreateX Average Response Time (ms)  | Network › SMB1      | NTCreateX average response time.                        |
| NTCreateX Calls/s                     | Network › SMB1      | NTCreateX calls per second.                             |
| NTCreateX Max Response Time (ms)      | Network › SMB1      | NTCreateX maximum response time.                        |
| Reads (IOPS)                          | Network › SMB1      | Input/output operations per second for CIFS SMB1 reads. |
| Reads (MB/s)                          | Network › SMB1      | Megabytes per second for CIFS SMB1 reads.               |
| ReadX Average Response Time (ms)      | Network › SMB1      | Average response time for ReadX.                        |
| ReadX Calls/s                         | Network › SMB1      | ReadX calls per second.                                 |
| ReadX Max Response Time (ms)          | Network › SMB1      | Maximum response time for ReadX.                        |
| Trans2Prim Average Response Time (ms) | Network › SMB1      | Trans2Prim average response time.                       |

**Table 34** VNXe metrics for Storage Processor (continued)

| <b>Metric</b>                     | <b>Metric group</b> | <b>Description</b>                                       |
|-----------------------------------|---------------------|--|
| Trans2Prim Calls/s                | Network › SMB1      | Trans2Prim calls per second.                             |
| Trans2Prim Max Response Time (ms) | Network › SMB1      | Trans2Prim maximum response time.                        |
| Writes (IOPS)                     | Network › SMB1      | Input/output operations per second for CIFS SMB1 writes. |
| Writes (MB/s)                     | Network › SMB1      | Megabytes per second for CIFS SMB1 writes.               |
| WriteX Average Response Time (ms) | Network › SMB1      | WriteX average response time.                            |
| WriteX Calls/s                    | Network › SMB1      | WriteX calls per second.                                 |
| WriteX Max Response Time (ms)     | Network › SMB1      | WriteX maximum response time.                            |
| Close Average Response Time (ms)  | Network › SMB2      | Close average response time.                             |
| Close Calls/s                     | Network › SMB2      | Close calls per second.                                  |
| Close Max Response Time (ms)      | Network › SMB2      | Close maximum response time.                             |
| Create Average Response Time (ms) | Network › SMB2      | Create average response time.                            |
| Create Calls/s                    | Network › SMB2      | Create calls per second.                                 |
| Create Max Response Time (ms)     | Network › SMB2      | Create maximum response time.                            |
| Flush Average Response Time (ms)  | Network › SMB2      | Flush average response time.                             |
| Flush Calls/s                     | Network › SMB2      | Flush calls per second.                                  |
| Flush Max Response Time (ms)      | Network › SMB2      | Flush maximum response time.                             |
| Ioctl Average Response Time (ms)  | Network › SMB2      | IO Control (IOCTL) average response time.                |
| Ioctl Calls/s                     | Network › SMB2      | IOCTL calls per second.                                  |
| Ioctl Max Response Time           | Network › SMB2      | IOCTL maximum response time.                             |

**Table 34** VNXe metrics for Storage Processor (continued)

| <b>Metric</b>                        | <b>Metric group</b> | <b>Description</b>  |
|--------------------------------------|---------------------|---|
| Queryinfo Average Response Time (ms) | Network › SMB2      | Queryinfo average response time.  |
| Queryinfo Calls/s                    | Network › SMB2      | Queryinfo calls per second.   |
| Queryinfo Max Response Time (ms)     | Network › SMB2      | Queryinfo maximum response time.  |
| Read Average Response Time (ms)      | Network › SMB2      | Read average response time.   |
| Read Calls/s                         | Network › SMB2      | Read calls per second.  |
| Read Max Response Time (ms)          | Network › SMB2      | Read maximum response time.   |
| Reads (IOPS)                         | Network › SMB2      | Input/output operations per second for CIFS SMB2 reads.   |
| Reads (MB/s)                         | Network › SMB2      | Megabytes per second for CIFS SMB2 reads.   |
| Write Average Response Time (ms)     | Network › SMB2      | Write average response time.  |
| Write Calls/s                        | Network › SMB2      | Write calls per second.   |
| Write Max Response Time (ms)         | Network › SMB2      | Write maximum response time.  |
| Writes (IOPS)                        | Network › SMB2      | Input/output operations per second for CIFS SMB2 writes.  |
| Writes (MB/s)                        | Network › SMB2      | Megabytes per second for CIFS SMB2 writes.  |
| Busy (%)                             | Performance         | The percentage of time during which the SP is serving requests. When the SP becomes the bottleneck, the utilization will be at or close to 100%. An increase in workload will have no further impact on the SP throughput, but the I/O response time will start increasing more aggressively. |
| Reads (IOPS)                         | Performance         | The average number of host read requests that is passed through the SP per second. Smaller requests usually result in a higher read throughput than larger requests.  |
| Reads (MB/s)                         | Performance         | The average amount of host read data in megabytes that is passed through the SP per second. Larger requests usually result in a higher bandwidth than smaller requests.   |

**Table 34** VNXe metrics for Storage Processor (continued)

| Metric        | Metric group | Description   |
|---------------|--------------|---|
| Writes (IOPS) | Performance  | The number of writes per second at the time when the SP is polled. that is passed through the SP per second. Smaller requests usually result in a higher write throughput than larger requests. |
| Writes (MB/s) | Performance  | The average write request size in megabytes that passes through the SP per second. Larger requests usually result in higher bandwidth than smaller requests.                                    |

**Table 35** VNXe metrics for Tier

| Metric                   | Description                                   |
|--------------------------|---|
| Available Capacity (GB)  | Capacity available for use in this tier       |
| Consumed Capacity (GB)   | Capacity used in this tier                    |
| Data to Move Down (GB)   | Amount of data that is going to be moved down |
| Data to Move Up (GB)     | Amount of data that is going to be moved up   |
| Data to Move Within (GB) | Amount of data to move within tiers           |
| Disk Count               | Number of disks in the tier                   |
| Full (%)                 | Percentage of total capacity that is consumed |
| Raid Type                | Type of RAID applied to the tier              |
| User Capacity (GB)       | The amount of space available in this tier    |

## VPLEX metrics

EMC Storage Analytics provides metrics for these Resource Kinds:

- [Cluster on page 94](#)
- [Director on page 96](#)
- [Distributed Device on page 99](#)
- [Engine on page 100](#)
- [Ethernet Port on page 101](#)
- [Extent on page 101](#)
- [FC Port on page 101](#)
- [Local Device on page 102](#)
- [Storage Array on page 103](#)
- [Storage View on page 103](#)
- [Storage Volume on page 104](#)
- [Virtual Volume on page 104](#)
- [VPLEX Metro on page 106](#)

**Table 36** VPLEX metrics for Cluster

| Metric       | Metric Group | Definition  |
|--------------|--------------|---|
| Cluster Type | Status       | Local or Metro.   |
| Health State | Status       | <p>Possible values include:</p> <p><b>Ok</b> - The cluster is functioning normally.</p> <p><b>Degraded</b> - The cluster is not functioning at an optimal level. This may indicate non-functioning remote virtual volumes, unhealthy devices or storage volumes, suspended devices, conflicting director count configuration values, or out-of-date devices.</p> <p><b>Unknown</b> - VPLEX cannot determine the cluster's health state, or the state is invalid.</p> <p><b>Major failure</b> - The cluster is failing and some functionality may be degraded or unavailable. This may indicate complete loss of back-end connectivity.</p> <p><b>Minor failure</b> - The cluster is functioning, but some functionality may be degraded. This may indicate one or more unreachable storage volumes.</p> <p><b>Critical failure</b> - The cluster is not functioning and may have failed completely. This may indicate a complete loss of back-end connectivity.</p> |

Table 36 VPLEX metrics for Cluster (continued)

| Metric                        | Metric Group | Definition  |
|-------------------------------|--------------|---|
| Operational Status            | Status       | <p>During transition periods, the cluster moves from one operational state to another. Possible values include:</p> <p><b>Ok</b> - The cluster is operating normally.</p> <p><b>Cluster departure</b> - One or more of the clusters cannot be contacted. Commands affecting distributed storage are refused.</p> <p><b>Degraded</b> - The cluster is not functioning at an optimal level. This may indicate non-functioning remote virtual volumes, unhealthy devices or storage volumes, suspended devices, conflicting director count configuration values, or out-of-date devices.</p> <p><b>Device initializing</b> - If clusters cannot communicate with each other, then the distributed-device will be unable to initialize.</p> <p><b>Device out of date</b> - Child devices are being marked fully out of date. Sometimes this occurs after a link outage.</p> <p><b>Expelled</b> - The cluster has been isolated from the island either manually (by an administrator) or automatically (by a system configuration setting).</p> <p><b>Shutdown</b> - The cluster's directors are shutting down.</p> <p><b>Suspended exports</b> - Some I/O is suspended. This could be result of a link failure or loss of a director. Other states might indicate the true problem. The VPLEX might be waiting for you to confirm the resumption of I/O.</p> <p><b>Transitioning</b> - Components of the software are recovering from a previous incident (for example, the loss of a director or the loss of an inter-cluster link).</p> |
| Exported Virtual Volumes      | Capacity     | Number of exported virtual volumes.   |
| Exported Virtual Volumes (GB) | Capacity     | Gigabytes of exported virtual volumes.  |
| Used Storage Volumes          | Capacity     | Number of used storage volumes.   |
| Used Storage Volumes (GB)     | Capacity     | Gigabytes of used storage volumes.  |
| Unused Storage Volumes        | Capacity     | Number of unused storage volumes.   |
| Unused Storage Volumes (GB)   | Capacity     | Gigabytes of unused storage volumes.  |

**Table 37** VPLEX metrics for Director

| Metric                            | Metric Group       | Definition   |
|-----------------------------------|--------------------|--|
| Busy (%)                          | CPU                | Percentage of director CPU usage.  |
| Operational Status                | Status             | <p>Possible values include:</p> <p><b>OK</b> - Functioning normally.</p> <p><b>Degraded</b> - May be out-of-date compared to its mirror.</p> <p><b>Unknown</b> - Cannot determine the health state, or the state is invalid.</p> <p><b>Error</b> - VPLEX has marked the object as hardware-dead.</p> <p><b>Starting</b> - Not yet ready.</p> <p><b>Lost-communication</b> - The object is unreachable.</p> |
| Read Latency (ms)                 | Storage Volumes    | Average read latency in milliseconds.  |
| Write Latency (ms)                | Storage Volumes    | Average write latency in milliseconds.   |
| Read Latency (ms)                 | Virtual Volumes    | Average read latency in milliseconds.  |
| Reads (MB/s)                      | Virtual Volumes    | Number of bytes read per second.   |
| Total Reads and Writes (counts/s) | Virtual Volumes    | Total number of reads and writes per second.   |
| Write Latency (ms)                | Virtual Volumes    | Average write latency in milliseconds.   |
| Writes (MB/s)                     | Virtual Volumes    | Number of bytes written per second.  |
| Memory Used (%)                   | Memory             | Percentage of memory heap usage by the firmware for its accounting on the director. This value is not the percentage of cache pages in use for user data.  |
| Aborts (counts/s)                 | Front-end Director | Number of aborted I/O operations per second through the director's front-end ports.  |
| Active Operations (counts)        | Front-end Director | Number of active, outstanding I/O operations on the director's front-end ports.  |
| Compare and Write Latency (ms)    | Front-end Director | The average time, in milliseconds, that it takes for VAAI CompareAndWrite request to complete on the director's front-end ports.   |
| Operations (counts/s)             | Front-end Director | Number of I/O operations per second through the director's front-end ports.  |
| Queued Operations (counts)        | Front-end Director | Number of queued, outstanding I/O operations on the director's front-end ports.  |
| Read Latency (ms)                 | Front-end Director | The average time, in milliseconds, that it takes for read requests to complete on the director's front-end   |

**Table 37** VPLEX metrics for Director (continued)

| Metric                | Metric Group       | Definition  |
|-----------------------|--------------------|---|
|                       |                    | ports. The total time it takes VPLEX to complete a read request.  |
| Reads (counts/s)      | Front-end Director | Number of read operations per second on the director's front-end ports.   |
| Reads (MB/s)          | Front-end Director | Number of bytes per second read from the director's front-end ports.  |
| Write Latency (ms)    | Front-end Director | The average time, in milliseconds, that it takes for write requests to complete on the director's front-end ports. The total time it takes VPLEX to complete a write request. |
| Writes (counts/s)     | Front-end Director | Number of write operations per second on the director's front-end ports.  |
| Writes (MB/s)         | Front-end Director | Number of bytes per second written to the director's front-end ports.   |
| Aborts (counts/s)     | Back-end Director  | Number of aborted I/O operations per second on the director's back-end ports.   |
| Operations (counts/s) | Back-end Director  | Number of I/O operations per second through the director's back-end ports.  |
| Reads (counts/s)      | Back-end Director  | Number of read operations per second by the director's back-end ports.  |
| Reads (MB/s)          | Back-end Director  | Number of bytes read per second by the director's back-end ports.   |
| Resets (counts/s)     | Back-end Director  | Number of LUN resets issued per second through the director's back-end ports. LUN resets are issued after 20 seconds of LUN unresponsiveness to outstanding operations.       |
| Timeouts (counts/s)   | Back-end Director  | Number of timed out I/O operations per second on the director's back-end ports. Operations time out after 10 seconds.   |
| Writes (MB/s)         | Back-end Director  | Number of bytes written per second by the director's back-end ports.  |
| Average Latency (ms)  | COM Latency        | The average time, in milliseconds, that it took for inter-director WAN messages to complete on this director to the specified cluster in the last 5-second interval.          |
| Maximum Latency (ms)  | COM Latency        | The maximum time, in milliseconds, that it took for an inter-director WAN message to complete on this director to the specified cluster in the last 5-second interval.        |
| Minimum Latency (ms)  | COM Latency        | The minimum time, in milliseconds, that it took for an inter-director WAN message to complete on this   |

**Table 37** VPLEX metrics for Director (continued)

| Metric   | Metric Group   | Definition  |
|--|----------------|---|
|  |                | director to the specified cluster in the last five-second interval.   |
| Distributed Device Bytes Received (MB/s)         | WAN Link Usage | Number of bytes of distributed-device traffic per second received on the director's WAN ports.  |
| Distributed Device Bytes Sent (MB/s)             | WAN Link Usage | Number of bytes of distributed-device traffic per second sent on the director's WAN ports.  |
| Distributed Device Rebuild Bytes Received (MB/s) | WAN Link Usage | Number of bytes of distributed-device, rebuild/migration traffic per second received on the director's WAN ports.   |
| Distributed Device Rebuild Bytes Sent (MB/s)     | WAN Link Usage | Number of bytes of distributed-device rebuild/migration per second traffic sent on the director's WAN ports.  |
| Bytes Received (MB/s)                            | FC WAN COM     | Number of bytes of WAN traffic per second received on this director's FibreChannel port.  |
| Bytes Sent (MB/s)                                | FC WAN COM     | Number of bytes of WAN traffic per second sent on this director's FibreChannel port.  |
| Packets Received (counts/s)                      | FC WAN COM     | Number of packets of WAN traffic per second received on this director's FibreChannel port.  |
| Packets Sent (counts/s)                          | FC WAN COM     | Number of packets of WAN traffic per second sent on this director's FibreChannel port.  |
| Average Latency (ms)                             | IP WAN COM     | The average time, in milliseconds, that it took for inter-director WAN messages to complete on this director's IP port in the last 5-second interval.       |
| Bytes Received (MB/s)                            | IP WAN COM     | Number of bytes of WAN traffic per second received on this director's IP port.  |
| Bytes Sent (MB/s)                                | IP WAN COM     | Number of bytes of WAN traffic per second sent on this director's IP port.  |
| Maximum Latency (ms)                             | IP WAN COM     | The maximum time, in milliseconds, that it took for an inter-director WAN message to complete on this director's IP port in the last five-second interval.  |
| Minimum Latency (ms)                             | IP WAN COM     | The minimum time, in milliseconds, that it takes for an inter-director WAN message to complete on this director's IP port in the last five-second interval. |
| Packets Received (counts/s)                      | IP WAN COM     | Number of packets of WAN traffic per second received on this director's IP port.  |
| Packets Resent (counts/s)                        | IP WAN COM     | Number of WAN traffic packets re-transmitted per second that were sent on this director's IP port.  |
| Packets Sent (counts/s)                          | IP WAN COM     | Number of packets of WAN traffic per second sent on this director's IP port.  |

**Table 37** VPLEX metrics for Director (continued)

| Metric                              | Metric Group | Definition  |
|-------------------------------------|--------------|---|
| Received Packets Dropped (counts/s) | IP WAN COM   | Number of WAN traffic packets dropped per second that were received on this director's IP port. |
| Sent Packets Dropped (counts/s)     | IP WAN COM   | Number of WAN traffic packets dropped per second that were sent on this director's IP port.     |

**Table 38** VPLEX metrics for Distributed Device

| Metric             | Metric Group | Definition  |
|--------------------|--------------|---|
| Capacity (GB)      | Capacity     | Capacity in gigabytes.  |
| Health State       | Status       | <p>Possible values include:</p> <ul style="list-style-type: none"> <li><b>Ok</b> - Functioning normally.</li> <li><b>Degraded</b> - May be out-of-date compared to its mirror.</li> <li><b>Unknown</b> - Cannot determine the health state, or the state is invalid.</li> <li><b>Non-recoverable error</b> - May be out-of-date compared to its mirror, or VPLEX cannot determine the health state.</li> <li><b>Critical failure</b> - VPLEX has marked the object as hardware-dead.</li> </ul>                                       |
| Operational Status | Status       | <p>Possible values include:</p> <ul style="list-style-type: none"> <li><b>OK</b> - Functioning normally.</li> <li><b>Degraded</b> - May be out-of-date compared to its mirror.</li> <li><b>Unknown</b> - Cannot determine the health state, or the state is invalid.</li> <li><b>Error</b> - VPLEX has marked the object as hardware-dead.</li> <li><b>Starting</b> - Not yet ready.</li> <li><b>Lost-communication</b> - The object is unreachable.</li> </ul>   |
| Service Status     | Status       | <p>Possible values include:</p> <ul style="list-style-type: none"> <li><b>Cluster unreachable</b> - VPLEX cannot reach the cluster; the status is unknown.</li> <li><b>Need resume</b> - The other cluster detached the distributed device while it was unreachable. The distributed device needs to be manually resumed for I/O to resume at this cluster.</li> <li><b>Need winner</b> - All clusters are reachable again, but both clusters had detached this distributed device and resumed I/O. You must pick a winner</li> </ul> |

**Table 38** VPLEX metrics for Distributed Device (continued)

| Metric | Metric Group | Definition  |
|--------|--------------|---|
|        |              | <p>cluster whose data will overwrite the other cluster's data for this distributed device.</p> <p><b>Potential conflict</b> - The clusters have detached each other resulting in a potential for detach conflict.</p> <p><b>Running</b> - The distributed device is accepting I/O.</p> <p><b>Suspended</b> - The distributed device is not accepting new I/O; pending I/O requests are frozen.</p> <p><b>Winner-running</b> - This cluster detached the distributed device while the other cluster was unreachable, and is now sending I/O to the device.</p> |

**Table 39** VPLEX metrics for Engine

| Metric             | Metric Group | Definition   |
|--------------------|--------------|--|
| Health State       | Status       | <p>Possible values include:</p> <p><b>Ok</b> - Functioning normally.</p> <p><b>Degraded</b> - May be out-of-date compared to its mirror.</p> <p><b>Unknown</b> - Cannot determine the health state, or the state is invalid.</p> <p><b>Non-recoverable error</b> - May be out-of-date compared to its mirror, or VPLEX cannot determine the health state.</p> <p><b>Critical failure</b> - VPLEX has marked the object as hardware-dead.</p> |
| Operational Status | Status       | <p>Possible values include:</p> <p><b>OK</b> - Functioning normally.</p> <p><b>Degraded</b> - May be out-of-date compared to its mirror.</p> <p><b>Unknown</b> - Cannot determine the health state, or the state is invalid.</p> <p><b>Error</b> - VPLEX has marked the object as hardware-dead.</p> <p><b>Starting</b> - Not yet ready.</p> <p><b>Lost-communication</b> - The object is unreachable.</p>                                   |

**Table 40** VPLEX metrics for Ethernet Port

| Metric             | Metric Group | Definition   |
|--------------------|--------------|--|
| Operational Status | Status       | <p>Possible values include:</p> <p><b>OK</b> - Functioning normally.</p> <p><b>Degraded</b> - May be out-of-date compared to its mirror.</p> <p><b>Unknown</b> - Cannot determine the health state, or the state is invalid.</p> <p><b>Error</b> - VPLEX has marked the object as hardware-dead.</p> <p><b>Starting</b> - Not yet ready.</p> <p><b>Lost-communication</b> - The object is unreachable.</p> |

**Table 41** VPLEX metrics for Extent Device

| Metric             | Metric Group | Definition  |
|--------------------|--------------|---|
| Capacity (GB)      | Capacity     | Capacity in gigabytes.  |
| Health State       | Status       | <p>Possible values include:</p> <p><b>OK</b> - The extent is functioning normally.</p> <p><b>Degraded</b> - The extent may be out-of-date compared to its mirror (applies only to extents that are part of a RAID 1 device).</p> <p><b>Unknown</b> - VPLEX cannot determine the extent's operational state, or the state is invalid.</p> <p><b>Non-recoverable error</b> - The extent may be out-of-date compared to its mirror (applies only to extents that are part of a RAID 1 device), and/or the health state cannot be determined.</p> |
| Operational Status | Status       | <p>Possible values include:</p> <p><b>OK</b> - The extent is functioning normally.</p> <p><b>Degraded</b> - The extent may be out-of-date compared to its mirror (applies only to extents that are part of a RAID 1 device).</p> <p><b>Unknown</b> - VPLEX cannot determine the extent's operational state, or the state is invalid.</p> <p><b>Starting</b> - The extent is not yet ready.</p>  |

**Table 42** VPLEX metrics for FC Port

| Metric             | Metric Group | Definition               |
|--------------------|--------------|--------------------------|
| Operational Status | Status       | Possible values include: |

**Table 42** VPLEX metrics for FC Port

| Metric | Metric Group | Definition   |
|--------|--------------|--|
|        |              | <p><b>OK</b> - Functioning normally.</p> <p><b>Degraded</b> - May be out-of-date compared to its mirror.</p> <p><b>Unknown</b> - Cannot determine the health state, or the state is invalid.</p> <p><b>Error</b> - VPLEX has marked the object as hardware-dead.</p> <p><b>Starting</b> - Not yet ready.</p> <p><b>Lost-communication</b> - The object is unreachable.</p> |

**Table 43** VPLEX metrics for Local Device

| Metric             | Metric Group | Definition   |
|--------------------|--------------|--|
| Capacity (GB)      | Capacity     | Capacity in gigabytes.   |
| Health State       | Status       | <p>Possible values include:</p> <p><b>Ok</b> - Functioning normally.</p> <p><b>Degraded</b> - May be out-of-date compared to its mirror.</p> <p><b>Unknown</b> - Cannot determine the health state, or the state is invalid.</p> <p><b>Non-recoverable error</b> - May be out-of-date compared to its mirror, or VPLEX cannot determine the health state.</p> <p><b>Critical failure</b> - VPLEX has marked the object as hardware-dead.</p> |
| Operational Status | Status       | <p>Possible values include:</p> <p><b>OK</b> - Functioning normally.</p> <p><b>Degraded</b> - May be out-of-date compared to its mirror.</p> <p><b>Unknown</b> - Cannot determine the health state, or the state is invalid.</p> <p><b>Error</b> - VPLEX has marked the object as hardware-dead.</p> <p><b>Starting</b> - Not yet ready.</p> <p><b>Lost-communication</b> - The object is unreachable.</p>                                   |
| Service Status     | Status       | <p>Possible values include:</p> <p><b>Cluster unreachable</b> - VPLEX cannot reach the cluster; the status is unknown.</p>   |

**Table 43** VPLEX metrics for Local Device (continued)

| Metric | Metric Group | Definition   |
|--------|--------------|--|
|        |              | <p><b>Need resume</b> - The other cluster detached the distributed device while it was unreachable. The distributed device needs to be manually resumed for I/O to resume at this cluster.</p> <p><b>Need winner</b> - All clusters are reachable again, but both clusters had detached this distributed device and resumed I/O. You must pick a winner cluster whose data will overwrite the other cluster's data for this distributed device.</p> <p><b>Potential conflict</b> - The clusters have detached each other resulting in a potential for detach conflict.</p> <p><b>Running</b> - The distributed device is accepting I/O.</p> <p><b>Suspended</b> - The distributed device is not accepting new I/O; pending I/O requests are frozen.</p> <p><b>Winner-running</b> - This cluster detached the distributed device while the other cluster was unreachable, and is now sending I/O to the device.</p> |

**Table 44** VPLEX metrics for Storage Array

| Metric                         | Metric Group | Definition                              |
|--------------------------------|--------------|---|
| Allocated Storage Volumes      | Capacity     | Number of allocated storage volumes.    |
| Allocated Storage Volumes (GB) | Capacity     | Gigabytes of allocated storage volumes. |
| Used Storage Volumes           | Capacity     | Number of used storage volumes.         |
| Used Storage Volumes (GB)      | Capacity     | Gigabytes of used storage volumes.      |

**Table 45** VPLEX metrics for Storage View

| Metric               | Metric Group | Definition   |
|----------------------|--------------|--|
| Virtual Volumes (GB) | Capacity     | Gigabytes of virtual volumes.  |
| Operational Status   | Status       | <p>Possible values include:</p> <p><b>OK</b> - Functioning normally.</p> <p><b>Degraded</b> - May be out-of-date compared to its mirror.</p> |

**Table 45** VPLEX metrics for Storage View (continued)

| Metric | Metric Group | Definition  |
|--------|--------------|---|
|        |              | <p><b>Unknown</b> - Cannot determine the health state, or the state is invalid.</p> <p><b>Error</b> - VPLEX has marked the object as hardware-dead.</p> <p><b>Starting</b> - Not yet ready.</p> <p><b>Lost-communication</b> - The object is unreachable.</p> |

**Table 46** VPLEX metrics for Storage Volume

| Metric             | Metric Group | Definition   |
|--------------------|--------------|--|
| Capacity (GB)      | Capacity     | Capacity in gigabytes.   |
| Health State       | Status       | <p>Possible values include:</p> <p><b>Ok</b> - The storage volume is functioning normally.</p> <p><b>Degraded</b> - The storage volume may be out-of-date compared to its mirror.</p> <p><b>Unknown</b> - Cannot determine the health state, or the state is invalid.</p> <p><b>Non-recoverable error</b> - May be out-of-date compared to its mirror, or VPLEX cannot determine the health state.</p> <p><b>Critical failure</b> - VPLEX has marked the object as hardware-dead.</p>              |
| Operational Status | Status       | <p>Possible values include:</p> <p><b>OK</b> - Functioning normally.</p> <p><b>Degraded</b> - May be out-of-date compared to its mirror. (This state applies only to a storage volume that is part of a RAID 1 Metadata Volume.)</p> <p><b>Unknown</b> - Cannot determine the health state, or the state is invalid.</p> <p><b>Error</b> - VPLEX has marked the object as hardware-dead.</p> <p><b>Starting</b> - Not yet ready.</p> <p><b>Lost-communication</b> - The object is unreachable.</p> |

**Table 47** VPLEX metrics for Virtual Volume

| Metric        | Metric Group | Definition             |
|---------------|--------------|------------------------|
| Capacity (GB) | Capacity     | Capacity in gigabytes. |
|               |              |                        |

**Table 47** VPLEX metrics for Virtual Volume (continued)

| Metric             | Metric Group | Definition  |
|--------------------|--------------|---|
| Locality           | Locality     | <p>Possible values include:</p> <p><b>Local</b> - The volume is local to the enclosing cluster.</p> <p><b>Remote</b> - The volume is made available by a different cluster than the enclosing cluster, and is accessed remotely.</p> <p><b>Distributed</b> - The virtual volume either has, or is capable of having, legs at more than one cluster.</p>   |
| Health State       | Status       | <p>Possible values include:</p> <p><b>Ok</b> - Functioning normally.</p> <p><b>Unknown</b> - Cannot determine the health state, or the state is invalid.</p> <p><b>Major failure</b> - One or more of the virtual volume's underlying devices is out-of-date, but will never rebuild.</p> <p><b>Minor failure</b> - One or more of the virtual volume's underlying devices is out-of-date, but will rebuild.</p>  |
| Operational Status | Status       | <p>Possible values include:</p> <p><b>OK</b> - Functioning normally.</p> <p><b>Degraded</b> - The virtual volume may have one or more out-of-date devices that will eventually rebuild.</p> <p><b>Unknown</b> - VPLEX cannot determine the virtual volume's operational state, or the state is invalid.</p> <p><b>Error</b> - One or more of the virtual volume's underlying devices is hardware-dead.</p> <p><b>Starting</b> - Not yet ready.</p> <p><b>Stressed</b> - One or more of the virtual volume's underlying devices is out-of-date and will never rebuild.</p> |
| Service Status     | Status       | <p>Possible values include:</p> <p><b>Running</b> - I/O is running.</p> <p><b>Inactive</b> - The volume is part of an inactive storage-view and is not visible from the host.</p> <p><b>Unexported</b> - The volume is unexported.</p> <p><b>Suspended</b> - I/O is suspended for the volume.</p> <p><b>Cluster-unreachable</b> - Cluster is unreachable at this time.</p>  |

**Table 47** VPLEX metrics for Virtual Volume (continued)

| Metric | Metric Group | Definition  |
|--------|--------------|---|
|        |              | <b>Need-resume</b> - Issue re-attach to resume after link has returned. |

**Table 48** VPLEX metrics for VPLEX Metro

| Metric             | Metric Group | Definition  |
|--------------------|--------------|---|
| Health State       | Status       | <p>Possible values include:</p> <p><b>Ok</b> - The cluster is functioning normally.</p> <p><b>Degraded</b> - The cluster is not functioning at an optimal level. This may indicate non-functioning remote virtual volumes, unhealthy devices or storage volumes, suspended devices, conflicting director count configuration values, or out-of-date devices.</p> <p><b>Unknown</b> - VPLEX cannot determine the cluster's health state, or the state is invalid.</p> <p><b>Major failure</b> - The cluster is failing and some functionality may be degraded or unavailable. This may indicate complete loss of back-end connectivity.</p> <p><b>Minor failure</b> - The cluster is functioning, but some functionality may be degraded. This may indicate one or more unreachable storage volumes.</p> <p><b>Critical failure</b> - The cluster is not functioning and may have failed completely. This may indicate a complete loss of back-end connectivity.</p> |
| Operational Status | Status       | <p>During transition periods, the cluster moves from one operational state to another. Possible values include:</p> <p><b>Ok</b> - The cluster is operating normally.</p> <p><b>Cluster departure</b> - One or more of the clusters cannot be contacted. Commands affecting distributed storage are refused.</p> <p><b>Degraded</b> - The cluster is not functioning at an optimal level. This may indicate non-functioning remote virtual volumes, unhealthy devices or storage volumes, suspended devices, conflicting director count configuration values, or out-of-date devices.</p> <p><b>Device initializing</b> - If clusters cannot communicate with each other, then the distributed-device will be unable to initialize.</p>   |

**Table 48** VPLEX metrics for VPLEX Metro (continued)

| Metric | Metric Group | Definition  |
|--------|--------------|---|
|        |              | <p><b>Device out of date</b> - Child devices are being marked fully out of date. Sometimes this occurs after a link outage.</p> <p><b>Expelled</b> - The cluster has been isolated from the island either manually (by an administrator) or automatically (by a system configuration setting).</p> <p><b>Shutdown</b> - The cluster's directors are shutting down.</p> <p><b>Suspended exports</b> - Some I/O is suspended. This could be result of a link failure or loss of a director. Other states might indicate the true problem. The VPLEX might be waiting for you to confirm the resumption of I/O.</p> <p><b>Transitioning</b> - Components of the software are recovering from a previous incident (for example, the loss of a director or the loss of an inter-cluster link).</p> |

## XtremIO metrics

XtremIO provides metrics for these resource kinds:

- [Cluster on page 107](#)
- [Data Protection Group on page 109](#)
- [Snapshot on page 109](#)
- [SSD on page 110](#)
- [Storage Controller on page 110](#)
- [Volume on page 111](#)
- [X-Brick on page 112](#)

**Table 49** XtremIO metrics for Cluster

| Metric              | Metric Group | Description  |
|---------------------|--------------|--|
| Deduplication Ratio | Capacity     | Ratio of inline data reduction (data written to the array compared to physical capacity used). |
| Compression Ratio   | Capacity     | Compression ratio (unique data on the SSD compared to the physical capacity used)              |

**Table 49** XtremIO metrics for Cluster (continued)

| Metric                     | Metric Group                   | Description  |
|----------------------------|--------------------------------|--|
| Total Efficiency           | Capacity                       | Amount of disk space saved (based on Volume Capacity / Physical Space Used). |
| Thin Provision Savings (%) | Capacity                       | Disk space actually used compared to disk space allocated.                   |
| Available Capacity (TBs)   | Capacity › Physical            | Available capacity in terabytes.   |
| Consumed Capacity (TBs)    | Capacity › Physical            | Consumed physical capacity in terabytes.                                     |
| Total Capacity (TBs)       | Capacity › Physical            | Total physical capacity in terabytes.  |
| Available Capacity (TBs)   | Capacity › Volume              | Available volume capacity in terabytes.                                      |
| Consumed Capacity (TBs)    | Capacity › Volume              | Consumed volume capacity in terabytes.                                       |
| Total Capacity (TBs)       | Capacity › Volume              | Total volume capacity in terabytes.  |
| Total Bandwidth (MB/s)     | Performance                    | Total bandwidth in megabytes per second.                                     |
| Total Latency (usec)       | Performance                    | Total latency in microseconds.   |
| Total Operations (IOPs)    | Performance                    | Total input/output operations per second.                                    |
| Read Bandwidth (MB/s)      | Performance › Read Operations  | Total read bandwidth in megabytes per second.                                |
| Read Latency (usec)        | Performance › Read Operations  | Total read latency in microseconds.  |
| Reads (IOPS)               | Performance › Read Operations  | Total read input/output operations per second.                               |
| Writes (MB/s)              | Performance › Write Operations | Total write bandwidth in megabytes per second.                               |
| Write Bandwidth (MB/s)     | Performance › Write Operations | Total write latency in microseconds.   |
| Write Latency (usec)       | Performance › Write Operations | Total write input/output operations in microseconds.                         |

**Table 49** XtremIO metrics for Cluster (continued)

| Metric       | Metric Group | Description                  |
|--------------|--------------|------------------------------|
| Health State | Status       | Health state of the cluster. |

**Table 50** XtremIO metrics for Data Protection Group

| Metric                      | Metric Group | Description                      |
|-----------------------------|--------------|----------------------------------|
| Average SSD Utilization (%) | Performance  | SSD utilization as a percentage. |

**Table 51** XtremIO metrics for Snapshot

| Metric                         | Metric Group                  | Description  |
|--------------------------------|-------------------------------|--|
| Consumed Capacity (GB)         | Capacity                      | Consumed capacity in Gigabytes.                                |
| Total Capacity (GB)            | Capacity                      | Total capacity in Gigabytes.                                   |
| Average Block Size (KB)        | Performance                   | Average block size in Kilobytes.                               |
| Total Bandwidth (MB/s)         | Performance                   | Total bandwidth in megabytes per second.                       |
| Total Latency (usec)           | Performance                   | Total latency in microseconds.                                 |
| Total Operations (IOPS)        | Performance                   | Total input/output operations per second.                      |
| Unaligned (%)                  | Performance                   | Percentage of unaligned I/O blocks.                            |
| Average Block Size (KB)        | Performance > Read Operations | Average read block size in Kilobytes.                          |
| Average Small Reads (IOPS)     | Performance > Read Operations | Average small reads in input/output operations per second.     |
| Average Unaligned Reads (IOPS) | Performance > Read Operations | Average unaligned reads in input/output operations per second. |
| Read Bandwidth (MB/s)          | Performance > Read Operations | Read bandwidth in megabytes per second.                        |
| Read Latency (usec)            | Performance > Read Operations | Read latency in microseconds.                                  |
| Reads (IOPS)                   | Performance > Read Operations | Read input/output operations per second.                       |

**Table 51** XtremIO metrics for Snapshot (continued)

| Metric                          | Metric Group                   | Description   |
|---------------------------------|--------------------------------|---|
| Average Block Size (KB)         | Performance > Write Operations | Average write block size in Kilobytes.                          |
| Average Small Writes (IOPS)     | Performance > Write Operations | Average small writes in input/output operations per second.     |
| Average Unaligned Writes (IOPS) | Performance > Write Operations | Average unaligned writes in input/output operations per second. |
| Write Bandwidth (MB/s)          | Performance > Write Operations | Write bandwidth in megabytes per second.                        |
| Write Latency (usec)            | Performance > Write Operations | Write latency in microseconds.                                  |
| Writes (IOPS)                   | Performance > Write Operations | Write input/output operations per second.                       |

**Table 52** XtremIO metrics for SSD

| Metric                  | Metric Group | Description                            |
|-------------------------|--------------|--|
| Disk Utilization (%)    | Capacity     | Percentage of disk utilization.        |
| Endurance Remaining (%) | Endurance    | Percentage of SSD remaining endurance. |

**Table 53** XtremIO metrics for Storage Controller

| Metric                | Metric Group  | Description   |
|-----------------------|---------------|---|
| Encrypted             | Configuration | Storage Controller encryption status.   |
| CPU 1 Utilization (%) | Performance   | The Storage Controller has two CPU cores. This metric shows the percent utilization of the first core.  |
| CPU 2 Utilization (%) | Performance   | The Storage Controller has two CPU cores. This metric shows the percent utilization of the second core. |
| Health State          | Status        | Storage Controller health status.   |

**Table 54** XtremIO metrics for Volume

| <b>Metric</b>                   | <b>Metric Group</b>            | <b>Description</b>  |
|---------------------------------|--------------------------------|---|
| Consumed Capacity (GB)          | Capacity                       | Consumed capacity in Gigabytes.                                 |
| Total Capacity (GB)             | Capacity                       | Total capacity in Gigabytes.                                    |
| Average Block Size (KB)         | Performance                    | Average block size in Kilobytes.                                |
| Total Bandwidth (MB/s)          | Performance                    | Total bandwidth in megabytes per second.                        |
| Total Latency (usec)            | Performance                    | Total latency in microseconds.                                  |
| Total Operations (IOPS)         | Performance                    | Total input/output operations per second.                       |
| Unaligned (%)                   | Performance                    | Percentage of unaligned I/O blocks.                             |
| Average Block Size (KB)         | Performance > Read Operations  | Average read block size in Kilobytes.                           |
| Average Small Reads (IOPS)      | Performance > Read Operations  | Average small reads in input/output operations per second.      |
| Average Unaligned Reads (IOPS)  | Performance > Read Operations  | Average unaligned reads in input/output operations per second.  |
| Read Bandwidth (MB/s)           | Performance > Read Operations  | Read bandwidth in megabytes per second.                         |
| Read Latency (usec)             | Performance > Read Operations  | Read latency in microseconds.                                   |
| Reads (IOPS)                    | Performance > Read Operations  | Read input/output operations per second.                        |
| Average Block Size (KB)         | Performance > Write Operations | Average write block size in Kilobytes.                          |
| Average Small Writes (IOPS)     | Performance > Write Operations | Average small writes in input/output operations per second.     |
| Average Unaligned Writes (IOPS) | Performance > Write Operations | Average unaligned writes in input/output operations per second. |
| Write Bandwidth (MB/s)          | Performance > Write Operations | Write bandwidth in megabytes per second.                        |
| Write Latency (usec)            | Performance > Write Operations | Write latency in microseconds.                                  |

**Table 54** XtremIO metrics for Volume (continued)

| Metric        | Metric Group                   | Description                               |
|---------------|--------------------------------|---|
| Writes (IOPS) | Performance > Write Operations | Write input/output operations per second. |

**Table 55** XtremIO metrics for X-Brick

| Metric    | Metric Group | Description               |
|-----------|--------------|---------------------------|
| Reporting | X-Brick      | X-Brick reporting status. |

## RecoverPoint for Virtual Machines metrics

EMC Storage Analytics provides metrics for RecoverPoint for Virtual Machines resource kinds.

This section contains RecoverPoint for Virtual Machines metrics for the following resource kinds:

- [Cluster on page 112](#)
- [Consistency Group on page 113](#)
- [Copy on page 113](#)
- [Journal Volume on page 114](#)
- [Link on page 114](#)
- [RecoverPoint Appliance \(RPA\) on page 114](#)
- [RecoverPoint for Virtual Machines System on page 115](#)
- [Replication Set on page 115](#)
- [Repository Volume on page 115](#)
- [Splitter on page 115](#)
- [User Volume on page 115](#)

### RecoverPoint metrics for Cluster

**Table 56** RecoverPoint metrics for Cluster

| Metric Group | Metric                           | Additional Information  |
|--------------|----------------------------------|---|
| Performance  | Incoming Writes (IOPS)           | Sum of incoming cluster writes from all child RPAs  |
|              | Incoming Writes (KB/s)           | Sum of incoming cluster throughput from all child RPAs  |
| Summary      | Number of Consistency Groups     | Sum of all child RPA consistency groups   |
|              | Number of Protected User Volumes | Sum of user volumes that the cluster protects on all virtual machines, including replica virtual machines |

**Table 56** RecoverPoint metrics for Cluster (continued)

| Metric Group | Metric                  | Additional Information   |
|--------------|-------------------------|--|
|              | Number of Protected VMs | Sum of virtual machines, including replica virtual machines, that the cluster protects |
|              | Number of RPAs          | Sum of all child RPAs  |

**RecoverPoint metrics for Consistency Group****Table 57** RecoverPoint metrics for Consistency Group

| Metric Group | Metric                                | Additional Information   |
|--------------|---------------------------------------|--|
| Performance  | Incoming Writes (IOPS)                | Sum of incoming consistency group writes per second  |
|              | Incoming Writes (KB/s)                | Sum of incoming consistency group writes throughput  |
| Status       | Enabled                               | Boolean value that indicates the consistency group is enabled  |
| Protection   | Current Protection Window Ratio (Hrs) | The farthest time in hours for which RecoverPoint can roll back the consistency group's replica copy                             |
|              | Current Protection Window Ratio       | Ratio of the current protection window for the consistency group's replica copy as compared with your required protection window |

**RecoverPoint metrics for Copy****Table 58** RecoverPoint metrics for Copy

| Metric Group | Metric                                | Additional Information   |
|--------------|---------------------------------------|--|
| Protection   | Current Protection Window Ratio (Hrs) | The farthest time in hours for which RecoverPoint can roll back the replica copy                         |
|              | Current Protection Window Ratio       | Ratio of current protection window for the replica copy as compared with your required protection window |
| Status       | Active                                | Boolean value indicates if the copy is active  |
|              | Enabled                               | Boolean value indicates if the copy is enabled   |
|              | Regulated                             | Boolean value indicates if the copy is regulated   |
|              | Removable                             | Boolean value indicates if the copy is removable   |
|              | Role                                  | Role of the copy, which is retrieved from the role of the consistency group copy settings                |
|              | Suspended                             | Boolean value indicates if the copy is suspended   |

**RecoverPoint metrics for Journal Volume****Table 59** RecoverPoint metrics for Journal Volume

| Metric        | Additional Information       |
|---------------|------------------------------|
| Capacity (GB) | Size of journal volume in GB |

**RecoverPoint metrics for Link****Table 60** RecoverPoint metrics for Link

| Metric Group  | Metric                       | Additional Information   |
|---------------|------------------------------|--|
| Configuration | RecoverPoint Objective (RPO) | The allowed maximum for lag times of consistency group copies  |
|               | RPO type                     | The set type of RPOs to measure  |
| Status        | Current Compression Ratio    | The compression ratio through the link   |
|               | Current Lag                  | Current lag time between the copy and production   |
|               | Current Lag Type             | The type set to measure the current lag time   |
|               | Is In Compliance             | Exists only with consistency groups in asynchronous replication mode; a yes-no value that indicates if the current lag is in compliance with the RPO |
| Protection    | Current Lag (%)              | Exists only with consistency groups in asynchronous replication mode; indicates current lag ratio as compared with RPO                               |

**RecoverPoint metrics for RecoverPoint Appliance (RPA)****Table 61** RecoverPoint metrics for RecoverPoint Appliance (RPA)

| Metric Group | Metric                 | Additional Information  |
|--------------|------------------------|---|
| Performance  | CPU Utilization (%)    | CPU usage of RPAs<br><br><b>Note</b><br>Utilization values appear as decimals (not percentages). Values can range from 0.0 to 1.0, with a value of 1.0 indicating 100%. |
|              | Incoming Writes (IOPS) | Incoming application writes per second  |
|              | Incoming Writes (KB/s) | Incoming application writes for throughput  |

**RecoverPoint metrics for RecoverPoint for Virtual Machines System****Table 62** RecoverPoint metrics for RecoverPoint for Virtual Machines System

| Metric Group | Metric              | Additional Information                              |
|--------------|---------------------|---|
| Summary      | Number of Clusters  | Sum of all the clusters in the RecoverPoint system  |
|              | Number of Splitters | Sum of all the splitters in the RecoverPoint system |

**RecoverPoint metrics for Replication Set****Table 63** RecoverPoint metrics for Replication Set

| Metric        | Additional Information   |
|---------------|--|
| Capacity (GB) | Size of the user volume in GB that the replication set is protecting |

**RecoverPoint metrics for Repository Volume****Table 64** RecoverPoint metrics for Repository Volume

| Metric        | Additional Information          |
|---------------|---------------------------------|
| Capacity (GB) | Size of repository volume in GB |

**RecoverPoint metrics for Splitter****Table 65** RecoverPoint metrics for Splitter

| Metric                       | Additional Information                        |
|------------------------------|---|
| Number of volumes attached   | Number of volumes attached to the splitter    |
| Number of clusters connected | Number of clusters connecting to the splitter |

**RecoverPoint metrics for User Volume****Table 66** RecoverPoint metrics for User Volume

| Metric Group | Metric        | Additional Information                            |
|--------------|---------------|---|
| Capacity     | Capacity (GB) | Size of user volume                               |
| Status       | Role          | Role of the copy to which the user volume belongs |



# CHAPTER 5

## Troubleshooting

This chapter contains the following topics:

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## Badges for monitoring resources

This topic describes the use of vRealize Operations Manager badges to monitor EMC Storage Analytics resources.

vRealize Operations Manager enables you to analyze capacity, workload, and stress of supported resource objects. vRealize Operations Manager badges are available for these EMC products: VNX Block, VNX File, VNXe, and VMAX.

The badges include:

### Workload

The **Workload** badge defines the current workload of a monitored resource. It displays a breakdown of the workload based on supported metrics.

### Stress

The **Stress** badge is similar to the **Workload** badge but defines the workload over a period of time. The **Stress** badge displays one-hour time slices over the period of a week. The color of each slice reflects the stress status of the resource.

### Capacity

The **Capacity** badge displays the percentage of a resource that is currently consumed and the remaining capacity for the resource.

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#### Note

Depending on the resource and supported metrics, full capacity is sometimes defined as 100% (for example, Busy %). Full capacity can also be defined by the maximum observed value (for example, Total Operations IO/s).

---

### Time Remaining

This badge is calculated from the **Capacity** badge and estimates when the resource will reach full capacity.

The badges are based on a default policy that is defined in vRealize Operations Manager for each resource kind.

## Navigating inventory trees

This topic describes how to navigate vRealize Operations Manager inventory trees for EMC resource objects.

Navigating inventory trees in vRealize Operations Manager can help you to troubleshoot problems you encounter with EMC resources.

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#### Note

vRealize Operations Manager inventory trees are available for these EMC products: VNX Block, VNX File, and VNXe.

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### Procedure

1. Log into vRealize Operations Manager.
2. Open the **Environment Overview**.
3. Locate **Inventory Trees**.
4. Click the tree name to view its nodes. Click > to expand the list to view objects under the selected node.

# EMC symptoms, alerts, and recommendations

This topic describes the symptoms, alerts, and recommendations that display in vRealize Operations Manager for EMC adapter instances.

---

## Note

You can view EMC symptoms, alerts, and recommendations in vRealize Operations Manager for these EMC products: VNX Block, VNX File, VNXe, VMAX, VPLEX, XtremIO, and RecoverPoint for Virtual Machines.

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You can view symptoms, alerts, and recommendations for EMC adapter instances through the vRealize Operations Manager GUI. EMC Storage Analytics generates the alerts, which appear with other alerts that VMware generates. EMC Storage Analytics defines the alerts, symptoms, and recommendations for resources that the EMC adapter instance monitors. You can view the symptoms, alerts, and recommendations in these vRealize Operations Manager windows.

## Home dashboard

The vRealize Operations Manager home page dashboard displays EMC symptoms, alerts, and recommendations along with VMware-generated alerts. You can view health, risk, and efficiency alerts, listed in order of severity.

## Alerts Overview

You can view EMC alerts along with VMware-generated alerts in the **Alerts Overview** window. In this view, vRealize Operations Manager groups the alerts in health, risk, and efficiency categories.

## Alert Details

This vRealize Operations Manager view displays detailed properties of a selected alert. Properties include title, description, related resources, type, subtype, status, impact, criticality, and alert start time. This view also shows the symptoms that triggered the alert as well as recommendations for responding to the alert.

## Summary

In the **Summary** view for resource details, vRealize Operations Manager displays the alerts for the selected resource. It also displays alerts for the children of the selected resource, which affect the badge color of the selected resource.

## Symptom definition

You can find symptom definitions for EMC Storage Analytics-generated alerts in the **Definitions Overview** (configuration page). Each definition includes the resource kind, metric key, and lists EMC Adapter as the **Adapter Kind**.

## Recommendations

You can find the recommendation descriptions for EMC Storage Analytics-generated alerts in the **Recommendations Overview** (configuration page).

## Alert definition

You can find alert definitions for EMC Storage Analytics-generated alerts in the **Alert Definitions Overview** (configuration page). Each definition includes the resource kind, type of alert, criticality, and impact (health, risk, or efficiency alert).

## Event correlation

Event correlation enables users to correlate alerts with the resources that generate them.

Event correlation is available for:

- VNX Block
- VNX File

EMC adapter instances registered with the vRealize Operations Manager monitor events on select resources. These events appear as alerts in vRealize Operations Manager. The events are associated with the resources that generate them and aid the user in troubleshooting problems that may occur.

vRealize Operations Manager manages the life cycle of an alert and will cancel an active alert based on its rules. For example, vRealize Operations Manager may cancel an alert if EMC Storage Analytics no longer reports it.

vRealize Operations Manager-generated events influence the health score calculation for select resources. For example, in the **RESOURCE:DETAILS** pane for a selected resource, vRealize Operations Manager-generated events that contribute to the health score appear as alerts.

vRealize Operations Manager only generates events and associates them with the resources that triggered them. vRealize Operations Manager determines how the alerts appear and how they affect the health scores of the related resources.

---

### Note

When a resource is removed, vRealize Operations Manager automatically removes existing alerts associated with the resource, and the alerts no longer appear in the user interface.

---

## Viewing all alerts

This procedure shows you how to view a list of all the alerts in the vRealize Operations Manager system.

### Procedure

1. Log into the vRealize Operations Manager user interface.
2. From the vRealize Operations Manager menu, select **ALERTS > ALERTS OVERVIEW**.  
A list of alerts appears in the **ALERTS OVERVIEW** window.
3. (Optional) To refine your search, use the tools in the menu bar. For example, select a start and end date or enter a search string.
4. (Optional) To view a summary of information about a specific alert, select the alert and double-click it.

The **ALERT SUMMARY** window appears and provides reason, impact, and root cause information for the alert.

## Finding resource alerts

An alert generated by EMC Storage Analytics is associated with a resource. This procedure shows you how to find an alert for a specific resource.

### Procedure

1. Log into the vRealize Operations Manager user interface.
2. Select the resource from one of the dashboard views.  
The number that appears on the alert icon represents the number of alerts for this resource.
3. Click the **Show Alerts** icon on the menu bar to view the list of alerts for the resource.  
Alert information for the resource appears in the popup window.

## Locating alerts that affect the health score for a resource

This procedure shows how to locate an alert that affects the health score of a resource.

Different types of alerts can contribute to the health score of a resource, but a resource with an abnormal health score might not have triggered the alert. For example, the alert might be triggered by a parent resource. To locate an alert that affects the health score of a resource:

### Procedure

1. Log into the vRealize Operations Manager user interface.
2. View the **RESOURCE DETAIL** window for a resource that shows an abnormal health score.  
Events that contributed to the resource health score appear in the **ROOT CAUSE RANKING** pane.
3. Click an event to view the event details and investigate the underlying cause.

## List of alerts and notifications

EMC Storage Analytics generates the listed events when the resources are queried.

This section provides the following information:

- [VMAX alerts on page 121](#)
- [VNX Block alerts on page 123](#)
- [VNX Block notifications on page 127](#)
- [VNX File alerts on page 129](#)
- [VNX File notifications on page 132](#)
- [VNXe alerts on page 137](#)

### VMAX alerts

The Wait Cycle is 1 for all these VMAX alerts.

**Table 67** List of VMAX alerts

| Resource Kind                     | Symptom   | Badge | Severity  | Condition                      | Message  |
|-----------------------------------|---|-------|-----------|--------------------------------|--|
| Device                            | VmaxDevice_percent_full98.0                       | Risk  | Critical  | > 98                           | Device available capacity is low.                |
|                                   | VmaxDevice_percent_full95.0                       | Risk  | Immediate | > 95                           | Device available capacity is low.                |
| SRP (VMAX3 Storage Resource Pool) | VmaxSRPStoragePool_percent_full98.0               | Risk  | Critical  | > 98                           | Storage Resource Pool available capacity is low. |
|                                   | VmaxSRPStoragePool_percent_full95.0               | Risk  | Immediate | > 95                           | Storage Resource Pool available capacity is low. |
| Thin Pool (VMAX)                  | VmaxThinPool_percent_full98.0                     | Risk  | Critical  | > 98                           | Thin Pool available capacity is low.             |
|                                   | VmaxThinPool_percent_full95.0                     | Risk  | Immediate | > 95                           | Thin Pool available capacity is low.             |
| Front-End Port                    | VmaxPort_Operational_Status_Predictive_failure    | Risk  | Warning   | Contains predictive failure    | Front-End Port is having a problem.              |
|                                   | VmaxPort_Operational_Status_Other                 | Risk  | Info      | Contains Other                 | Front-End Port is having a problem.              |
|                                   | VmaxPort_Operational_Status_Stressed              | Risk  | Warning   | Contains Stressed              | Front-End Port is having a problem.              |
|                                   | VmaxPort_Operational_Status_Degraded              | Risk  | Warning   | Contains Degraded              | Front-End Port is having a problem.              |
|                                   | VmaxPort_Operational_Status_Error                 | Risk  | Immediate | Contains Error                 | Front-End Port is having a problem.              |
|                                   | VmaxPort_Operational_Status_Non-recoverable_error | Risk  | Immediate | Contains Non-recoverable error | Front-End Port is having a problem.              |
|                                   | VmaxPort_Operational_Status_No_contact            | Risk  | Warning   | Contains No contact            | Front-End Port is having a problem.              |
|                                   | VmaxPort_Operational_Status_Stopping              | Risk  | Info      | Contains Stopping              | Front-End Port is having a problem.              |
|                                   | VmaxPort_Operational_Status_Stopped               | Risk  | Info      | Contains Stopped               | Front-End Port is having a problem.              |
|                                   | VmaxPort_Operational_Status_Lost_communication    | Risk  | Immediate | Contains Lost communications   | Front-End Port is having a problem.              |

**VNX Block alerts**

**Table 68** List of VNX Block alerts

| Resource Kind                       | Metric                              | Badge  | Severity  | Condition                        | Message Summary  |   |
|-------------------------------------|-------------------------------------|--|-----------|----------------------------------|--|---|
| Storage Pool                        | Full (%)                            | Risk   | Critical  | > 90                             | Capacity used in this storage pool is very high.             |   |
|                                     |                                     |  | Immediate | > 85                             | Capacity used in this storage pool is very high.             |   |
|                                     |                                     | Efficiency   | Info      | < 5                              | Capacity used in this storage pool is low.                   |   |
|                                     | Subscribed (%)                      | Risk   | Info      | >100                             | This storage pool is oversubscribed.                         |   |
|                                     | State                               | Health   | Critical  | Offline                          | Offline  | This storage pool is offline.                             |
|                                     |                                     |  |           | Faulted                          | Faulted  | This storage pool is faulted.                             |
|                                     |                                     |  |           | Expansion Failed                 | Expansion Failed   | This storage pool's expansion failed.                     |
|                                     |                                     |  |           | Cancel Expansion Failed          | Cancel Expansion Failed                                      | The cancellation of this storage pool's expansion failed. |
|                                     |                                     |  |           | Verification Failed              | Verification Failed  | The verification of this storage pool failed.             |
|                                     |                                     |  |           | Initialize Failed                | Initialize Failed  | The initialization of this storage pool failed.           |
|                                     |                                     |  |           | Destroy Failed                   | Destroy Failed   | The destruction of this storage pool failed.              |
|                                     |                                     |  | Warning   | Offline and Recovering           | Offline and Recovering                                       | This storage pool is offline and recovering.              |
|                                     |                                     |  | Critical  | Offline and Recovery Failed      | Offline and Recovery Failed                                  | The recovery of this offline storage pool failed.         |
|                                     |                                     |  | Warning   | Offline and Verifying            | Offline and Verifying  | This storage pool is offline and verifying.               |
|                                     |                                     |  | Critical  | Offline and Verification Failed  | Offline and Verification Failed                              | This storage pool is offline and verification failed.     |
|                                     |                                     |  |           | Faulted and Expanding            | Faulted and Expanding  | This storage pool is faulted and expanding.               |
|                                     |                                     |  |           | Faulted and Expansion Failed     | Faulted and Expansion Failed                                 | This expansion of this storage pool failed.               |
| Faulted and Cancelling Expansion    |                                     |  |           | Faulted and Cancelling Expansion | This storage pool is faulted and is cancelling an expansion. |   |
| Faulted and Cancel Expansion Failed | Faulted and Cancel Expansion Failed | This storage pool is faulted and the cancellation of the expansion failed. |           |                                  |  |   |
| Faulted and Verifying               | Faulted and Verifying               | This storage pool is faulted and verifying.                                |           |                                  |  |   |
| Faulted and Verification Failed     | Faulted and Verification Failed     | This storage pool is faulted and verification failed.                      |           |                                  |  |   |

**Table 68** List of VNX Block alerts (continued)

| Resource Kind           | Metric                    | Badge                       | Severity  | Condition                                      | Message Summary                                     |
|-------------------------|---------------------------|-----------------------------|-----------|--|---|
|                         |                           |                             |           | Unknown  | The status of this storage pool is unknown.         |
| FAST Cache              | State                     | Health                      | Info      | Enabling                                       | FAST Cache is enabling.                             |
|                         |                           |                             | Warning   | Enabled_Degraded                               | The status of this storage pool is unknown.         |
|                         |                           |                             | Info      | Disabling                                      | FAST Cache is disabling.                            |
|                         |                           |                             | Warning   | Disabled                                       | FAST Cache is created but disabled.                 |
|                         |                           |                             | Critical  | Disabled_Faulted                               | FAST Cache is faulted.                              |
|                         |                           |                             | Critical  | Unknown  | The state of FAST cache is unknown.                 |
| Tier                    | Subscribed (%)            | Risk                        | Info      | > 95   | Consumed Capacity (%) of this tier is high.         |
| SP (Storage Processor ) | Busy (%)                  | Risk                        | Info      | > 90   | Storage Processor Utilization is high.              |
|                         |                           |                             | Warning   | > 80   | Storage Processor Utilization is high.              |
|                         | Read Cache Hit Ratio (%)  | Efficiency                  | Info      | < 50   | Storage Processor Read Cache Hit Ratio (%) is low.  |
|                         | Dirty Cache Pages (%)     | Efficiency                  | Critical  | > 95   | Storage Processor Dirty Cache Pages (%) is high.    |
|                         |                           |                             | Info      | < 10   | Storage Processor Dirty Cache Pages (%) is high.    |
|                         | Write Cache Hit Ratio (%) | Efficiency                  | Warning   | > 20   | Storage Processor Write Cache Hit Ratio (%) is low. |
|                         |                           |                             | Info      | < 25   | Storage Processor Write Cache Hit Ratio (%) is low. |
| N/A                     | Health                    | Critical                    | N/A       | Storage Processor could not be reached by CLI. |   |
| RAID Group              | Full (%)                  | Risk                        | Info      | > 90   | RAID Group capacity used (%) is high.               |
|                         |                           | Efficiency                  | Info      | < 5  | RAID Group capacity used (%) is low.                |
|                         | State                     | Health                      | Critical  | Invalid  | The status of this RAID Group is invalid.           |
|                         |                           |                             | Info      | Explicit_Remove                                | This RAID Group is explicit remove.                 |
|                         |                           |                             | Info      | Expanding                                      | This RAID Group is expanding.                       |
|                         |                           |                             | Info      | Defragmenting                                  | This RAID Group is defragmenting.                   |
|                         |                           |                             | Critical  | Halted   | This RAID Group is halted.                          |
|                         |                           |                             | Info      | Busy   | This RAID Group is busy.                            |
| Critical                | Unknown                   | This RAID Group is unknown. |           |  |   |
| Disk                    | Busy (%)                  | Risk                        | Critical  | > 95   | Disk Utilization (%) is High.                       |
|                         |                           |                             | Immediate | > 90   | Disk Utilization (%) is High.                       |

**Table 68** List of VNX Block alerts (continued)

| Resource Kind | Metric                   | Badge  | Severity             | Condition                         | Message Summary                              |
|---------------|--------------------------|--------|----------------------|-----------------------------------|--|
|               |                          |        | Warning              | > 85                              |  |
|               |                          |        | Info                 | > 75                              |  |
|               | Hard Read Error (count)  | Health | Critical             | > 10                              | Disk has Read Error.                         |
|               |                          |        | Immediate            | > 5                               | Disk has Read Error.                         |
|               |                          |        | Warning              | > 0                               | Disk has Read Error.                         |
|               | Hard Write Error (count) | Health | Critical             | > 75                              | Disk has Write Error.                        |
|               |                          |        | Immediate            | And                               | Disk has Write Error.                        |
|               |                          |        | Warning              | Total IO/s > 1                    | Disk has Write Error.                        |
|               | Response Time (ms)       | Risk   | Critical             | > 75                              | Disk Average Response Time (ms) is in range. |
|               |                          |        |                      | And                               | N/A  |
|               |                          |        |                      | Total IO/s > 1                    | Disk is not idle.                            |
|               |                          |        | Immediate            | 75 >= x > 50                      | Disk Average Response Time (ms) is in range. |
|               |                          |        |                      | And                               | N/A  |
|               |                          |        |                      | Total IO/s > 1                    | Disk is not idle.                            |
|               |                          |        | Warning              | 50 >= x > 25                      | Disk Average Response Time (ms) is in range. |
|               |                          |        |                      | And                               | N/A  |
|               |                          |        |                      | Total IO/s > 1                    | Disk is not idle.                            |
|               | State                    | Health | Critical             | Removed                           | This disk is removed.                        |
|               |                          |        |                      | Faulted                           | The disk is faulted.                         |
|               |                          |        |                      | Unsupported                       | The disk is unsupported.                     |
|               |                          |        |                      | Unknown                           | The disk is unknown.                         |
|               |                          |        | Info                 | Powering up                       | The disk is powering up.                     |
| Unbound       |                          |        |                      | The disk is unbound.              |  |
| Warning       |                          |        | Rebuilding           | The disk is rebuilding.           |  |
| Info          |                          |        | Binding              | The disk is binding.              |  |
| Info          |                          |        | Formatting           | The disk is formatting.           |  |
| Warning       |                          |        | Equalizing           | The disk is equalizing.           |  |
| Info          |                          |        | Unformatted          | The disk is unformatted.          |  |
|               |                          |        | Probation            | The disk is in probation          |  |
| Warning       |                          |        | Copying to Hot Spare | The disk is copying to hot spare. |  |

**Table 68** List of VNX Block alerts (continued)

| Resource Kind | Metric            | Badge  | Severity      | Condition                  | Message Summary                     |
|---------------|-------------------|--------|---------------|----------------------------|-------------------------------------|
|               | N/A               |        | Critical      | N/A                        | Disk failure occurred.              |
| LUN           | Service Time (ms) | Risk   | Critical      | > 25                       | LUN Service Time (ms) is in range.  |
|               |                   |        |               | And                        | N/A                                 |
|               |                   |        |               | Total IO/s > 1             | LUN is not idle.                    |
|               |                   |        | Immediate     | > 25                       | LUN Service Time (ms) is in range.  |
|               |                   |        |               | And                        | N/A                                 |
|               |                   |        |               | Total IO/s > 1             | LUN is not idle.                    |
|               |                   |        | Warning       | > 25                       | LUN Service Time (ms) is in range.  |
|               |                   |        |               | And                        | N/A                                 |
|               |                   |        |               | Total IO/s > 1             | LUN is not idle.                    |
|               | Latency (ms)      | Risk   | Critical      | 75 >= x > 50               | LUN Total Latency (ms) is in range. |
|               |                   |        |               | And                        | N/A                                 |
|               |                   |        |               | Total IO/s > 1             | LUN is not idle.                    |
|               |                   |        | Immediate     | 75 >= x > 50               | LUN Total Latency (ms) is in range. |
|               |                   |        |               | And                        | N/A                                 |
|               |                   |        |               | Total IO/s > 1             | LUN is not idle.                    |
|               |                   |        | Warning       | 50 >= x > 25               | LUN Total Latency (ms) is in range. |
|               |                   |        |               | And                        | N/A                                 |
|               |                   |        |               | Total IO/s > 1             | LUN is not idle.                    |
|               | State             | Health | Critical      | Device Map Corrupt         | This LUN's device map is corrupt.   |
|               |                   |        |               | Faulted                    | This LUN is faulted.                |
|               |                   |        |               | Unsupported                | This LUN is unsupported.            |
|               |                   |        |               | Unknown                    | This LUN is unknown.                |
|               |                   |        | Info          | Binding                    | This LUN is binding.                |
|               |                   |        | Warning       | Degraded                   | This LUN is degraded.               |
| Info          |                   |        | Transitioning | This LUN is transitioning. |                                     |
| Info          |                   |        | Queued        | This LUN is queued.        |                                     |
| Critical      |                   |        | Offline       | This LUN is offline.       |                                     |
| Port          | N/A               | Health | Info          | N/A                        | Link down occurred.                 |
|               |                   |        |               | N/A                        | The port is not in use.             |
|               |                   |        | Warning       | N/A                        | Link down occurred.                 |
|               |                   |        | Info          | N/A                        | The port is not in use.             |

**Table 68** List of VNX Block alerts (continued)

| Resource Kind        | Metric | Badge  | Severity | Condition | Message Summary  |
|----------------------|--------|--------|----------|-----------|--|
| Fan and Power Supply | N/A    | Health | Critical | N/A       | Device (FAN or Power Supply) is having problem. Device state is "empty".   |
|                      |        |        | Warning  | N/A       | Device (FAN or Power Supply) is having problem. Device state is "unknown". |
|                      |        |        | Critical | N/A       | Device (FAN or Power Supply) is having problem. Device state is "removed". |
|                      |        |        |          | N/A       | Device (FAN or Power Supply) is having problem. Device state is "faulted". |
|                      |        |        |          | N/A       | Device (FAN or Power Supply) is having problem. Device state is "missing". |
| Array                | N/A    | Health | Warning  | N/A       | Statistics logging is disabled.  |
|                      |        |        |          | N/A       | Performance data won't be available until it is enabled.                   |

**VNX Block notifications**

**Table 69** List of VNX Block notifications

| Category         | Message  | Resource kind        |
|------------------|--|----------------------|
| Failures         | Disk failure occurred.   | Disk                 |
|                  | Link down occurred.  | SP Front-end Port    |
| Background Event | Disk rebuilding started.   | Disk                 |
| Background Event | Disk rebuilding completed.   | Disk                 |
| Background Event | Disk zeroing started.<br><hr/> <b>Note</b><br><hr/> This alert is not available for 1st generation models.   | Disk                 |
| Background Event | Disk zeroing completed.<br><hr/> <b>Note</b><br><hr/> This alert is not available for 1st generation models. | Disk                 |
| Background Event | LUN migration queued.  | LUN                  |
| Background Event | LUN migration completed.   | LUN                  |
| Background Event | LUN migration halted.  | LUN                  |
| Background Event | LUN migration started.   | LUN                  |
| Background Event | Fast VP relocation resumed.  | EMC Adapter Instance |

**Table 69** List of VNX Block notifications (continued)

| Category         | Message   | Resource kind        |
|------------------|---|----------------------|
|                  | <hr/> <b>Note</b> <hr/> This alert is not available for 1st generation models.                                    |                      |
| Background Event | Fast VP relocation paused <hr/> <b>Note</b> <hr/> This alert is not available for 1st generation models.          | EMC Adapter Instance |
| Background Event | Fast VP relocation started.   | Storage Pool         |
| Background Event | Fast VP relocation stopped.   | Storage Pool         |
| Background Event | Fast VP relocation completed.   | Storage Pool         |
| Background Event | SP boot up.   | Storage Processor    |
| Background Event | SP is down. <hr/> <b>Note</b> <hr/> This alert is not available for 1st generation models.                        | Storage Processor    |
| Background Event | FAST Cache started.   | FAST Cache           |
| Configuration    | Storage Pool background initialization started.   | Storage Pool         |
| Configuration    | Storage Pool background initialization completed.   | Storage Pool         |
| Configuration    | LUN creation started.   | LUN                  |
| Configuration    | LUN creation completed.   | LUN                  |
| Configuration    | Snapshot<snapshot name>creation completed.  | LUN                  |
| Configuration    | SP Write Cache was disabled.  | EMC Adapter Instance |
| Configuration    | SP Write Cache was enabled. <hr/> <b>Note</b> <hr/> This alert is not available for 1st generation models.        | EMC Adapter Instance |
| Configuration    | Non-Disruptive upgrading started.   | EMC Adapter Instance |
| Configuration    | Non-Disruptive upgrading completed.   | EMC Adapter Instance |
| Configuration    | Deduplication on LUN was disabled. <hr/> <b>Note</b> <hr/> This alert is not available for 1st generation models. | LUN                  |
| Configuration    | Deduplication on LUN was enabled. <hr/> <b>Note</b> <hr/>   | LUN                  |

**Table 69** List of VNX Block notifications (continued)

| Category      | Message   | Resource kind |
|---------------|---|---------------|
|               | This alert is not available for 1st generation models.  |               |
| Configuration | Deduplication on Storage Pool paused.<br><hr/> <b>Note</b><br><hr/> This alert is not available for 1st generation models.  | Storage Pool  |
| Configuration | Deduplication on Storage Pool resumed.<br><hr/> <b>Note</b><br><hr/> This alert is not available for 1st generation models. | Storage Pool  |
| Configuration | Compression on LUN started.   | LUN           |
| Configuration | Compression on LUN completed.   | LUN           |
| Configuration | Compression on LUN was turned off.  | LUN           |

**VNX File alerts**

**Table 70** List of VNX File alerts

| Resource Kind | Metric                  | Badge      | Severity  | Condition | Message Summary                                     |
|---------------|-------------------------|------------|-----------|-----------|---|
| File Pool     | Full (%)                | Risk       | Critical  | > 90      | Capacity consumed (%) of the file pool is high.     |
|               |                         |            | Immediate | > 85      |   |
|               |                         | Efficiency | Info      | < 5       | Capacity consumed (%) of the file pool is low.      |
| Disk Volume   | Request Comp. Time (µs) | Risk       | Critical  | > 25,000  | dVol's Average Request Completion Time (µs) is high |
|               |                         |            | Immediate | > 15,000  |   |
|               |                         |            | Warning   | > 10,000  |   |
|               | Service Comp. Time (µs) | Risk       | Critical  | > 25,000  |   |
|               |                         |            | Immediate | > 15,000  |   |
|               |                         |            | Warning   | > 10,000  |   |
| File System   | Full (%)                | Risk       | Critical  | > 90      | Capacity consumed (%) of this file system is high.  |
|               |                         |            | Immediate | > 85      |   |
|               |                         | Efficiency | Info      | < 5       |   |

**Table 70** List of VNX File alerts (continued)

| Resource Kind                  | Metric                        | Badge     | Severity  | Condition   | Message Summary                                      |
|--------------------------------|-------------------------------|-----------|-----------|---|--|
| Data Mover                     | NFS v2 Read Response (ms)     | Risk      | Critical  | > 75  | NFS v2 Average Read Response Time (ms) is high.      |
|                                |                               |           | Immediate | > 50  |  |
|                                |                               |           | Warning   | > 25  |  |
|                                | NFS v2 Write Response (ms)    | Risk      | Critical  | > 75  | NFS v2 Average Write Response Time (ms) is high.     |
|                                |                               |           | Immediate | > 50  |  |
|                                |                               |           | Warning   | > 25  |  |
|                                | NFS v3 Read Response (ms)     | Risk      | Critical  | > 75  | NFS v3 Average Read Response Time (ms) is high.      |
|                                |                               |           | Immediate | > 50  |  |
|                                |                               |           | Warning   | > 25  |  |
|                                | NFS v3 Write Response (ms)    | Risk      | Critical  | > 75  | NFS v3 Average Write Response Time (ms) is high.     |
|                                |                               |           | Immediate | > 50  |  |
|                                |                               |           | Warning   | > 25  |  |
|                                | NFS v4 Read Response (ms)     | Risk      | Critical  | > 75  | NFS v4 Average Read Response Time (ms) is high.      |
|                                |                               |           | Immediate | > 50  |  |
|                                |                               |           | Warning   | > 25  |  |
|                                | NFS v4 Write Response (ms)    | Risk      | Critical  | > 75  | NFS v4 Average Write Response Time (ms) is high.     |
|                                |                               |           | Immediate | > 50  |  |
|                                |                               |           | Warning   | > 25  |  |
|                                | CIFS SMBv1 Read Response (ms) | Risk      | Critical  | > 75  | CIFS SMB v1 Average Read Response Time (ms) is high. |
|                                |                               |           | Immediate | > 50  |  |
|                                |                               |           | Warning   | > 25  |  |
| CIFS SMBv1 Write Response (ms) | Risk                          | Critical  | > 75      | CIFS SMB v1 Average Write Response Time (ms) is high. |  |
|                                |                               | Immediate | > 50      |   |  |

**Table 70** List of VNX File alerts (continued)

| Resource Kind | Metric                         | Badge  | Severity  | Condition                              | Message Summary                                       |   |
|---------------|--------------------------------|--------|-----------|--|---|---|
|               |                                |        | Warning   | > 25                                   |   |   |
|               | CIFS SMBv2 Read Response (ms)  | Risk   | Critical  | > 75                                   | CIFS SMB v2 Average Read Response Time (ms) is high.  |   |
|               |                                |        | Immediate | > 50                                   |   |   |
|               |                                |        | Warning   | > 25                                   |   |   |
|               | CIFS SMBv2 Write Response (ms) | Risk   | Critical  | > 75                                   | CIFS SMB v2 Average Write Response Time (ms) is high. |   |
|               |                                |        | Immediate | > 50                                   |   |   |
|               |                                |        | Warning   | > 25                                   |   |   |
|               | State                          | Health | Info      | Offline                                | Data Mover is powered off.                            |   |
|               |                                |        | Error     | Disabled                               |   | Data Mover will not reboot.   |
|               |                                |        |           | Out_of_service                         |   | Data Mover cannot provide service. (For example, taken over by its standby) |
|               |                                |        | Warning   | Boot_level=0                           |   | Data Mover is powered up.   |
|               |                                |        |           |  |   | Data Mover is booted to BIOS.   |
|               |                                |        |           |  |   | Data Mover is booted to DOS.  |
|               |                                |        |           |  |   | DART is loaded and initializing.  |
|               |                                |        |           |  |   | DART is initialized.  |
|               |                                |        | Info      |  |   | Data Mover is controlled by Control Station.                                |
|               |                                |        | Error     | Fault/Panic                            |   | Data Mover has faulted.   |
|               |                                |        |           | Online                                 |   | Data Mover is inserted and has power, but not active or ready.              |
|               |                                |        |           | Slot_empty                             |   | There is no Data Mover in the slot.   |
|               | Unknown                        |        |           | Cannot determine the Data Mover state. |   |   |

**Table 70** List of VNX File alerts (continued)

| Resource Kind | Metric | Badge | Severity | Condition              | Message Summary                       |
|---------------|--------|-------|----------|------------------------|---------------------------------------|
|               |        |       |          | Hardware misconfigured | Data Mover hardware is misconfigured. |
|               |        |       |          | Hardware error         | Data Mover hardware has error.        |
|               |        |       |          | Firmware error         | Data Mover firmware has error.        |
|               |        |       |          |                        | Data Mover firmware is updating.      |

**VNX File notifications**

**Table 71** List of VNX File notifications

| Category               | Message   | Resource kind        |
|------------------------|---|----------------------|
| Control Station Events | The NAS Command Service daemon is shutting down abnormally. (MessageID:<id>)  | Array                |
| Control Station Events | The NAS Command Service daemon is shutting down abnormally. (MessageID:<id>)  | Array                |
| Control Station Events | The NAS Command Service daemon is shutdown completely.  | Array                |
| Control Station Events | The NAS Command Service daemon is forced to shutdown. (MessageID:<id>)  | Array                |
| Control Station Events | Warm reboot is about to start on this data mover.   | Data Mover           |
| Control Station Events | Unable to warm reboot this data mover. Cold reboot has been performed.  | Data Mover           |
| Control Station Events | AC power has been lost. VNX storage system will be powerdown in<value>seconds. (MessageID:<id>)(timeout_wait)                                     | EMC adapter instance |
| Control Station Events | AC power is restored and back on.   | EMC adapter instance |
| Control Station Events | Automatic extension failed. Reason: Internal error. COMMAND:<value>, ERROR:<value>, STAMP:<value>(MessageID:<id>)(COMMAND, DM_EVENT_STAMP, ERROR) | File system          |
| Control Station Events | Automatic extension started.  | File system          |
| Control Station Events | Automatic extension failed. Reason: Filesystem has reached the maximum size. STAMP:<value>(MessageID:<id>)(DM_EVENT_STAMP)                        | File system          |

**Table 71** List of VNX File notifications (continued)

| Category               | Message  | Resource kind |
|------------------------|--|---------------|
| Control Station Events | Automatic extension failed. Reason: Percentage used could not be determined. STAMP:<value>(MessageID:<id>) (DM_EVENT_STAMP)                      | File system   |
| Control Station Events | Automatic extension failed. Reason: Filesystem size could not be determined. STAMP:<value>(MessageID:<id>) (DM_EVENT_STAMP)                      | File system   |
| Control Station Events | Automatic extension failed. Reason: Available space could not be determined. STAMP:<value>(MessageID:<id>) (DM_EVENT_STAMP)                      | File system   |
| Control Station Events | Automatic extension failed. Reason: Filesystem is not RW mounted. STAMP:<value>(MessageID:<id>) (DM_EVENT_STAMP)                                 | File system   |
| Control Station Events | Automatic extension failed. Reason: Insufficient available sapace. STAMP:<value>(MessageID:<id>) (DM_EVENT_STAMP)                                | File system   |
| Control Station Events | Automatic extension failed. Reason: Available pool size could not be determined. STAMP:<value>(MessageID:<id>) (DM_EVENT_STAMP)                  | File system   |
| Control Station Events | Automatic extension failed. Reason: Slice flag could not be determined. STAMP:<value>(MessageID:<id>) (DM_EVENT_STAMP)                           | File system   |
| Control Station Events | Automatic extension failed. Reason: Available space is not sufficient for minimum size extension. STAMP:<value>(MessageID:<id>) (DM_EVENT_STAMP) | File system   |
| Control Station Events | Automatic extension failed. Reason: Maximum filesystem size could not be determined. STAMP:<value>(MessageID:<id>) (DM_EVENT_STAMP)              | File system   |
| Control Station Events | Automatic extension failed. Reason: High Water Mark (HWM) could not be determined. STAMP:<value>(MessageID:<id>) (DM_EVENT_STAMP)                | File system   |
| Control Station Events | Forced automatic extension started.  | File system   |
| Control Station Events | Automatic extension ended.   | File system   |
| Control Station Events | Automatic extension ended. The filesystem is now at its maximum size limit.  | File system   |
| Control Station Events | Forced automatic extension is cancelled. The requested extension size is less than the high water mark (HWM) set for the filesystem.             | File system   |
| Control Station Events | The filesystem's available storage pool size will be used as the extension size instead of the requested size.                                   | File system   |
| Control Station Events | Automatic extension completed.   | File system   |

**Table 71** List of VNX File notifications (continued)

| Category               | Message  | Resource kind        |
|------------------------|--|----------------------|
| Control Station Events | Forced automatic extension completed. The file system is at the maximum size.  | File system          |
| Control Station Events | Automatic extension failed. Reason: Volume id could not be determined. STAMP:<value>(MessageID:<id>) (DM_EVENT_STAMP)                    | File system          |
| Control Station Events | Automatic extension failed. Reason: Storage system id could not be determined. STAMP:<value>(MessageID:<id>) (DM_EVENT_STAMP)            | File system          |
| Control Station Events | Automatic extension failed. Reason: Filesystem is spread across multiple storage systems. STAMP:<value>(MessageID:<id>) (DM_EVENT_STAMP) | File system          |
| Control Station Events | Automatic extension failed. STAMP:<value>(MessageID:<id>) (DM_EVENT_STAMP)   | File system          |
| Control Station Events | The JServer is not able to start. VNX File System statistics will be impacted. (MessageID:<id>)  | EMC adapter instance |
| Control Station Events | Filesystem is using<value>of its<value><value>capacity. (condition, cap_setting, prop_name)  | File system          |
| Control Station Events | Filesystem has<value>of its<value><value>capacity available. (condition, cap_setting, prop_name)   | File system          |
| Control Station Events | Storage pool is using<value>of its <value><value>capacity (condition, cap_setting)   | File pool            |
| Control Station Events | Storage pool has<value>of its<value>capacity available. (condition, cap_setting)   | File pool            |
| Control Station Events | Filesystem is using<value>of the maximum allowable file system size (16 TB). (condition)   | File system          |
| Control Station Events | Filesystem has<value>of the maximum allowable file system size (16 TB). (condition)  | File system          |
| Control Station Events | Filesystem is using<value>of the maximum storage pool capacity available. (condition)  | File system          |
| Control Station Events | Filesystem has <value> of the maximum storage pool capacity available.(condition)  | File system          |
| Control Station Events | Filesystem will fill its<value><value>capacity on<value>. (cap_setting, prop_name, sdate)  | File system          |
| Control Station Events | Storage pool will fill its<value>capacity on<value>. (cap_setting, sdate)  | File pool            |
| Control Station Events | Filesystem will reach the 16 TB file system size limit on<value>. (sdate)  | File system          |
| Control Station Events | Filesystem will fill its storage pool's maximum capacity on<value>. (sdate)  | File system          |
| Control Station Events | Data Mover is using<value>of its<value>capacity. (stat_value, stat_name)   | Data Mover           |

**Table 71** List of VNX File notifications (continued)

| Category               | Message  | Resource kind        |
|------------------------|--|----------------------|
| Control Station Events | Storage usage has crossed threshold value<value>and has reached to<value>. (threshold, pool_usage_percentage)                                  | File pool            |
| Control Station Events | Storage usage has crossed threshold value<value>and has reached to<value>. (threshold, pool_usage_percentage)                                  | File pool            |
| Control Station Events | Filesystem has filled its<value><value>capacity. (cap_setting, prop_name)  | File system          |
| Control Station Events | Storage pool has filled its<value>capacity. (cap_setting)  | File pool            |
| Control Station Events | Filesystem has almost filled its<value><value>capacity. (cap_setting, prop_name)   | File system          |
| Control Station Events | Storage pool has almost filled its<value>capacity. (cap_setting)   | File pool            |
| Control Station Events | Filesystem is using<value>of its current inode capacity. (condition)   | File system          |
| Dart Events            | The SCSI HBA<value>is operating normally. (hbano)  | Data Mover           |
| Dart Events            | The SCSI HBA<value>has failed. (MessageID:<id>) (hbano)  | Data Mover           |
| Dart Events            | The SCSI HBA<value>is inaccessible. (MessageID:<id>) (hbano)   | Data Mover           |
| Dart Events            | Filesystem has encountered a critical fault and is being unmounted internally. (MessageID:<id>)  | File system          |
| Dart Events            | Filesystem has encountered a corrupted metadata and filesystem operation is being fenced. (MessageID:<id>)                                     | File system          |
| Dart Events            | Filesystem usage rate<value>% crossed the high water mark threshold<value>%. Its size will be automatically extended. (currentUsage, usageHWM) | File system          |
| Dart Events            | Filesystem is full.  | File system          |
| Dart Events            | Power Supply A in Data Mover Enclosure was removed.  | EMC adapter instance |
| Dart Events            | Power Supply A in Data Mover Enclosure is OK.  | EMC adapter instance |
| Dart Events            | Power Supply A in Data Mover Enclosure failed:<value>(MessageID:<id>) (details)  | EMC adapter instance |
| Dart Events            | Power Supply B in Data Mover Enclosure was installed.  | EMC adapter instance |
| Dart Events            | Power Supply B in Data Mover Enclosure was removed.  | EMC adapter instance |
| Dart Events            | Power Supply B in Data Mover Enclosure is OK.  | EMC adapter instance |
| Dart Events            | Power Supply B in Data Mover Enclosure failed:<value>(MessageID:<id>) (details)  | EMC adapter instance |

**Table 71** List of VNX File notifications (continued)

| Category    | Message  | Resource kind        |
|-------------|--|----------------------|
| Dart Events | One or more fans in Fan Module 1 in Data Mover Enclosure failed. (MessageID:<id>)                                | EMC adapter instance |
| Dart Events | One or more fans in Fan Module 2 in Data Mover Enclosure failed. (MessageID:<id>)                                | EMC adapter instance |
| Dart Events | One or more fans in Fan Module 3 in Data Mover Enclosure failed. (MessageID:<id>)                                | EMC adapter instance |
| Dart Events | Multiple fans in Data Mover Enclosure failed. (MessageID:<id>)   | EMC adapter instance |
| Dart Events | All Fan Modules in Data Mover Enclosure are in OK status.  | EMC adapter instance |
| Dart Events | Power Supply A in Data Mover Enclosure is going to shutdown due to over heating. (MessageID:<id>)                | EMC adapter instance |
| Dart Events | Power Supply B in Data Mover Enclosure is going to shutdown due to over heating. (MessageID:<id>)                | EMC adapter instance |
| Dart Events | Both Power Supplies in Data Mover Enclosure are going to shutdown due to over heating. (MessageID:<id>)          | EMC adapter instance |
| Dart Events | Power Supply A in Data Mover Enclosure was installed.  | EMC adapter instance |
| Dart Events | DNS server<value>is not responding. Reason:<value>(MessageID:<id>) (serverAddr, reason)                          | Data Mover           |
| Dart Events | Network device<value>is down. (MessageID:<id>) (deviceName)  | Data Mover           |
| Dart Events | Automatic fsck is started via Data Mover<value>. Filesystem may be corrupted. (MessageID:<id>) (DATA_MOVER_NAME) | File system          |
| Dart Events | Manual fsck is started via Data Mover<value>. (DATA_MOVER_NAME)  | File system          |
| Dart Events | Automatic fsck succeeded via Data mover<value>. (DATA_MOVER_NAME)  | File system          |
| Dart Events | Manual fsck succeeded via Data mover<value>. (DATA_MOVER_NAME)   | File system          |
| Dart Events | Automatic fsck failed via Data mover<value>. (DATA_MOVER_NAME)   | File system          |
| Dart Events | Manual fsck failed via Data mover<value>. (DATA_MOVER_NAME)  | File system          |

**VNXe alerts**

**Table 72** List of VNXe alerts

| Resource Kind                  | Metric                 | Badge                         | Severity  | Condition           | Message Summary                                     |
|--------------------------------|------------------------|-------------------------------|-----------|---------------------|---|
| Disk                           | Total Latency (ms)     | Risk                          | Critical  | > 75                | Disk Total Latency (ms) is high.                    |
|                                |                        |                               | Immediate | > 50                |   |
|                                |                        |                               | Warning   | > 25                |   |
|                                | State                  | Health                        | Critical  | Includes "critical" | This disk is reporting a problem.                   |
|                                |                        |                               | Immediate |                     |   |
|                                |                        |                               | Warning   |                     |   |
|                                |                        |                               | Info      |                     |   |
| Tier                           | Full (%)               | Risk                          | Info      | > 95                | Consumed Capacity (%) of this tier is high.         |
| Storage Pool                   | Full (%)               | Risk                          | Critical  | > 90                | Consumed Capacity (%) of this storage pool is high. |
|                                |                        |                               | Immediate | > 85                |   |
|                                |                        | Efficiency                    | Info      | < 5                 | Consumed Capacity (%) of this storage pool is low.  |
|                                |                        | State                         | Health    | Critical            | Includes "critical"                                 |
|                                | Immediate              |                               |           |                     |   |
|                                | Warning                |                               |           |                     |   |
|                                | SP (Storage Processor) | CIFS SMBv1 Read Response (ms) | Risk      | Critical            | > 75  |
| Immediate                      |                        |                               |           | > 50                |   |
| Warning                        |                        |                               |           | > 25                |   |
| CIFS SMBv1 Write Response (ms) |                        | Risk                          | Critical  | > 75                |   |
|                                |                        |                               | Immediate | > 50                |   |
|                                |                        |                               | Warning   | > 25                |   |
| CIFS SMBv2 Read Response (ms)  |                        | Risk                          | Critical  | > 75                | CIFS SMBv2 Average Read Response Time (ms) is high. |
|                                |                        |                               | Immediate | > 50                |   |
|                                |                        |                               | Warning   | > 25                |   |

**Table 72** List of VNXe alerts (continued)

| Resource Kind | Metric                         | Badge  | Severity  | Condition                   | Message Summary                                |
|---------------|--------------------------------|--------|-----------|-----------------------------|--|
|               | CIFS SMBv2 Write Response (ms) | Risk   | Critical  | > 75                        |  |
|               |                                |        | Immediate | > 50                        |  |
|               |                                |        | Warning   | > 25                        |  |
|               | NFS v3 Read Response (ms)      | Risk   | Critical  | > 75                        | NFSv3 Average Read Response Time (ms) is high. |
|               |                                |        | Immediate | > 50                        |  |
|               |                                |        | Warning   | > 25                        |  |
|               | NFS v3 Write Response (ms)     | Risk   | Critical  | > 75                        |  |
|               |                                |        | Immediate | > 50                        |  |
|               |                                |        | Warning   | > 25                        |  |
|               | State                          | Health | Critical  | Includes "critical"         | This storage processor is reporting a problem. |
|               |                                |        | Immediate |                             |  |
|               |                                |        | Warning   |                             |  |
|               |                                |        | Info      |                             |  |
| LUN           | State                          | Health | Critical  | Condition includes critical | This LUN is reporting a problem.               |
|               |                                |        | Immediate |                             |  |
|               |                                |        | Warning   |                             |  |
|               |                                |        | Info      |                             |  |
| File System   | State                          | Health | Critical  | Condition includes critical | This File System is reporting a problem.       |
|               |                                |        | Immediate |                             |  |
|               |                                |        | Warning   |                             |  |
|               |                                |        | Info      |                             |  |
| NAS Server    | State                          | Health | Critical  | Condition includes critical | This NAS Server is reporting a problem.        |
|               |                                |        | Immediate |                             |  |
|               |                                |        | Warning   |                             |  |
|               |                                |        | Info      |                             |  |

## Launching Unisphere

EMC Storage Analytics provides metrics that enable you to assess the health of monitored resources. If the resource metrics indicate that you need to troubleshoot those resources, EMC Storage Analytics provides a way to launch Unisphere on the array.

The capability to launch Unisphere on the array is available for:

- VNX Block
- VNX File
- VNXe

To launch Unisphere on the array, select the resource and click the **Link and Launch** icon. The **Link and Launch** icon is available on most widgets (hovering over an icon displays a tooltip that describes its function).

---

### Note

This feature requires a fresh installation of the EMC Adapter (not an upgrade) and vCenter Operations Manager 5.8.0 or later. You must select the object to launch Unisphere. Unisphere launch capability does not exist for VMAX or VPLEX objects.

---

## Installation logs

This topic lists the log files to which errors in the EMC Storage Analytics installation are written.

Errors in the EMC Storage Analytics installation are written to log files in the following directory in vRealize Operations Manager:

```
/var/log/emc
```

Log files in this directory follow the naming convention:

```
install-2012-12-11-10:54:19.log.
```

Use a text editor to view the installation log files.

## Log Insight overview

This topic provides an overview of Log Insight and its use with EMC Storage Analytics.

VMware vRealize Log Insight provides log management for VMware environments. Log Insight includes dashboards for visual display of log information. Content packs extend this capability by providing dashboard views, alerts, and saved queries.

For information on working with Log Insight, refer to the Log Insight documentation: <http://pubs.vmware.com/log-insight-25/index.jsp>.

## Log Insight configuration

This topic describes important background information about the integration of Log Insight with EMC Storage Analytics.

You can send the EMC Storage Analytics logs stored on the vRealize Operations Manager virtual machine to the Log Insight instance to facilitate performance analysis and perform root cause analysis of problems.

The adapter logs in vRealize Operations Manager are stored in a subdirectory of the `/storage/vcops/log/adapters/EmcAdapter` directory. The directory name and the log file are created by concatenating the adapter instance name with the adapter instance ID.

An example of the contents of `EmcAdapter` follows. Notice that the adapter name parsing changes dots and spaces into underscores. For example, the adapter instance named `ESA3.0 Adapter VNX File` is converted to `ESA3_0_Adapter_VNX_File`. The adapter instance ID of `455633441` is concatenated to create the subdirectory name as well as the log file name.

```
-rw-r--r-- 1 admin admin 27812 Sep 26 10:37 ./
ESA3_0_Adapter_VNX_File-455633441/
ESA3_0_Adapter_VNX_File-455633441.log
-rw-r--r-- 1 admin admin 1057782 Sep 26 15:51 ./
ESA3_0_VNX_Adapter-1624/ESA3_0_VNX_Adapter-1624.log
-rw-r--r-- 1 admin admin 40712 Sep 23 11:58 ./
ESA3_0_VNX_Adapter-616398625/ESA3_0_VNX_Adapter-616398625.log
-rw-r--r-- 1 admin admin 40712 Sep 23 11:58 ./
ESA3_0_VNX_Adapter-725881978/ESA3_0_VNX_Adapter-725881978.log
-rw-r--r-- 1 admin admin 31268 Sep 10 11:33 ./
ESA_3_0_Adapter-1324885475/ESA_3_0_Adapter-1324885475.log
-rw-r--r-- 1 admin admin 193195 Sep 26 10:48 ./EmcAdapter.log
-rw-r--r-- 1 admin admin 25251 Sep 26 10:48 ./My_VNXe-1024590653/
My_VNXe-1024590653.log
-rw-r--r-- 1 admin admin 25251 Sep 26 10:48 ./My_VNXe-1557931636/
My_VNXe-1557931636.log
-rw-r--r-- 1 admin admin 4853 Sep 26 10:48 ./My_VNXe-1679/
My_VNXe-1679.log
```

In the vRealize Operations Manager **Solution Details** view, the corresponding adapter instance names appear as follows:

- ESA3.0 Adapter VMAX
- My VNXe
- ESA3.0 VNX Adapter
- ESA3.0 Adapter VNX File

As seen in the example, multiple instances of each of the adapter types appear because EMC Storage Analytics creates a new directory and log file for the Test Connection part of discovery as well as for the analytics log file.





## Error handling and event logging

Errors in the EMC Storage Analytics operation are written to log files available through vRealize Operations Manager.

Error logs are available in the `/data/vcops/log` directory. This directory contains the vRealize Operations Manager logs.

Adapter logs (including adapters other than the EMC Adapter) are in `/data/vcops/log/adapters`.

View logs relating to EMC Storage Analytics operation in the vRealize Operations Manager GUI. Create and download a support bundle used for troubleshooting.

### Viewing error logs

EMC Storage Analytics enables you to view error log files for each adapter instance.

#### Procedure

1. Start the vRealize Operations Manager custom user interface and log in as administrator.  
For example in a web browser, type: `http://<vROPs_ip_address>/vcops-web-ent`
2. Select **Admin > Support**. Select the **Logs** tab.
3. Expand the `vCenter Operations Collector` folder, then the `adapter` folder, then the `EmcAdapter` folder. Log files appear under the `EmcAdapter` folder. Double-click a log entry in the log tree.  
Entries appear in the **Log Content** pane.

### Creating and downloading a support bundle

#### Procedure

1. On the **Logs** tab, click the **Create Support Bundle** icon.  
The bundle encapsulates all necessary logs.
2. Select the bundle name and click the **Download Bundle** icon.

## Log file sizes and rollover counts

This topic describes the default log file size and rollover count for EMC adapter instances.

Logs for each EMC Adapter instance are in folders under `/data/vcops/log/adapters/EmcAdapter`, one folder for each adapter instance. For example, if you have five EMC Adapter instances, a directory (folder) appears for each of them.

Log files in this directory follow this naming convention:

```
<EMC_adapter_name>-<adapter_instance_ID>.log.<rollover_count>
```

For example: `VNX_File-131.log.9`

The log filename begins with the name of the EMC Adapter instance. Filenames beginning with `EmcAdapter` are common to all connectors.

The number that follows the EMC Adapter instance name is the adapter instance ID, which corresponds to a VMware internal ID.

The last number in the filename indicates the rollover increment. When the default log file size is reached, the system starts a new log file with a new increment. The lowest-numbered increment represents the most recent log. Each rollover is 10 MB (default value, recommended). Ten rollovers (default value) are allowed; the system deletes the oldest log files.

## Finding adapter instance IDs

This describes how to find the ID for an EMC adapter instance.

### Procedure

1. In vRealize Operations Manager, select **Administration** > **Environment** > **Adapter Types** > **EMC Adapter**.
2. In the **Internal ID** column, you can view the IDs for adapter instances.

## Configuring log file sizes and rollover counts

This topic describes how to change the default values for all adapter instances or for a specific adapter instance.

### Before you begin



**EMC recommends that you not increase the 10 MB default value for the log file size. Increasing this value makes the log file more difficult to load and process as it grows in size. If more retention is necessary, increase the rollover count instead.**

### Procedure

1. On the vRealize Operations Manager virtual machine, find and edit the `adaptor.properties` file:
 

```
/usr/lib/vmware-vcops/user/plugins/inbound/emc-vcops-adapter/conf/adapter.properties
```
2. Locate these EMC adapter instance properties:
 

```
com.emc.vcops.adapter.log.size=10MB
com.emc.vcops.adapter.log.count=10
```

3. To change the properties for all EMC adapter instances, edit only the log size or log count values. For example:

```
com.emc.vcops.adapter.log.size=12MB
```

```
com.emc.vcops.adapter.log.count=15
```

4. To change the properties for a specific EMC adapter instance, insert the EMC adapter instance ID as shown in this example:

```
com.emc.vcops.adapter.356.log.size=8MB
```

```
com.emc.vcops.adapter.356.log.count=15
```

## Activating configuration changes

This topic describes how to activate changes you made to the log file size or rollover count for an EMC adapter instance.

### Procedure

1. In vRealize Operations Manager, select **Environment** > **Environment Overview**.
2. In the navigation pane, expand **Adapter Kinds**, then select **EMC Adapter**.
3. In the **List** tab, select a resource from the list and click the **Edit Resource** icon.

The **Resource Management** window for the EMC adapter opens.

4. Click the **OK** button. No other changes are required.

This step activates the changes you made to the log file size or rollover count for the EMC adapter instance.

## Verifying configuration changes

This topic describes how to verify the changes you made to the log file size or rollover counts of an EMC adapter instance.

### Procedure

1. Log into vRealize Operations Manager.
2. Change directories to `/data/vcops/log/adapters/EmcAdapter`.
3. Verify the changes you made to the size of the log files or the number of saved rollover backups.

If you changed:

- Only the default properties for log file size and rollover count, all adapter instance logs will reflect the changes
- Properties for a specific adapter instance, only the logs for that adapter instance will reflect the changes
- Log file size or rollover count to higher values, you will not notice the resulting changes until those thresholds are crossed

## Editing the Collection Interval for a resource

From the vRealize Operations Manager user interface, you can edit the Collection Interval for a resource.

The interval time is five minutes by default. Changing this time will affect the frequency of collection times for metrics, but the EMC Adapter will only recognize the change if the resource is the EMC Adapter instance. This is normal vRealize Operations Manager behavior.

---

### Note

For VNXe, the maximum collection interval is five minutes.

Instructions on configuring Resource Management settings are provided in the vRealize Operations Manager online help.

## Configuring the thread count for an adapter instance

This topic describes two ways to configure the thread count for an adapter instance.

Only administrative personnel should perform this procedure. Use this procedure to change the thread count for best performance. If the thread count is not specified in `adapter.properties`, `thread count = vCPU count + 2`. The maximum allowed thread count is 20.

### Procedure

1. Access the `adapter.properties` file. You can find this file at:

```
/usr/vmware-vcops/user/plugins/inbound/emc-vcops-adapter/
conf/adapter.properties
```

2. Open and edit the thread count property for all adapter instances or for a specific adapter instance.
  - If you want to edit the thread count property for all adapter instances, change the `com.emc.vcops.adapter.threadcount` property.
  - If you want to edit the thread count property for a specific adapter instance, insert the adapter instance ID after `adapter`, for example:
 

```
com.emc.vcops.adapter.7472.threadcount
```

, and change the property value.

---

### Note

To find an adapter instance ID, refer to [Finding adapter instance IDs on page 144](#).

3. To activate the property change, restart the adapter instance in the vRealize Operations Manager.

## Connecting to vRealize Operations Manager by using SSH

This topic describes how to use SSH to login to vRealize Operations Manager as root.

### Procedure

1. Open the VM console for the vRealize Operations Manager.
2. Press **Alt-F1** to open the command prompt.
3. Enter **root** for the login and leave the password field blank.

You are prompted for a password.

4. Set the root password.

You will be logged in.

5. Use this command to enable SSH:

```
service sshd start
```

You will be able to successfully login as root by using SSH.

## Frequently Asked Questions

### How many nodes are supported per vRealize Operations Manager cluster?

vRealize Operations Manager clusters consist of a master node and data nodes. A total of eight nodes are supported. The master node (required) and up to seven data nodes.

### How many resources and metrics are supported per node in vRealize Operations Manager?

- Small Node - 4vCPU, 16GB Memory - Supports 2,000 objects and 1,000,000 metrics
- Medium Node - 8vCPU, 32GB Memory - Supports 6,000 objects and 3,000,000 metrics
- Large Node - 16vCPU, 64GB Memory - Supports 10,000 objects and 5,000,000 metrics

### How does a trial license work?

A 90-day trial license is provided for each platform that EMC Storage Analytics supports. The 90-day trial license provides the same features as a permanent license, but after 90 days, the adapter stops collecting data. You can add a permanent license at any time during or after the trial period.

### How do health scores work?

Health scores measure how normal a resource is and grades it on a scale of 0-100. A health score of 100 indicates normal behavior while a lower health score indicates that the resource is acting abnormally. The resource may not be in an unhealthy state but there is an abnormality. Health scores are calculated by a proprietary algorithm which account for several factors including thresholds and historical statistics. vRealize Operations Manager may take up to 30 days to gather enough information to determine what is considered normal in your environment. Until then, you may not see any changes in your health scores.

### I deleted a resource. Why does it still appear in the vRealize Operations Manager?

vRealize Operations Manager will not delete any resources automatically because it retains historical statistics and topology information that may be important to the user. The resource enters an unknown state (blue). To remove the resource, delete it on the **Environment Overview** page.

### What does the blue question mark in the health score indicate?

The blue question mark indicates that vRealize Operations Manager was unable to poll that resource. It will retry during the next polling interval.

### What does it mean when a resource has a health score of 0?

This indicates that the resource is either down or not available.

### Why are my EMC Adapter instances marked down after upgrading to the latest version of the EMC Adapter?

EMC Adapter instances require a license to operate. Edit your EMC Adapter instances to add license keys obtained from EMC. Select **Environment Overview** > **Configuration** > **Adapter Instances**.

### I have multiple EMC Adapter instances for my storage systems, and I have added license keys for each of them. Why are they still marked down?

License keys are specific to the model for which the license was purchased. Verify that you are using the correct license key for the adapter instance. After adding a license, click the **Test** button to test the configuration and validate the license key. If you saved the configuration without performing a test and the license is invalid, the adapter instance

will be marked `Resource down`. To verify that a valid license exists, select **Environment Overview**. The list that appears shows the license status.

**How is the detailed view of vCenter resources affected in EMC Storage Analytics?**

Any changes in the disk system affects the health of vCenter resources such as virtual machines, but EMC Storage Analytics does not show changes in other subsystems. Metrics for other subsystems will either show `No Data` or `?`.

**Can I see relationships between my vCenter and EMC storage resources?**

Yes. Relationships between resources are not affected and you can see a top to bottom view of the virtual and storage infrastructures if the two are connected.

**How do I uninstall EMC Storage Analytics?**

No uninstall utility exists. However, to remove EMC Storage Analytics objects, remove adapter instances for which the Adapter Kind is **EMC Adapter (Environment > Configuration > Adapter Instances)**. Then delete objects in the **Environment Overview** for which the Data Source is **EMC (Environment > Environment Overview)**.

**If I test a connection and it fails, how do I know which field is wrong?**

Unfortunately, the only field that produces a unique message when it is wrong is the license number field. If any other field is wrong, the user is informed the connection was not successful. To resolve the issue, verify all the other fields are correct. Remove any white spaces after the end of the values.

**Can I modify or delete a dashboard?**

Yes, the environment can be customized to suit the needs of the user. Rename the dashboard so that it is not overwritten during an upgrade.

**Why do some of the boxes appear white in the Overview dashboard?**

While the metrics are being gathered for an adapter instance, some of the heat maps in the dashboard may be white. This is normal. Another reason the boxes may appear white is that the adapter itself or an individual resource has been deleted, but the resources remain until they are removed from the **Environment Overview** page.

**Which arrays does EMC Storage Analytics support?**

A complete list of the supported models for EMC storage arrays is available in the *EMC Storage Analytics Release Notes*.

**Will EMC Storage Analytics continue to collect VNX statistics if the primary SP or CS goes down?**

Storage Analytics will continue to collect statistics through the secondary Storage Processor if the primary Storage Processor goes down. EMC Storage Analytics will automatically collect metrics from the secondary Control Station in the event of a Control Station failover. Note that the credentials on the secondary Control Station must match the credentials on the primary Control Station.

**Does the Unisphere Analyzer for VNX need to be running to collect metrics?**

No. VNX Block metrics are gathered through `naviseccli` commands and VNX File metrics are gathered through CLI commands. However, statistics logging must be enabled on each storage processor (SP) on VNX Block, and statistics logging will have a performance impact on the array. No additional services are required for VNX File.

**How does the FAST Cache heat map work?**

The FAST Cache heatmaps are based on the FAST Cache read and write hit ratios. This heat map will turn red if these ratios are low because that indicates that FAST Cache is not being utilized efficiently. These heat maps will turn green when FAST Cache is servicing a high percentage of I/O.

**I purchased a license for the model of the VNX array that I plan to monitor. When I configure the adapter instance for VNX File, why does an "invalid license" error message appear?**

Control Station may not be reporting the correct model or the array. Log into Control Station and check the array model with the command: `/nas/sbin/model`. Verify that the array model returned matches the model on the Right to Use certificate.

**After a Control Station failover, why is the VNX File adapter instance marked down and why does metric collection stop?**

The failover may have been successful, but the new Control Station may not be reporting the correct model of the array. This results in a failure to validate the license and all data collection stops. Log into Control Station and check the array model with the command: `/nas/sbin/model`. If the model returned does not match the actual model of the array, Primus case emc261291 in the EMC Knowledgebase provides possible solutions.

**The disk utilization metric is not visible for my VNX Block array. Why not?**

The disk utilization metric is not supported on VNX arrays running a VNX Block OE earlier than Release 32. Upgrade to VNX Block OE Release 32 or later to see this metric in vRealize Operations Manager.

**I am unable to successfully configure an EMC Adapter instance for VNX File when using a user with read-only privileges. Why does this happen?**

A user with administrative privileges is required while configuring an EMC Adapter instance for VNX File arrays running an OE earlier than 7.1.56.2. Upgrade to VNX File OE 7.1.56.2 or later to be able to configure an adapter instance using a user with read-only privileges.

**The user LUNs on my VNX Block vault drives are not reporting performance metrics. Why not?**

Performance metrics are not supported for user LUNs on vault drives. Place user LUNs on drives other than vault drives.

**Why is my VMAX array showing as red rather than blue (unknown) just after adding it?**

If the array is red, the SMI-S may be down or there may be an incorrect parameter in the adapter configuration. Return to the adapter instance configuration and test the configured instance. If it fails, verify all fields are correct. Determine if the SMI-S server is running and can recognize the VMAX array that you are configuring. If the license and user credentials are correct but connection issues remain, see the *EMC Storage Analytics Release Notes*.

**All my configured VMAX adapter instances changed to red. Why?**

This usually happens when the EMC SMI-S Provider is unavailable or there is a clock synchronization problem. This might be network-related or application-related. The EMC SMI-S Provider may have reached the connection limit if the network IP is available. Look for errors in the cimom.log file on the SMI-S box similar to:

```
26-Mar-2013 05:47:59.817 -900-E- WebServer: The webserver hits its
connection limit, closing connection.
```

Follow the steps in the *SMI-S Provider Release Notes* to increase the count.

A message next to the array will indicate a clock synchronization problem if a problem exists.

**I received the following error when I attempted to modify the VNX Overview dashboard although I have only VMAX arrays. Is this a problem?**

Error occurred

An error occurred on the page; please contact support.

Error Message: org.hibernate.exception.SQLGrammarException: could not execute query

No, this is a generic error that VMware produces when you attempt to modify a component you do not have.

