

# EMC Storage Analytics

Version 4.3

## Product Guide

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# CHAPTER 1

## Introduction

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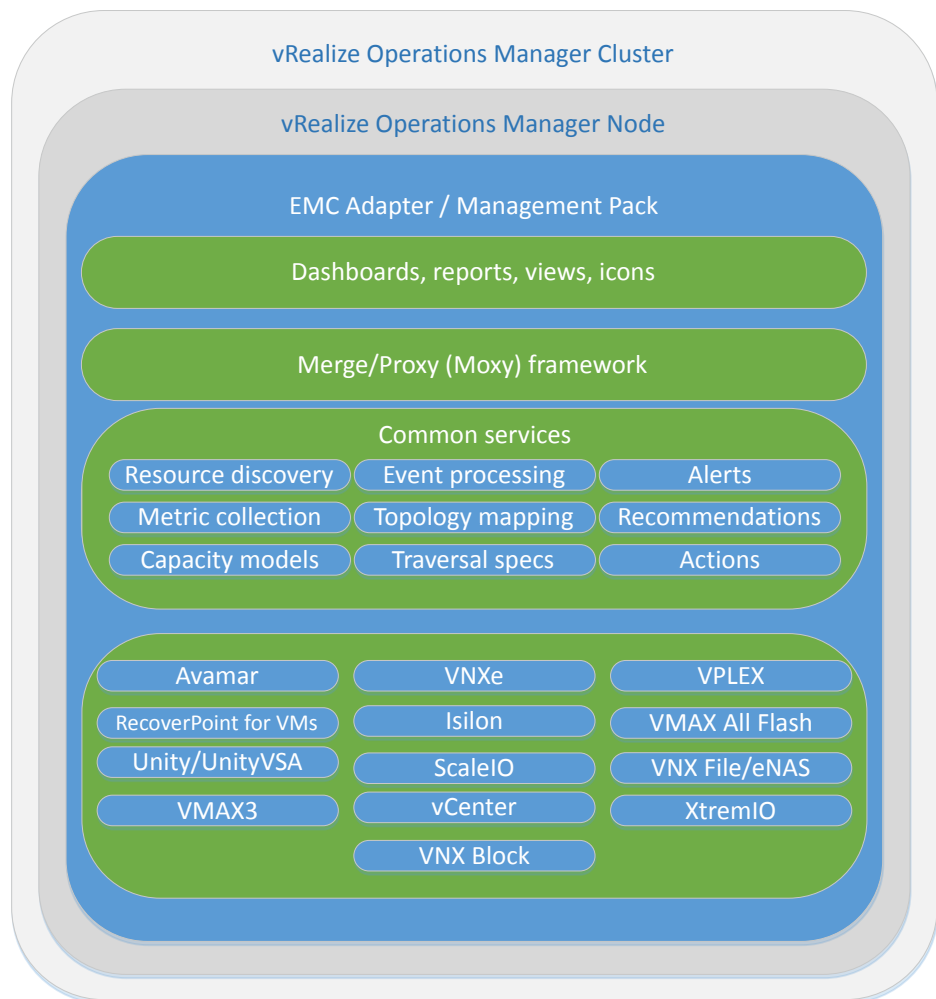
## Product overview

EMC Storage Analytics (ESA) is a management pack for VMware vRealize Operations Manager that enables the collection of analytical data from EMC resources.

ESA complies with VMware management pack certification requirements and has received the VMware Ready certification.

The collector types are shown in the following figure. Refer to the [EMC Simple Support Matrix](#) for a list of supported product models.

**Figure 1** EMC Adapter architecture





# Terminology

Familiarize yourself with commonly used terms.

## **adapter**

A vRealize Operations Manager component that collects performance metrics from an external source such as VMware vCenter or a 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 an EMC VNX™ storage system.

## **dashboard**

A tab on the home page of the vRealize Operations Manager graphical user interface (GUI). vRealize Operations Manager ships with default dashboards. Dashboards are 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. Hover over an icon to display 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 that are collected.

## **widget**

An area of the ESA GUI that displays metrics-related information. You can customize widgets for your own environment.



# CHAPTER 2

## Installation and Licensing

This chapter contains the following topics:

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- [Installing the EMC Adapter](#) ..... 15
- [Installing Navisphere CLI](#)..... 15
- [About adapter instances](#)..... 16
- [Uninstalling ESA](#).....22

# Prerequisites

Before you install ESA, verify that you have configured your environment according to the requirements in this section.

## Software requirements

The following software is required:

- A supported version of VMware vRealize Operations Manager Advanced or Enterprise edition as listed in the [EMC Simple Support Matrix](#). Obtain the OVA installation package for vRealize Operations Manager from VMware. Refer to the *vRealize Operations Manager vApp Deployment and Configuration Guide* on the [VMware support page](#) to install the software. ESA does not support Foundation and Standard editions.
- Supported versions of EMC systems and minimum operating environment requirements as listed in the [EMC Simple Support Matrix](#).
- A supported web browser as listed in the release notes for your version of vRealize Operations Manager.

## License requirements

You must purchase the following licenses:

- VMware license for vRealize Operations Manager (Advanced or Enterprise).
- EMC Storage Analytics electronic or physical license.  
If you purchase an electronic license for ESA, you receive a letter that directs you to an electronic licensing system to activate the software to which you are entitled. Otherwise, you receive a physical license key.
- EMC product licenses.  
A 90-day trial for all supported products is available with ESA. The 90-day trial provides the same features as licensed products, but after 90 days of use, the adapter stops collecting data. You can add a license at any time. To install software for trial, leave the license field blank.
  - Unity™ and UnityVSA adapter instances do not require you to provide a license in the configuration wizard. The ESA license for the Unity and UnityVSA collector is tracked on the array. In EMC Unisphere™, select **Settings** > **Software and Licenses** > **License Information** to ensure that the ESA license is valid and current.
  - Only one EMC Adapter instance is required for VPLEX™ Local or VPLEX Metro systems. You can monitor both clusters in a VPLEX Metro system by adding a single EMC Adapter instance for one of the clusters. Adding an EMC Adapter instance for each cluster in a VPLEX Metro system introduces unnecessary stress on the system.

## System configuration

### User accounts

- Storage—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 an operator or administrator role (a local account does not work).
- vCenter—To create an EMC Adapter instance for vCenter (where **Adapter Type** = **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 (not the EMC Adapter) enforces access credentials. To create an EMC Adapter instance for vCenter, use an account assigned with a minimum role of **Read-Only** at the vCenter root 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 about user accounts and access rights is available in the vSphere API/SDK documentation (see information about authentication and authorization for VMware ESXi and vCenter Server). Ensure that the adapter points to the vCenter server that vRealize Operations Manager monitors.

### 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 ESA resources by using Network Time Protocol (NTP). Also, set correct time zones for ESA resources. Failure to observe these practices might affect the collection of performance metrics and topology updates.

### EMC system configuration requirements

Use the port assignments and IP addresses in the following table to configure the environment for EMC systems.

**Table 1** EMC system configuration requirements

Connection type	Data source	Protocol	Default port	IP address/credential/notes
EMC Avamar™	MCSDK API	HTTP SOAP	9443	
Isilon	REST API	HTTPS	8080	Isilon Storage Administration web interface IP address
EMC RecoverPoint™ for Virtual Machines	REST API	HTTPS	443	
EMC ScaleIO™	REST API	HTTPS	443	IP address and port of the ScaleIO Gateway
Unity/UnityVSA	REST API	HTTPS	443	Unisphere Management IP address and user credential that has the array Administrator role.
VMAX™ and Unisphere for VMAX	Unisphere for VMAX REST API	HTTPS	8443	<ul style="list-style-type: none"> <li>Unisphere must be available on the network and accessible through a port specified at the end of the IP address (for example, 10.10.10.10:8443).</li> <li>All VMAX systems must be registered for performance data collection to work with ESA.</li> <li>For data collection only, the Unisphere user credentials for ESA must have PERF_MONITOR permissions</li> <li>For the ability to use actions, the user must have STORAGE_ADMIN permissions.</li> </ul>

**Table 1** EMC system configuration requirements (continued)

Connection type	Data source	Protocol	Default port	IP address/credential/notes
VMware vSphere	vCenter Web Services SDK	HTTPS	443	
VNX Block	Navisphere CLI (naviseccli)	TCP/SSL	443 or 2163	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 ( <b>System &gt; System Properties &gt; Statistics Logging in Unisphere</b> ).
VNX File/eNAS	Control Station CLI	SSH	22	IP address that is reachable from the vRealize Operations Manager server. Bi-directional Ethernet traffic flows through port 22 using Secure Shell (SSH). If you are using the EMC VNX <code>nas_stig</code> script for security ( <code>/nas/tools/nas_stig</code> ), do not use root in the password credentials. Setting <code>nas_stig</code> to <b>On</b> limits direct access for root accounts, preventing the adapter instance from collecting metrics for VNX File and eNAS.
VNXe™	REST API	HTTPS	443	Unisphere's Management IP address and user credential that has the array's Administrator role.
VPLEX	REST API (topology) Vplexcli (metrics)	HTTPS SSH	443 22	
XtremIO™	REST API	HTTPS	443	IP address of the XtremIO Management Server (XMS) and the serial number of the XtremIO Cluster to monitor. If enhanced performance is required, administrators can configure the thread count for the XtremIO adapter instance. See <a href="#">Configuring the thread count for an adapter instance</a> on page 52.

## Installing the EMC Adapter

The ESA installation procedure installs the EMC Adapter and the dashboards.

### Before you begin

Obtain the PAK file for the EMC Adapter from [EMC Online Support](#).

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### Note

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

---

### WARNING

**When you upgrade EMC Storage Analytics the standard EMC dashboards are overwritten. To customize a standard EMC dashboard, clone it, rename it, and then customize it.**

---

### 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 **Add (+)** to upload the PAK file.
4. When the message appears that the PAK file is ready to install, complete the wizard.

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

5. When the installation completes, click **Finish**.

The EMC Adapter appears in the list of installed solutions.

## Installing Navisphere CLI

For vRealize Operations Manager 6.1 or later, the Navisphere CLI (naviseccli) is automatically installed on all Data Nodes that are available during the initial installation. If you add more nodes in the vRealize Operations Manager cluster after ESA is installed or if you are using vRealize Operations Manager 6.0 or earlier, use this procedure to manually install nviseccli.

- Install nviseccli before you add the EMC Adapter instance to vRealize Operations Manager.  
If nviseccli is not installed, errors could might in scaled-out vCenter environments that consist of a Master Node and multiple Data Nodes. Naviseccli is automatically installed on the Master Node. However, because the Data Node collects metrics, the EMC Adapter might report errors if nviseccli is not installed.
- For VNX Block systems, install the nviseccli in the Data Node that you assign to collect metrics for VNX systems.

The `naviseccli-bin-xxx-rpm` file is included in the ESA package.

### Procedure

1. Enable SSH for both master and data nodes.  
Refer to [Using SSH to connect to vRealize Operations Manager](#) on page 53 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.

## About adapter instances

Adapter instances specify the adapter type and the information that is needed for vRealize Operations Manager to identify and access resources.

The vCenter adapter instance enables other adapter instances to display visible connections between the VMware objects and the array objects.

EMC Adapter instances provide access to EMC resources.

---

### Note

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. Once the initial data is collected, future statistical collections run quickly.

---

## Adding an EMC Adapter instance for vCenter

To view health trees for the storage environment from the virtual environment, install an EMC Adapter instance for vCenter before installing other EMC resource adapter instances.

Install a separate instance for each vCenter that the vRealize Operations Manager environment monitors.

### 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 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: *My vCenter*
  - **Description**—Optional
  - **Connection Type**—VMware vSphere
  - **License** (optional)—Leave blank for EMC Adapter instance for vCenter
  - **Management IP**—IP address of the vCenter server
  - **Array ID** (optional)—Leave 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: *My VMware Credentials*
  - **Username**—Username that ESA uses to connect to the VMware vRealize system

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**Note**

If a domain user is used, the format for the username is DOMAIN \USERNAME.

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- **Password**—Password for the ESA username
6. Click **OK**.
7. Configure the **Advanced Settings**, if they are required:
- **Collector**—vRealize Operations Manager Collector
  - **Log Level**—Configure log levels for each adapter instance. The levels for logging information are ERROR, WARN, INFO, DEBUG, and TRACE.

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 collects 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.

---

## Configuring the vCenter Adapter

After the vCenter Adapter is installed, configure it manually.

### Procedure

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

In a web browser, type `https://vROps_ip_address/vcops-webent` and type the password.

2. Select **Administration > Solutions**.
3. In the solutions list, select **VMware vSphere > vCenter Adapter**, and click the **Configure** icon.

The **Manage Solution** dialog box appears.

4. Click the **Add** icon.
5. In the **Manage Solution** dialog box, provide values for the following parameters:

- a. Under **Adapter Settings**, type a name and optional description.

- b. Under **Basic Settings**:

- For **vCenter Server**, type the vCenter IP address.
- For **Credential**, either select a previously defined credential or click the **Add** icon to add a new credential.

For a new credential, in the **Manage Credential** dialog box, type a descriptive name and the username and password for the vRealize system. If you use a domain username, the format is DOMAIN \USERNAME. Optionally, you can edit the credential using the **Manage Credential** dialog box. Click **OK** to close the dialog box.

- c. (Optional) Configure the **Advanced Settings**:

- **Collector**: The vRealize Operations Manager Collector
- **Auto Discovery**: **True** or **False**
- **Process Change Events**: **True** or **False**
- **Registration user**: The registration username used to collect data from vCenter Server.
- **Registration password**: The registration password used to collect data from vCenter Server

6. Click **Test Connection**.
7. Click **OK** in the confirmation dialog box.
8. Click **Save Settings** to save the adapter.
9. Click **Yes** to force the registration.
10. Click **Next** to go through a list of questions to create a new default policy, if required.

## Adding EMC Adapter instances for EMC resources

Each EMC resource requires an adapter instance.

### Before you begin

- Install the EMC Adapter for vCenter. All EMC resources adapter instances require the EMC Adapter instance for vCenter to be installed first.
- Obtain the adapter license key (if required) for your EMC product.

Adapter instances are licensed by product. Observe these exceptions and requirements:

Product	Comment
eNAS adapter instance	No license required.
Unity adapter instance	The license is automatically verified through the array.
VNX Unified array	Uses the same license for VNX File and VNX Block.
VNX File adapter instance	License required for VNX File system.
VNX Block	<ul style="list-style-type: none"> <li>To avoid a certificate error if the main storage processor is down, test both storage processors for the VNX Block system to accept both certificates.</li> <li>Global Scope is required for VNX Block access.</li> </ul>
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.
EMC RecoverPoint for Virtual Machines	Ensure that your EMC RecoverPoint model matches your license.

### Procedure

- 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.
- Select **Administration > Solutions > EMC Adapter** and click the **Configure** icon.  
The **Manage Solution** dialog box appears.
- Click the **Add** icon to add a new adapter instance.
- Configure the following **Adapter Settings** and **Basic Settings**:
  - Display Name**—A descriptive name, such as *My Storage System* or the array ID
  - Description**(optional)—Description with more details
  - License**—License key (if 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.

#### Note

If you leave the license field blank, the adapter instance runs under a 90-day trial. When the 90-day trial expires, ESA stops collecting metrics until you add a valid license to the adapter instance.

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

Supported product	Field: Connection Type	Field: Management IP	Field: Array ID
Avamar	Avamar	Use the IP address of the Avamar server where MCS is running.	Not applicable
eNAS	eNAS	Use the IP address of the primary Control Station (CS).	Not applicable

Supported product	Field: Connection Type	Field: Management IP	Field: Array ID
Isilon arrays	Isilon	If SmartConnect Zone is configured, use the SmartConnect zone name or IP address. Otherwise, use any node IP address.	
EMC RecoverPoint for Virtual Machines	RecoverPoint for Virtual Machines	Use the IP address of the virtual EMC RecoverPoint appliance.	Not applicable
ScaleIO arrays	ScaleIO	Use the IP address and port of the ScaleIO Gateway.	Not applicable
Unity	Unity	Use the IP address of the management server.	Not applicable
UnityVSA	UnityVSA	Use the IP address of the management server.	Not applicable
VMAX3 and VMAX All Flash	VMAX	Use the IPv4 or IPv6 address, and the port number of the configured EMC Unisphere for VMAX.	Required
VNX Block arrays	VNX Block	Use the IP address of one 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 CS.	Not applicable
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 XMS that manages the XtremIO target cluster.	Use the serial number of the XtremIO target cluster.

6. In the **Credential** field, select any previously defined credentials for this product; otherwise, click the **Add New** icon and configure these settings:
- **Credential name**—A name for the credentials information
  - **Username**—Username that EMC Storage Analytics uses to connect to the EMC product:
    - Avamar—MCUser account, or another Avamar Administrator user
    - Isilon—OneFS storage administration server
    - ScaleIO—ScaleIO Gateway
    - RecoverPoint for Virtual Machines—Virtual EMC RecoverPoint appliance
    - Unity and UnityVSA—Management server
    - VMAX—Unisphere user. For data collection only, the Unisphere user credentials for ESA must have PERF\_MONITOR permissions and, for the ability to use actions, the user must have STORAGE\_ADMIN permissions.
    - VNX File or eNAS—CS username
    - VNX Block—SP username
    - VNXe—Management server
    - VPLEX—Management server (for example, the service user). The default credentials are `service/Mi@Dim7T`.

- XtremIO—XMS username
  - **Password**—EMC product management password.
7. Click **OK**.
- The **Manage Solution** dialog reappears.
8. If required, configure the following **Advanced Settings**:
- **Collector**—**Automatically select collector**
  - **Log Level** —Configure log levels for each adapter instance. The levels for logging information are ERROR, WARN, INFO, DEBUG, and TRACE.
- 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.

---

#### Note

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. If the connection test fails, verify that all fields contain the correct information and remove any white spaces at the end of the values.

---

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

## Editing EMC Adapter instances

You can edit installed EMC Adapter instances.

### Before you begin

- Install the EMC Adapter.
- Configure the EMC Adapter instance for your EMC product.
- Obtain an adapter license key for your product.

Adapter instances are licensed per product. For details, refer to [License requirements](#).

### 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 > Inventory Explorer > 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 EMC products](#) for field descriptions.
5. Click **Test Connection** to verify the connection.
6. To finish editing the adapter instance, click **OK**.

## Uninstalling ESA

Remove ESA objects to uninstall ESA.

### Procedure

1. Select **Home > Administration > Inventory Explorer > Adapter Instances > EMC Adapter Instance**.
2. Remove adapter instances for which the **Adapter Type** is **EMC Adapter**.

# CHAPTER 3

## Monitoring your Environment

This chapter contains the following topics:

- [About EMC dashboards](#).....24
- [Using badges to monitor resources](#)..... 30
- [Adjusting default tolerances](#).....30
- [Monitoring storage](#).....30
- [Checking capacity and performance](#)..... 31
- [Troubleshooting with inventory trees](#).....32

## About EMC dashboards

Dashboards provide a graphic representation of the status and relationships of selected objects.

The standard dashboards are delivered as templates. If a dashboard is accidentally deleted or changed, you can generate a new one. Use the standard vRealize Operations Manager dashboard customization features to create additional dashboards if required (some restrictions might apply).

The dashboards are listed as tabs on the vRealize Operations Manager Home page. You can also see the list of dashboards by selecting **Home > Dashboard List > EMC**.

Dashboards include various widgets, depending on the type of dashboard.

- **Resource Tree**—Shows the end-to-end topology and health of resources across vSphere and storage domains. 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**—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.
- **Sparkline Chart**—Shows sparklines for the metrics of the resource you select in the **Resource Tree** widget.
- **Metric Picker**—Lists all the metrics that are collected for the resource you select in the **Resource Tree** widget. Double-click a metric to create a graph of the metric in the **Metric Chart** widget.
- **Metric Chart**—Graphs the metrics you select in the **Metric Picker** widget. Display multiple metrics simultaneously in a single graph or in multiple graphs.
- **Resource Events (VNX/VNXe only)**—Shows a graph that illustrates the health of the selected object over a period of time. Object events are labeled on the graph. Hover over or click a label to display event details, including event ID, start time, cancel time, trigger, resource name, and event details.

---

### Note

The [VMware documentation](#) provides instructions for modifying or deleting dashboards to suit your environment.

- Be sure to rename modified dashboards so that they will not be overwritten during an upgrade.
  - If you attempt to modify a component that does not exist, such as modifying a dashboard for a storage system that is not in your environment, vRealize Operations Manager generates a generic error message indicating that the task failed.
-



The following table lists the default dashboards for each EMC resource.

**Table 2** Default dashboards

Dashboard name	Avamar	Isilon	ScaleIO	VNX	Unity	VMAX	VPLEX	XtremIO	RecoverPoint for VMs
Storage Topology	---	X	X	X	X	X	X	X	X
Storage Metrics	---	X	X	X	X	X	X	X	X
Overview	X	X	X	X	X	X	X	X	X
Topology	X	X	X	X	X	X	X	---	---
Metrics	X	X	X	X	X	X	---	X	X
Top-N	---	X	---	X	X	---	---	X	X
Performance	---	---	---	---	---	---	X	X	X
Communication	---	---	---	---	---	---	X	---	---
Properties	X	---	---	---	---	---	---	---	---

---

**Note**

eNAS dashboards are available on the [Dashboard XChange](#).

---

## EMC overview dashboards

Overview tabs for EMC resources display a single view of performance and capacity metrics for selected resources that have configured adapter instances. Scoreboards and heat maps group the contents by adapter instance.

Heatmaps and scoreboards use color to provide a high-level view of performance and capacity metrics for selected devices. Tolerances are displayed in the key at the bottom of each heatmap. Hover your mouse over specific areas of a graph or heatmap to see more details.

- For measurable metrics, colors range from green to shades of yellow and orange to red.
- Metrics with varied values that cannot be assigned a range show relative values from lowest (light blue or light green) to highest (dark blue or dark green). Because the range of values for relative metrics have no lower or upper limits, the numerical difference between light and dark blue or green might be minimal.

---

**Note**

It is normal for white boxes to appear in the heatmap:

- While the metrics are being gathered for an adapter instance.
  - When the adapter itself or an individual resource has been deleted and the resources have not been removed from the **Environment Overview** page.
- 

The following figures show examples of Overview dashboards.

Figure 2 VNX Overview dashboard

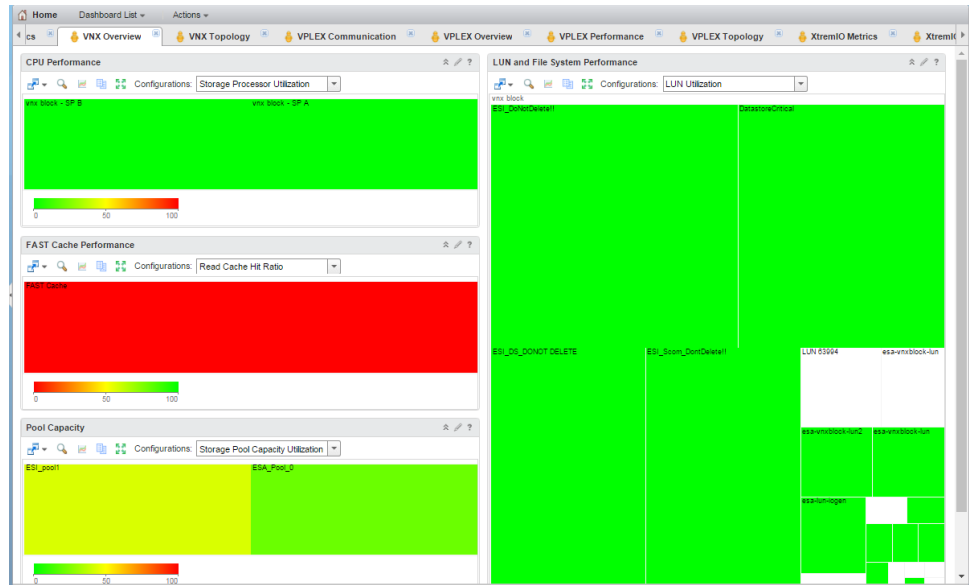


Figure 3 ScaleIO Overview dashboard

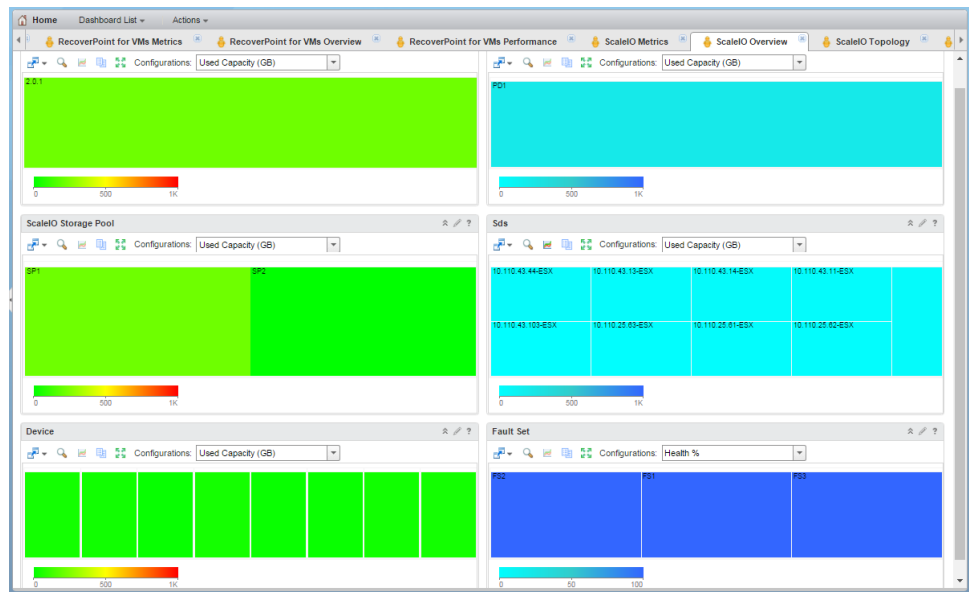
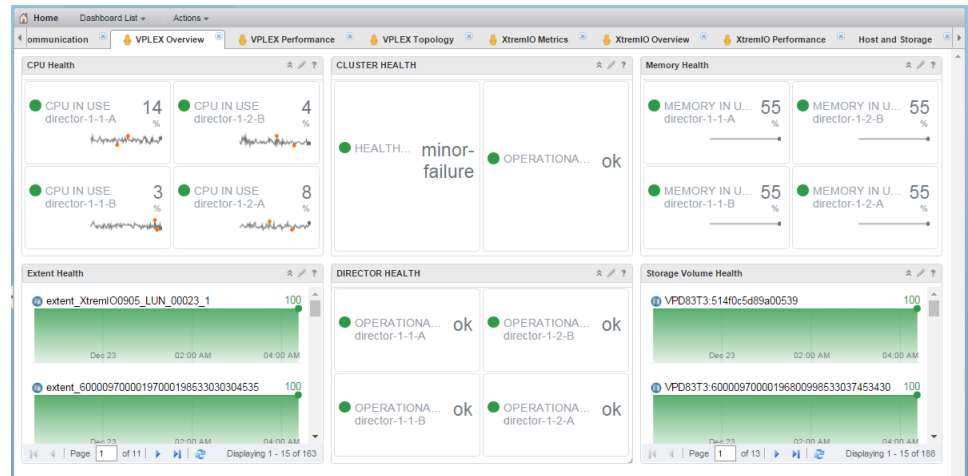


Figure 4 VPLEX Overview dashboard



## Topology dashboards

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

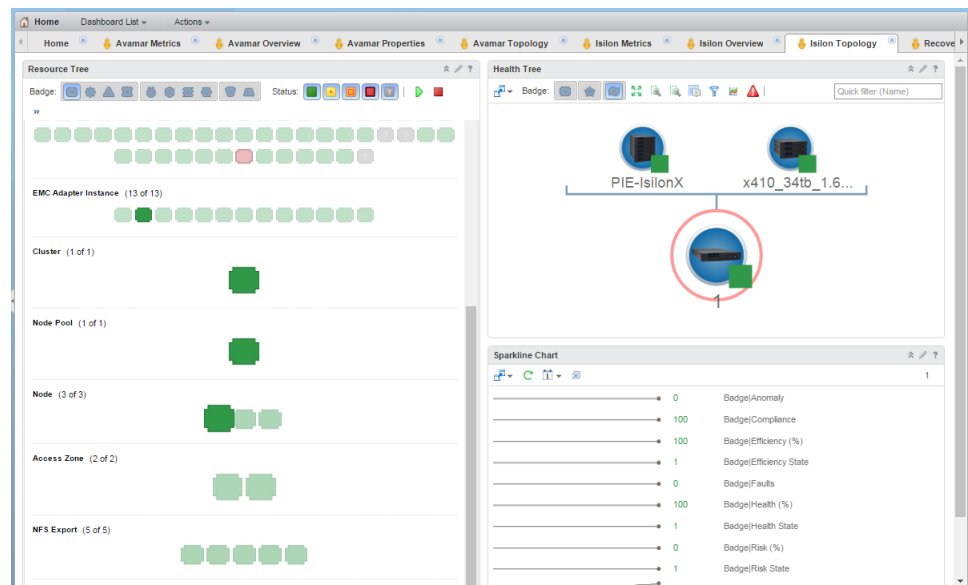
Click the **Topology** tab for the EMC Adapter instance you want to view.

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 default topology dashboards contain the **Resource Tree**, **Health Tree**, and **Sparkline Chart** widgets.

The following figure shows the **Isilon Topology** dashboard with a node selected in the **Resource Tree** widget. The **Sparkline Chart** reflects the information for the selected node.

Figure 5 Isilon Topology dashboard



## Metrics dashboards

The metrics dashboards display resources and metrics for storage systems and enable you to view graphs of resource metrics.

Click the **Metrics** tab for the EMC Adapter instance you want to view.

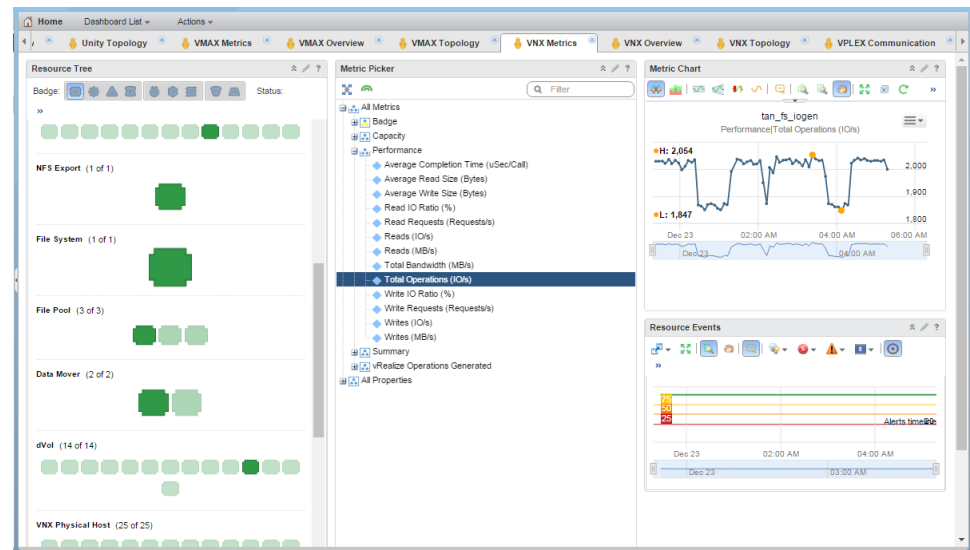
The default Metrics dashboards contain the **Resource Tree**, **Metric Picker**, **Metric Chart**, and **Resource Events** (VNX/VNXe only) widgets.

### Note

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

The following figure shows the VNX Metrics dashboard with a VNX storage pool selected in the Resource Tree.

**Figure 6** VNX Metrics dashboard



## Top-N dashboards

The Top-N dashboards enable you to view your top performing devices at a glance.

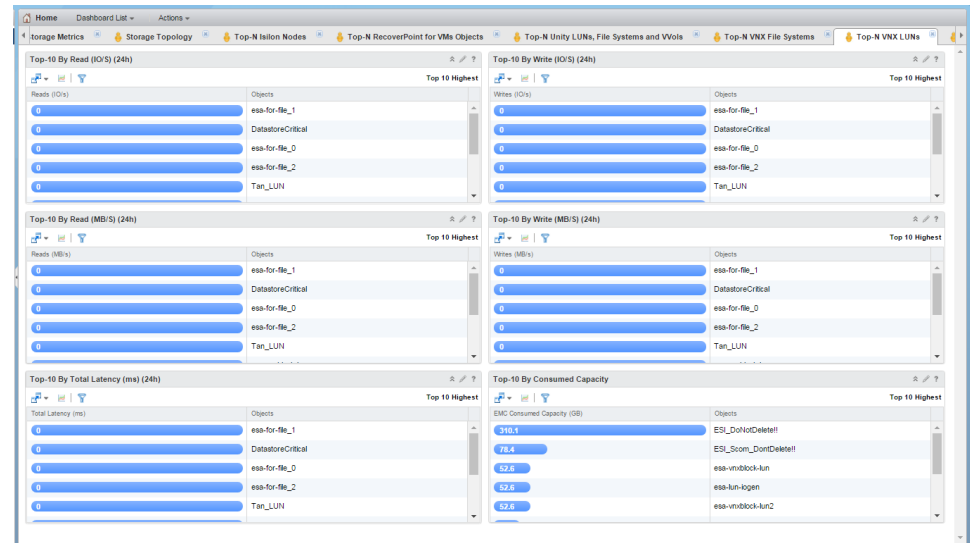
The Top-N dashboards are available for:

- Isilon Nodes
- EMC RecoverPoint for Virtual Machines Objects
- Unity LUNs, File Systems, and VVols
- VNX File Systems
- VNX LUNs
- XtremIO Volumes

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 and the number of objects in your top performer list.

The following figure shows the **Top-N VNX LUNs** dashboard.

Figure 7 Top-N VNX LUNs dashboard



## Dashboard XChange

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

ESA provides a set of default dashboards that provide you with a variety of functional views into your storage environment. You can also create custom dashboards to visualize collected data according to your own requirements. The Dashboard XChange on [ESA Community](#) 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 Dell EMC Community Network, also hosts dashboards designed by EMC to showcase widget functions that might satisfy a particular use case in your environment. Import these dashboards into your existing environment to enhance the functionality offered by EMC Storage Analytics and edit imported dashboards to meet the specific requirements of your own storage environment.

The Dashboard XChange provides these resources to help you create 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

Note that there are XChange Zones for supported platforms.

## Using badges to monitor resources

vRealize Operations Manager provides badges that enable you to analyze capacity, workload, and stress of supported resource objects.

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

- **Workload** badge—Defines the current workload of a monitored resource. It displays a breakdown of the workload based on supported metrics.
- **Stress** badge—Defines the workload over a period of time. It displays one-hour time slices over the period of a week. The color of each slice reflects the stress status of the resource.
- **Capacity** badge—Displays the percentage of a resource that is currently consumed and the remaining capacity for the resource.

---

### Note

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

- 
- **Time Remaining** badge—Calculated from the **Capacity** badge and estimates when the resource will reach full capacity.

## Adjusting default tolerances

Change the values for metric tolerance levels to suit your environment.

ESA contains default tolerance ranges for metrics that are appropriate for the majority of users. The ranges are displayed at the bottom of each heatmap. Change them to suit your needs. Be sure to note the default values in case you want to revert to the original tolerance levels. The [VMware documentation](#) provides detailed instructions for modifying heatmap widget configurations.

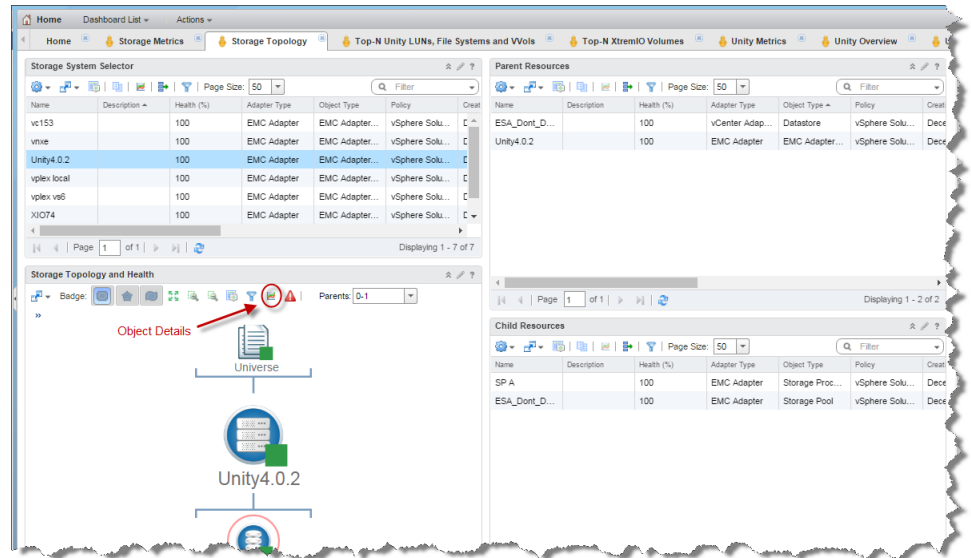
## Monitoring storage

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

### Procedure

1. Select **Home > Storage Topology**.
2. In the **Storage System Selector** widget, select an object to display its topology in the **Storage Topology and Health** widget.
3. Select an object in the **Storage Topology and Health** widget to display its Parent and Child resources, as shown in the following figure.

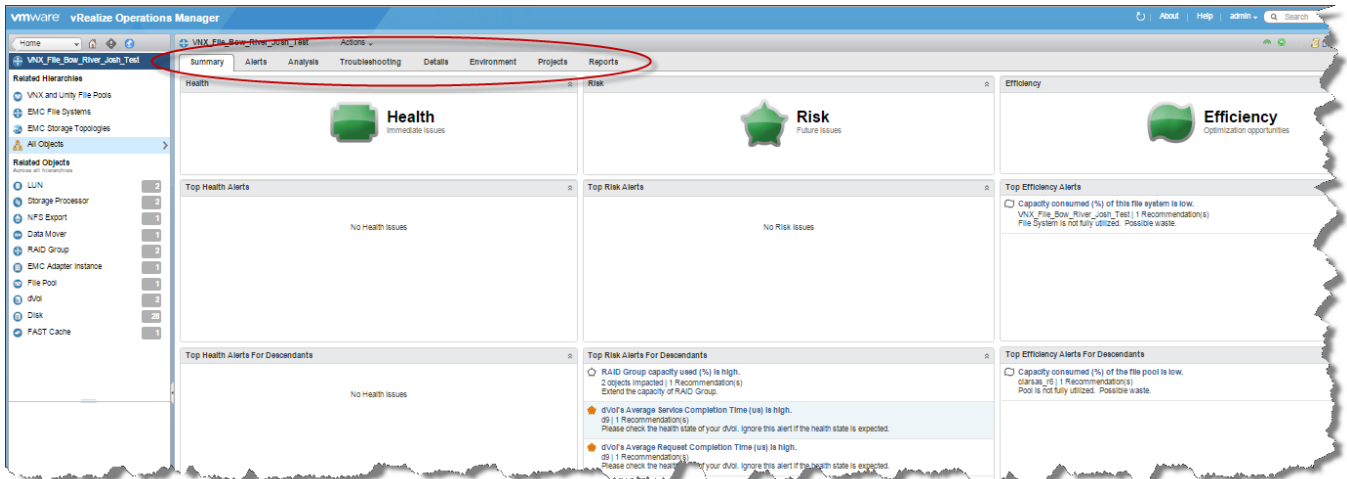
Figure 8 Storage Topology dashboard



4. (Optional) Double-click an object to change the navigation focus.
5. To view more details, select an object and click **Object Detail**.

The tabs shown in the following figure provide more details for the selected object.

Figure 9 Viewing storage details



## Checking capacity and performance

Monitor the capacity and performance of your system using the Storage Metrics dashboard.

Monitoring helps you plan ahead and avoid congestion on your system.

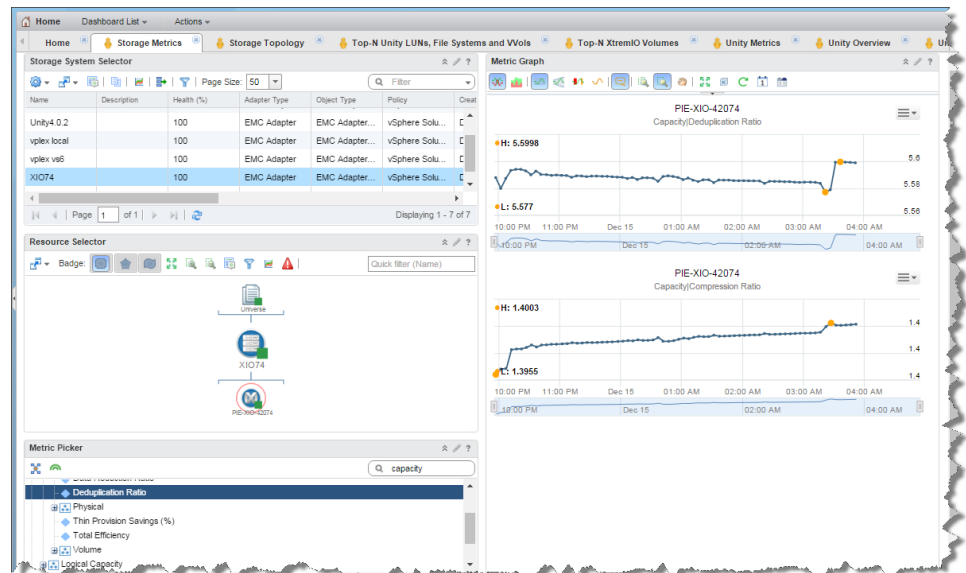
### Procedure

1. Select **Home > Storage Metrics**.
2. In the **Storage System Selector**, select a storage array to populate the **Resource Selector**.

3. In the **Resource Selector**, select an object to populate the **Metric Picker** widget with all metrics collected for the selected resource.
4. Double-click a metric to create a graph of the metric in the **Metric Graph** widget.

The following figure shows an example of the Storage Metrics dashboard with all widgets populated.

**Figure 10** Storage Metrics dashboard



## Troubleshooting with inventory trees

Inventory trees in vRealize Operations Manager help troubleshoot problems you encounter with EMC resources by filtering out irrelevant data.

vRealize Operations Manager inventory trees are available for these EMC resources: VNX Block, VNX File, Unity, and VMAX.

### Procedure

1. Select **Home > Environment**.
2. Under **Inventory Trees**, select the tree name to view its nodes and expand the list to view objects under the selected node.

For detailed instructions, refer to the VMware documentation.



# CHAPTER 4

## Managing Alerts and Recommendations

This chapter contains the following topics:

- [Viewing alerts](#).....34
- [Finding resource alerts](#)..... 37
- [Enabling XtremIO alerts](#)..... 38
- [Understanding event correlation](#)..... 38

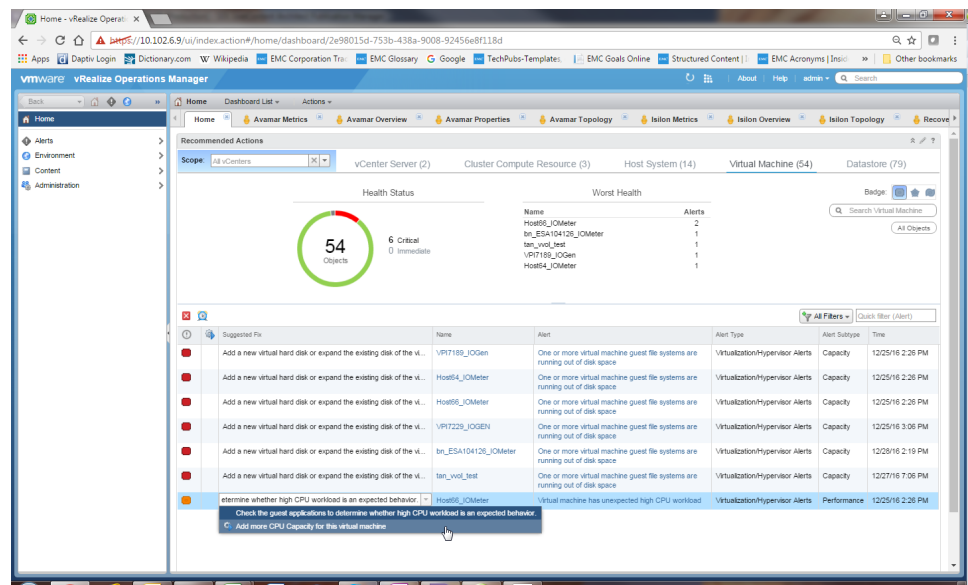
# Viewing alerts

View symptoms, alerts, and recommendations for EMC Adapter instances through the vRealize Operations Manager GUI. ESA defines the alerts, symptoms, and recommendations for resources that the EMC Adapter instance monitors.

## Home dashboard

The vRealize Operations Manager home page dashboard displays all alerts, including ESA symptoms, alerts, and recommendations. View health, risk, and efficiency alerts, listed in order of severity. The following figure shows the **Home** dashboard with the **Virtual Machine** tab selected. Hover your mouse over an item in the **Suggested Fix** column to see more information, as shown in the following figure.

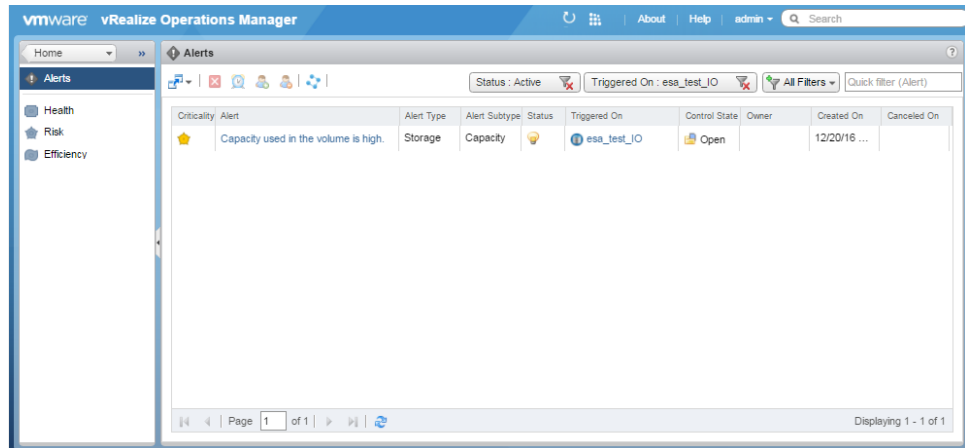
**Figure 11** vRealize Operations Manager Home dashboard



## Alerts

Select **Alerts** from the vRealize Operations Manager navigation panel to view ESA alerts as well as the alerts that vRealize Operations Manager generates. Select **Health**, **Risk**, or **Efficiency** to view the alerts in each category. To refine your search, use the tools in the menu bar. For example, select a start and end date or enter a search string. The following figure shows the **Alerts** window.

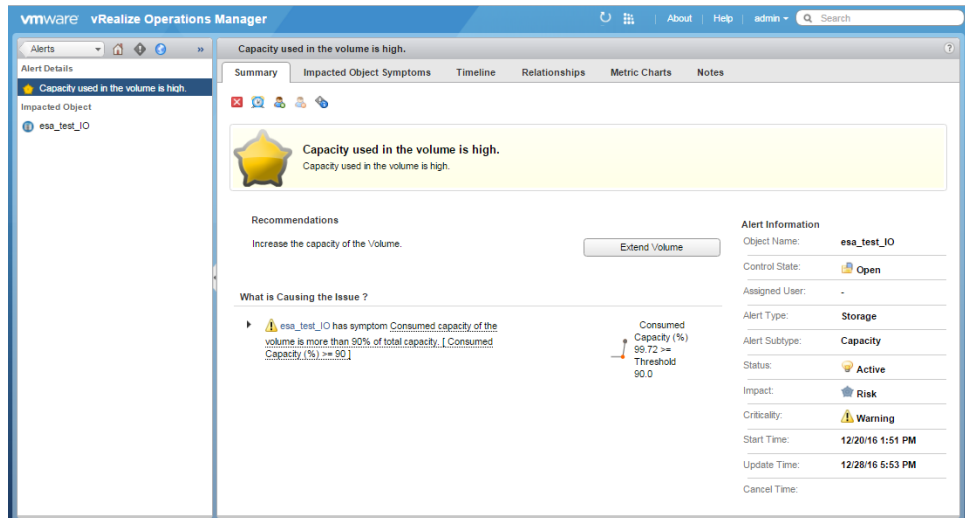
Figure 12 Alerts window



### Alert Details

Select an alert to view detailed properties of the 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, as shown in the following figure.

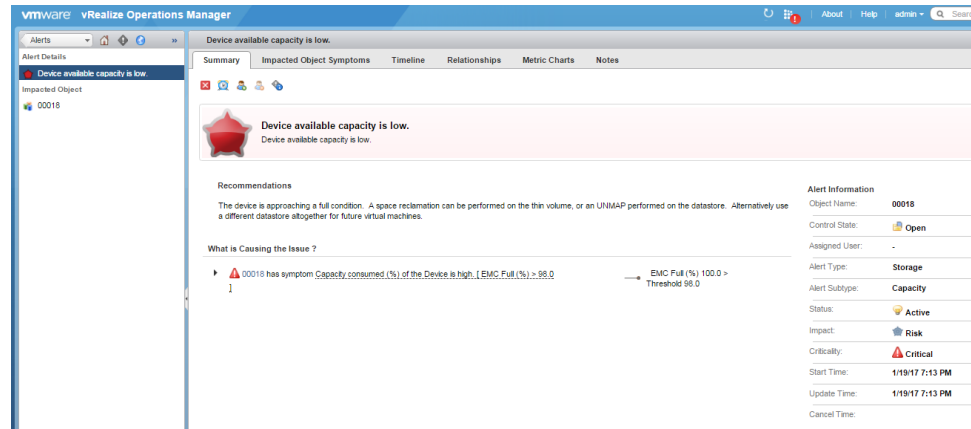
Figure 13 Alert Details window



### Summary

Click the **Object Detail** button on the health tree for a resource or double-click an alert to view the **Summary** tab for the resource, as shown in the following figure. vRealize Operations Manager displays the alerts for the selected resource and for the children of the selected resource that affect the badge color of the selected resource.

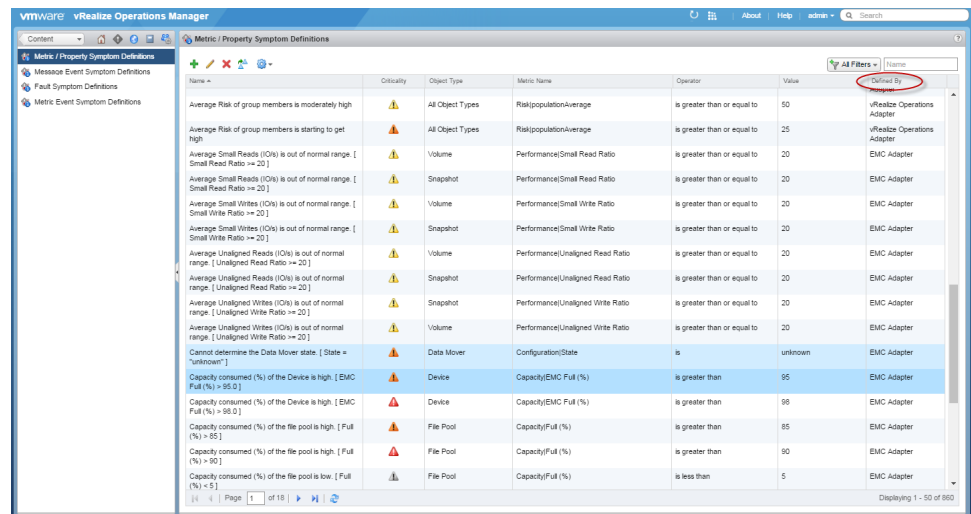
Figure 14 Summary tab



### Symptom definitions

Click **Home > Content > Symptom Definitions** to view symptom definitions for alerts ESA generates. Each definition includes the information shown in the following figure.

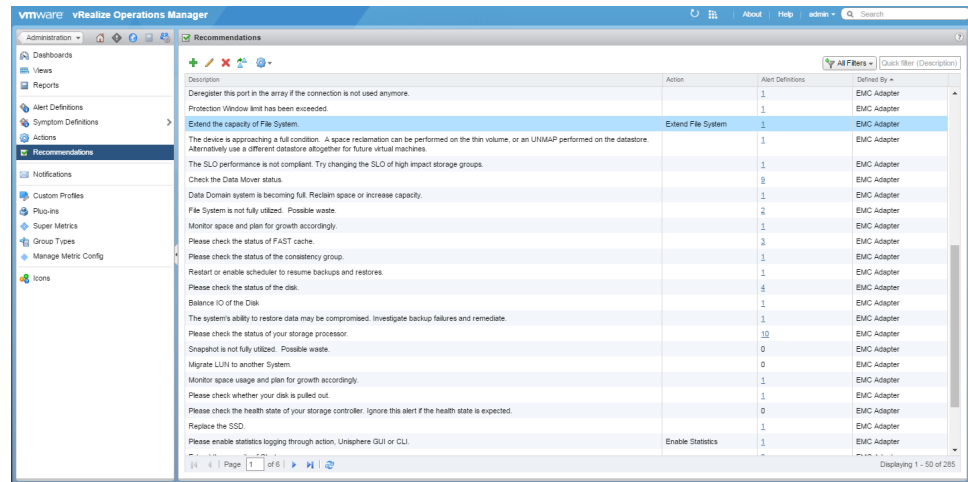
Figure 15 Symptom Definitions window



### Recommendations

Click **Home > Content > Recommendations** to view the recommendation descriptions for alerts ESA generates. The following figure shows an example of the **Recommendations** window. Click a number in the **Alert Definitions** column to see the alert definitions that trigger the recommendation.

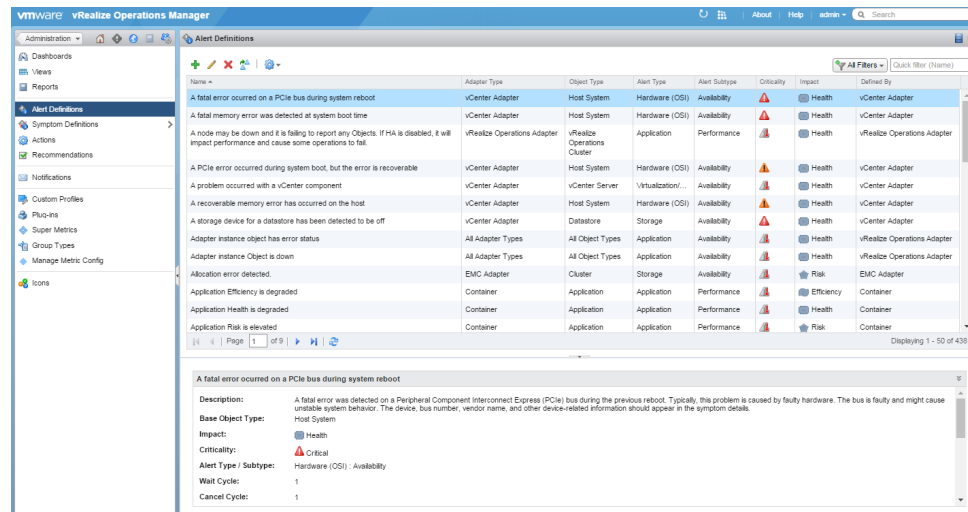
Figure 16 Recommendations window



### Alert definitions

Select **Home > Content > Alert Definitions** to view alert definitions for alerts ESA generates. Each definition includes the details shown in the following figure.

Figure 17 Alert Definitions window



## Finding resource alerts

An alert generated by ESA is associated with a specific resource.

### Procedure

1. 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.

2. 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.

## Enabling XtremIO alerts

The following alerts for XtremIO Volume and Snapshot metrics out of range are disabled by default to align with XMS default settings:

- Average Small Reads (IO/s)
- Average Small Writes (IO/s)
- Average Unaligned Reads (IO/s)
- Average Unaligned Writes (IO/s)

Use the following procedure to enable alerts.

### Procedure

1. Select **Administration > Policies > Policy Library**.
2. Select **Default Policy** and click the **Edit Selected Policy** button (pencil icon).
3. Select **Edit > 6. Alert/Symptom Definitions**.
4. For each alert that you want to enable, select the alert, select **State**, and select **Local** to enable it.
5. Click **Save**.

## Understanding event correlation

Understanding how events, alerts, and resources are related helps with troubleshooting. Event correlation is available for VNX Block and VNX File.

EMC Adapter instances monitor events on certain resources, which appear as alerts in vRealize Operations Manager.

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

Events that vRealize Operations Manager generates influence the health score calculation for certain resources. For example, in the **Details** pane for the selected resource, events that contribute to the health score appear as alerts.

vRealize Operations Manager generates events and associates them only 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 you remove a resource, vRealize Operations Manager automatically removes existing alerts associated with the resource, and the alerts no longer appear in the GUI.

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# CHAPTER 5

## Performing Recommended Actions

This chapter contains the following topics:

- [Actions menu overview](#) ..... 40
- [Managing policies](#) ..... 40
- [Managing capacity](#) ..... 41
- [Managing VNX storage resources](#) ..... 42
- [Enabling FAST Cache on Unity and VNXe storage pools](#) ..... 44
- [Managing VPLEX data migrations](#) ..... 44

## Actions menu overview

As an administrator, you can perform certain actions on EMC storage resources. These actions are available from the **Actions** menu on the storage system's resource page and, in some cases, from the **Details** tab for an alert.

For these actions to be available, the following requirements must be met:

- ESA must be installed and the EMC Adapter instances configured.
- The EMC Adapter instances require the use of administrator credentials on the storage array.
- The vRealize Operations Manager user must have an administrator role that can access the **Actions** menu.

## Managing policies

Change service level objectives and tier policies.

### Changing the service level objective (SLO) for a VMAX3 storage group

This action is available from the Actions menu when you select a VMAX3 storage group.

#### Procedure

1. From the summary page of a VMAX3 storage group, click **Actions > Change SLO**.
2. In the **Change SLO** dialog box, provide the following information for the storage group:
  - New SLO
  - New Workload type
3. Click **OK**.

#### Results

The SLO for the storage group is changed.

### Changing the tier policy for a File System

This action is available in the **Actions** menu when you select a File System on the **Summary** tab.

#### Procedure

1. From the File System's **Summary** page, click **Actions > Change File System Tiering Policy**.
2. In the dialog box, select a tiering policy and click **Begin Action**.

#### Results

The policy is changed. You can check the status under **Recent Tasks**.



## Changing the tier policy for a LUN

This action is available from the **Actions** menu when you select a Unity, UnityVSA, VNX, or VNXe LUN on the **Summary** tab.

### Procedure

1. From the **Summary** tab of a supported storage system LUN, click **Action > Change Tiering Policy**.
2. In the **Change Tiering Policy** dialog box, select a tiering policy and click **Begin Action**.

### Results

The policy is changed. Check the status under **Recent Tasks**.

## Managing capacity

Extend storage on file systems, LUNs, and volumes.

### Extending file system capacity

This action is available from the **Actions** menu when you select a file system or under a recommended action when a file system's used capacity is high.

#### Procedure

1. Do one of the following:
  - Select a file system and click **Actions > Extend File System**.
  - From the alert details window for a file system, click **Extend File System**.
2. In the **Extend File System** dialog box, type a number in the **New Size** text box, and then click **OK**.
3. Click **OK** in the status dialog box.

#### Results

The file system size is increased and the alert (if present) is cancelled.

### Extending volumes on EMC XtremIO storage systems

Extend XtremIO volumes manually or configure a policy to extend them automatically when used capacity is high.

- To extend a volume manually if you have not configured an automated policy, refer to [Extending XtremIO volumes manually](#).
- To configure a policy that automatically extends an XtremIO volume when capacity becomes high, refer to [Configuring an extend volume policy for XtremIO](#).

### Configuring an extend volume policy for XtremIO

Set a policy that automatically extends an XtremIO volume when capacity becomes high.

#### Procedure

1. In the vRealize Operations Manager main menu, click **Administration > Policies**.  
**Default Policy** appears under **Active Policies**.

2. Select **Policy Library**, select **Edit the Default Policy**.
3. In the left panel, select **Alert/System Definitions**.
4. Under **Alert Definitions**, select **Capacity used in the volume is high**.
5. In the **Automate** column, select **Local**, and then click **Save**.

### Results

When **Capacity used in the volume is high** is triggered, the volume is extended automatically.

## Extending XtremIO volumes manually

Extend XtremIO volumes manually if you have not configured an automated policy.

This action is available from the **Actions** menu when you select XtremIO volume or as a recommended action when a volume's used capacity is high.

### Procedure

1. Do one of the following:
  - Select an XtremIO volume and click **Actions > Extend Volume**.
  - From the alert details window for an XtremIO volume, click **Extend Volume**.
2. In the **Extend Volume** dialog box, type a number in the **New Size** text box, and then click **OK**.
3. Click **OK** in the status dialog box.

### Results

The volume size is increased and the alert (if present) is cancelled.

## Expanding LUN capacity

This action is available from the **Actions** menu when you select a Unity, UnityVSA, VNX, or VNXe LUN.

### Procedure

1. Select a LUN for a supported storage system.
2. Under **Actions**, click **Expand**.
3. Type the new size and select the size qualifier.
4. Click **Begin Action**.

### Results

The LUN is expanded. You can check the status under **Recent Tasks**.

## Managing VNX storage resources

This section includes instructions for migrating LUNs, rebooting a data mover or storage processor, enabling performance statistics, and enabling FAST Cache.

## Migrating a VNX LUN to another storage pool

This action is available from the vRealize Operations Manager **Actions** menu.

### Procedure

1. From the **Summary** page of the VNX LUN, click **Actions > Migrate**.

2. In the **Migrate** dialog box, provide the following information:
  - **Storage Pool Type**—Select **Pool** or **RAID Group**.
  - **Storage Pool Name**—Type the name of the pool to migrate to.
  - **Migration Rate**—Select **Low**, **Medium**, **High**, or **ASAP**.
3. Click **OK**.

### Results

The LUN is migrated.

## Rebooting a Data Mover on VNX storage

This action is available from the **Actions** menu when a VNX Data Mover is selected or under a recommended action when the health state of the Data Mover has an error.

### Procedure

1. Do one of the following:
  - Select a VNX Data Mover and click **Actions > Reboot Data Mover**.
  - From the alert details window for a VNX Data Mover, click **Reboot Data Mover**.
2. In the **Reboot Data Mover** dialog box, click **OK**.

### Results

The Data Mover is restarted and the alert is cancelled.

## Rebooting a VNX storage processor

This action is available from the **Actions** menu on the **Summary** tab for the storage processor or as a recommendation when the storage processor cannot be accessed.

### Procedure

1. Do one of the following:
  - On the **Summary** tab for the storage processor, click **Actions > Reboot Storage Processor**.
  - Under **Recommendations**, click **Reboot Storage Processor**.
2. In the **Reboot Storage Processor** dialog box, click **Begin Action**.

### Results

The storage processor is restarted. The restart can take several minutes. Check the status under **Recent Tasks**.

## Enabling performance statistics for VNX Block

This action is available only as a recommended action when an error or warning occurs on a VNX Block array. It is not available from the vRealize Operations Manager **Actions** menu.

### Procedure

1. From the **Summary** page of the VNX Block array that reports an error or warning, click **Enable Statistics**.
2. In the **Enable Statistics** dialog box, click **OK**.

3. Confirm the action by checking the **Message** column under **Recent Tasks**.

## Enabling FAST Cache on a VNX Block storage pool

This action is available from the **Actions** menu when you select a VNX Block storage pool or as a recommended action when FAST Cache is configured and available.

### Procedure

1. Select the **Summary** tab for a VNX Block storage pool.
2. Do one of the following:
  - From the **Actions** menu, select **Enable FAST Cache**.
  - Under **Recommendations**, click **Configure FAST Cache**.
3. In the **Configure FAST Cache** dialog box, click **OK**.
4. Check the status under **Recent Tasks**.

## Enabling FAST Cache on Unity and VNXe storage pools

This action is available from the **Actions** menu when you select a Unity or VNXe storage pool and FAST Cache is enabled and configured.

### Procedure

1. Under Details for the storage pool, select **Actions > Configure FAST Cache**.
2. In the **Configure FAST Cache** dialog box, click **Begin Action**.
3. Check the status under **Recent Tasks**.

## Managing VPLEX data migrations

EMC VPLEX systems are commonly used to perform non-disruptive data migrations. Analytics for storage system performance and trends for the entire VPLEX storage environment are impacted when you swap a back-end storage system on a VPLEX system. Therefore, EMC recommends that you start a new ESA baseline for the VPLEX system after data migration.

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

Use the following procedure to start a new baseline.

### Procedure

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

# CHAPTER 6

## Troubleshooting

This chapter contains the following topics:

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### Note

*EMC Storage Analytics Release Notes* contains a list of known problems and limitations that address many issues not included here.

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## 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
- Unity

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). You must select the object to launch Unisphere. Unisphere launch capability does not exist for VMAX or VPLEX objects.

---

## Finding adapter instance IDs

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, view the IDs for adapter instances.

## Managing log files

Find information about installation logs, VMware vRealize Log Insight, support bundles, error logs, and log file sizes and rollover counts.

### Installation logs

Find error logs.

Errors in the ESA 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

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 about working with Log Insight, refer to the [Log Insight documentation](#).

## Log Insight configuration

Send the ESA 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.

Note that the adapter name parsing changes dots and spaces into underscores. The adapter instance ID is concatenated to create the subdirectory name as well as the log file name.

Multiple instances of each of the adapter types appear because ESA creates a new directory and log file for the Test Connection part of discovery as well as for the analytics log file.

The Test Connection logs have a null name associated with the adapter ID.

You can forward any logs of interest to Log Insight, but remember that forwarding logs consumes bandwidth.

## Sending logs to Log Insight

Set up `syslog-ng` to send ESA logs to Log Insight.

### Before you begin

Import the vRealize Operations Manager content pack into Log Insight. This context-aware content pack includes content for supported EMC Adapter instances.

VMware uses `syslog-ng` for sending logs to Log Insight. Search online for `syslog-ng` documentation. Refer to the [EMC Simple Support Matrix](#) for the EMC products that support Log Insight.

The steps that follow represent an example of sending VNX and VMAX logs to Log Insight.

### Procedure

1. Access the `syslog-ng.conf` directory:
 

```
cd /etc/syslog-ng
```
2. Save a copy of the file:
 

```
cp syslog-ng.conf syslog-ng.conf.noli
```
3. Save another copy to modify:
 

```
cp syslog-ng.conf syslog-ng.conf.tmp
```
4. Edit the temporary (`.tmp`) file by adding the following to the end of the file:

```
#LogInsight Log forwarding for ESA <<<<<<<<<<<< comment
source esa_logs { internal(); <<<<<<<<<<<<<<<<<< internal syslog-
```





## Viewing error logs

ESA 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.

## About log file sizes and rollover counts

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.

## Configuring log file sizes and rollover counts

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

Activate changes you made to the log file size or rollover count for an EMC Adapter instance.

### Procedure

1. In vRealize Operations Manager, select **Administration > Inventory Explorer > Adapter Instances > EMC Adapter Instance**.
2. In the navigation pane, select an adapter instance to populate the **List** tab.
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 **OK**.

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

## Verifying configuration changes

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 reflect the changes.
- Properties for a specific adapter instance, only the logs for that adapter instance reflect the changes.
- Log file size or rollover count to higher values, you do not see the resulting changes until those thresholds are crossed.

## Managing the collection of XtremIO snapshots

XtremIO snapshots are collected by default. In some environments, an excessive number of snapshots in the system can cause performance issues for the vRealize Operations server. To avoid an excess of snapshots, turn off collection of XtremIO snapshots.

### Before you begin

For multiple XtremIO adapter instances, use the instructions in [Finding adapter instance IDs](#) on page 46 to find the IDs for the adapters you want to modify.

### Procedure

1. Log in to the vRealize Operations server using SSH.  
[Using SSH to connect to vRealize Operations Manager](#) on page 53 provides instructions.
2. Open `/usr/lib/vmware-vcops/user/plugins/inbound/emc-vcops-adapter/conf/adapter.properties`
3. Change: `com.emc.vcops.adapter.xtremio.skip.snapshots=false` to `com.emc.vcops.adapter.xtremio.skip.snapshots=true`.

For multiple XtremIO adapter instances, you can specify the adapter ID in the key to make changes to only the corresponding adapter instances. For example, to skip collecting snapshots for the XtremIO adapter instance with ID 623, modify the entry to: `com.emc.vcops.adapter.623.xtremio.skip.snapshots=true`

4. Follow the steps in [Activating configuration changes](#) on page 50 to save your changes.

Snapshot collection is turned off.

---

**Note**

If the vRealize Operations environment is a multi-node cluster setup, change the configuration for each node.

---

## Editing the Collection Interval for a resource

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

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

---

**Note**

For Unity systems, the maximum collection interval is five minutes.

---

The vRealize Operations Manager online help provides instructions for configuring Resource Management settings.

## Configuring the thread count for an adapter instance

Configure the thread count for an adapter instance for best performance.

EMC recommends that only administrative personnel perform this procedure. If the thread count is not specified in `adapter.properties`, then the thread count = vCPU count +2. The maximum allowed thread count is 20.

**Procedure**

1. Access the `/usr/vmware-vcops/user/plugins/inbound/emc-vcops-adapter/conf/adapter.properties` file.
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` and change the property value. For example: `com.emc.vcops.adapter.7472.threadcount`.

---

**Note**

To find an adapter instance ID, refer to [Finding adapter instance IDs](#) on page 46.

---

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

## Using SSH to connect to vRealize Operations Manager

Use SSH to log in 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 are logged in.

5. Use this command to enable SSH:

```
service sshd start
```

You can use SSH to log in successfully.

## Troubleshooting metrics and scoreboards

**Table 3** Metrics and scoreboard questions

Symptom	Problem or question	Resolution
Unisphere Analyzer	Must the Unisphere Analyzer for VNX be running to collect metrics?	No. VNX Block metrics are gathered through <code>naviseccli</code> commands. VNX File metrics are gathered through CLI commands. However, statistics logging must be enabled on each SP on VNX Block, and statistics logging has a performance impact on the array. No additional services are required for VNX File.
Primary SP or CS down	Will ESA continue to collect VNX statistics if the primary SP or CS goes down?	Yes. ESA automatically collects metrics from the secondary CS if the CS fails over. The credentials on the secondary CS must match the credentials on the primary CS.
Resources and metrics per node	How many resources and metrics are supported per node in vRealize Operations Manager?	<ul style="list-style-type: none"> <li>• Small Node—4vCPU, 16 GB Memory. Supports 2,000 objects and 1,000,000 metrics.</li> <li>• Medium Node—8vCPU, 32 GB Memory. Supports 6,000 objects and 3,000,000 metrics.</li> <li>• Large Node—16vCPU, 64 GB Memory. Supports 10,000 objects and 5,000,000 metrics.</li> </ul>
Health score is 0	What does it mean when a resource has a health score of 0?	The resource is either down or not available.
Blue question mark	What does the blue question mark in the health score indicate?	A blue question mark indicates that vRealize Operations Manager was unable to poll that resource. It will retry during the next polling interval.
Health scores	How do health scores work?	Health scores measure a resource's behavior 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 might not be in an unhealthy state but

**Table 3** Metrics and scoreboard questions (continued)

Symptom	Problem or question	Resolution
		there is an abnormality. Health scores are calculated by a proprietary algorithm that accounts for several factors, including thresholds and historical statistics. vRealize Operations Manager might take up to 30 days to gather enough information to determine what is considered normal in your environment. Until then, you might not see any changes in your health scores.
FAST Cache heat map	How does the FAST Cache heat map work?	The FAST Cache heat maps are based on the FAST Cache read and write hit ratios. This heat map turns red if these ratios are low, indicating that FAST Cache is not being used efficiently. The heat maps turn green when FAST Cache is servicing a high percentage of I/O.
VMAX metrics	A VMAX device is not visible and metrics are not collected on a multi-node vRealize Operations cluster for a virtual machine -> VMAX device relationship. The virtual machine -> VMAX device cross-adapter relationship is only supported on single vRealize Operations node because of technical restraints. Metrics for a VMAX device are only displayed if it has a corresponding consumer.	Workaround: Create an extra VMware adapter instance on the node where the VMAX adapter instance is running.

## Understanding error messages

Learn the meaning of resource down and license errors.

**Table 4** Error messages

Symptom	Problem or question	Resolution
Invalid license error	Why do I receive an invalid license error message when I configure the adapter instance for VNX File, even though I purchased the license of the model of the VNX array that I plan to monitor?	The CS might not be reporting the correct model or the array. Log in to the CS and check the array model with the command: <code>/nas/sbin/model</code> . Verify that the returned array model matches the model on the <i>Right to Use</i> certificate.
Resource down	Why are multiple EMC Adapter instances for my storage systems marked as down, even though I have added license keys for each of them?	License keys are specific to the model for which the license was purchased. <ul style="list-style-type: none"> <li>• Verify that you are using the correct license key for the adapter instance.</li> <li>• After adding a license, click the <b>Test</b> button to test the configuration and validate the license key.</li> </ul>

**Table 4** Error messages (continued)

Symptom	Problem or question	Resolution
		<ul style="list-style-type: none"> <li>If you saved the configuration without performing a test and the license is invalid, the adapter instance is marked as <code>Resource down</code>.</li> <li>To verify that a valid license exists, select <b>Environment Overview</b>. The list that appears shows the license status.</li> </ul>
Resource down after upgrade	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 <b>Environment Overview &gt; Configuration &gt; Adapter Instances</b> .
Resource down after CS failover	Why is the VNX File adapter instance marked as down and metric collection stopped after a CS failover?	The failover might have been successful, but the new CS might not be reporting the correct model of the array. This results in a failure to validate the license and all data collection stops. Log in to the CS and check the array model with the command: <code>/nas/sbin/model</code> . If the model returned does not match the actual model of the array, <a href="#">Primus case emc261291</a> in the EMC Knowledgebase provides possible solutions.

## Understanding resources and relationships

Frequently asked questions about resources and relationships within vCenter are answered here.

**Table 5** Questions about resources and relationships

Symptom	Problem or question	Resolution
vCenter resources details	How is the detailed view of vCenter resources affected in ESA?	Any changes in the disk system affects the health of vCenter resources such as virtual machines, but ESA does not show changes in other subsystems. Metrics for other subsystems show either <code>No Data</code> or <code>?</code> .
Relationships	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.
Deleted resource still appears	I deleted a resource. Why does it still appear in the vRealize Operations Manager?	vRealize Operations Manager does not delete any resources automatically because it retains historical statistics and topology information that might be important to the user. The resource enters an unknown state (blue). To remove the resource, delete it on the <b>Inventory Explorer</b> page.
Nodes per cluster	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.

## References

Read these documents for more information.

### VMware vRealize Operations Manager documentation

- *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

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

---

#### Note

The [EMC Storage Analytics Community](#) provides more information about installing and configuring ESA.

---



# APPENDIX A

## List of Alerts

ESA generates the listed events when the resources are queried. This appendix contains the following topics:

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- [Isilon alerts](#)..... 59
- [RecoverPoint alerts](#)..... 60
- [ScaleIO alerts](#)..... 61
- [Unity, UnityVSA, and VNXe alerts](#)..... 64
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## Avamar alerts

ESA provides alerts for Avamar DPN, DDR, and Client resources.

**Table 6** Avamar DPN alert messages

Alert message	Badge	Severity	Condition	Description/Recommendation
DPN used capacity (%) is high	Risk	Critical	>= 90%	Avamar system is almost full and may become read-only soon. Reclaim space or increase capacity.
		Warning	>= 80%	Reclaim space or increase capacity.
		Info	>= 70%	Monitor space usage and plan for growth accordingly.
The DPN has experienced a problem. State: Offline	Health	Critical	Offline	If ConnectEMC has been enabled, a Service Request (SR) is logged. Go to EMC Online Support to view existing SRs. Search the knowledgebase for Avamar Data Node offline solution esg112792.
Avamar server has experienced a disk failure on one or more nodes. State: Degraded		Warning	Degraded	All operations are allowed, but immediate action should be taken to fix the problem.
Avamar Administrator was able to communicate with the Avamar server, but normal operations have been temporarily suspended. State: Suspended		Warning	Suspended	Restart or enable scheduler to resume backups and restores.
MCS could not communicate with this node. State: Time-Out	Health	Critical	Time-Out	Refer to Avamar Administrator guide, Troubleshooting guide and KB articles for assistance.
Node status cannot be determined. State: Unknown		Critical	Unknown	
One or more Avamar server nodes are in an offline state. State: Node Offline		Warning	Node Offline	
Avamar Administrator was unable to communicate with the Avamar server. State: Inactive		Warning	Inactive	
Successful backups (%) in the last 24 hours is low	Risk	Info	<= 90%	Investigate backup failures and remediate.
		Warning	<= 80%	The system's ability to restore data may be compromised. Investigate backup failures and remediate

**Table 7** Avamar DDR alert messages

Alert message	Badge	Severity	Condition	Description/Recommendation
DDR used capacity (%) is high.	Risk	Critical	>= 90%	Data Domain system is almost full and may become read-only soon. Reclaim space or increase capacity
		Warning	>= 80%	Data Domain system is becoming full. Reclaim space or increase capacity.
		Info	>= 70%	Monitor space and plan for growth accordingly.
The file system has experienced a problem.	Health	Critical	Disabled	Data Domain file system disabled. Contact administrator to enable. No backups or restores can be performed.
		Critical	Unknown	Data Domain file system in an unknown state. Contact administrator to resolve. Backups and restores may fail.

**Table 8** Avamar Client alert messages

Alert message	Badge	Severity	Condition	Description/Recommendation
The latest backup operation for this client has failed.	Risk	Warning	Failed	Remediate failure.
The backup elapsed time for this client is high.	Efficiency	Warning	>= 24 hours	Backups are running longer than expected. Investigate and remediate
The change rate between backups exceeds 20%.	Efficiency	Info	Job Bytes Scanned >= 20%	Change rate exceeds 20%. Change Block Tracking may have been disabled.

## Isilon alerts

Cluster and Node alerts are available for Isilon 8.0 and later. Alert messages are collected from REST API.

**Table 9** Isilon Cluster alert messages

Alert Message	Badge	Severity	Type/ID
Allocation error detected.	Risk	Warning	800010002
System is running out of file descriptors.			800010006

**Table 10** Isilon Node alert messages

Alert Message	Badge	Severity	Type/ID
CPU 0 about to throttle due to temperature.	Risk	Warning	900020026
CPU 1 about to throttle due to temperature.			900020027

**Table 10** Isilon Node alert messages (continued)

Alert Message	Badge	Severity	Type/ID
CPU throttling	Health		900020035
Internal network <i>interface</i> link down.	Efficiency		200020003
External network link down.			200020005
Node <i>integer</i> offline.	Health	Critical	200010001
The snapshot reserve space is nearly full ( <i>value</i> % used).	Risk	Info	600010005

## RecoverPoint alerts

ESA provides RecoverPoint alerts based on events for Consistency Group, Copy, and vPRA and alerts based on metrics for vRPA, Consistency Group, System, Cluster, and Splitter. Cancel cycle and Wait cycle for these alerts is 1.

**Table 11** RecoverPoint for Virtual Machines alerts based on message event symptoms

Resource kind	Message summary	Badge	Severity	Event message	Recommendation
Consistency group	Problem with RecoverPoint consistency group.	Health	Critical	RecoverPoint consistency group state is unknown.	Check the status of the consistency group.
			Warning	RecoverPoint consistency group is disabled.	
Copy	Problem with RecoverPoint copy.	Health	Critical	RecoverPoint copy state is unknown.	Check the status of the copy.
			Warning	RecoverPoint copy state is disabled.	
vPRA	Problem with vPRA	Health	Critical	vRPA status is down.	Check the status of the vPRA.
			Warning	vRPA status is removed for maintenance.	
			Immediate	vRPA status is unknown.	

**Table 12** RecoverPoint for Virtual Machines alerts based on metrics

Resource kind	Message summary	Metric and criteria	Badge	Severity	Recommendation
vRPA	Problem with vRPA.	vRPA   CPU Utilization (%) >95	Health	Warning	Check the status of the vRPA.
Consistency group	Consistency group protection window limit has been exceeded.	Consistency group protection window ratio < 1			Protection window limit has been exceeded.
	Lag limit has been exceeded.	Link   Lag (%) > 95			Lag limit has been exceeded.

**Table 12** RecoverPoint for Virtual Machines alerts based on metrics (continued)

Resource kind	Message summary	Metric and criteria	Badge	Severity	Recommendation
RecoverPoint for Virtual Machines system	Number of splitters is reaching upper limit. (Version 4.3.1)	RecoverPoint System   Number of splitters > 30	Risk	Information	Consider adding another RecoverPoint for Virtual Machines system.
	Number of splitters is reaching upper limit. (Version 5.0)	RecoverPoint System   Number of splitters > 60			
Cluster	Number of consistency groups per cluster is reaching upper limit.	RecoverPoint cluster   number of consistency groups > 122			Consider adding another RecoverPoint cluster.
	Number of vRPAs per cluster is reaching upper limit.	RecoverPoint cluster   number of vRPAs > 8			Consider adding another RecoverPoint cluster.
	Number of protected virtual machines per cluster is reaching upper limit.	RecoverPoint cluster   number of protected virtual machines > 486			Consider adding another RecoverPoint cluster.
	Number of protected volumes per cluster is reaching upper limit.	RecoverPoint cluster   number of protected VMDKs > 1946	The maximum number of protected volumes per vRPA cluster is 2K.		
Splitter	Number of attached volumes per splitter is reaching upper limit.	Splitter   number of volumes attached > 3890	The maximum number of attached volumes per splitter is 4K.		

## ScaleIO alerts

ESA provides ScaleIO alerts for System, Protection Domain, Device Disk, SDS, Storage pool, SDC, and MDM.

**Table 13** ScaleIO System alerts

Metric	Badge	Severity	Condition
Used Capacity	Risk	Critical Warning	> 95 >85
Thick Used Capacity		Critical Warning	> 95 >85
Thin Used Capacity		Critical Warning	> 95 >85
Snap Used Capacity		Critical Warning	> 95 >85

**Table 14** ScaleIO Protection Domain alerts

Metric	Badge	Severity	Condition
Status	Health	Critical	No Active
Used Capacity	Risk	Critical Warning	> 95 >85
Thick Used Capacity		Critical Warning	> 95 >85
Thin Used Capacity		Critical Warning	> 95 >85
Snap Used Capacity		Critical Warning	> 95 >85

**Table 15** ScaleIO Device/Disk alerts

Metric	Badge	Severity	Condition
Status	Health	Critical -> Error, Info -> {Remove, Pending}	
Used Capacity	Risk	Critical Warning	> 95 >85
Spare Capacity Allocated		Critical Warning	> 95 >85
Thick Used Capacity		Critical Warning	> 95 >85
Thin Used Capacity		Critical Warning	> 95 >85
Protected Capacity		Critical Warning	> 95 >85

**Table 16** ScaleIO SDS alerts

Metric	Badge	Severity	Condition
Status	Health	Critical	Disconnected
Used Capacity	Risk	Critical Warning	> 95 >85
Thick Used Capacity		Critical Warning	> 95 >85
Thin Used Capacity		Critical Warning	> 95 >85
Protected Capacity		Critical Warning	> 95 >85

**Table 16** ScaleIO SDS alerts (continued)

Metric	Badge	Severity	Condition
<b>Note</b> Note: Not available from REST API			
Snap Used Capacity		Critical Warning	> 95 >85

**Table 17** ScaleIO Storage Pool alerts

Metric	Badge	Severity	Condition
Status <b>Note</b> Not available from REST API	Health	Critical Warning Warning Warning Warning	Degraded capacity Unreachable capacity Unavailable unused capacity Extremely unbalanced Unbalanced
Used Capacity	Risk	Critical Warning	> 95 >85
Thick Used Capacity		Critical Warning	> 95 >85
Thin Used Capacity		Critical Warning	> 95 >85
Protected Capacity		Critical Warning	> 95 >85
Snap Used Capacity		Critical Warning	> 95 >85

**Table 18** ScaleIO SDC alerts

Metric	Badge	Severity	Condition
State	Health	Critical	Disconnected

**Table 19** ScaleIO MDM Cluster alerts

Metric	Badge	Severity	Condition
State	Health	Critical	Not clustered Clustered degraded Clustered tie breaker down

**Table 19** ScaleIO MDM Cluster alerts

Metric	Badge	Severity	Condition
			Clustered degraded tie breaker down

## Unity, UnityVSA, and VNXe alerts

ESA provides alerts for the following resources on Unity, UnityVSA, and VNXe: Disk, Tier, Storage Pool, Storage Processor, LUN, File System, and NAS Server.

**Table 20** Unity, UnityVSA, and 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	



Table 20 Unity, UnityVSA, and VNXe alerts (continued)

Resource kind	Metric	Badge	Severity	Condition	Message summary
	CIFS SMBv2 Read Response (ms)	Risk	Warning	> 25	
			Critical	> 75	CIFS SMBv2 average read response time(ms) is high.
			Immediate	> 50	
	CIFS SMBv2 Write Response (ms)	Risk	Warning	> 25	
			Critical	> 75	
			Immediate	> 50	
	NFS v3 Read Response (ms)	Risk	Warning	> 25	
			Critical	> 75	NFSv3 average read response time (ms) is high.
			Immediate	> 50	
	NFS v3 Write Response (ms)	Risk	Warning	> 25	
			Critical	> 75	
			Immediate	> 50	
	State	Health	Warning	> 25	
			Critical	Includes "critical"	This storage processor is reporting a problem.
			Immediate		
Info					
LUN	State	Health	Warning		
			Critical	Condition includes critical	This LUN is reporting a problem.
			Immediate		
			Info		
File System	State	Health	Warning		
			Critical	Condition includes critical	This file system is reporting a problem.
			Immediate		
			Info		
NAS Server	State	Health	Warning		
			Critical	Condition includes critical	This NAS Server is reporting a problem.
			Immediate		

**Table 20** Unity, UnityVSA, and VNXe alerts (continued)

Resource kind	Metric	Badge	Severity	Condition	Message summary
			Info		

## VMAX alerts

ESA provides alerts for VMAX Device, Storage Resource Pool, and SLO resources. The Wait Cycle is 1 for all these VMAX alerts.

**Table 21** 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.
SLO	Compliance	Risk	Warning	is MARGINAL	SLO compliance status needs attention.
			Critical	is CRITICAL	SLO compliance status needs attention.

## VNX Block alerts

ESA provides alerts for the following resources on VNX Block: Storage Pool, FAST Cache, Tier, Storage Processor, RAID Group, Disk, LUN, Port, Fan and Power Supply, and Array.

**Table 22** VNX Block alerts

Resource type	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.

Table 22 VNX Block alerts (continued)

Resource type	Metric	Badge	Severity	Condition	Message summary
	State	Health	Critical	Offline	This storage pool is offline.
				Faulted	This storage pool is faulted.
				Expansion Failed	This storage pool's expansion failed.
				Cancel Expansion Failed	The cancellation of this storage pool's expansion failed.
				Verification Failed	The verification of this storage pool failed.
				Initialize Failed	The initialization of this storage pool failed.
				Destroy Failed	The destruction of this storage pool failed.
			Warning	Offline and Recovering	This storage pool is offline and recovering.
			Critical	Offline and Recovery Failed	The recovery of this offline storage pool failed.
			Warning	Offline and Verifying	This storage pool is offline and verifying.
			Critical	Offline and Verification Failed	This storage pool is offline and verification failed.
				Faulted and Expanding	This storage pool is faulted and expanding.
				Faulted and Expansion Failed	This expansion of this storage pool failed.
				Faulted and Cancelling Expansion	This storage pool is faulted and is cancelling an expansion.
				Faulted and Cancel Expansion Failed	This storage pool is faulted and the cancellation of the expansion failed.
				Faulted and Verifying	This storage pool is faulted and verifying.
				Faulted and Verification Failed	This storage pool is faulted and verification failed.
			Unknown	The status of this storage pool is unknown.	
			FAST Cache	State	Health
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.			

Table 22 VNX Block alerts (continued)

Resource type	Metric	Badge	Severity	Condition	Message summary
			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.
Storage Processor	Busy (%)	Risk	Warning	> 90	Storage processor utilization is high.
			Info	> 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.
			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.

Table 22 VNX Block alerts (continued)

Resource type	Metric	Badge	Severity	Condition	Message summary	
	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.	
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.	

Table 22 VNX Block alerts (continued)

Resource type	Metric	Badge	Severity	Condition	Message summary		
				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.		
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."		

Table 22 VNX Block alerts (continued)

Resource type	Metric	Badge	Severity	Condition	Message summary
			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

ESA provides the following notifications for the VNX Block resources listed in the table in this section.

Table 23 VNX Block notifications

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

Table 23 VNX Block notifications (continued)

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



Table 23 VNX Block notifications (continued)

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

## VNX File alerts

ESA provides alerts for File Pool, Disk Volume, File System, and Data Mover resources for VNX File.

Table 24 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 ( $\mu$ s)	Risk	Critical	> 25,000	dVol's average request completion time is high.
			Immediate	> 15,000	
			Warning	> 10,000	
	Service Comp. Time ( $\mu$ s)	Risk	Critical	> 25,000	
			Immediate	> 15,000	
			Warning	> 10,000	
File System	Full (%)	Risk	Critical	> 90	Capacity consumed of this file system is high.

Table 24 VNX File alerts (continued)

Resource kind	Metric	Badge	Severity	Condition	Message summary
			Immediate	> 85	
		Efficiency	Info	< 5	
Data Mover	NFS v2 Read Response (ms)	Risk	Critical	> 75	NFS v2 average read response time is high.
			Immediate	> 50	
			Warning	> 25	
	NFS v2 Write Response (ms)	Risk	Critical	> 75	NFS v2 Average write response time is high.
			Immediate	> 50	
			Warning	> 25	
	NFS v3 Read Response (ms)	Risk	Critical	> 75	NFS v3 average read response time is high.
			Immediate	> 50	
			Warning	> 25	
	NFS v3 Write Response (ms)	Risk	Critical	> 75	NFS v3 average write response time is high.
			Immediate	> 50	
			Warning	> 25	
	NFS v4 Read Response (ms)	Risk	Critical	> 75	NFS v4 average read response time is high.
			Immediate	> 50	
			Warning	> 25	
	NFS v4 Write Response (ms)	Risk	Critical	> 75	NFS v4 average write response time is high.
			Immediate	> 50	
			Warning	> 25	
	CIFS SMBv1 Read Response (ms)	Risk	Critical	> 75	CIFS SMB v1 average read response time is high.
			Immediate	> 50	
			Warning	> 25	
	CIFS SMBv1 Write Response (ms)	Risk	Critical	> 75	CIFS SMB v1 average write response time is high.
			Immediate	> 50	
			Warning	> 25	

Table 24 VNX File alerts (continued)

Resource kind	Metric	Badge	Severity	Condition	Message summary
	CIFS SMBv2 Read Response (ms)	Risk	Critical	> 75	CIFS SMB v2 average read response time is high.
			Immediate	> 50	
			Warning	> 25	
	CIFS SMBv2 Write Response (ms)	Risk	Critical	> 75	CIFS SMB v2 average write response time 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.			
	Hardware misconfigured	Data Mover hardware is misconfigured.			

Table 24 VNX File alerts (continued)

Resource kind	Metric	Badge	Severity	Condition	Message summary
				Hardware error	Data Mover hardware has error.
				Firmware error	Data Mover firmware has error.
					Data Mover firmware is updating.

## VNX File notifications

ESA provides notifications for the VNX File resources listed in the table in this section.

Table 25 VNX File notifications

Category	Resource type	Message
Control Station Events	Array	The NAS Command Service daemon is shutting down abnormally. (MessageID:ID)
		The NAS Command Service daemon is shutting down abnormally. (MessageID:ID)
		The NAS Command Service daemon is shut down completely.
		The NAS Command Service daemon is forced to shut down. (MessageID:ID)
	Data Mover	Warm reboot is about to start on this data mover.
		Unable to warm reboot this data mover. Cold reboot has been performed.
	EMC Adapter instance	AC power has been lost. VNX storage system will be powered down in <i>timeout_wait</i> seconds. (MessageID:ID)
		AC power is restored and back on.
	File system	Automatic extension failed. Reason: Internal error. COMMAND:COMMAND, ERROR:DM_EVENT_STAMP, STAMP:ERROR (MessageID:ID)
		Automatic extension started.
		Automatic extension failed. Reason: File system has reached the maximum size. STAMP:DM_EVENT_STAMP (MessageID: ID)
		Automatic extension failed. Reason: Percentage used could not be determined. STAMP:DM_EVENT_STAMP (MessageID:ID)

Table 25 VNX File notifications (continued)

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

Table 25 VNX File notifications (continued)

Category	Resource type	Message
		Automatic extension failed. Reason: Storage system ID could not be determined. STAMP:DM_EVENT_STAMP(MessageID:ID)
		Automatic extension failed. Reason: Filesystem is spread across multiple storage systems. STAMP:DM_EVENT_STAMP(MessageID:ID)
		Automatic extension failed. STAMP:DM_EVENT_STAMP(MessageID: ID)
	EMC Adapter instance	The JServer is not able to start. VNX File System statistics will be impacted. (MessageID:ID)
	File system	Filesystem is using <i>condition</i> of its <i>cap_setting prop_name</i> capacity.
		Filesystem has <i>condition</i> of its <i>cap_setting prop_name</i> capacity available.
	File pool	Storage pool is using <i>condition</i> of its value <i>cap_setting</i> capacity
		Storage pool has <i>condition</i> of its <i>cap_setting</i> capacity available.
	File system	Filesystem is using <i>condition</i> of the maximum allowable file system size (16 TB).
		Filesystem has <i>condition</i> of the maximum allowable file system size (16 TB).
		Filesystem is using <i>condition</i> of the maximum storage pool capacity available.
		Filesystem has <i>condition</i> of the maximum storage pool capacity available.
		Filesystem will fill its value <i>cap_setting</i> capacity on <i>sdate</i> .
	File pool	Storage pool will fill its <i>cap_setting</i> capacity on <i>sdate</i> .
	File system	Filesystem will reach the 16 TB file system size limit on <i>sdate</i> .
		Filesystem will fill its storage pool's maximum capacity on <i>sdate</i> .
	Data Mover	Data Mover is using <i>stat_value</i> of its <i>stat_name</i> capacity.
	File pool	Storage usage has crossed threshold value <i>threshold</i> and has reached to <i>pool_usage_percentage</i> .

Table 25 VNX File notifications (continued)

Category	Resource type	Message
		Storage usage has crossed threshold <i>threshold</i> <i>pool_usage_percentag</i> and has reached <i>tovalue</i> .
	File system	Filesystem has filled its <i>cap_setting prop_name</i> capacity.
	File pool	Storage pool has filled its <i>cap_setting</i> capacity.
	File system	Filesystem has almost filled its <i>cap_setting prop_name</i> capacity.
	File pool	Storage pool has almost filled its <i>cap_setting</i> capacity.
	File system	Filesystem is using <i>condition</i> of its current node capacity.
Dart Events	Data Mover	The SCSI HBA <i>hbano</i> is operating normally.
		The SCSI HBA <i>hbano</i> has failed. (MessageID: <i>ID</i> )
		The SCSI HBA <i>hbano</i> is inaccessible. (MessageID: <i>ID</i> )
	File system	Filesystem has encountered a critical fault and is being unmounted internally. (MessageID: <i>ID</i> )
		Filesystem has encountered a corrupted metadata and filesystem operation is being fenced. (MessageID: <i>ID</i> )
		Filesystem usage rate <i>currentUsage%</i> crossed the high water mark threshold <i>usageHWM%</i> . Its size will be automatically extended.
		Filesystem is full.
	EMC Adapter instance	Power Supply A in Data Mover Enclosure was removed.
		Power Supply A in Data Mover Enclosure is OK.
		Power Supply A in Data Mover Enclosure failed: <i>details</i> (MessageID: <i>ID</i> )
		Power Supply B in Data Mover Enclosure was installed.
		Power Supply B in Data Mover Enclosure was removed.
		Power Supply B in Data Mover Enclosure is OK.
		Power Supply B in Data Mover Enclosure failed: <i>details</i> (MessageID: <i>ID</i> )
		One or more fans in Fan Module 1 in Data Mover Enclosure failed. (MessageID: <i>ID</i> )
One or more fans in Fan Module 2 in Data Mover Enclosure failed. (MessageID: <i>ID</i> )		
One or more fans in Fan Module 3 in Data Mover Enclosure failed. (MessageID: <i>ID</i> )		

**Table 25** VNX File notifications (continued)

Category	Resource type	Message
		Multiple fans in Data Mover Enclosure failed. (MessageID:ID)
		All Fan Modules in Data Mover Enclosure are in OK status.
		Power Supply A in Data Mover Enclosure is going to shut down due to overheating. (MessageID:ID)
		Power Supply B in Data Mover Enclosure is going to shut down due to overheating. (MessageID:ID)
		Both Power Supplies in Data Mover Enclosure are going to shut down due to overheating. (MessageID:ID)
		Power Supply A in Data Mover Enclosure was installed.
	Data Mover	DNS server <i>serverAddr</i> is not responding. Reason: <i>reason</i> (MessageID:ID)
		Network device <i>deviceName</i> is down. (MessageID:ID)
	File system	Automatic fsck is started via Data Mover <i>DATA_MOVER_NAME</i> . Filesystem may be corrupted. (MessageID:ID)
		Manual fsck is started via Data Mover <i>DATA_MOVER_NAME</i> .
		Automatic fsck succeeded via Data mover <i>DATA_MOVER_NAME</i> .
		Manual fsck succeeded via Data mover <i>DATA_MOVER_NAME</i> .
		Automatic fsck failed via Data mover <i>DATA_MOVER_NAME</i> .
		Manual fsck failed via Data mover <i>DATA_MOVER_NAME</i> .

## VPLEX alerts

ESA provides alerts for the following VPLEX resources: Cluster, FC Port, Ethernet, Local Device, Storage View, Storage Volume, Virtual Volume, VPLEX Metro, Distributed Device, Engine, Director, and Extent.

**Table 26** VPLEX alerts

Resource kind	Message	Badge	Recommendation	Severity	Condition
Cluster	VPLEX cluster is having a problem.	Health	Check the health state of your VPLEX cluster. Ignore this alert if the health state is expected.	Critical	VPLEX cluster health state is "major-failure."
					VPLEX cluster health state is "critical-failure."
				Immediate	VPLEX cluster health state is "unknown."



Table 26 VPLEX alerts (continued)

Resource kind	Message	Badge	Recommendation	Severity	Condition
				Warning	VPLEX cluster health state is "minor-failure."
					VPLEX cluster health state is "degraded."
FC Port	FC port is having a problem.	Health	Check the operational status of your FC port. Ignore this alert if the operational status is expected.	Critical	FC port operational status is "error."
					FC port operational status is "lost-communication."
				Immediate	FC port operational status is "unknown."
				Warning	FC port operational status is "degraded."
FC port operational status is "stopped."					
Ethernet Port	Ethernet port is having a problem.	Health	Check the operational status of your Ethernet port. Ignore this alert if the operational status is expected.	Critical	Ethernet port operational status is "error."
					Ethernet port operational status is "lost-communication."
				Immediate	Ethernet port operational status is "unknown."
				Warning	Ethernet port operational status is "degraded."
Ethernet port operational status is "stopped."					
Local Device	Local device is having a problem.	Health	Check the health state of your local device. Ignore this alert if the health state is expected.	Critical	Local device health state is "major-failure."
					Local device health state is "critical-failure."
				Immediate	Local device health state is "unknown."
				Warning	Local device health state is "minor-failure."
Local device health state is "degraded."					
Storage View	Storage view is having a problem.	Health	Check the operational status of your storage view. Ignore this alert if the operational status is expected.	Critical	Storage view operational status is "error."
				Warning	Storage view operational status is "degraded."
					Storage view operational status is "stopped."

Table 26 VPLEX alerts (continued)

Resource kind	Message	Badge	Recommendation	Severity	Condition
Storage Volume	Storage volume is having a problem.	Health	Check the health state of your storage volume. Ignore this alert if the health state is expected.	Critical	Storage volume health state is "critical-failure."
				Immediate	Storage volume health state is "unknown."
				Warning	Storage volume health state is "non-recoverable-error."
					Storage volume health state is "degraded."
Virtual Volume	Virtual volume is having a problem.	Health	Check the health state of your virtual volume. Ignore this alert if the health state is expected.	Critical	Virtual volume health state is "critical-failure."
					Virtual volume health state is "major-failure."
				Immediate	Virtual volume health state is "unknown."
				Warning	Virtual volume health state is "minor-failure."
Virtual volume health state is "degraded."					
VPLEX Metro	VPLEX metro is having a problem.	Health	Check the health state of your VPLEX metro. Ignore this alert if the health state is expected.	Critical	VPLEX metro health state is "critical-failure."
					VPLEX metro health state is "major-failure."
				Immediate	VPLEX metro health state is "unknown."
				Warning	VPLEX metro health state is "minor-failure."
VPLEX metro health state is "degraded."					
Distributed Device	Distributed device is having a problem.	Health	Check the health state of your distributed device. Ignore this alert if the health state is expected.	Critical	Distributed device health state is "critical-failure."
					Distributed device health state is "major-failure."
				Immediate	Distributed device health state is "unknown."
				Warning	Distributed device health state is "minor-failure."
Distributed device health state is "non-recoverable-error."					
Distributed device health state is "degraded."					

Table 26 VPLEX alerts (continued)

Resource kind	Message	Badge	Recommendation	Severity	Condition
Engine	Engine is having a problem.	Health	Check the operational status of your engine. Ignore this alert if the health state is expected.	Critical	Engine operational status is "error."
					Engine operational status is "lost-communication."
				Immediate	Engine operational status is "unknown."
				Warning	Engine operational status is "degraded."
Director	Director is having a problem.	Health	Check the operational status of your director. Ignore this alert if the health state is expected.	Critical	Director operational status is "critical-failure."
					Director operational status is "major-failure."
				Immediate	Director operational status is "unknown."
				Warning	Director operational status is "minor-failure."
Director operational status is "degraded."					
Extent	Extent is having a problem.	Health	Check the health state of your extent. Ignore this alert if the health state is expected.	Critical	Extent health state is "critical-failure."
					Immediate
				Warning	Extent health state is "non-recoverable-error."
					Extent health state is "degraded."

## XtremIO alerts

ESA provides alerts for XtremIO Cluster, Storage Controller, and Disk Array Enclosure (DAE) resources and alerts based on metrics for Cluster SSD, Volume, and Snapshot. The Wait Cycle is 1 for all these XtremIO alerts.

Table 27 XtremIO alerts based on external events

Resource kind	Message	Badge	Recommendation	Severity	Condition
Cluster	XtremIO cluster is having a problem.	Health	Check the state of your XtremIO cluster. Ignore this alert if the state is expected.	Critical	XtremIO cluster health state is "failed."
				Warning	XtremIO cluster health state is "degraded."

**Table 27** XtremIO alerts based on external events (continued)

Resource kind	Message	Badge	Recommendation	Severity	Condition
					XtremIO cluster health state is "partial fault."
Storage Controller	Storage controller is having problem.	Health	Check the state of your storage controller. Ignore this alert if the state is expected.	Critical	Storage controller health state is "failed."
				Warning	Storage controller health state is "degraded."
					Storage controller health state is "partial fault."
DAE	XtremIO DAE is having a problem.	Health	Check the health state of the DAE	Warning	DAE health state is "minor failure."
				Immediate	DAE health state is "major failure."
				Critical	DAE health state is "critical failure."
				Warning	DAE health state is "initializing."
				Warning	DAE health state is "uninitialized."
				Critical	DAE health state is "failed."
				Critical	DAE health state is "disconnected."

**Table 28** XtremIO alerts based on metrics

Resource kind	Message	Badge	Severity	Condition	Recommendation
Cluster SSD	Consumed Capacity Ratio (%) is high.	Health	Warning	Consumed Capacity Ratio (%) $\geq$ 60	1. Free capacity from cluster 2. Extend capacity of cluster
	Subscription Ratio is high.			Subscription Ratio $\geq$ 5	1. Unsubscribe capacity from cluster 2. Extend capacity of cluster
	Physical capacity used in the cluster is high.	Risk		Consumed capacity $\geq$ 90%	Migrate the volume to another cluster.
	Physical capacity used in the cluster is low.	Efficiency		Consumed capacity $\leq$ 5%	Cluster is not fully utilized. Possible waste.

**Table 28** XtremIO alerts based on metrics (continued)

Resource kind	Message	Badge	Severity	Condition	Recommendation
	Endurance Remaining (%) is low.	Health		Endurance Remaining (%) <= 10	Replace SSD
Volume	Average Small Reads (IO/s) is out of normal range.*	Health	Warning	Average Small Read Ratio >= 20	Check the status of the volume.
	Average Small Writes (IO/s) is out of normal range.*			Average Small Write Ratio >= 20	Check the status of the volume.
	Average Unaligned Reads (IO/s) is out of normal range.*			Average Unaligned Read Ratio >= 20	Check the status of the volume.
	Average Unaligned Writes (IO/s) is out of normal range.*			Average Unaligned Write Ratio >= 20	Check the status of the volume.
	Capacity used in the volume is high.	Risk		Consumed capacity >= 90%	Extend the capacity of the volume.
	Capacity used in the volume is low.	Efficiency		Consumed capacity <= 5%	Volume is not fully utilized. Possible waste.
Snapshot	Average Small Reads (IO/s) is out of normal range.*	Health	Warning	Average Small Read Ratio >= 20	Check the status of the snapshot.
	Average Small Writes (IO/s) is out of normal range.*			Average Small Write Ratio >= 20	Check the status of the snapshot.
	Average Unaligned Reads (IO/s) is out of normal range.*			Average Unaligned Read Ratio >= 20	Check the status of the snapshot.

**Table 28** XtremIO alerts based on metrics (continued)

Resource kind	Message	Badge	Severity	Condition	Recommendation
	Average Unaligned Writes (IO/s) is out of normal range.*			Average Unaligned Write Ratio >= 20	Check the status of the snapshot.

\* Alerts for these metrics are disabled by default to align with the XMS defaults. You can enable them using the procedure in [Enabling XtremIO alert settings](#).

# APPENDIX B

## Dashboards and Metric Tolerances

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## EMC Avamar Overview dashboard

This dashboard displays heat maps for Client and Policy and scoreboards for DPN and DDR.

The following tables describe the dashboard items available for EMC Avamar.

**Table 29** Avamar heat maps

Heat map	Metric
Client	Last changed (GB)
	Unintentionally Skipped Files
	Last Backup Date
	Last Backup Status
	Last Elapsed Time
	Overhead (GB)
Policy	Policy Client Count
	DDR Used Capacity

**Table 30** Avamar scoreboards

Metric group	Scoreboard	Metric	Yellow	Orange	Red
DPN	Status	State Active Sessions (count) HFS Address License Expiration Scheduler Enabled			
	Capacity Data	Used Capacity (%) Protected Capacity (%) Total Capacity (GB)	70	80	90
	Success History (24 hrs)	Backup failures (Count)	1	2	3
		Restore failures (Count)	1	2	3
	Garbage Collection	Status Result Passes (Count) End Time Recovered (GB) Chunks Deleted (Count)			
Performance History (24hrs)	Average Files Changed (Count) Average Files Unintentionally Skipped (Count) Average Overhead (GB)				



**Table 30** Avamar scoreboards (continued)

Metric group	Scoreboard	Metric	Yellow	Orange	Red
DDR	Status	File System Status Monitoring Status Default Replication Storage System			
	Capacity Data	Used Capacity (%) Protected Capacity (%) Total Capacity (GB)	70	80	90

## Isilon Overview dashboard

The Isilon dashboard displays scoreboards for the resources listed in this section.

For each scoreboard and selected metric, the configured Isilon adapter is shown.

**Table 31** Isilon Overview dashboard

Scoreboard	Green	Yellow	Red
CPU Performance (% used)	0% in use		100% in use
Overall Cache Hit Rate			
Remaining Capacity (%)	> 20% available	10 – 20% available	0 – 10% available
Disk Operations Latency	0–20 ms	20 – 50 ms	> 50 ms
Number of Active Clients	0		1,500

## Top-N Isilon Nodes dashboard

By default, the Top-N Isilon Nodes dashboard shows the top 10 devices in these categories across your Isilon system.

- Top-10 Active Nodes (24h) by number of active clients
- Top-10 CPU % Usage
- Top-10 Disk Throughput Rate In by Write (MB/s)
- Top-10 Disk Throughput Rate Out by Read (MB/s)
- Top-10 Overall Cache Hit Rate (24 hr) (Bytes/s)
- Top-10 L1 Cache Hit Rate (24 hr) (MB/s)
- Top-10 L2 Cache Hit Rate (24 hr) (MB/s)
- Top-10 L3 Cache Hit Rate (24 hr) (MB/s)

## RecoverPoint for VMs Overview dashboard

The table in this section describes the dashboard items available for RecoverPoint for Virtual Machines.

**Table 32** RecoverPoint for VMs Overview dashboard

Heat map	Metric	Yellow	Orange	Red
RecoverPoint for VMs System	Number of RecoverPoint clusters	n/a		
	Number of splitters (version 5.0)	48	54	60
	Number of splitters (version 4.3.1)	24	27	30
RecoverPoint Cluster	Number of consistency groups	96	109	122
	Number of protected Virtual Machine Disks (VMDKs)	1536	1741	1946
	Number of protected virtual machines for each RecoverPoint system	384	435	486
	Number of virtual RecoverPoint Appliances (vRPAs) for each cluster (version 5.0)	8	1	n/a
	Number of virtual RecoverPoint Appliances (vRPAs) for each cluster (version 4.3.1)	8	n/a	1
Consistency Group	Displays all RecoverPoint for Virtual Machines consistency groups	Enabled	Disabled	Unknown
Splitter	Number of vSphere ESX Clusters connected to a given splitters	n/a		
	Number of attached volumes	1536	1741	1946

## RecoverPoint for VMs Performance dashboard

The RecoverPoint for VMs 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).

**Table 33** RecoverPoint for VMs Performance dashboard

Heat map	Description	Yellow	Orange	Red
Link   Lag (%)	Percent of the current lag for the link and for protection		90%	100%
Consistency Group   Protection Window	<p><b>Current Protection Window (Hrs)</b> shows the earliest point in hours for which RecoverPoint can roll back the consistency group's replica copy.</p> <p><b>Current Protection Window Ratio</b> shows the ratio of the current protection window compared with the required protection window for the Consistency Group.</p>			

**Table 33** RecoverPoint for VMs Performance dashboard (continued)

Heat map	Description	Yellow	Orange	Red
vRPA   CPU Utilization (%)	Percent utilization of virtual RecoverPoint Appliance (vRPA) CPUs	75%	85%	95%
Cluster	Performance for incoming writes (IOPS and MB/s) to clusters			
Consistency Group	Performance for incoming writes (IOPS and MB/s) to consistency groups			
vRPA	Performance for incoming writes (IOPS and MB/s) to vRPAs	75%	85%	95%

## Top-N RecoverPoint for VMs Objects dashboard

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

- Top-10 vRPAs by Incoming Writes (IO/s) (24h)
- Top-10 vRPAs by Incoming Writes (KB/s) (24h)
- Top-10 Clusters by Incoming Writes (IO/s) (24h)
- Top-10 Clusters by Incoming Writes (KB/s) (24h)
- Top-10 Consistency Groups by Incoming Writes (IO/s) (24h)
- Top-10 Consistency Groups by Incoming Writes (KB/s) (24h)

## ScaleIO Overview dashboard

The ScaleIO dashboard displays the heat maps listed in this section.

For each heat map and selected metric, the configured ScaleIO adapter is shown.

**Table 34** ScaleIO heat maps for System, Storage Pool, and Device

Heat map	Description	Green	Yellow	Red
System	Displays the In Use Capacity metric	0 GB allocated	500 GB allocated	1000 GB allocated
Storage Pool	Displays the In Use Capacity metric for each ScaleIO Storage Pool grouped by ScaleIO System	0 GB allocated	500 GB allocated	1000 GB allocated
Device	Displays the In Use Capacity metric for each ScaleIO Device grouped by ScaleIO System and SDS associated with	0 GB allocated	500 GB allocated	1000 GB allocated

**Table 35** ScaleIO heat maps for Protection Domain, SDS, and Fault Set

Heat map	Description	Light blue	Dark blue
Protection Domain	Displays the In Use Capacity metric for each ScaleIO Protection Domain grouped by ScaleIO System	0 GB allocated	>=1000 GB allocated
SDS	Displays the In Use Capacity metric for each SDS grouped by ScaleIO System and Protection Domain	0 GB allocated	>=1000 GB allocated

**Table 35** ScaleIO heat maps for Protection Domain, SDS, and Fault Set (continued)

Heat map	Description	Light blue	Dark blue
Fault Set	Displays the In Health% metric for each Fault Set	0%	100%

## Unity Overview dashboard

The Unity Overview dashboard displays heat maps for Unity, UnityVSA, and VNXe.

**Table 36** Unity Overview dashboard

Heat map	Metric	Green	Red
CPU Performance	Storage Processor Utilization	0% busy	100% busy
Pool capacity	Storage Pool Capacity Utilization	0% full	100% full
	Storage Pool Available Capacity	Largest available capacity	0 GB available
LUN, File System, and VVol Performance	LUN Read IOPS	Dark green = highest Light green = lowest	n/a
	LUN Write IOPS		
	LUN Read Bandwidth		
	LUN Write Bandwidth		
	LUN Total Latency		
	File System Read IOPS		
	File System Write IOPS		
	File System Read Bandwidth		
	File System Write Bandwidth		
	VVol Read IOPS		
	VVol Write IOPS		
	VVol Read Bandwidth		
	VVol Write Bandwidth		
	VVol Total Latency		

## Top-N Unity LUNs, File Systems and VVols dashboard

By default, the Top-N Unity LUNs, File Systems and VVols dashboard shows the top ten devices in these categories across your Unity systems.

### Unity LUNs

- 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 Consumed Capacity

**Unity File System**

Top-10 by Consumed Capacity

**Unity VVols**

- Total Latency (ms)
- 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 Consumed Capacity (GB)

## VMAX Overview dashboard

The table in this section describes the heat maps displayed on the VMAX Overview tab.

### Note

Latency scales are based on average customer requirements. If they do not meet your particular requirements for latency, EMC recommends that you adjust the scale appropriately.

**Table 37** VMAX Overview dashboard

Heat map	Metric	Description	Green	Yellow	Red
Storage Resource Pool Capacity	Total Managed Space (GB)		Dark blue = highest		
	Used Capacity (GB)		Light blue = lowest		
	Full (%)		0	50	100
Storage Group Capacity	Total Capacity (GB)		Dark blue = highest		
	Used Capacity (GB)		Light blue = lowest		
Storage Group Performance	Total Reads (IO/s)	Aggregate reads for all LUNs in the storage group	Dark blue = highest		
	Total Writes (IO/s)	Aggregate writes for all LUNs in the storage group	Light blue = lowest		
	Read Latency (ms)	Average read latency of all LUNs in the storage group	0 ms	20 ms	40 ms
	Write Latency (ms)	Average write latency of all LUNs in the storage group	0 ms	20 ms	40 ms
	Hit (%)		100	50	0
	Miss (%)		0	50	100
Storage Resource Pool Performance	Total Reads (IO/s)		Dark blue = highest		
	Total Writes (IO/s)		Light blue = lowest		
	Total Latency (ms)		0 ms	20 ms	40 ms
Front End Director Performance	Total Bandwidth (MB/s)	Cumulative amount of data transferred over all ports of the front-end director	Dark blue = highest		
	Total Operations (IO/s)	Total number of operations taking place over all ports of a front-end director	Light blue = lowest		
	Busy (%)		0	50	100
Back End Director Performance	Total Bandwidth (MB/s)	Cumulative amount of data transferred over all ports of the back-end director	Dark blue = highest		
	Busy (%)		0	50	100

**Table 37** VMAX Overview dashboard (continued)

Heat map	Metric	Description	Green	Yellow	Red
	Read (IO/s)		Dark blue = highest		
	Write (IO/s)		Light blue = lowest		
SRDF Director Performance	Total Bandwidth (MB/s)	Cumulative amount of data transferred over an SRDF director	Dark blue = highest		
	Total Writes (IO/s)	Total number of writes over an SRDF director	Light blue = lowest		
VVol Storage Container Capacity	Subscribed Free (GB)		Dark blue = highest		
	Subscribed Limit (GB)		Light blue = lowest		
	Subscribed Used (GB)				
VVol Storage Resource Capacity	Subscribed Free (GB)		Dark blue = highest		
	Subscribed Limit (GB)		Light blue = lowest		
	Subscribed Used (GB)				

## Top-N VNX File Systems dashboard

By default, the Top-N VNX File Systems dashboard shows the top ten devices in these categories across your VNX File 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 Consumed Capacity

## Top-N VNX LUNs dashboard

By default, the Top-N VNX LUNs dashboard shows the top ten devices in these categories across your VNX system.

- Total Latency (ms)
- 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 Consumed Capacity (GB)

## VNX Overview dashboard

The VNX Overview dashboard displays the heat maps listed in this section.

**Table 38** VNX Overview dashboard

Heat map	Metric	Description	Green	Red
CPU performance		The CPU utilization of each Storage Processor and Data Mover on each configured adapter instance	0% busy	100% busy
FAST cache performance	Read Cache Hit Ratio (%)	Number of FAST Cache read hits divided by the total number of read or write I/Os across all RG LUNs and Pools configured to use FAST Cache	High ratio	Low ratio
	Write Cache Hit Ratio (%)	Number of FAST Cache write hits divided by the total number of read or write I/Os across all RG LUNs and Pools configured to use FAST Cache	High ratio	Low ratio
Pool capacity	RAID Group Available Capacity		Largest available capacity	0 GB available
	Storage Pool Capacity Utilization		0% full	100% full
	Storage Pool Available Capacity		Largest available capacity	0 GB available
	File Pool Available Capacity		Largest available capacity	0 GB available
LUN and file system performance	LUN Utilization (%)	Percentage busy for all LUNs grouped by adapter instance	0% busy	100% busy
	LUN Latency (ms)	Latency values appear for RAID Group LUNs. Pool LUNS appear in white with no latency values reported.	0 ms latency	>= 20 ms latency
	LUN Read IO/s	Relative number of read I/O operations per second serviced by the LUN	Dark green = highest Light green = lowest	
	LUN Write IO/s	Relative number of write I/O operations per second serviced by the LUN	Dark green = highest Light green = lowest	
	File System Read IO/s	Relative number of read I/O operations per second serviced by the file system	Dark green = highest Light green = lowest	
	File System Write IO/s	Relative number of write I/O operations per second serviced by the file system	Dark green = highest Light green = lowest	



## 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 (0–15 ms) 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).

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### Note

Latency scales are based on average customer requirements. If they do not meet your particular requirements for latency, EMC recommends that you adjust the scale appropriately. For VPLEX Metro, EMC recommends adjusting the scale based on your discovered WAN round-trip time.

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**Table 39** VPLEX Communication dashboard

Heat map	Metric	Description	Green	Red
Cluster-1 COM Latency	Average Latency (ms)	Intra-cluster local COM latency, which occurs within the rack and is typically fast (less than 1 msec)	0 ms	15 ms
Cluster-2 COM Latency				
WAN Link Usage (VPLEX Metro only)	Distributed Device Bytes Received (MB/s)	Total amount of traffic received for all distributed devices on a director	Light blue = lowest Dark blue = highest	
	Distributed Device Bytes Sent (MB/s)	Total amount of traffic sent for all distributed devices on a director		
	Distributed Device Rebuild Bytes Received (MB/s)	Total amount of rebuild/migration traffic received for all distributed devices on a director		
	Distributed Device Rebuild Bytes Sent (MB/s)	Total amount of rebuild/migration traffic sent for all distributed devices on a director		

## VPLEX Overview dashboard

The EMC VPLEX Overview dashboard displays the widgets listed in this section.

### 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 in the table show green (good). Because vRealize Operations Manager expects numeric values, you cannot modify these widgets.

**Table 40** VPLEX Overview dashboard

Widget	Description	Green	Yellow	Orange	Red
CPU Health	<p>Displays the CPU usage, as a percentage, for each director on the VPLEX system</p> <hr/> <p><b>Note</b></p> <p>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.</p> <hr/>	0–75% usage	75–85% usage	85–95% usage	95–100% usage
Cluster Health	Health State	Normal	Degraded	Major failure	Critical failure
	Operational Status	Normal	Degraded	Major failure	Critical failure
Memory Health	Displays the memory usage, as a percentage, of each director on the VPLEX system	0–70% usage	70–80% usage	80–90% usage	90–100% usage
Director Health	Operational Status	Normal	Degraded	Major failure	Critical failure
Extent Health					
Storage Volume Health					

## 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 Performance dashboard displays two types of heat maps:

- Metrics with definitive measurements such as CPU usage (0–100%), response time latency (0–15 ms), or errors (0–5) 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).

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### Note

Latency scales are based on average customer requirements. If they do not meet your particular requirements for latency, EMC recommends that you adjust the scale appropriately.

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**Table 41** VPLEX Performance dashboard

Heatmap	Metric	Description	Metric value
Front-end Bandwidth	Reads (MB/s)	Total reads for the storage volumes across the front-end ports on a director	Light blue = lowest Dark blue = highest
	Writes (MB/s)	Total writes for the storage volumes across the front-end ports on a director	
	Active Operations (Counts/s)	Number of active, outstanding I/O operations on the director's front-end ports	
Back-end Bandwidth	Reads (MB/s)	Total reads for the storage volumes across the back-end ports on a director	
	Writes (MB/s)	Total writes for the storage volumes across the back-end ports on a director	
	Active Operations (Counts/s)	Number of I/O operations per second through the director's back-end ports	
Back-end Errors	Resets (count/s)	LUN resets sent by VPLEX to a storage array LUN when it does not respond to I/O operations for over 20 seconds	Green = 0 errors Red = 5 or more errors
	Timeouts (count/s)	An I/O from VPLEX to a storage array LUN takes longer than 10 seconds to complete	
	Aborts (count/s)	An I/O from VPLEX to a storage array LUN is cancelled in transit. Resets indicate more serious problems than timeouts and aborts	
Front-end Latency	Read Latency (ms)	Average read latency for all virtual volumes across all front-end ports on a director	Green = 0 ms Red = 15 ms
	Write Latency (ms)	Average write latency for all virtual volumes across all front-end ports on a director	

**Table 41** VPLEX Performance dashboard (continued)

Heatmap	Metric	Description	Metric value
		<p><b>Note</b></p> <p>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.</p>	
	Queued Operations (Counts/s)	Number of operations in the queue	
Virtual Volumes Latency	Read Latency (ms)	Average read latency for all virtual volumes on a director	Green = 0 ms Red = 15 ms
	Write Latency (ms)	Average write latency for all virtual volumes on a director	
	Total Reads & Writes (Counts/s)	Virtual volume total reads and writes per director	
Storage Volumes Latency	Read Latency (ms)	Average read latency for all storage volumes on a director	Green = 0 ms Red = 15 ms
	Write Latency (ms)	Average write latency for all storage volumes on a director	

## XtremIO Overview dashboard

The XtremIO Overview dashboard displays the heat maps listed in this section.

**Table 42** XtremIO Overview dashboard

Heatmap	Description	Green	Yellow	Orange	Red
Cluster Data Reduction	Deduplication Ratio	>= 3.0	< 3.0		
	Compression Ratio	>= 1.5	< 1.5		
	<p><b>Note</b></p> <p>Compression Ratio shows as blue if XtremIO version 2.4.1 is running.</p>				
	Data Reduction Ratio	>= 3.5	< 3.5		
Cluster Efficiency	Thin Provisioning Savings (%)				
	Total Efficiency				
Cluster Memory Usage	Total Memory In Use (%)	0 – 90	90 – 95	95 – 99	99 – 100
Volume	Total Capacity (GB)				
	Consumed Capacity (GB)				
Volume Capacity	Total Capacity (GB)				

**Table 42** XtremIO Overview dashboard (continued)

Heatmap	Description	Green	Yellow	Orange	Red
	Consumed Capacity (GB)				
Cluster	Total Physical Capacity (TB)				
	Total Logical Capacity (TB)				
	Available Physical Capacity (TB)				
	Available Logical Capacity (TB)				
	Consumed Physical Capacity (TB)				
	Consumed Logical Capacity (TB)				
Snapshot	Total Capacity (GB)				
	Consumed Capacity (GB)				
Snapshot Capacity	Total Capacity (GB)				
	Consumed Capacity (GB)				

## XtremIO Top-N dashboard

By default, the XtremIO Top-N dashboard shows the top 10 devices in these 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)

## 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).

**Table 43** XtremIO Performance dashboard

Heatmap	Metric	Notes
Storage Controllers	CPU 1 Utilization (%)	

**Table 43** XtremIO Performance dashboard (continued)

Heatmap	Metric	Notes
	CPU 2 Utilization (%)	
Volume	Total Operations	Select a volume from this widget to display spark lines for it.
	Total Bandwidth	
	Total Latency	
	Unaligned (%)	
	Average Block Size	
SSD	Endurance Remaining	Select an SSD from this widget to display sparklines for it
	Disk Utilization	

# APPENDIX C

## Metrics

This appendix includes the following topics:

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## Avamar metrics

EMC Storage Analytics provides Avamar metrics for DPN, DDR, Domain, Policy, and Client.

The following tables show the metrics available for each resource.

### Note

ESA does not monitor replication domain or client resources.

**Table 44** Avamar DPN metrics

Metric Group	Metric	Description
General	HFS Address (String)	(Hash File System address) The hostname or IP address that backup clients use to connect to this Avamar server
	License Expiration (String)	Calendar date on which this server's licensing expires
	Scheduler Enabled (String)	True or False
	Active Sessions (Count)	Number of active Avamar sessions
Status	State	<p>Status of the node. One of the following values:</p> <ul style="list-style-type: none"> <li>• <b>Online</b>—The node is functioning correctly.</li> <li>• <b>Read-Only</b>—This status occurs normally as background operations are performed and when backups have been suspended.</li> <li>• <b>Time-Out</b>—MCS could not communicate with this node.</li> <li>• <b>Unknown</b>—Node status cannot be determined.</li> <li>• <b>Offline</b>—The node has experienced a problem. If ConnectEMC has been enabled, a Service Request (SR) is logged. Go to EMC Online Support to view existing SRs. Search the knowledgebase for Avamar Data Node offline solution esg112792.</li> <li>• <b>Full Access</b>—Normal operational state for an Avamar server. All operations are allowed.</li> <li>• <b>Admin</b>—The Avamar server is in an administrative state in which the Avamar server and root user can read and write data; other users are only allowed to read data.</li> <li>• <b>Admin Only</b>—The Avamar server is in an administrative state in which the Avamar server or root user can read or write data; other users are not allowed access.</li> <li>• <b>Admin Read-Only</b>—The Avamar server is in an administrative read-only state in which the Avamar server or root user can read data; other users are not allowed access.</li> <li>• <b>Degraded</b>—The Avamar server has experienced a disk failure on one or more nodes. All operations are allowed, but immediate action should be taken to fix the problem.</li> <li>• <b>Inactive</b>—Avamar Administrator was unable to communicate with the Avamar server.</li> </ul>



Table 44 Avamar DPN metrics (continued)

Metric Group	Metric	Description
		<ul style="list-style-type: none"> <li>• <b>Node Offline</b>—One or more Avamar server nodes are in an OFFLINE state.</li> <li>• <b>Suspended</b>—Avamar Administrator was able to communicate with the Avamar server, but normal operations have been temporarily suspended.</li> <li>• <b>Synchronizing</b>—The Avamar server is in a transitional state. It is normal for the server to be in this state during startup and for short periods of time during maintenance operations.</li> </ul>
Garbage Collection	Status	<b>Idle</b> or <b>Processing</b>
	Result	<b>OK</b> or Error code
	Start Time	Time format is: "January 1, 1970, 00:00:00 GMT."
	End Time	Time format is: "January 1, 1970, 00:00:00 GMT."
	Passes	
	Recovered (GB)	
	Chunks Deleted	
	Index Stripes	
	Index Stripes Processed	
Capacity	Total Capacity (GB)	
	Used Capacity (GB)	
	Used Capacity (%)	This value is derived from the largest Disk Utilization value on the Avamar tab in the Server Monitor, and therefore represents the absolute maximum Avamar server storage utilization. Actual utilization across all modules, nodes, and drives might be slightly lower.
	Protected Capacity (GB)	
	Protected Capacity (%)	Percent of client data in proportion to total capacity that has been backed up (protected) on this server
	Free Capacity (GB)	
	Free Capacity (%)	
	Success history (Over Last 24 Hours)	Backup Failures (Count)
Backup Success (%)		
Backup Successes (Count)		
Restore Failures (Count)		
Restores Success (%)		
Restores Successes (Count)		
Performance History Averages	Backup Average Elapsed Time	

**Table 44** Avamar DPN metrics (continued)

<b>Metric Group</b>	<b>Metric</b>	<b>Description</b>
(Over Last 24 Hours)	Average Scanned (GB)	
	Average Changed (GB)	
	Average Files Changed (Count)	
	Average Files Skipped (Count)	
	Average Sent (GB)	
	Average Excluded (GB)	
	Average Skipped (GB)	
	Average Modified & Sent (GB)	
	Average Modified & Not Sent (GB)	
	Average Overhead (GB)	

**Table 45** Avamar DDR metrics

<b>Metric Group</b>	<b>Metric</b>	<b>Description</b>
Capacity	Total Capacity (GB)	
	Used Capacity (%)	
	Used Capacity (GB)	
	Free Capacity (GB)	
	Free Capacity (%)	
	Protected Capacity (GB)	
	Protected Capacity (%)	
General	Hostname	IP or FQDN of the DDR
	DDOS Version	Data Domain Operating System version
	Serial Number	Disk serial number
	Target for Avamar Checkpoint Backups	
	Model Number	
	Default replication storage system	
	Maximum Streams	The maximum number of Data Domain system streams that Avamar can use at any one time to perform backups and restores. This number

**Table 45** Avamar DDR metrics (continued)

Metric Group	Metric	Description
		is configured for the Data Domain system when you add the system to the Avamar configuration.
	Maximum Streams Limit	
	User Name	
	SNMP Community	
	SNMP Trap Port	
Status	File System Status	
	Monitoring Status	

**Table 46** Avamar Domain metrics

Metric group	Metric
General	Description
	Contact
	Directory
	Email
	Location
	Phone

**Table 47** Avamar Policy metrics

Metric group	Metric
General	Encryption Method
	Override Schedule
	Auto Proxy Mapping
	Client Count
	Enabled
	Domain
	Dataset
Schedule	Recurrence
	Days of Week
	Hours of Day
	Next Run Time
	Terminate Date
Retention	Name

**Table 47** Avamar Policy metrics (continued)

Metric group	Metric
	Expiration Date
	Duration

**Table 48** Avamar Client metrics

Metric group	Metric
General	Description
Latest operation	Start Time
	End Time
	Status
	Elapsed Time
	Type
	Description
	Expiration Time
	Retention Tag
	Size (GB)
	Scanned (GB)
	Changed (GB)
	Number
	Excluded (GB)
	Modified & Sent (GB)
	Modified & Not Sent (GB)
	Skipped (GB)
	Overhead (GB)
Files Changed (Count)	
Files Skipped (Count)	
Change Rate (%)	

## Isilon metrics

EMC Storage Analytics provides metrics for Isilon clusters and nodes.

### Note

Only the resource kinds with associated metrics are shown. Performance metrics that cannot be calculated are not displayed.

Table 49 Isilon Cluster metrics

Metric group	Metric	Description
Summary	Cluster Name	Name
	Share Count	Total count of SMB shares and NFS exports
	CPU % Use	Average CPU usage for all nodes in the monitored cluster
	Number of Total Jobs	Total number of active and inactive jobs on the cluster
	Number of Active Jobs	Total number of active jobs on the cluster
Capacity	Total Capacity (TB)	Total cluster capacity in terabytes
	Used Capacity (%)	Percent of total cluster capacity that has been used
	Remaining Capacity (TB)	Total unused cluster capacity in terabytes
	Remaining Capacity (%)	Total unused cluster capacity in percent
	User Data Including Protection (TB)	Amount of storage capacity that is occupied by user data and protection for that user data
	Snapshots Usage (TB)	Amount of data occupied by snapshots on the cluster
Deduplication	Deduplicated Data > Physical (GB)	Amount of data that has been deduplicated on the physical cluster
	Deduplicated Data > Logical (GB)	Amount of data that has been deduplicated on the logical cluster
	Space Saved > Physical (GB)	Amount of physical space that deduplication has saved on the cluster
	Space Saved > Logical (GB)	Amount of logical space that deduplication has saved on the cluster
Performance	Disk Operations Rate > Read Operations	Average rate at which the disks in the cluster are servicing data read change requests
	Disk Operations Rate > Write Operations	Average rate at which the disks in the cluster are servicing data write change requests
	Pending Disk Operations Latency (ms)	Average amount of time disk operations spend in the input output scheduler
	Disk Throughput Rate > Read Throughput (MB/s)	Total amount of data being read from the disks in the cluster
	Disk Throughput Rate > Write Throughput (MB/s)	Total amount of data being written to the disks in the cluster
Cache	L1 Cache Hits (MB/s)	Amount of requested data that was available from the L1 cache
	L2 Cache Hits (MB/s)	Amount of requested data that was available from the L2 cache
	L3 Cache Hits (MB/s)	Amount of requested data that was available from the L3 cache
	Overall Cache Hit Rate (MB/s)	Amount of data requests that returned hits
Quotas	Directory Total Soft Quota (GB)	Amount of total capacity allocated in all directory soft quotas

**Table 49** Isilon Cluster metrics (continued)

Metric group	Metric	Description
	Directory Total Hard Quota (GB)	Amount of total capacity allocated in all directory hard quotas
	Directory Total Hard Quota Subscribed (%)	Percent of total capacity allocated in all directory hard quotas
	Group Total Soft Quota (GB)	Amount of total capacity allocated in all group soft quotas
	Group Total Hard Quota (GB)	Amount of total capacity allocated in all group hard quotas
	Group Total Hard Quota Subscribed (%)	Percent of total capacity allocated in all group hard quotas
	User Total Soft Quota (GB)	Amount of total capacity allocated in all user soft quotas
	User Total Hard Quota (GB)	Amount of total capacity allocated in all user hard quotas
	User Total Hard Quota Subscribed (%)	Percent of total capacity allocated in all user hard quotas

**Note**

The [Isilon Quota Management white paper](#) provides details about Isilon Smart Quotas.

**Table 50** Isilon Node metrics

Metric group	Metric	Description
Summary	CPU % Use	Average percentage of the total available node CPU capacity used for this node
	Number of Active Clients	Number of unique client addresses generating protocol traffic on the monitored node
	Number of Connected Clients	Number of unique client addresses with established TCP connections to the node
	Number of Total Job Workers	Number of active and assigned workers on the node
Performance	Deadlock File System Event Rate	Number of file system deadlock events that the file system is processing per second
	Locked File System Event Rate	Number of file lock operations occurring in the file system per second
	Blocking File System Event Rate	Number of file blocking events occurring in the file system per second
	Average Operations Size (MB)	Average size of the operations or transfers that the disks in the node are servicing
	Contended File System Event Rate	Number of file contention events, such as lock contention or read/write contention, occurring in the file system per second
	File System Event Rate	Number of file system events, or operations, (such as read, write, lookup, or rename) that the file system is servicing per second

Table 50 Isilon Node metrics (continued)

Metric group	Metric	Description
	Disk Operations Rate > Read Operations	Average rate at which the disks in the node are servicing data read requests
	Disk Operations Rate > Write Operations	Average rate at which the disks in the node are servicing data write requests
	Average Pending Disk Operations Count	Average number of operations or transfers that are in the processing queue for each disk in the node
	Disk Throughput Rate > Read Operations	Total amount of data being read from the disks in the node
	Disk Throughput Rate > Write Operations	Total amount of data being written to the disks in the node
	Pending Disk Operation Latency (ms)	Average amount of time that disk operations spend in the input/output scheduler
	Disk Activity (%)	Average percentage of time that disks in the node spend performing operations instead of sitting idle
	Protocol Operations Rate	Total number of requests that were originated by clients for all file data access protocols
	Slow Disk Access Rate	Rate at which slow (long-latency) disk operations occur
External Network	External Network Errors > In	Number of incoming errors generated for the external network interfaces
	External Network Errors > Out	Number of outgoing errors generated for the external network interfaces
	External Network Packets Rate > In	Total number of packets that came in through the external network interfaces in the monitored node
	External Network Packets Rate > Out	Total number of packets that went out through the external network interfaces in the monitored node
	External Network Throughput Rate > In (MB/s)	Total amount of data that came in through the external network interfaces in the monitored node
	External Network Throughput Rate > Out (MB/s)	Total amount of data that went out through the external network interfaces in the monitored node
Cache	Average Cache Data Age	Average amount of time data has been in the cache
	L1 Data Prefetch Starts (Bytes/s)	Amount of data that was requested from the L1 prefetch
	L1 Data Prefetch Hits (Bytes/s)	Amount of requested data that was available in the L1 prefetch
	L1 Data Prefetch Misses (Bytes/s)	Amount of requested data that did not exist in the L1 prefetch
	L1 Cache Starts (Bytes/s)	Amount of data that was requested from the L1 cache
	L1 Cache Hits (Bytes/s)	Amount of requested data that was available in the L1 cache
	L1 Cache Misses (Bytes/s)	Amount of requested data that did not exist in the L1 cache
	L1 Cache Waits (Bytes/s)	Amount of requested data that existed in the L1 cache but was not available because the data was in use

**Table 50** Isilon Node metrics (continued)

Metric group	Metric	Description
	L2 Data Prefetch Starts (Bytes/s)	Amount of data that was requested from the L2 prefetch
	L2 Data Prefetch Hits (Bytes/s)	Amount of requested data that was available in the L2 prefetch
	L2 Data Prefetch Misses (Bytes/s)	Amount of requested data that did not exist in the L2 prefetch
	L2 Cache Starts (Bytes/s)	Amount of data that was requested from the L2 cache
	L2 Cache Hits (Bytes/s)	Amount of requested data that was available in the L2 cache
	L2 Cache Misses (Bytes/s)	Amount of requested data that did not exist in the L2 cache
	L2 Cache Waits (Bytes/s)	Amount of requested data that existed in the L2 cache but was not available because the data was in use
	L3 Cache Starts (Bytes/s)	The amount of data that was requested from the L3 cache
	L3 Cache Hits (Bytes/s)	Amount of requested data that was available in the L3 cache
	L3 Cache Misses (Bytes/s)	Amount of requested data that did not exist in the L3 cache
	L3 Cache Waits (Bytes/s)	Amount of requested data that existed in the L3 cache but was not available because the data was in use
	Overall Cache Hit Rate (Bytes/s)	Amount of data requests that returned hits
	Overall Cache Throughput Rate (Bytes/s)	Amount of data that was requested from cache

## ScaleIO metrics

EMC Storage Analytics provides ScaleIO metrics for System, Protection Domain, Device, SDS, Storage pool, Snapshot, MDM cluster, MDM, SDC, Fault Set, and Volume.

### Note

Only the resource kinds with associated metrics are shown. Most performance metrics with values of zero are not displayed.

The following table shows the metrics available for each resource kind.

**Table 51** ScaleIO metrics

Metric	System	Protection Domain	Device	SDS	Storage pool	Snapshot	MDM cluster	MDM	SDC	Fault Set	Volume
Maximum Capacity (GB)	X	X	X	X	X						
Used Capacity (GB)	X	X	X	X	X						



Table 51 ScaleIO metrics (continued)

Metric	System	Protection Domain	Device	SDS	Storage pool	Snapshot	MDM cluster	MDM	SDC	Fault Set	Volume
Spare Capacity Allocated (GB)	X	X	X	X	X						
Thin Used Capacity (GB)	X	X	X	X	X						
Thick Used Capacity (GB)	X	X	X	X	X						
Protected Capacity (GB)	X	X	X	X	X						
Snap Used Capacity (GB)	X	X	X	X	X						
Unused Capacity (GB)	X	X	X	X	X						
Used Capacity (%)	X	X	X	X	X						
Thin Used Capacity (%)	X	X	X	X	X						
Thick Used Capacity (%)	X	X	X	X	X						
Protected Capacity (%)	X	X	X	X	X						
Snap Used Capacity (%)	X	X	X	X	X						
Total Reads (MB/s)	X	X	X	X	X	X			X		X
Total Writes (MB/s)	X	X	X	X	X	X			X		X
Average Read IO size (MB)		X	X	X	X	X			X		X

**Table 51** ScaleIO metrics (continued)

Metric	System	Protection Domain	Device	SDS	Storage pool	Snapshot	MDM cluster	MDM	SDC	Fault Set	Volume
Average Write IO Size (MB)		X	X	X	X	X			X		X
Size (GB)						X					
Total Read IO/s						X			X		X
Total Write IO/s						X			X		X
MDM Mode (String)							X				
State (String)							X				
Name (String)								X		X	

## RecoverPoint for Virtual Machines metrics

EMC Storage Analytics provides RecoverPoint for Virtual Machines metrics for Cluster, Consistency Group, Copy, Journal Volume, Link, Virtual RecoverPoint Appliance (vRPA), RecoverPoint for Virtual Machines System, Replication Set, Repository Volume, Splitter, and User Volume.

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

**Table 52** RecoverPoint metrics for Cluster

Metric Group	Metric	Additional Information
Performance	Incoming Writes (IO/s)	Sum of incoming cluster writes from all child vRPAs
	Incoming Writes (MB/s)	Sum of incoming cluster throughput from all child vRPAs
Summary	Number of Consistency Groups	Sum of all child vRPA consistency groups
	Number of Protected VMDKs	Sum of user volumes that the cluster protects on all virtual machines, including replica virtual machines
	Number of Protected VMs	Sum of virtual machines, including replica virtual machines, that the cluster protects
	Number of vRPAs	Sum of all child vRPAs

**Table 53** RecoverPoint metrics for Consistency Group

Metric Group	Metric	Additional Information
Performance	Incoming Writes (IO/s)	Sum of incoming consistency group writes per second

**Table 53** RecoverPoint metrics for Consistency Group (continued)

Metric Group	Metric	Additional Information
	Incoming Writes (MB/s)	Sum of incoming consistency group writes throughput
Status	Enabled	Boolean value that indicates the consistency group is enabled
Protection	Current Protection Window (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

**Table 54** RecoverPoint metrics for Copy

Metric Group	Metric	Additional Information
Protection	Current Protection Window (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

**Table 55** RecoverPoint metrics for Journal Volume

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

**Table 56** RecoverPoint metrics for Link

Metric Group	Metric	Additional Information
Configuration	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

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

Metric Group	Metric	Additional Information
Protection	Current Lag (%)	Exists only with consistency groups in asynchronous replication mode; indicates current lag ratio as compared with RPO

**Table 57** RecoverPoint metrics for virtual RecoverPoint Appliance (vRPA)

Metric Group	Metric	Additional Information
Performance	CPU Utilization (%)	CPU usage of vRPAs  <b>Note</b> 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 (IO/s)	Incoming application writes per second
	Incoming Writes (MB/s)	Incoming application writes for throughput
Summary	Summary	Number of consistency groups

**Table 58** RecoverPoint metrics for RecoverPoint for Virtual Machines System

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

**Table 59** RecoverPoint metrics for Replication Set

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

**Table 60** RecoverPoint metrics for Repository Volume

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

**Table 61** RecoverPoint metrics for Splitter

Metric Group	Metric	Additional Information
Summary	Number of Volumes Attached	Number of volumes attached to the splitter
	Number of ESX Clusters Connected	Number of clusters connecting to the splitter

**Table 62** 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

## Unity and UnityVSA metrics

EMC Storage Analytics provides Unity and UnityVSA metrics for Array, Disk, FAST Cache, File System, LUN, Storage Container, Storage Pool, Tier, VVol, and Virtual Disk, and Storage Processor. Only the resource kinds with associated metrics are shown.

### Unity and UnityVSA metrics for EMC Adapter Instance (array)

- Elapsed collect time (ms)
- New metrics in each collect call
- New resources in each collect call
- Number of down resources
- Number of metrics collected
- Number of resources collected

**Table 63** Unity and UnityVSA metrics for Disk, FAST Cache, File System, LUN, Storage Pool, Tier, VVol, Virtual Disk

Metric group	Metric	Disk	FAST Cache <sup>a</sup>	File System	LUN	Storage Container	Storage Pool	Tier	VVol	Virtual Disk <sup>b</sup>
Capacity	Size (GB)	X								X
	Available Capacity (GB)		X	X			X	X	X	
	Capacity/Total capacity (GB)			X	X	X			X	
	Consumed Capacity (GB)			X	X	X	X	X	X	
	Full (%)			X			X	X		
	Max Capacity (GB)									
	Thin Provisioning			X						
	Subscribed (%)						X			
	User Capacity (GB)						X	X		
	Compression Percent (%)					X				
	Compression Ratio					X				

**Table 63** Unity and UnityVSA metrics for Disk, FAST Cache, File System, LUN, Storage Pool, Tier, VVol, Virtual Disk (continued)

Metric group	Metric	Disk	FAST Cache <sup>a</sup>	File System	LUN	Storage Container	Storage Pool	Tier	VVol	Virtual Disk <sup>b</sup>
	Compression Size Saved (GB)				X					
Configuration	State	X								X
	RAID type		X					X		
	FAST Cache						X			
	Disk Count							X		
	Burst Frequency (hours)				X					
	Burst Rate %				X					
	Burst Time (minutes)				X					
	Description				X					
	Max MB/s				X					
	Max IO/s				X					
	Max MB/s per GB				X					
	Max IO/s per GB				X					
Performance	Busy (%)	X			X		X			
	Reads (IO/s)	X		X	X	X			X	
	Reads (MB/s)	X		X	X	X			X	
	Total Latency (ms)	X			X	X			X	
	Writes (IO/s)	X		X	X	X			X	
	Writes (MB/s)	X		X	X	X			X	
	Queue Length	X			X					
	Total (IO/s)				X				X	
	Total (MB/s)				X				X	
	Data to Move Down (GB)							X		
	Data to Move Up (GB)							X		
	Data to Move Within (GB)							X		
Property	Compression Enabled				X					

a. Applies to Unity only

**Table 63** Unity and UnityVSA metrics for Disk, FAST Cache, File System, LUN, Storage Pool, Tier, VVol, Virtual Disk (continued)

b. Applies to UnityVSA only

**Table 64** Unity and UnityVSA metrics for Storage Processor

Metric group	Metric
Cache	Dirty Cache Pages (MB)
	Read Cache Hit Ratio (%)
	Write Cache Hit Ratio (%)
Network	CIFS Reads (IOPS)
	CIFS Reads (MB/s)
	CIFS Writes (IOPS)
	CIFS Writes (MB/s)
	Network In Bandwidth (MB/s)
	Network Out Bandwidth (MB/s)
	NFS Reads (IOPS)
	NFS Reads (MB/s)
	NFS Writes (IOPS)
	NFS Writes (MB/s)
Network > NFSv2	Read Calls/s
	Read Errors/s
	Read Response Time (ms)
	Reads (IOPS)
	Write Calls/s
	Write Errors/s
	Write Response Time (ms)
	Writes (IOPS)
Network > NFSv3 Network > NFSv4	Access Calls/s
	Access Errors/s
	Access Response Time (ms)
	GetAttr Calls/s
	GetAttr Errors/s
	GetAttr Response Time (ms)
	Lookup Calls/s
	Lookup Errors/s
	Lookup Response Time (ms)

**Table 64** Unity and UnityVSA metrics for Storage Processor (continued)

<b>Metric group</b>	<b>Metric</b>
	Read Calls/s
	Read Errors/s
	Read Response Time (ms)
	Reads (IOPS)
	SetAttr Calls/s
	SetAttr Errors/s
	SetAtt Response Time (ms)
	Write Calls/s
	Write Errors/s
	Write Response Time (ms)
	Writes (IOPS)
Network > SMB1	Close Average Response Time (ms)
	Close Calls/s
	Close Max Response Time (ms)
	NtCreateX Average Response Time (ms)
	NtCreateX Calls/s
	NtCreateX Max Response Time (ms)
	Reads (IOPS)
	Reads (MB/s)
	ReadX Average Response Time (ms)
	ReadX Calls/s
	ReadX Max Response Time (ms)
	Trans2Prim Average Response Time (ms)
	Trans2Prim Calls/s
	Trans2Prim Max Response Time (ms)
	Writes (IOPS)
	Writes (MB/s)
	WriteX Average Response Time (ms)
	WriteX Calls/s
	WriteX Max Response Time (ms)
	Network > SMB2
Close Calls/s	
Close Max Response Time (ms)	



**Table 64** Unity and UnityVSA metrics for Storage Processor (continued)

<b>Metric group</b>	<b>Metric</b>
	Create Average Response Time (ms)
	Create Calls/s
	Create Max Response Time (ms)
	Flush Average Response Time (ms)
	Flush Calls/s
	Flush Max Response Time (ms)
	loctl Average Response Time (ms)
	loctl Calls/s
	loctl Max Response Time
	Queryinfo Average Response Time (ms)
	Queryinfo Calls/s
	Queryinfo Max Response Time (ms)
	Read Average Response Time (ms)
	Read Calls/s
	Read Max Response Time (ms)
	Reads (IOPS)
	Reads (MB/s)
	Write Average Response Time (ms)
	Write Calls/s
	Write Max Response Time (ms)
	Writes (IOPS)
	Writes (MB/s)
<b>Performance</b>	Busy (%)
	Reads (IOPS)
	Reads (MB/s)
	Writes (IOPS)
	Writes (MB/s)

## VMAX metrics

EMC Storage Analytics provides metrics for Device, Front-End Director, Front-End Port, Back-end Director, Back-end Port, Remote Replica Group, SRDF Director, Storage Group, Storage Resource Pool (SRP), SLO, VVol Protocol Endpoint (VVol PE), and SRDF Port.

**Table 65** VMAX Performance metrics

Metric	Front-end director	Front-end port	Back-end director	Back-end port	Remote replica group	SRDF director	Storage group	SRP
Read Latency (ms)							X	
Reads (IO/s)	X	X	X	X			X	X
Reads (MB/s)		X	X	X			X	X
Total Bandwidth (MB/s)	X	X	X	X		X	X	X
Total Operations (IO/s)	X	X	X	X		X	X	X
Write Latency (ms)							X	
Writes (IO/s)	X	X	X	X	X	X	X	X
Writes (MB/s)		X	X	X	X		X	X
Total Hits (IO/s)	X							
Total Latency (ms)							X	X
Busy (%)	X	X	X	X		X		
Average Cycle Time (s)					X			
Minimum Cycle Time (s)								
Delta Set Extension Threshold					X			
HA Repeat Writes (counts/s)					X			
Devices in Session (count)					X			
SRDFA Writes (IO/s)						X		
SRDFA Writes (MB/s)						X		
SRDFS Writes (IO/s)						X		
SRDFS Writes (MB/s)						X		
Response Time (ms)		X	X	X			X	
Host Reads/sec							X	
Host Writes/sec							X	
Hit (%)							X	
Miss (%)							X	
Queue Depth Utilization	X							

**Table 65** VMAX Performance metrics (continued)

Metric	Front-end director	Front-end port	Back-end director	Back-end port	Remote replica group	SRDF director	Storage group	SRP
Read Reqs/sec			X					
Write Reqs/sec			X					
IOPS			X					
MBs/sec			X					
Host IOPS				X				
Host MB/s				X				

**Table 66** VMAX Capacity metrics

Metric	Device	Storage group	SRP	VVol Storage Container	VVol Storage Resource
Total Capacity (GB)	X	X			
Used Capacity (GB)	X	X	X		
EMC VP Space Saved (%)		X			
EMC Compression Ratio		X			
EMC Full (%)	X		X		
EMC Snapshot space (GB)			X		
EMC Total Managed Space (GB)			X		
EMC Remaining Managed Space (GB)			X		
Subscribed Limit (GB)				X	X
Subscribed Free (GB)				X	X
Subscribed Used (GB)				X	X

**Note**

The VMAX storage group capacity metrics related to compression are only valid for VMAX All Flash arrays running HYPERMAX OS 5977 2016 Q3 SR and later. Because VMAX3 arrays do not support compression, non-zero values for VMAX3 arrays are irrelevant and should be ignored.

**Table 67** VMAX Configuration metrics

Metric	Remote replica group	VVol Protocol Endpoint	Description
Number of Masking Views		X	

**Table 67** VMAX Configuration metrics (continued)

Metric	Remote replica group	VVol Protocol Endpoint	Description
Number of Storage Groups		X	
Modes	X		
Type	X		
Metro	X		
Async	X		
Witness	X		RDF group is configured as Physical Witness (Yes, No)
Witness Array or Name	X		

**Table 68** VMAX Status metrics

Metric	Remote replica group
Witness Configured	X
Witness Effective	X
Bias Configured	X
Bias Effective	X
Witness Degraded	X

**Table 69** VMAX Summary metrics

Metric	VVol Protocol Endpoint
Reserved	X
Status	X

**Table 70** VMAX Default metrics

Metric	SLO
Compliance	X

## VNX Block metrics

EMC Storage Analytics provides VNX Block metrics for Array, Disk, FAST Cache, Pool LUN, RAID Group, RAID Group LUN, SP Front-end Port, Storage Pool, Storage Processor, and Tier.

The following table shows the metrics available for each resource kind.

**Table 71** VNX Block metrics

Metric	Array	Disk	FAST Cache	Pool LUN	RAID group	RAID group LUN	SP Front-end port	Storage pool	Storage processor	Tier
Elapsed collect time (ms)	X									
New metrics in each collect call (count)	X									
New resources in each collect call (count)	X									
Number of down resources	X									
Number of metrics collected	X									
Number of resources collected	X									
Busy (%)		X		X		X			X	
Capacity (GB)		X								
Hard Read Errors (Count)		X								
Hard Write Errors (Count)		X								
LUN Count		X								
Queue Length		X		X		X				
Read Size (MB)		X		X		X			X	
Reads (IOPS)		X		X		X	X		X	
Reads (MB/s)		X		X		X	X		X	
Total Latency (ms)		X		X		X				
Total Operations (IOPS)		X		X		X	X		X	
Total Bandwidth (MB/s)		X		X		X	X		X	
Write Size (MB)		X		X		X			X	

Table 71 VNX Block metrics (continued)

Metric	Array	Disk	FAST Cache	Pool LUN	RAID group	RAID group LUN	SP Front-end port	Storage pool	Storage processor	Tier
Writes (IOPS)		X		X		X	X		X	
Writes (MB/s)		X		X		X	X		X	
Current Operation			X					X		
Current Operation Status			X					X		
Current Operation Complete (%)			X							
Dirty (%)			X							
Flushed (MB)			X							
Mode			X							
RAID Type			X							X
Read Cache Hit Ratio (%)			X					X	X	
Read Cache Hits (Hits/s)			X							
Read Cache Misses (Misses/s)			X							
Size (GB)			X							
Write Cache Hit Ratio (%)			X						X	
Write Cache Hits (Hits/s)			X							
Write Cache Misses (Misses/s)			X							
Average Busy Queue Length				X		X				
Capacity Tier Distribution (%)				X						
Consumed Capacity (GB)				X				X		X
Explicit trespasses (Count)				X						
Extreme Performance Tier Distribution (%)				X						
Implicit trespasses (Count)				X						

Table 71 VNX Block metrics (continued)

Metric	Array	Disk	FAST Cache	Pool LUN	RAID group	RAID group LUN	SP Front-end port	Storage pool	Storage processor	Tier
Initial Tier				X						
Performance Tier Distribution (%)				X						
Read Cache State				X		X			X	
Service Time (ms)				X		X				
Tiering Policy				X						
User Capacity (GB)				X	X	X				X
Write Cache State				X		X			X	
Available Capacity (GB)					X			X		X
Defragmented (%)					X					
Disk Count					X					X
Free Continuous Group of Unbound Segments (GB)					X					
Full (%)					X					
LUN Count					X					
Max Disks					X					
Max LUNs					X					
Raw Capacity (GB)					X					
Queue Full Count							X	X		
Auto Tiering								X		
Auto-Tiering State								X		
Data Movement Completed (GB)								X		
Data to Move Down (GB)								X		
Data to Move Up (GB)								X		
Data to Move Within (GB)								X		
Deduplicated LUNs Shared Capacity (GBs)								X		

**Table 71** VNX Block metrics (continued)

Metric	Array	Disk	FAST Cache	Pool LUN	RAID group	RAID group LUN	SP Front-end port	Storage pool	Storage processor	Tier
Deduplication and Snapshot Savings (GBs)								X		
Deduplication Rate								X		
Dirty Cache Pages (%)									X	
Dirty Cache Pages (MB)									X	
Read Cache Size (MB)									X	
Write Cache Flushes (MB/s)									X	
Write Cache Size (MB)									X	
Higher Tier (GB)										X
Lower Tier (GB)										X
Subscribed (%)										X



## VNX File/eNAS metrics

EMC Storage Analytics provides VNX File metrics for Array, Data Mover (includes Virtual Data Mover), dVol, File Pool, and File System.

### VNX File/eNAS metrics for Array

- Elapsed collect time (ms)
- New metrics in each collect call
- New resources in each collect call
- Number of down resources
- Number of metrics collected
- Number of resources collected

### VNX File/eNAS metrics for Data Mover

**Table 72** VNX File/eNAS metrics for Data Mover

Metric Group	Metric
Cache	Buffer Cache Hit Ratio (%)
	DNLC Hit Ratio (%)
	Open File Cache Hit Ratio (%)
Configuration	Type
CPU	Busy (%)
Disk	Reads (MB/s)
	Total Bandwidth (MB/s)
	Writes (MB/s)
Network	CIFS Average Read Size (KB)
	CIFS Average Write Size (KB)
	CIFS Reads (IOPS)
	CIFS Reads (MB/s)
	CIFS Total Operations (IOPS)
	CIFS Total Bandwidth (MB/s)
	CIFS Writes (IOPS)
	CIFS Writes (MB/s)
	NFS Average Read Size (Bytes)
	NFS Average Write Size (Bytes)
	NFS Reads (IOPS)
	NFS Reads (MB/s)
	NFS Total Bandwidth (MB/s)
	NFS Total Operations (IOPS)

**Table 72** VNX File/eNAS metrics for Data Mover (continued)

<b>Metric Group</b>	<b>Metric</b>
	NFS Writes (IOPS)
	NFS Writes (MB/s)
	Network In Bandwidth (MB/s)
	Network Out Bandwidth (MB/s)
	Total Network Bandwidth (MB/s)
Network > NFSv2, NFSv3, and NFSv4	Read Calls/s
	Read Errors/s
	Read Response Time (ms)
	Write Calls/s
	Write Errors/s
	Write Response Time (ms)
Network > NFSv3	Access Calls/s
	Access Errors/s
	Access Response Time (ms)
	GetAttr Calls/s
	GetAttr Errors/s
	GetAttr Response Time (ms)
	Lookup Calls/s
	Lookup Errors/s
	Lookup Response Time (ms)
	SetAttr Calls/s
	SetAttr Errors/s
	SetAttr Response Time (ms)
	Network > NFSv4
Close Errors/s	
Close Response Time (ms)	
Compound Calls/s	
Compound Errors/s	
Compound Response Time (ms)	
Open Calls/s	
Open Errors/s	
Open Response Time (ms)	
Network > SMB1	Close Average Response Time (ms)

Table 72 VNX File/eNAS metrics for Data Mover (continued)

Metric Group	Metric
	Close Calls/s
	Close Max Response Time (ms)
	NTCreateX Average Response Time (ms)
	NTCreateX Calls/s
	NTCreateX Max Response Time (ms)
	ReadX Average Response Time (ms)
	ReadX Calls/s
	ReadX Max Response Time (ms)
	Trans2Prim Average Response Time (ms)
	Trans2Prim Calls/s
	Trans2Prim Max Response Time (ms)
	WriteX Average Response Time (ms)
	WriteX Calls/s
	WriteX Max Response Time (ms)
Network > SMB2	Close Average Response Time (ms)
	Close Calls/s
	Close Max Response Time (ms)
	Flush Average Response Time (ms)
	Flush Calls/s
	Flush Max Response Time (ms)
	Create Average Response Time (ms)
	Create Calls/s
	Create Max Response Time (ms)
	IOCTL Average Response Time (ms)
	IOCTL Calls/s
	IOCTL Max Response Time (ms)
	Queryinfo Average Response Time (ms)
	Queryinfo Calls/s
	Queryinfo Max Response Time (ms)
	Read Average Response Time (ms)
	Read Calls/s
	Read Max Response Time (ms)
	Write Average Response Time (ms)

**Table 72** VNX File/eNAS metrics for Data Mover (continued)

Metric Group	Metric
	Write Calls/s
	Write Max Response Time (ms)

**VNX File/eNAS metrics for dVol, File pool, and File system****Table 73** VNX File/eNAS metrics for dVol, File pool, and File system

Metric	dVol	File pool	File system	Note
Average Read Size (Bytes)	X		X	
Average Write Size (Bytes)	X		X	
Average Completion Time (ms/call)	X			
Average Service Time (ms/call)	X			
Available Capacity (GB)		X	X	
Capacity (GB)	X	X	X	
Consumed Capacity (GB)		X	X	
Max Capacity (GB)			X	If automatic extension is enabled, the file system automatically extends to this maximum size when the high water mark is reached. The default value for the high water mark is 90 percent.
Full (%)			X	
IO Retries (IO/s)	X			
Queue Length	X			
Reads (IO/s)	X		X	
Reads (MB/s)	X		X	
Total Operations (IO/s)	X			
Total Bandwidth (MB/s)	X		X	
Utilization (%)	X			
Writes (IO/s)	X		X	
Writes (MB/s)	X		X	
Thin Provisioning			X	<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

**Table 73** VNX File/eNAS metrics for dVol, File pool, and File system (continued)

Metric	dVol	File pool	File system	Note
				either the virtual maximum file system size or real file system size, whichever is larger.
Read IO Ratio (%)			X	
Write IO Ratio (%)			X	
Read Requests (Requests/s)			X	
Write Requests (Requests/s)			X	

## VNXe metrics

EMC Storage Analytics provides VNXe metrics for Array, Disk, FAST Cache, File System, LUN, Storage Pool, Tier, VVol, Virtual Disk, and Storage Processor. Only the resource kinds with associated metrics are shown.

The following metrics are available:

- Elapsed collect time (ms)
- New metrics in each collect call
- New resources in each collect call
- Number of down resources
- Number of metrics collected
- Number of resources collected

**Table 74** VNXe metrics for Disk, FAST Cache, File System, LUN, Storage Pool, Tier, Virtual Disk

Metric group	Metric	Disk	FAST Cache	File System	LUN	Storage Pool	Tier
Capacity	Size (GB)	X					
	Available Capacity (GB)		X	X		X	X
	Capacity/Total capacity (GB)			X	X		
	Consumed Capacity (GB)			X	X	X	X
	Full (%)			X		X	X
	Thin Provisioning			X			
	Subscribed (%)					X	
	User Capacity (GB)					X	X
Configuration	State	X					
	RAID type		X				X
	FAST Cache					X	
	Disk Count						X

**Table 74** VNXe metrics for Disk, FAST Cache, File System, LUN, Storage Pool, Tier, Virtual Disk (continued)

Metric group	Metric	Disk	FAST Cache	File System	LUN	Storage Pool	Tier
Performance	Busy (%)	X					
	Reads (IO/s)	X			X		
	Reads (MB/s)	X			X		
	Total Latency (ms)	X					
	Writes (IO/s)	X			X		
	Writes (MB/s)	X			X		
	Queue Length				X		
	Data to move Down (GB)						X
	Data to move Up (GB)						X
	Data to move Within (GB)						X
	Disk Count						X

**Table 75** VNXe metrics for Storage Processor

Metric Group	Metric
Cache	Dirty Cache Pages (MB)
	Read Cache Hit Ratio (%)
	Write Cache Hit Ratio (%)
Network	CIFS Reads (IOPS)
	CIFS Reads (MB/s)
	CIFS Writes (IOPS)
	CIFS Writes (MB/s)
	Network In Bandwidth (MB/s)
	Network Out Bandwidth (MB/s)
	NFS Reads (IOPS)
	NFS Reads (MB/s)
	NFS Writes (IOPS)
	NFS Writes (MB/s)
Network > NFSv2	Read Calls/s
	Read Errors/s
	Read Response Time (ms)
	Reads (IOPS)
	Write Calls/s

Table 75 VNXe metrics for Storage Processor (continued)

Metric Group	Metric
	Write Errors/s
	Write Response Time (ms)
	Writes (IOPS)
Network > NFSv3	Access Calls/s
	Access Errors/s
	Access Response Time (ms)
	GetAttr Calls/s
	GetAttr Errors/s
	GetAttr Response Time (ms)
	Lookup Calls/s
	Lookup Errors/s
	Lookup Response Time (ms)
	Read Calls/s
	Read Errors/s
	Read Response Time (ms)
	Reads (IOPS)
	SetAttr Calls/s
	SetAttr Errors/s
	SetAtt Response Time (ms)
	Write Calls/s
	Write Errors/s
	Write Response Time (ms)
	Writes (IOPS)
Network > SMB1	Close Average Response Time (ms)
	Close Calls/s
	Close Max Response Time (ms)
	NtCreateX Average Response Time (ms)
	NtCreateX Calls/s
	NtCreateX Max Response Time (ms)
	Reads (IOPS)
	Reads (MB/s)
	ReadX Average Response Time (ms)
	ReadX Calls/s

**Table 75** VNXe metrics for Storage Processor (continued)

<b>Metric Group</b>	<b>Metric</b>
	ReadX Max Response Time (ms)
	Trans2Prim Average Response Time (ms)
	Trans2Prim Calls/s
	Trans2Prim Max Response Time (ms)
	Writes (IOPS)
	Writes (MB/s)
	WriteX Average Response Time (ms)
	WriteX Calls/s
	WriteX Max Response Time (ms)
Network > SMB2	Close Average Response Time (ms)
	Close Calls/s
	Close Max Response Time (ms)
	Create Average Response Time (ms)
	Create Calls/s
	Create Max Response Time (ms)
	Flush Average Response Time (ms)
	Flush Calls/s
	Flush Max Response Time (ms)
	ioctl Average Response Time (ms)
	ioctl Calls/s
	ioctl Max Response Time
	Queryinfo Average Response Time (ms)
	Queryinfo Calls/s
	Queryinfo Max Response Time (ms)
	Read Average Response Time (ms)
	Read Calls/s
	Read Max Response Time (ms)
	Reads (IOPS)
	Reads (MB/s)
	Write Average Response Time (ms)
	Write Calls/s
	Write Max Response Time (ms)
	Writes (IOPS)



**Table 75** VNXe metrics for Storage Processor (continued)

<b>Metric Group</b>	<b>Metric</b>
	Writes (MB/s)
Performance	Busy (%)
	Reads (IOPS)
	Reads (MB/s)
	Writes (IOPS)
	Writes (MB/s)

## VPLEX metrics

EMC Storage Analytics provides VPLEX metrics for Cluster, Director, Distributed Device, Engine, Ethernet Port, Extent, FC Port, Local Device, Storage Array, Storage View, Storage Volume, Virtual Volume, and VPLEX Metro.

**Table 76** VPLEX metrics for Cluster

Metric group	Metric	Description
Status	Cluster Type	Local or Metro.
Status	Health State	<p>Possible values include:</p> <ul style="list-style-type: none"> <li>• <b>OK</b> - Cluster is functioning normally.</li> <li>• <b>Degraded</b> - 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.</li> <li>• <b>Unknown</b> - VPLEX cannot determine the cluster's health state, or the state is invalid.</li> <li>• <b>Major failure</b> - Cluster is failing and some functionality may be degraded or unavailable. This may indicate complete loss of back-end connectivity.</li> <li>• <b>Minor failure</b> - Cluster is functioning, but some functionality may be degraded. This may indicate one or more unreachable storage volumes.</li> <li>• <b>Critical failure</b> - Cluster is not functioning and may have failed completely. This may indicate a complete loss of back-end connectivity.</li> </ul>
Status	Operational Status	<p>During transition periods, the cluster moves from one operational state to another. Possible values include:</p> <ul style="list-style-type: none"> <li>• <b>OK</b> - Cluster is operating normally.</li> <li>• <b>Cluster departure</b> - One or more of the clusters cannot be contacted. Commands affecting distributed storage are refused.</li> <li>• <b>Degraded</b> - 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.</li> <li>• <b>Device initializing</b> - If clusters cannot communicate with each other, then the distributed-device will be unable to initialize.</li> <li>• <b>Device out of date</b> - Child devices are being marked fully out of date. Sometimes this occurs after a link outage.</li> <li>• <b>Expelled</b> - Cluster has been isolated from the island either manually (by an administrator) or automatically (by a system configuration setting).</li> <li>• <b>Shutdown</b> - Cluster's directors are shutting down.</li> <li>• <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.</li> <li>• <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).</li> </ul>

Table 76 VPLEX metrics for Cluster (continued)

Metric group	Metric	Description
Capacity	Exported Virtual Volumes	Number of exported virtual volumes.
	Exported Virtual Volumes (GB)	Gigabytes of exported virtual volumes.
	Used Storage Volumes	Number of used storage volumes.
	Used Storage Volumes (GB)	Gigabytes of used storage volumes.
	Unused Storage Volumes	Number of unused storage volumes.
	Unused Storage Volumes (GB)	Gigabytes of unused storage volumes.

Table 77 VPLEX metrics for Director

Metric Group	Metric	Description
CPU	Busy (%)	Percentage of director CPU usage
Status	Operational 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> - Object is unreachable</li> </ul>
Storage Volumes	Read Latency (ms)	Average read latency in milliseconds
	Write Latency (ms)	Average write latency in milliseconds
Virtual Volumes	Read Latency (ms)	Average read latency in milliseconds
	Reads (MB/s)	Number of bytes read per second
	Total Reads and Writes (counts/s)	Total number of reads and writes per second
	Write Latency (ms)	Average write latency in milliseconds
	Writes (MB/s)	Number of bytes written per second
Memory	Memory Used (%)	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
Front-end Director	Aborts (counts/s)	Number of aborted I/O operations per second through the director's front-end ports

**Table 77** VPLEX metrics for Director (continued)

<b>Metric Group</b>	<b>Metric</b>	<b>Description</b>
	Active Operations (counts)	Number of active, outstanding I/O operations on the director's front-end ports
	Compare and Write Latency (ms)	Average time, in milliseconds, that it takes for VAAI CompareAndWrite request to complete on the director's front-end ports
	Operations (counts/s)	Number of I/O operations per second through the director's front-end ports
	Queued Operations (counts)	Number of queued, outstanding I/O operations on the director's front-end ports
	Read Latency (ms)	Average time, in milliseconds, that it takes for read requests to complete on the director's front-end ports. Total time it takes VPLEX to complete a read request
	Reads (counts/s)	Number of read operations per second on the director's front-end ports
	Reads (MB/s)	Number of bytes per second read from the director's front-end ports
	Write Latency (ms)	Average time, in milliseconds, that it takes for write requests to complete on the director's front-end ports. Total time it takes VPLEX to complete a write request
	Writes (counts/s)	Number of write operations per second on the director's front-end ports
	Writes (MB/s)	Number of bytes per second written to the director's front-end ports
Back-end Director	Aborts (counts/s)	Number of aborted I/O operations per second on the director's back-end ports
	Operations (counts/s)	Number of I/O operations per second through the director's back-end ports
	Reads (counts/s)	Number of read operations per second by the director's back-end ports
	Reads (MB/s)	Number of bytes read per second by the director's back-end ports
	Resets (counts/s)	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)	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)	Number of bytes written per second by the director's back-end ports
COM Latency	Average Latency (ms)	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)	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)	Minimum time, in milliseconds, that it took for an inter-director WAN message to complete on this director to the specified cluster in the last five-second interval
WAN Link Usage	Distributed Device Bytes Received (MB/s)	Number of bytes of distributed-device traffic per second received on the director's WAN ports
	Distributed Device Bytes Sent (MB/s)	Number of bytes of distributed-device traffic per second sent on the director's WAN ports
	Distributed Device Rebuild Bytes Received (MB/s)	Number of bytes of distributed-device, rebuild/migration traffic per second received on the director's WAN ports

Table 77 VPLEX metrics for Director (continued)

Metric Group	Metric	Description
	Distributed Device Rebuild Bytes Sent (MB/s)	Number of bytes of distributed-device rebuild/migration per second traffic sent on the director's WAN ports
FC WAN COM	Bytes Received (MB/s)	Number of bytes of WAN traffic per second received on this director's Fibre Channel port
	Bytes Sent (MB/s)	Number of bytes of WAN traffic per second sent on this director's Fibre Channel port
	Packets Received (counts/s)	Number of packets of WAN traffic per second received on this director's Fibre Channel port
	Packets Sent (counts/s)	Number of packets of WAN traffic per second sent on this director's Fibre Channel port
IP WAN COM	Average Latency (ms)	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)	Number of bytes of WAN traffic per second received on this director's IP port
	Bytes Sent (MB/s)	Number of bytes of WAN traffic per second sent on this director's IP port
	Maximum Latency (ms)	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)	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)	Number of packets of WAN traffic per second received on this director's IP port
	Packets Resent (counts/s)	Number of WAN traffic packets re-transmitted per second that were sent on this director's IP port
	Packets Sent (counts/s)	Number of packets of WAN traffic per second sent on this director's IP port
	Received Packets Dropped (counts/s)	Number of WAN traffic packets dropped per second that were received on this director's IP port
	Sent Packets Dropped (counts/s)	Number of WAN traffic packets dropped per second that were sent on this director's IP port

Table 78 VPLEX metrics for Distributed Device

Metric Group	Metric	Description
Capacity	Capacity (GB)	Capacity in gigabytes
Status	Health State	Possible values include: <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> </ul>

Table 78 VPLEX metrics for Distributed Device (continued)

Metric Group	Metric	Description
		<ul style="list-style-type: none"> <li>• <b>Critical failure</b> - VPLEX has marked the object as hardware-dead</li> </ul>
	Operational 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> - Object is unreachable</li> </ul>
	Service 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. 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 cluster whose data will overwrite the other cluster's data for this distributed device.</li> <li>• <b>Potential conflict</b> - Clusters have detached each other resulting in a potential for detach conflict.</li> <li>• <b>Running</b> - Distributed device is accepting I/O</li> <li>• <b>Suspended</b> - Distributed device is not accepting new I/O; pending I/O requests are frozen.</li> <li>• <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.</li> </ul>

Table 79 VPLEX metrics for Engine

Metric Group	Metric	Description
Status	Health State	<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	<p>Possible values include:</p>

Table 79 VPLEX metrics for Engine (continued)

Metric Group	Metric	Description
		<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> - Object is unreachable</li> </ul>

Table 80 VPLEX metrics for Ethernet Port

Metric Group	Metric	Description
Status	Operational Status	Possible values include: <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> - Object is unreachable</li> </ul>

Table 81 VPLEX metrics for Extent Device

Metric Group	Metric	Description
Capacity	Capacity (GB)	Capacity in gigabytes
Status	Health State	Possible values include: <ul style="list-style-type: none"> <li>• <b>OK</b> - The extent is functioning normally</li> <li>• <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)</li> <li>• <b>Unknown</b> - VPLEX cannot determine the extent's operational state, or the state is invalid</li> <li>• <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</li> </ul>
	Operational Status	Possible values include: <ul style="list-style-type: none"> <li>• <b>OK</b> - The extent is functioning normally</li> <li>• <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)</li> </ul>

**Table 81** VPLEX metrics for Extent Device (continued)

Metric Group	Metric	Description
		<ul style="list-style-type: none"> <li>• <b>Unknown</b> - VPLEX cannot determine the extent's operational state, or the state is invalid</li> <li>• <b>Starting</b> - The extent is not yet ready</li> </ul>

**Table 82** VPLEX metrics for Fibre Channel Port

Metric Group	Metric	Description
Status	Operational 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> - Object is unreachable</li> </ul>

**Table 83** VPLEX metrics for Local Device

Metric Group	Metric	Description
Capacity	Capacity (GB)	Capacity in gigabytes
Status	Health State	<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	<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> - Object is unreachable</li> </ul>



Table 83 VPLEX metrics for Local Device (continued)

Metric Group	Metric	Description
	Service 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. 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 cluster whose data will overwrite the other cluster's data for this distributed device.</li> <li>• <b>Potential conflict</b> - Clusters have detached each other resulting in a potential for detach conflict.</li> <li>• <b>Running</b> - Distributed device is accepting I/O</li> <li>• <b>Suspended</b> - Distributed device is not accepting new I/O; pending I/O requests are frozen</li> <li>• <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.</li> </ul>

Table 84 VPLEX metrics for Storage Array

Metric Group	Metric	Description
Capacity	Allocated Storage Volumes	Number of allocated storage volumes
	Allocated Storage Volumes (GB)	Gigabytes of allocated storage volumes
	Used Storage Volumes	Number of used storage volumes
	Used Storage Volumes (GB)	Gigabytes of used storage volumes

Table 85 VPLEX metrics for Storage View

Metric Group	Metric	Description
Capacity	Virtual Volumes (GB)	Gigabytes of virtual volumes
Status	Operational 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> - Object is unreachable</li> </ul>

**Table 86** VPLEX metrics for Storage Volume

Metric Group	Metric	Description
Capacity	Capacity (GB)	Capacity in gigabytes
Status	Health State	Possible values include: <ul style="list-style-type: none"> <li>• <b>OK</b> - The storage volume is functioning normally</li> <li>• <b>Degraded</b> - The storage volume 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	Possible values include: <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 (This state applies only to a storage volume that is part of a RAID 1 Metadata Volume)</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> - Object is unreachable</li> </ul>

**Table 87** VPLEX metrics for Virtual Volume

Metric Group	Metric	Description
Capacity	Capacity (GB)	Capacity in gigabytes
Locality	Locality	Possible values include: <ul style="list-style-type: none"> <li>• <b>Local</b> - The volume is local to the enclosing cluster</li> <li>• <b>Remote</b> - The volume is made available by a different cluster than the enclosing cluster, and is accessed remotely</li> <li>• <b>Distributed</b> - The virtual volume has or is capable of having legs at more than one cluster</li> </ul>
Status	Health State	Possible values include: <ul style="list-style-type: none"> <li>• <b>OK</b> - Functioning normally</li> <li>• <b>Unknown</b> - Cannot determine the health state, or the state is invalid</li> <li>• <b>Major failure</b> - One or more of the virtual volume's underlying devices is out-of-date, but will never rebuild</li> <li>• <b>Minor failure</b> - One or more of the virtual volume's underlying devices is out-of-date, but will rebuild</li> </ul>
	Operational Status	Possible values include: <ul style="list-style-type: none"> <li>• <b>OK</b> - Functioning normally</li> </ul>

Table 87 VPLEX metrics for Virtual Volume (continued)

Metric Group	Metric	Description
		<ul style="list-style-type: none"> <li>• <b>Degraded</b> - The virtual volume may have one or more out-of-date devices that will eventually rebuild</li> <li>• <b>Unknown</b> - VPLEX cannot determine the virtual volume's operational state, or the state is invalid</li> <li>• <b>Error</b> - One or more of the virtual volume's underlying devices is hardware-dead</li> <li>• <b>Starting</b> - Not yet ready</li> <li>• <b>Stressed</b> - One or more of the virtual volume's underlying devices is out-of-date and will never rebuild</li> </ul>
	Service Status	Possible values include: <ul style="list-style-type: none"> <li>• <b>Running</b> - I/O is running</li> <li>• <b>Inactive</b> - The volume is part of an inactive storage-view and is not visible from the host</li> <li>• <b>Unexported</b>- The volume is unexported</li> <li>• <b>Suspended</b> - I/O is suspended for the volume</li> <li>• <b>Cluster-unreachable</b> - Cluster is unreachable at this time</li> <li>• <b>Need-resume</b> - Issue re-attach to resume after link has returned</li> </ul>

Table 88 VPLEX metrics for VPLEX Metro

Metric Group	Metric	Description
Status	Health State	Possible values include: <ul style="list-style-type: none"> <li>• <b>OK</b> - Cluster is functioning normally</li> <li>• <b>Degraded</b> - 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.</li> <li>• <b>Unknown</b> - VPLEX cannot determine the cluster's health state, or the state is invalid</li> <li>• <b>Major failure</b> - Cluster is failing and some functionality may be degraded or unavailable. This may indicate complete loss of back-end connectivity.</li> <li>• <b>Minor failure</b> - Cluster is functioning, but some functionality may be degraded. This may indicate one or more unreachable storage volumes.</li> <li>• <b>Critical failure</b> - Cluster is not functioning and may have failed completely. This may indicate a complete loss of back-end connectivity.</li> </ul>
	Operational Status	During transition periods, the cluster moves from one operational state to another. Possible values include: <ul style="list-style-type: none"> <li>• <b>OK</b> - Cluster is operating normally</li> <li>• <b>Cluster departure</b> - One or more of the clusters cannot be contacted. Commands affecting distributed storage are refused.</li> </ul>

**Table 88** VPLEX metrics for VPLEX Metro (continued)

Metric Group	Metric	Description
		<ul style="list-style-type: none"> <li>• <b>Degraded</b> - 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.</li> <li>• <b>Device initializing</b> - If clusters cannot communicate with each other, then the distributed-device will be unable to initialize.</li> <li>• <b>Device out of date</b> - Child devices are being marked fully out of date. Sometimes this occurs after a link outage.</li> <li>• <b>Expelled</b> - Cluster has been isolated from the island either manually (by an administrator) or automatically (by a system configuration setting).</li> <li>• <b>Shutdown</b> - Cluster's directors are shutting down.</li> <li>• <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.</li> <li>• <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).</li> </ul>

## XtremIO metrics

EMC Storage Analytics provides XtremIO metrics for Cluster, Data Protection Group, Snapshot, SSD, Storage Controller, Volume, Disk array enclosure (DAE), and X-Brick.

**Table 89** XtremIO metrics for Cluster

Metric Group	Metric
Capacity	Deduplication Ratio
	Compression Ratio
	Total Efficiency
	Thin Provision Savings (%)
	Data Reduction Ratio
Capacity > Physical	Available Capacity (TB)
	Remaining Capacity (%)
	Used Capacity (%)
	Consumed Capacity (TB)
	Total Capacity (TB)
Capacity > Volume	Available Capacity (TB)
	Consumed Capacity (TB)
	Total Capacity (TB)
Performance	Total Bandwidth (MB/s)
	Total Latency (ms)
	Total Operations (IO/s)
Performance > Read Operations	Read Bandwidth (MB/s)
	Read Latency (ms)
	Reads (IO/S)
Performance > Write Operations	Writes (MB/s)
	Write Bandwidth (MB/s)
	Write Latency (ms)
Status	Health State ; Green = Normal, Yellow = Free space <= 90%, Orange = Free space <= 95%, Red = Free space <= 99%
	Total Memory In Use (%)
Configuration	Encrypted

**Table 90** XtremIO metrics for Data Protection Group

Metric Group	Metric
Performance	Average SSD Utilization (%)

**Table 91** XtremIO metrics for Snapshot

Metric Group	Metric
Capacity	Consumed Capacity in XtremIO (GB)—Consumed capacity in gigabytes without "zeroed" space
	Consumed Capacity in VMware (GB)—Consumed capacity in gigabytes, including "zeroed" space
	<p><b>Note</b></p> <p>This metric is available only when a datastore is built on top of the snapshot. The value of the metric is the consumed datastore capacity, which might not be the same as the consumed snapshot capacity.</p>
	Total Capacity (GB)
Performance	Average Block Size (KB)
	Total Bandwidth (MB/s)
	Total Latency (usec)
	Total Operations (IOPS)
	Unaligned (%)
Performance > Read Operations	Average Block Size (KB)
	Average Small Reads (IOPS)
	Average Unaligned Reads (IOPS)
	Read Bandwidth (MB/s)
	Read Latency (usec)
	Reads (IOPS)
Performance > Write Operations	Average Block Size (KB)
	Average Small Writes (IOPS)
	Average Unaligned Writes (IOPS)
	Write Bandwidth (MB/s)
	Write Latency (usec)
	Writes (IOPS)
Configuration	Tag

**Table 92** XtremIO metrics for SSD

<b>Metric Group</b>	<b>Metric</b>
Capacity	Disk Utilization (%)
Endurance	Endurance Remaining (%)

**Table 93** XtremIO metrics for Storage Controller

<b>Metric Group</b>	<b>Metric</b>
Performance	CPU 1 Utilization (%)
	CPU 2 Utilization (%)
Status	Health State

**Table 94** XtremIO metrics for Volume

<b>Metric Group</b>	<b>Metric</b>
Capacity	Consumed Capacity in XtremIO (GB)
	Consumed Capacity in VMware (GB)
	Total Capacity (GB)
Performance	Average Block Size (KB)
	Total Bandwidth (MB/s)
	Total Latency (ms)
	Total Operations (IOPS)
	Unaligned (%)
Performance > Read Operations	Average Block Size (KB)
	Average Small Reads (IOPS)
	Average Unaligned Reads (IOPS)
	Read Bandwidth (MB/s)
	Read Latency (ms)
	Reads (IOPS)
Performance > Write Operations	Average Block Size (KB)
	Average Small Writes (IOPS)
	Average Unaligned Writes (IOPS)
	Write Bandwidth (MB/s)
	Write Latency (ms)
	Writes (IOPS)

**Table 94** XtremIO metrics for Volume (continued)

<b>Metric Group</b>	<b>Metric</b>
Configuration	Tag

**Table 95** XtremIO metrics for Disk Array Enclosure

<b>Metric Group</b>	<b>Metric</b>
Status	Health State

**Table 96** XtremIO metrics for X-Brick™

<b>Metric Group</b>	<b>Metric</b>
X-Brick	Reporting



# APPENDIX D

## Views and Reports

This appendix contains the following topics:

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## Avamar views and reports

The Avamar report includes all views and can be exported to CSV and PDF formats.

You can create Avamar reports for the following metrics:

**Table 97** Avamar views and reports

View	Metric
DPN Status Summary	General   HFS Address General   Active Sessions (Count) Status   State Garbage Collection   Status Garbage Collection   Result
DPN Capacity Summary	Capacity   Total Capacity (GB) Capacity   Used Capacity (GB) Capacity   Used Capacity (%) Capacity   Protected Capacity (GB) Capacity   Protected Capacity (%) Capacity   Free Capacity (GB) Capacity   Free Capacity (%)
DPN Backup Summary (last 24 hours)	Success History (last 24 hours)   Successful Backups (Count) Success History (last 24 hours)   Successful Backups (%) Success History (last 24 hours)   Failed Backups (Count) Success History (last 24 hours)   Successful Restores (Count) Success History (last 24 hours)   Successful Restores (%) Success History (last 24 hours)   Failed Restores (Count)
DPN Backup Performance (last 24 hours)	Job Performance History (last 24 hours)   Backup Average Elapsed Time Job Performance History (last 24 hours)   Average Scanned (GB) Job Performance History (last 24 hours)   Average Changed (GB) Job Performance History (last 24 hours)   Average Files Changed (Count) Job Performance History (last 24 hours)   Average Files Skipped (Count) Job Performance History (last 24 hours)   Average Sent (GB) Job Performance History (last 24 hours)   Average Excluded (GB) Job Performance History (last 24 hours)   Average Skipped (GB) Job Performance History (last 24 hours)   Average Modified & Sent (GB) Job Performance History (last 24 hours)   Average Modified & Not Sent (GB)

**Table 97** Avamar views and reports (continued)

View	Metric
	Job Performance History (last 24 hours)   Average Overhead (GB)
DDR Status Summary	General   Hostname General   Model Number Status   File System Status Status   Monitoring Status
DDR Capacity Summary	Capacity   Total Capacity (GB) Capacity   Used Capacity (GB) Capacity   Used Capacity (%) Capacity   Free Capacity (GB) Capacity   Free Capacity (%) Capacity   Protected Capacity (GB) Capacity   Protected Capacity (%)

## eNAS views and reports

The eNAS report includes all views and can be exported in CSV and PDF formats.

You can create views and reports for the following eNAS components.

**Table 98** eNAS views and reports

Component	Metric
Data Mover (In Use)	Avg. CPU Busy (%)
	Max CPU Busy (%)
	Avg. Total Network Bandwidth (MB/s)
	Max Total Network Bandwidth (MB/s)
	Type (String)
dVol (In Use)	Capacity (GB)
	Avg. Average Service Time (ms/call)
	Max Average Service Time (ms/call)
	Avg. Utilization (%)
	Max Utilization (%)
	Avg. Total Operations (IO/s)
	Max Total Operations (IO/s)
	Avg. Total Bandwidth (MB/s)
Max Total Bandwidth (MB/s)	
File Pool (In Use)	Consumed Capacity (GB)

**Table 98** eNAS views and reports (continued)

Component	Metric
	Available Capacity (GB)
	Total Capacity (GB)
File system	Total Capacity (GB)
	Allocated Capacity (GB)
	Consumed Capacity (GB)
	Available Capacity (GB)
	Avg. Total Operations (IO/s)
	Max Total Operations (IO/s)
	Avg. Total Bandwidth (MB/s)
	Max Total Bandwidth (MB/s)

## Isilon views and reports

You can create views and reports for Isilon components. The report name is Isilon Report, which contains all the following views:

**Table 99** Isilon views and reports

Component	Metric group	Metric
Isilon Cluster Performance	Summary	CPU Usage (%)
		Number of Active Jobs
	Node   External Network	External Throughput Rate (In, MB/s)
		External Throughput Rate (Out, MB/s)
	Node   Performance	Protocol Operations Rate
	Node   Summary	Connected Clients
	Cluster   Summary	Active Jobs
		Inactive Jobs
Node   Summary	Job Workers	
Isilon Cache Performance	Node   Cache	Overall Cache Hit Rate (MB/s)
		Overall Cache Throughput Rate (MB/s)
		Average Cache Data Age (s)
		L1 Cache Starts (MB/s)
		L1 Cache Hits (MB/s)
		L1 Cache Misses (MB/s)
		L1 Cache Waits (MB/s)
		L1 Cache Prefetch Starts (MB/s)
		L1 Cache Prefetch Hits (MB/s)
		L1 Cache Prefetch Misses (MB/s)
Isilon Cluster Capacity	Cluster   Capacity	Total Capacity (TB)
		Remaining Capacity (TB)
		Remaining Capacity (%)
		User Data Including Protection (TB)
		Snapshot Usage (TB)
Isilon Cluster Deduplication	Cluster   Deduplication	Deduplicated Data (Logical, GB)
		Deduplicated Data (Physical, GB)
		Saved Data (Logical, GB)
		Saved Data (Physical, GB)

**Table 99** Isilon views and reports (continued)

Component	Metric group	Metric
Isilon Disk Performance	Node   Performance	Protocol Operations Rate
		Disk Activity (%)
		Disk Operations Rate (Read)
		Disk Operations Rate (Write)
		Average Disk Operation Size (MB)
		Average Pending Disk Operations Count
		Slow Disk Access Rate
Isilon File System Performance	Node   Performance	File System Events Rate
		Deadlock File System Events Rate
		Locked File System Events Rate
		Contended File System Events Rate
		Blocking File System Events Rate
Isilon Network Performance	Node   External Network	External Network Throughput Rate (In, MB/s)
		External Network Throughput Rate (Out, MB/s)
		External Network Packets Rate (In, MB/s)
		External Network Packets Rate (Out, MB/s)
		External Network Errors (In, MB/s)
		External Network Errors (Out, MB/s)
Isilon Node Performance	Node   Summary	CPU Usage (%)
	Node   External Network	External Throughput Rate (In, MB/s)
		External Throughput Rate (Out, MB/s)
	Node   Performance	Disk Activity (%)
		Disk Throughput Rate (Read)
		Disk Throughput Rate (Write)
		Disk Operations Rate (Read)
		Disk Operations Rate (Write)
		Protocol Operations Rate
		Slow Disk Access Rate
	Node   Summary	Active Clients
		Connected Clients
		Pending Disk Operations Latency (ms)

## ScaleIO views and reports

You can create views and reports for the following ScaleIO components:

**Table 100** ScaleIO views and reports

Component	Metric
ScaleIO Volume	Number of Child Volumes (Count)
	Number of Descendant Volumes (Count)
	Number of Mapped SDCs (Count)
	Volume Size (GB)
	Average Read I/O Size (MB)
	Average Write I/O Size (MB)
	Total Read IO/s
	Total Write IO/s
	Total Reads (MB/s)
	Total Writes (MB/s)
ScaleIO Protection Domain	Maximum Capacity (GB)
	Protected Capacity (GB)
	Snap Used Capacity (GB)
	Thick Used Capacity (GB)
	Thin Used Capacity (GB)
	Unused Capacity (GB)
	Used Capacity (GB)
	Average Read I/O Size (MB)
	Average Write I/O Size (MB)
	Total Read IO/s
	Total Write IO/s
	Total Reads (MB/s)
	Total Writes (MB/s)
ScaleIO SDC	Number of Mapped Volumes (Count)
	Total Mapped Capacity (GB)
	Average Read I/O Size (MB)
	Average Write I/O Size (MB)
	Total Read IO/s
	Total Write IO/s
	Total Read (MB/s)

**Table 100** ScaleIO views and reports (continued)

Component	Metric
	Total Write (MB/s)
ScaleIO SDS	Maximum Capacity (GB)
	Snap Used Capacity (GB)
	Thick Used Capacity (GB)
	Thin Used Capacity (GB)
	Unused Capacity (GB)
	Used Capacity (GB)
	Average Read IO Size (MB)
	Average Write IO Size (MB)
	Total Read IO/s
	Total Write IO/s
	Total Read (MB/s)
	Total Write (MB/s)

**Note**

The MDM list view does not contain component-specific metrics.

## VMAX views and reports

VMAX reports consist of multiple component list views with the supported VMAX metrics. The reports can be exported in CSV and PDF formats.

You can create the following views and reports:

**Table 101** VMAX views and reports

Metric	SRDF Report	VMAX Report
Device	X	X
Front-End Director		X
Front-End Port		X
Back-End Director		X
Back-End Port		X
Remote Replica Group	X	
SRDF Director	X	
SRDF Port	X	
SLO		X
Storage Group		X



**Table 101** VMAX views and reports (continued)

Metric	SRDF Report	VMAX Report
Storage Resource Pool		X

The metrics available for each component are listed in the following table.

**Table 102** VMAX available metrics

Metric	Storage Group	Device	Front-End Director	Front-End Port	Back-End Director	Back-End Port	SRDF Director	Remote Replica Group	Storage Resource Pool
Total Capacity (GB)	X	X							X
Current Size (GB)	X	X							X
Used Capacity (GB)	X	X							X
Usable Capacity (GB)	X	X							X
Workload (%)	X	X							X
Under Used (%)	X	X							X
Reads IO/s	X		X		X	X			X
Reads MB/s	X		X		X	X			X
Writes IO/s	X		X		X	X	X	X	X
Writes MB/s	X		X		X	X		X	X
Total Operations IO/s	X		X	X	X	X	X		X
Total Bandwidth MB/s	X			X	X	X	X		
Full (%)		X							X
Total Bandwidth IO/s			X						
Total Hits IO/s			X						
Busy (%)			X	X	X	X	X		
SRDFA Writes IO/s							X		
SRDFA Writes MB/s							X		
SDRFS Writes IO/s							X		
SDRFS Writes MB/s							X		
Avg. Cycle Time (seconds)								X	
Delta Set Extension Threshold (integer)								X	
Devices in Session (count)								X	
HA Repeat Writes (count/s)								X	

**Table 102** VMAX available metrics (continued)

Metric	Storage Group	Device	Front-End Director	Front-End Port	Back-End Director	Back-End Port	SRDF Director	Remote Replica Group	Storage Resource Pool
Response Time (ms)	X		X	X		X			
Hit (%)	X								
Miss (%)	X								

**Note**

The current list views of SRDF Port and SLO do not contain any component-specific metrics.

## VNX, VNXe, and Unity/UnityVSA views and reports

You can create views and reports for VNX, VNXe, and Unity resources. Several predefined views and templates are also available.

### Report templates

**Note**

VNXe storage objects are contained in Unity views and reports.

The predefined report templates consist of several list views under the adapter instance, as shown in the following table.

**Table 103** VNX, VNXe, and Unity/UnityVSA views and reports

Metric	VNX Block Report	VNX File Report	VNXe Report	Unity/UnityVSA
Alerts	X	X	X	X
Storage Pool (In Use)	X		X	X
RAID Group (In Use)	X			
LUN	X		X	X
Disk (In Use)	X		X	X
SP Front-End Port	X			
Data Mover (In Use)		X		
File Pool (In Use)		X		
File System		X	X	X
dVol (In Use)		X		
VVol (In Use)				X

**Predefined views**

The following sections describe the available predefined views:

- [Alerts](#)

- [VNX Data Mover](#)
- [VNX File System](#)
- [VNX File Pool](#)
- [VNX dVol](#)
- [VNX LUN](#)
- [VNX Tier](#)
- [VNX FAST Cache](#)
- [VNX Storage Pool](#)
- [VNX Disk](#)
- [VNX Storage Processor](#)
- [VNX Storage Processor Front End Port](#)
- [VNX RAID Group](#)
- [Unity File System](#)
- [Unity LUN](#)
- [Unity Tier](#)
- [Unity Storage Pool](#)
- [Unity Disk](#)
- [Unity Storage Processor](#)
- [Unity VVol \(In Use\)](#) on page 171

### Alerts

Alert definitions apply to all resources.

**Table 104** Alerts

Metric	Description
Criticality level	The criticality level of the alert—Warning, Immediate, or Critical
Object name	Name of the impacted object
Object kind	Resource kind of the impacted object
Alert impact	Impacted badge (Risk, Health, or Efficiency) of the alert
Start time	Start time of the alert

### VNX Data Mover

**Table 105** VNX Data Mover

Metric group	Metric	Description
CPU	Busy (%)	VNX Data Mover CPU busy trend
Network	NFS Reads (MB/s)	VNX Data Mover NFS bandwidth trend
	NFS Writes (MB/s)	
	NFS Total Bandwidth (MB/s)	
	In Bandwidth (MB/s)	VNX Data Mover network bandwidth trend

**Table 105** VNX Data Mover (continued)

Metric group	Metric	Description
	Out Bandwidth (MB/s)	
	Total Bandwidth (MB/s)	
	NFS Reads (IO/s)	VNX Data Mover NFS IOPS trend
	NFS Writes (IO/s)	
	NFS Total Operations (IO/s)	
CPU	% Busy - Average	VNX Data Mover (in use)
	% Busy - Max	
Network	Total Network Bandwidth - Average (MB/s)	
	Total Network Bandwidth - Max (MB/s)	
Configuration	Data Mover Type	

**VNX File System****Table 106** VNX File System

Metric group	Metric	Description
Performance	Total Operations (IO/s)	VNX file system IOPS trend
	Reads (IO/s)	
	Writes (IO/s)	
	Total Bandwidth (MB/s)	VNX file system bandwidth trend
	Reads (MB/s)	
	Writes (MB/s)	
Capacity	Consumed Capacity (GB)	VNX file system capacity trend
	Total Capacity (GB)	
Capacity	Total Capacity (GB)	VNX file system List
	Allocated Capacity (GB)	
	Consumed Capacity (GB)	
	Available Capacity (GB)	
Performance	Avg. Total Operations (IO/s)	
	Max Total Operations (IO/s)	
	Avg. Total Bandwidth (MB/s)	

**Table 106** VNX File System (continued)

Metric group	Metric	Description
	Max Total Bandwidth (MB/s)	

**VNX File Pool****Table 107** VNX File Pool

Metric group	Metric	Description
Capacity	Consumed Capacity (GB)	VNX file pool capacity trend
	Total Capacity (GB)	
Capacity	Available Capacity (GB)	VNX file pool (in use) list
	Consumed Capacity (GB)	
	Total Capacity (GB)	

**VNX dVol****Table 108** VNX dVol

Metric group	Metric	Description
Performance	Utilization (%)	VNX dVol utilization trend
Performance	Total Operations (IO/s)	VNX dVol IOPS trend
	Reads (IO/s)	
	Writes (IO/s)	
Performance	Total Bandwidth (MB/s)	VNX dVol bandwidth trend
	Reads (MB/s)	
	Writes (MB/s)	
Capacity	Capacity (GB)	VNX dVol (in use) list
Performance	Avg. Average Service Time (uSec/call)	
	Max Average Service Time (uSec/call)	
	Avg. Utilization (%)	
	Max Utilization (%)	
	Avg. Total Operations (IO/s)	
	Max Total Operations (IO/s)	
	Avg. Total Bandwidth (MB/s)	
	Max Total Bandwidth (MB/s)	

**VNX LUN****Table 109** VNX LUN

<b>Metric group</b>	<b>Metric</b>	<b>Description</b>
Performance	Total Operations (IO/s)	VNX LUN IOPS trend
	Reads (IO/s)	
	Writes (IO/s)	
Performance	Total Bandwidth (MB/s)	VNX LUN bandwidth trend
	Reads (MB/s)	
	Writes (MB/s)	
Performance	Total Latency (ms)	VNX LUN total latency trend
Performance	Avg. Total Operations (IO/s)	VNX LUN list
	Max Total Operations (IO/s)	
	Avg. Total Bandwidth (MB/s)	
	Max Total Bandwidth (MB/s)	
	Avg. Total Latency (ms)	
	Max Total Latency (ms)	
Capacity	Total Capacity (GB)	

**VNX Tier****Table 110** VNX Tier

<b>Metric group</b>	<b>Metric</b>	<b>Description</b>
Capacity	Consumed Capacity (GB)	VNX Tier capacity trend
	Total Capacity (GB)	

**VNX FAST Cache****Table 111** VNX FAST Cache

<b>Metric group</b>	<b>Metric</b>	<b>Description</b>
Performance	Read Cache Hit Ratio (%)	VNX FAST Cache hit ratio trend
	Write Cache Hit Ratio (%)	

**VNX Storage Pool****Table 112** VNX Storage Pool

<b>Metric group</b>	<b>Metric</b>	<b>Description</b>
Capacity	Consumed Capacity (GB)	VNX storage pool capacity trend

**Table 112** VNX Storage Pool (continued)

Metric group	Metric	Description
	Total Capacity (GB)	
Capacity	Available Capacity (GB)	VNX storage pool (in use) List
	Consumed Capacity (GB)	
	Full (%)	
	Subscribed (%)	
Configuration	LUN Count	

**VNX Disk****Table 113** VNX Disk

Metric group	Metric	Description
Performance	Total Operations (IO/s)	VNX disk IOPS trend
	Reads (IO/s)	
	Writes (IO/s)	
Performance	Total Bandwidth (MB/s)	VNX disk bandwidth (MB/s) trend
	Reads (MB/s)	
	Writes (MB/s)	
Performance	Total Latency (ms)	VNX disk Total Latency (ms) trend
Performance	Busy (%)	VNX disk busy (%) trend
Capacity	Capacity (GB)	VNX disk (in use) List
Performance	Avg. Total Operations (IO/s)	
	Max Total Operations (IO/s)	
	Avg. Total Bandwidth (MB/s)	
	Max Total Bandwidth (MB/s)	
	Avg. Total Latency (ms)	
	Max Total Latency (ms)	
	Avg. Busy (%)	
	Max Busy (%)	
Configuration	Type	

## VNX Storage Processor

**Table 114** VNX Storage Processor

Metric group	Metric	Description
CPU	CPU Busy (%)	VNX storage processor CPU busy trend
Disk	Disk Total Operations (IO/s)	VNX storage processor disk IOPS trend
	Disk Reads (IO/s)	
	Disk Writes (IO/s)	
Disk	Disk Total Bandwidth (MB/s)	VNX storage processor disk bandwidth trend
	Disk Reads (MB/s)	
	Disk Writes (MB/s)	

## VNX Storage Processor Front End Port

**Table 115** VNX Storage Processor Front End Port

Metric group	Metric	Description
Performance	Total Operations (IO/s)	VNX SP front end port IOPS trend
	Reads (IO/s)	
	Writes (IO/s)	
Performance	Total Bandwidth (MB/s)	VNX SP front end port bandwidth trend
	Reads (MB/s)	
	Writes (MB/s)	
Performance	Avg. Total Operations (IO/s)	VNX SP front end port List
	Max Total Operations (IO/s)	
	Avg. Total Bandwidth (MB/s)	
	Max Total Bandwidth (MB/s)	

## VNX RAID Group

**Table 116** VNX RAID Group

Metric group	Metric	Description
Capacity	Available Capacity (GB)	VNX RAID group (in use) list
	Total Capacity (GB)	
	Full (%)	
Configuration	Disk Count	
	LUN Count	



**Table 116** VNX RAID Group (continued)

Metric group	Metric	Description
	Max Disks	
	Max LUNs	

**Unity File System****Table 117** Unity File System

Metric group	Metric	Description
Capacity	Consumed Capacity (GB)	Unity file system capacity trend
	Total Capacity (GB)	
Capacity	Total Capacity (GB)	Unity file system List
	Allocated Capacity (GB)	
	Consumed Capacity (GB)	
	Available Capacity (GB)	

**Unity LUN****Table 118** Unity LUN

Metric group	Metric	Description
Performance	Reads (IO/s)	Unity LUN IOPS trend
	Writes (IO/s)	
Performance	Reads (MB/s)	Unity LUN bandwidth trend
	Writes (MB/s)	
Capacity	Total Capacity (GB)	Unity LUN List
Performance	Avg. Reads (IO/s)	
	Max Reads (IO/s)	
	Avg. Writes (IO/s)	
	Max Writes (IO/s)	
	Avg. Reads (MB/s)	
	Max Reads (MB/s)	
	Avg. Writes (MB/s)	
Max Writes (MB/s)		

## Unity Tier

**Table 119** Unity Tier

Metric group	Metric	Description
Capacity	Consumed Capacity (GB)	Unity tier capacity trend
	Total Capacity (GB)	

## Unity Storage Pool

**Table 120** Unity Storage Pool

Metric group	Metric	Description
Capacity	Consumed Capacity (GB)	Unity storage pool capacity trend
	Total Capacity (GB)	
Capacity	Consumed Capacity (GB)	Unity storage pool (in use) List
	Total Capacity (GB)	
	Full (%)	
	Subscribed (%)	

## Unity Disk

**Table 121** Unity Disk

Metric group	Metric	Description
Performance	Reads (IO/s)	Unity disk IOPS trend
	Writes (IO/s)	
Performance	Reads (MB/s)	Unity disk bandwidth
	Writes (MB/s)	
Performance	Busy (%)	Unity disk busy trend
Capacity	Size (GB)	Unity disk (in use) list
Performance	Avg. Reads (IO/s)	
	Max Reads (IO/s)	
	Avg. Writes (IO/s)	
	Max Writes (IO/s)	
	Avg. Reads (MB/s)	
	Max Reads (MB/s)	
	Avg. Writes (MB/s)	
	Max Writes (MB/s)	
	Avg. Busy (%)	
	Max Busy (%)	

**Table 121** Unity Disk (continued)

Metric group	Metric	Description
Configuration	Type	

**Unity Storage Processor****Table 122** Unity Storage Processor

Metric group	Metric	Description
Performance	Busy (%)	Unity storage processor busy trend
Performance	Reads (IO/s)	Unity storage processor IOPS trend
	Writes (IO/s)	
Performance	Reads (MB/s)	Unity storage processor bandwidth trend
	Writes (MB/s)	
Network	NFS Reads (IO/s)	Unity storage processor NFS IOPS trend
	NFS Writes (IO/s)	
Network	NFS Reads (MB/s)	Unity storage processor NFS bandwidth trend
	NFS Writes (MB/s)	

**Unity VVol (In Use)****Table 123** Unity VVol (In Use)

Metric group	Metric	Description
Unity VVol Bandwidth Trend	Reads (MB/s)	
	Writes (MB/s)	
	Total (MB/s)	
	Reads (MB/s) (5 days forecast)	
	Writes (MB/s) (5 days forecast)	
	Total (MB/s) (5 days forecast)	
Unity VVol Capacity Trend	Consumed Capacity (GB)	
	Consumed Capacity (GB) (5 days forecast)	
	Total Capacity	
	Total Capacity (5 days forecast)	
Unity VVol IO Trend	Reads (IO/s)	
	Writes (IO/s)	

**Table 123** Unity VVol (In Use) (continued)

Metric group	Metric	Description
	Total (IO/s)	
	Reads (IO/s) (5 days forecast)	
	Writes (IO/s) (5 days forecast)	
	Total (IO/s) (5 days forecast)	
Unity VVol (In Use) List	Available Capacity (GB)	
	Reads (IO/s)	
	Writes (IO/s)	
	Total (IO/s)	
	Reads (MB/s)	
	Writes (MB/s)	
	Total (MB/s)	
	Latency (ms)	

## XtremIO views and reports

The XtremIO report includes all views and can be exported in CSV and PDF formats.

You can create views and reports for the following XtremIO components:

**Table 124** XtremIO views and reports

Component	Metric group	Metric
XtremIO cluster capacity consumption	n/a	Available Capacity (TB, physical)
		Consumed Capacity (TB, physical)
		Total Capacity (TB, physical)
		Available Capacity (TB, volume)
		Consumed Capacity (TB, volume)
		Total Capacity (TB, volume)
XtremIO health state	n/a	Cluster health state
		Storage Controller Health State
XtremIO LUN	Volume Performance:Read Operations Read Bandwidth	Read Bandwidth (MB/s)
	Volume Performance:Read Operations Read Latency	Read Latency (ms)
	Volume Performance:Read Operations Reads	Reads (IO/s)

Table 124 XtremIO views and reports (continued)

Component	Metric group	Metric
	Volume Performance:Write Operations Write Bandwidth	Write Bandwidth (MB/s)
	Volume Performance:Write Operations Write Latency	Write Latency (ms)
	Volume Performance:Write Operations Write	Write (IO/s)
	Volume Performance  Total Bandwidth	Total Bandwidth (MB/s)
	Volume Performance  Total Latency	Total Latency (ms)
	Volume Performance Total Operations	Total operations (IO/s)
	Volume Capacity  Consumed Capacity in VMware	Consumed Capacity in VMware (GB)
	Volume Capacity  Consumed Capacity in XtremIO	Consumed Capacity in XtremIO (GB)
	Volume Capacity Total Capacity	Total Capacity (GB)
		Summary (Min, Max, Average)
XtremIO performance	Cluster Performance:Read Operations Read Bandwidth	Read Bandwidth (MB/s)
	Cluster Performance:Read Operations Read Latency	Read Latency (ms)
	Cluster Performance:Read Operations Reads	Reads (IO/s)
	Cluster Performance:Write Operations Write Bandwidth	Write Bandwidth (MB/s)
	Cluster Performance:Write Operations Write Latency	Write Latency (ms)
	Cluster Performance:Write Operations Write	Write (IO/s)
	Cluster Performance  Total Bandwidth	Total Bandwidth (MB/s)
	Cluster Performance  Total Latency	Total Latency (ms)
	Cluster Performance Total Operations	Total Operations (IO/s)
	Storage Controller   Performance   CPU 1 Utilization	CPU 1 Utilization (%)
	Storage Controller   Performance   CPU 2 Utilization	CPU 2 Utilization (%)
		Summary (Max, Min, Average )
XtremIO storage efficiency	Cluster Capacity Deduplication Ratio	Deduplication Ratio
	Cluster Capacity Compression Ratio	Compression Ratio
	Cluster Capacity Thin Provision Savings	Thin provision Savings (%)
	SSD Endurance Endurance Remaining	SSD endurance Remaining (%)
	SSD Capacity Disk Utilization	Disk Utilization (%)
	Average	Summary



# APPENDIX E

## Topology Diagrams

This appendix includes the following topics:

- [Topology mapping](#).....176
- [Avamar topology](#).....176
- [Isilon topology](#).....177
- [RecoverPoint for Virtual Machines topology](#).....178
- [ScaleIO topology](#).....179
- [Unity topology](#).....180
- [UnityVSA topology](#).....181
- [VMAX3 and VMAX All Flash topology](#).....182
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- [VNX Block topology](#).....184
- [VNX File/eNAS topology](#).....185
- [VNXe topology](#).....186
- [VPLEX Local topology](#).....187
- [VPLEX Metro topology](#).....188
- [XtremIO topology](#).....189

## Topology mapping

You can view graphic representations of topology mapping using vRealize Operations Manager health trees. The ESA dashboards use topology mapping to display resources and metrics.

ESA establishes mappings between:

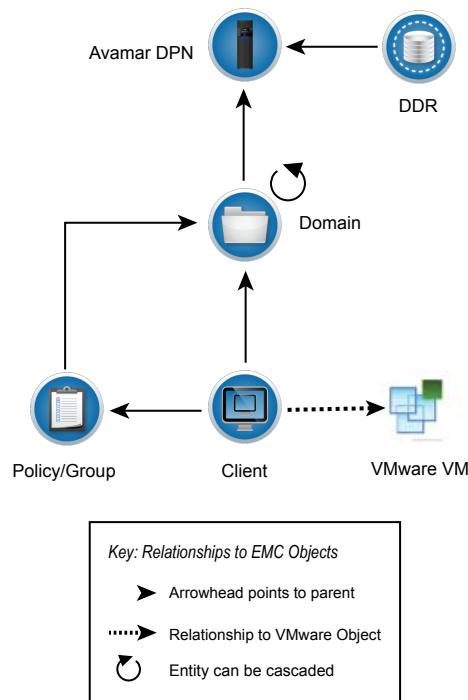
- Storage system components
- Storage system objects and vCenter objects

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 virtual machines. Topology mapping between storage system objects and vCenter objects uses a vCenter adapter instance.

## Avamar topology

The drawing in this section shows the components of the Avamar topology.

**Figure 18** Avamar components

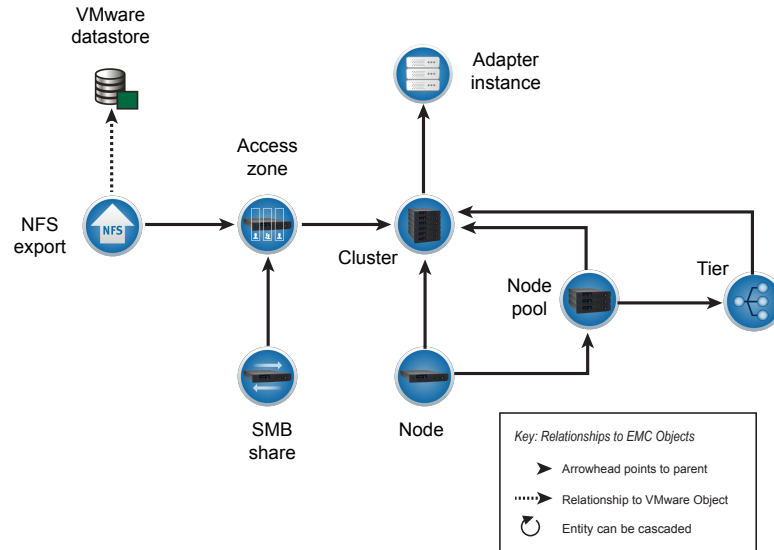




# Isilon topology

The drawing in this section shows the components of the Isilon topology.

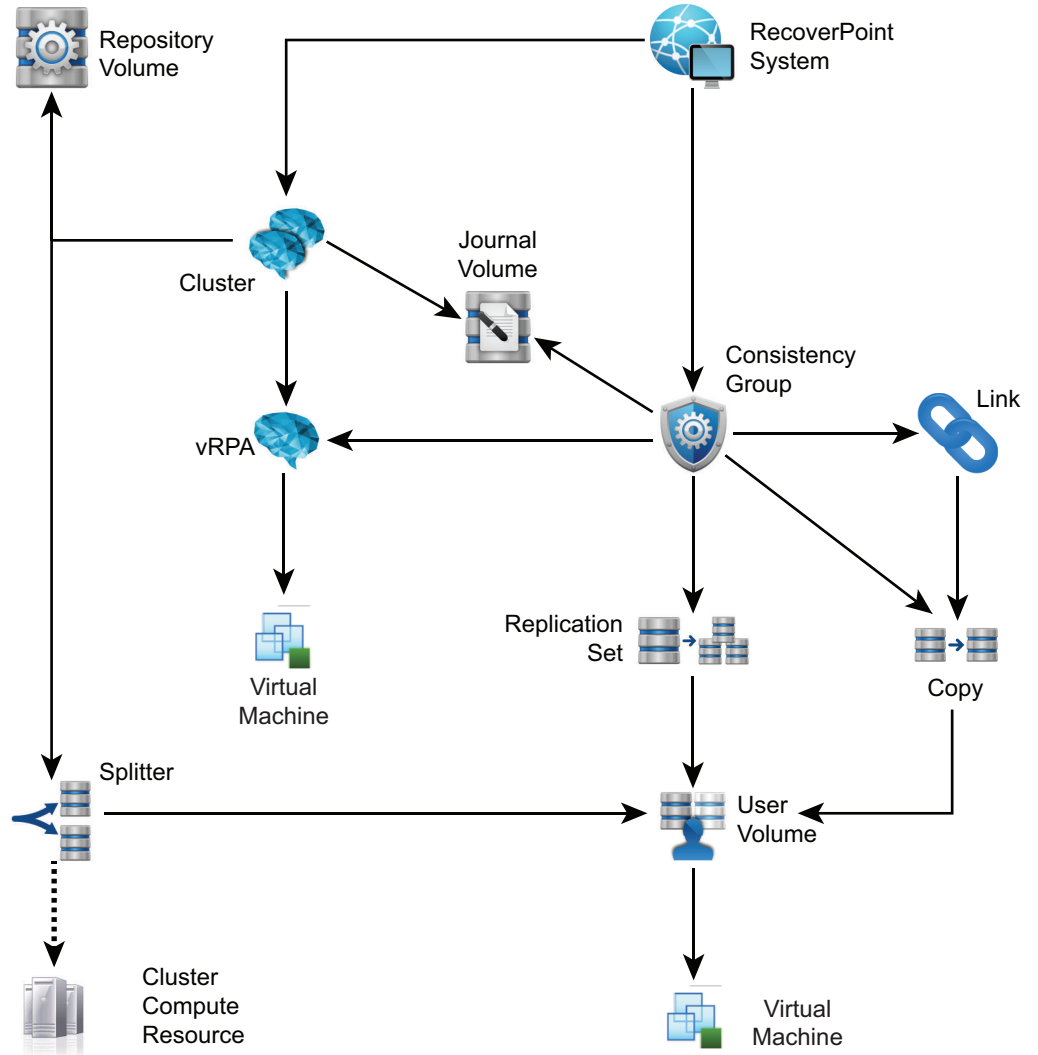
**Figure 19** Isilon components



# RecoverPoint for Virtual Machines topology

The drawing in this section shows the components of the RecoverPoint for Virtual Machines topology.

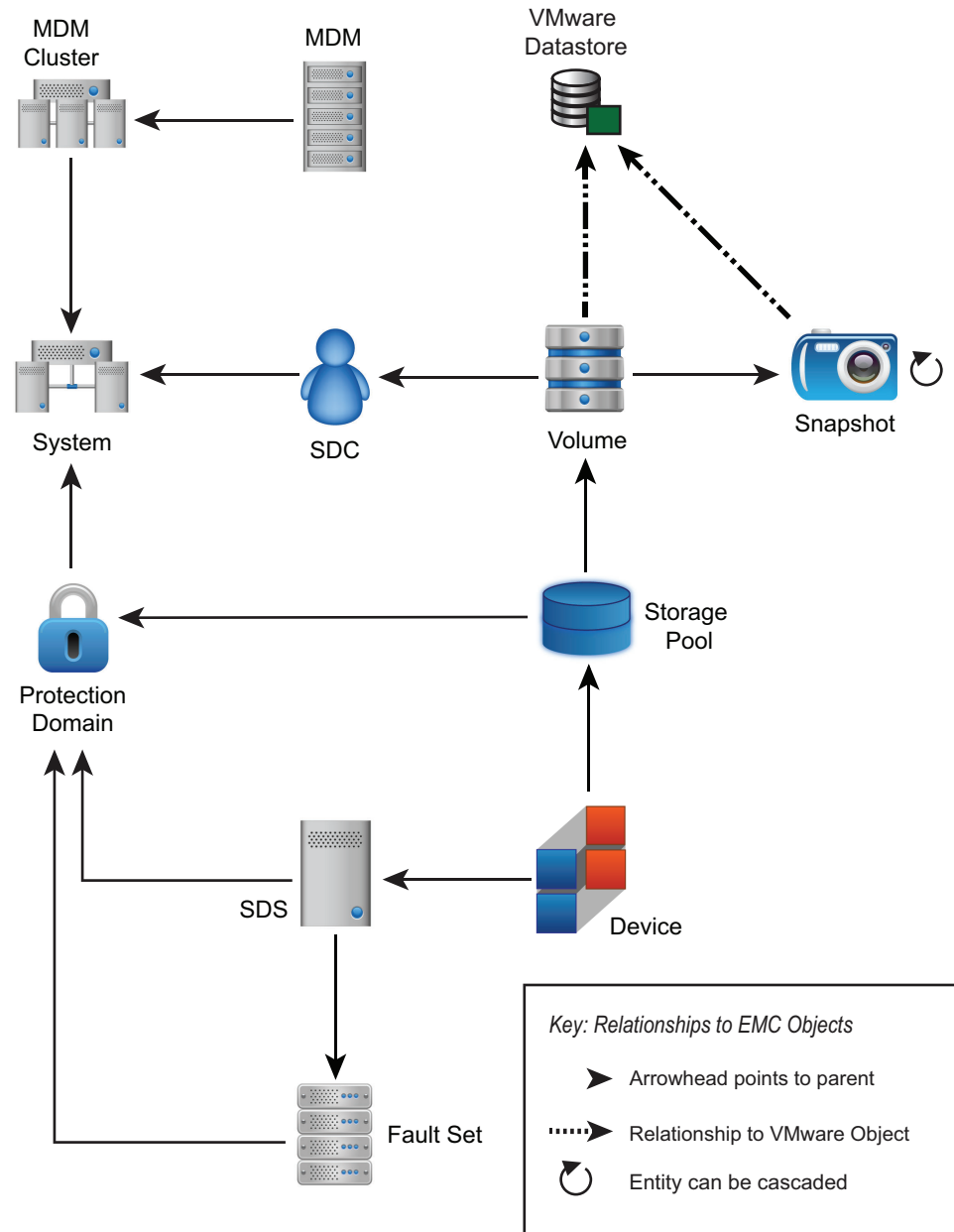
**Figure 20** RecoverPoint for Virtual Machines components



# ScaleIO topology

The drawing in this section shows the components of the ScaleIO topology.

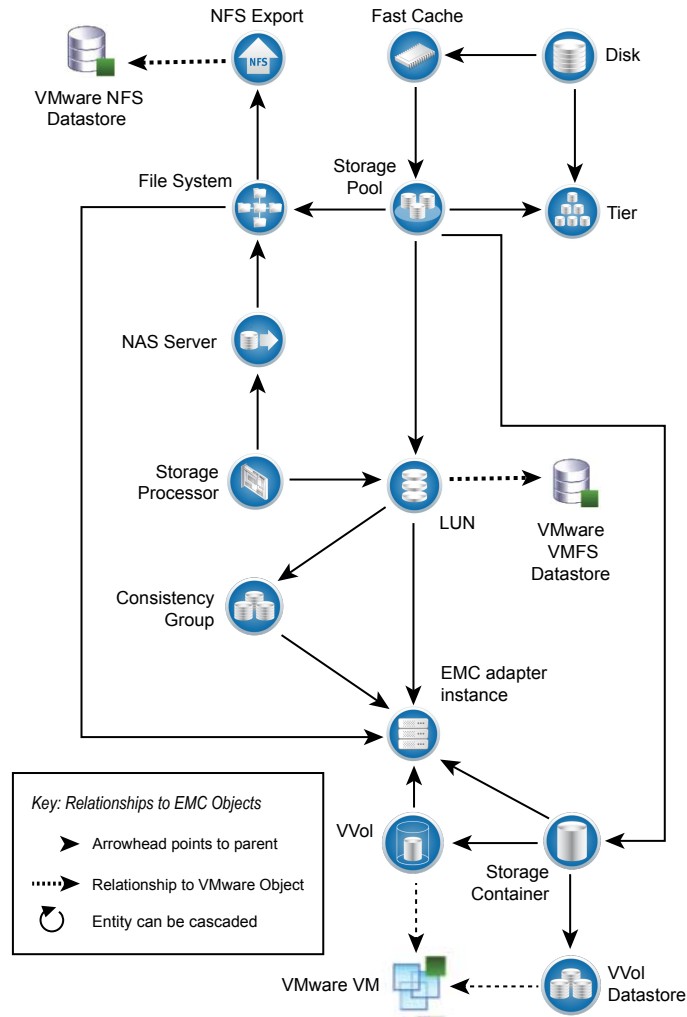
**Figure 21** ScaleIO components



# Unity topology

The drawing in this section shows the components of the Unity topology.

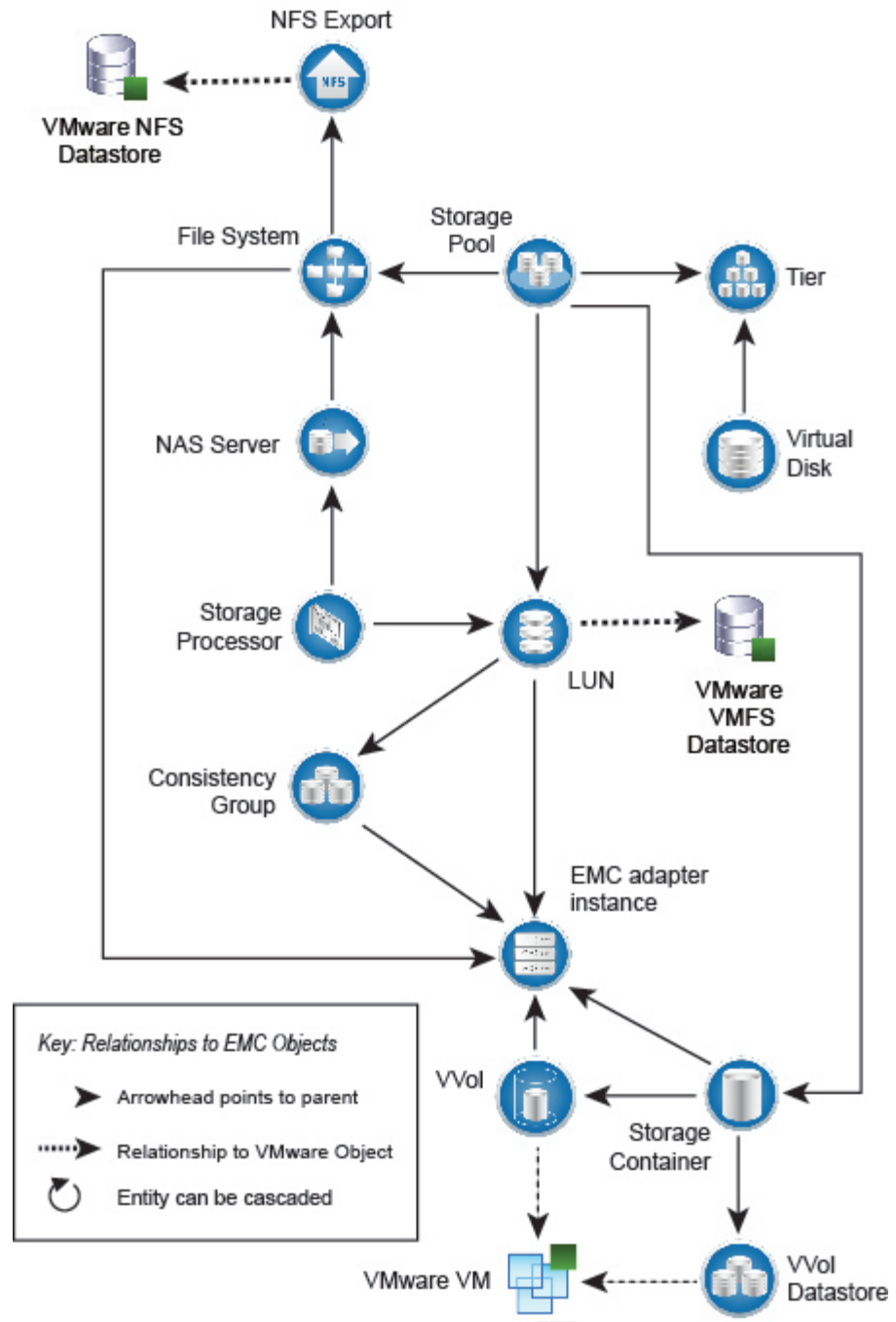
**Figure 22** Unity components



# UnityVSA topology

The drawing in this section shows the components of the UnityVSA topology.

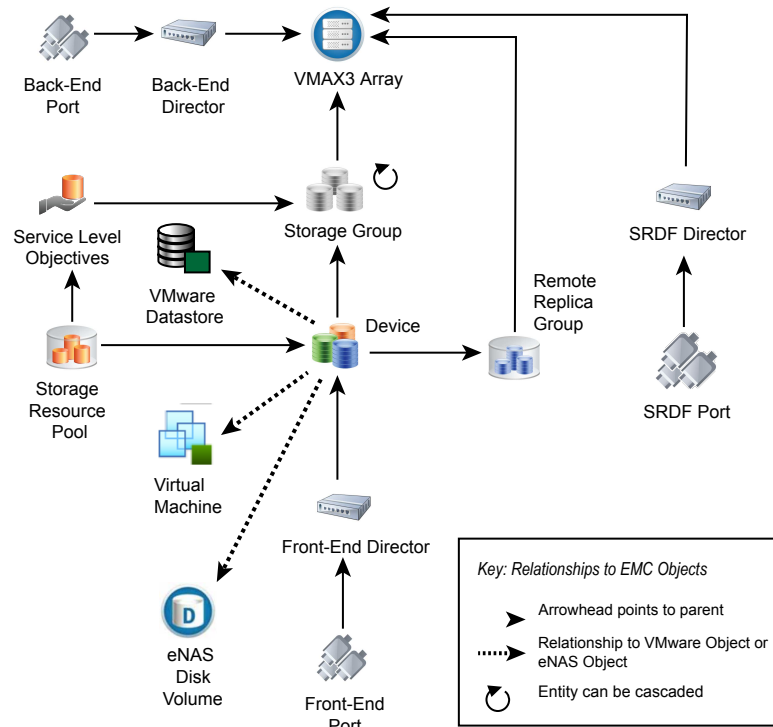
**Figure 23** UnityVSA components



## VMAX3 and VMAX All Flash topology

The drawing in this section shows the components of the VMAX topology.

**Figure 24** VMAX3 and VMAX All Flash components



## VMAX3 and VMAX All Flash topology rules

The rules in this section 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, eNAS, or VPLEX.
- 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.
- A VMAX device is displayed 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.

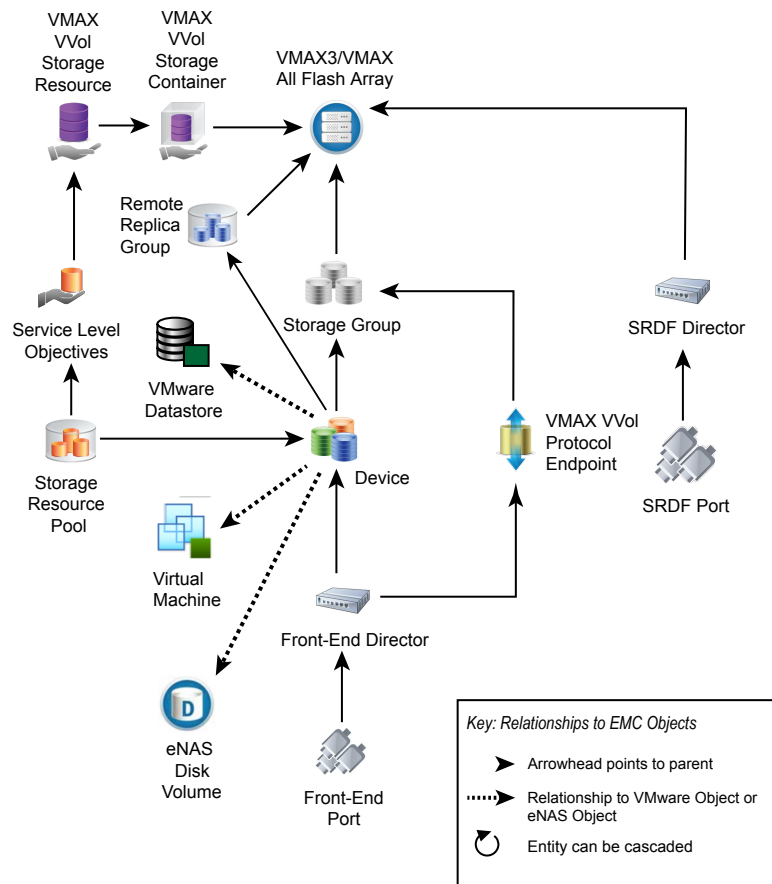
## VMAX VVol topology

The drawing in this section shows the components of the VMAX VVols topology.

### Note

Because of the limitations of both vRealize Operations and the VMAX VVol architecture, it is not possible to show the relationship between virtual machines, VVols, and the VMAX VVol Storage Resource.

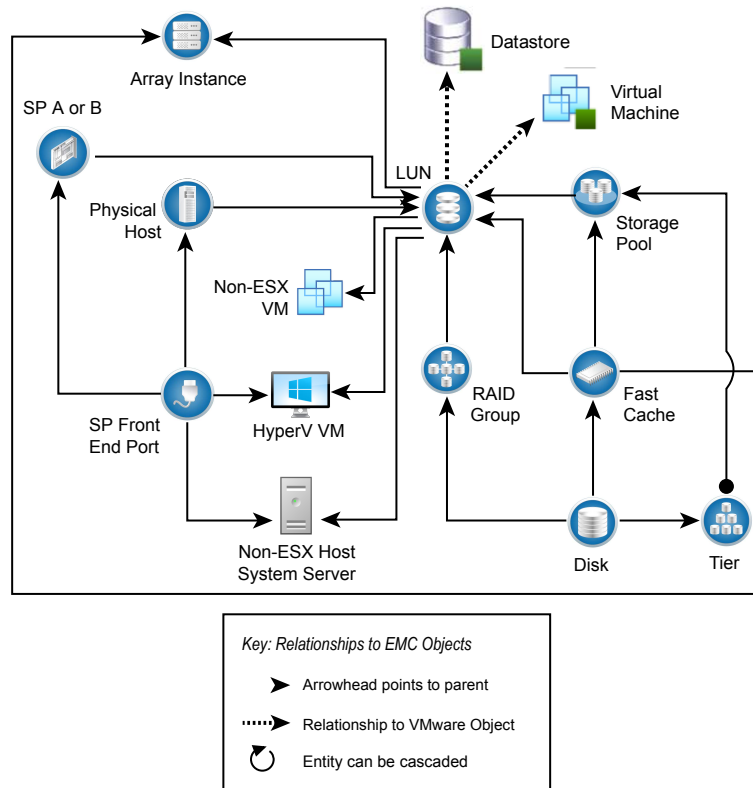
**Figure 25** VMAX VVol components



# VNX Block topology

The drawing in this section shows the components of the VNX Block topology.

**Figure 26** VNX Block components

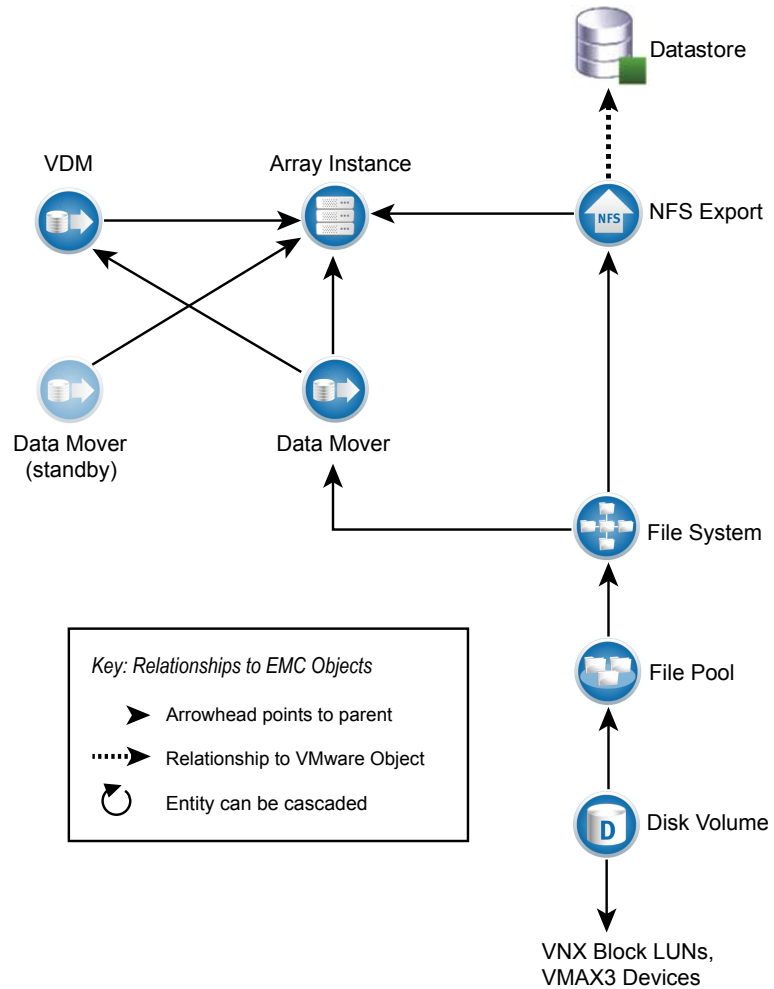




# VNX File/eNAS topology

The drawing in this section shows the components of the VNX File and eNAS topologies.

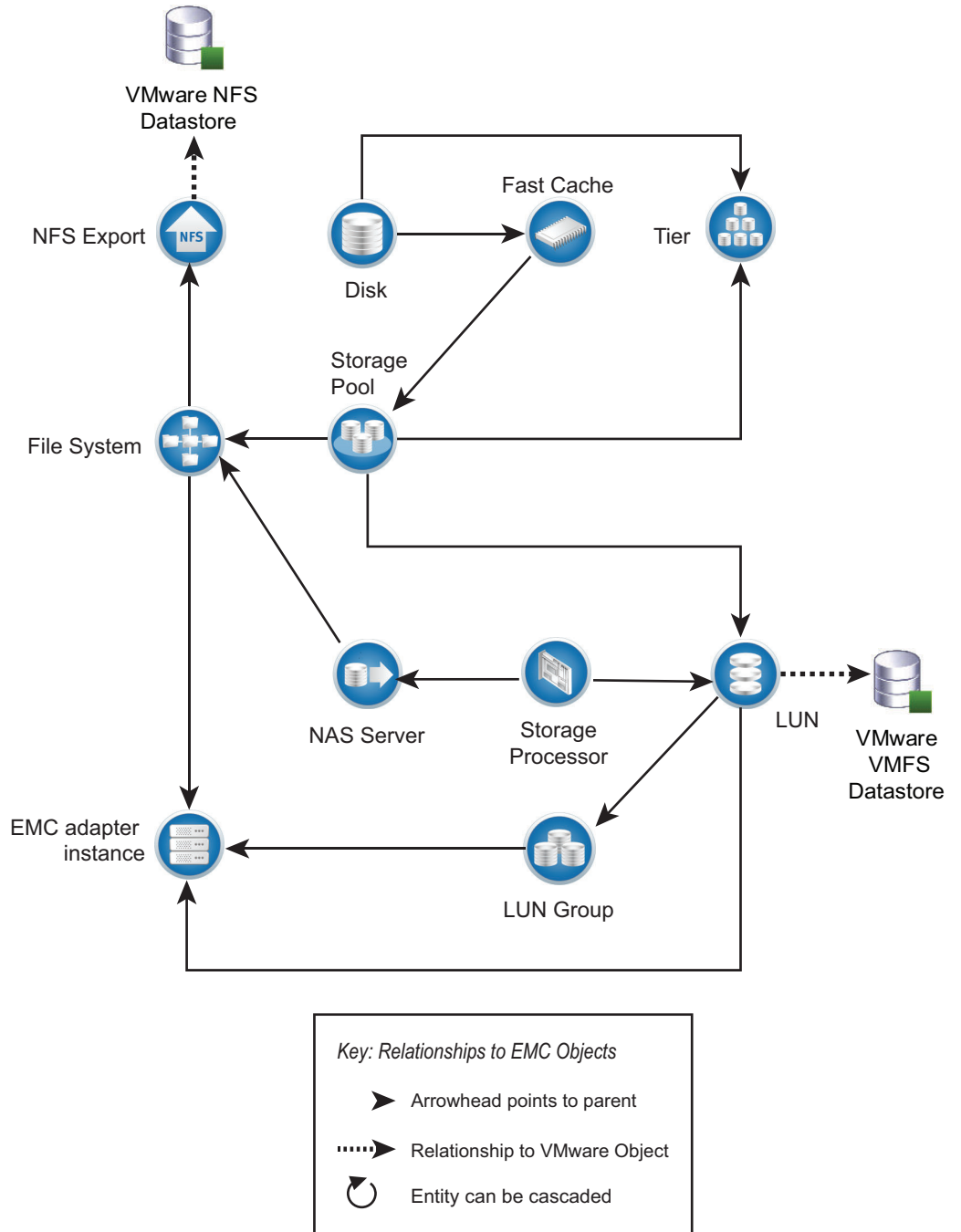
Figure 27 VNX File/eNAS topology



# VNXe topology

The drawing in this section shows the components of the VNXe topology.

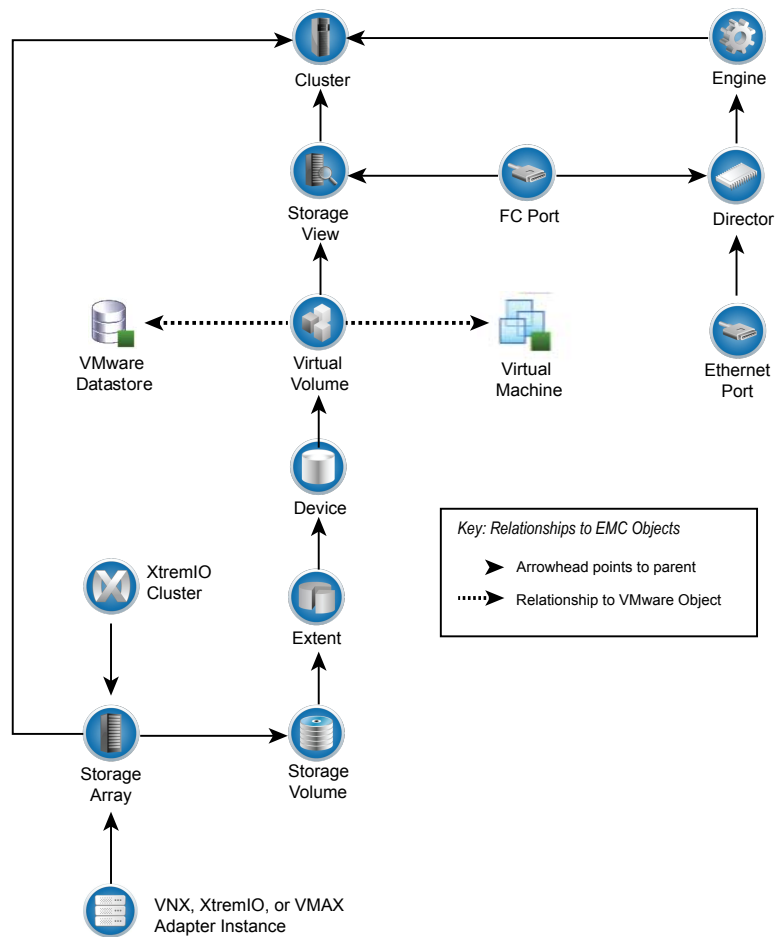
**Figure 28** VNXe components



# VPLEX Local topology

The drawing in this section shows the components of the VPLEX Local topology.

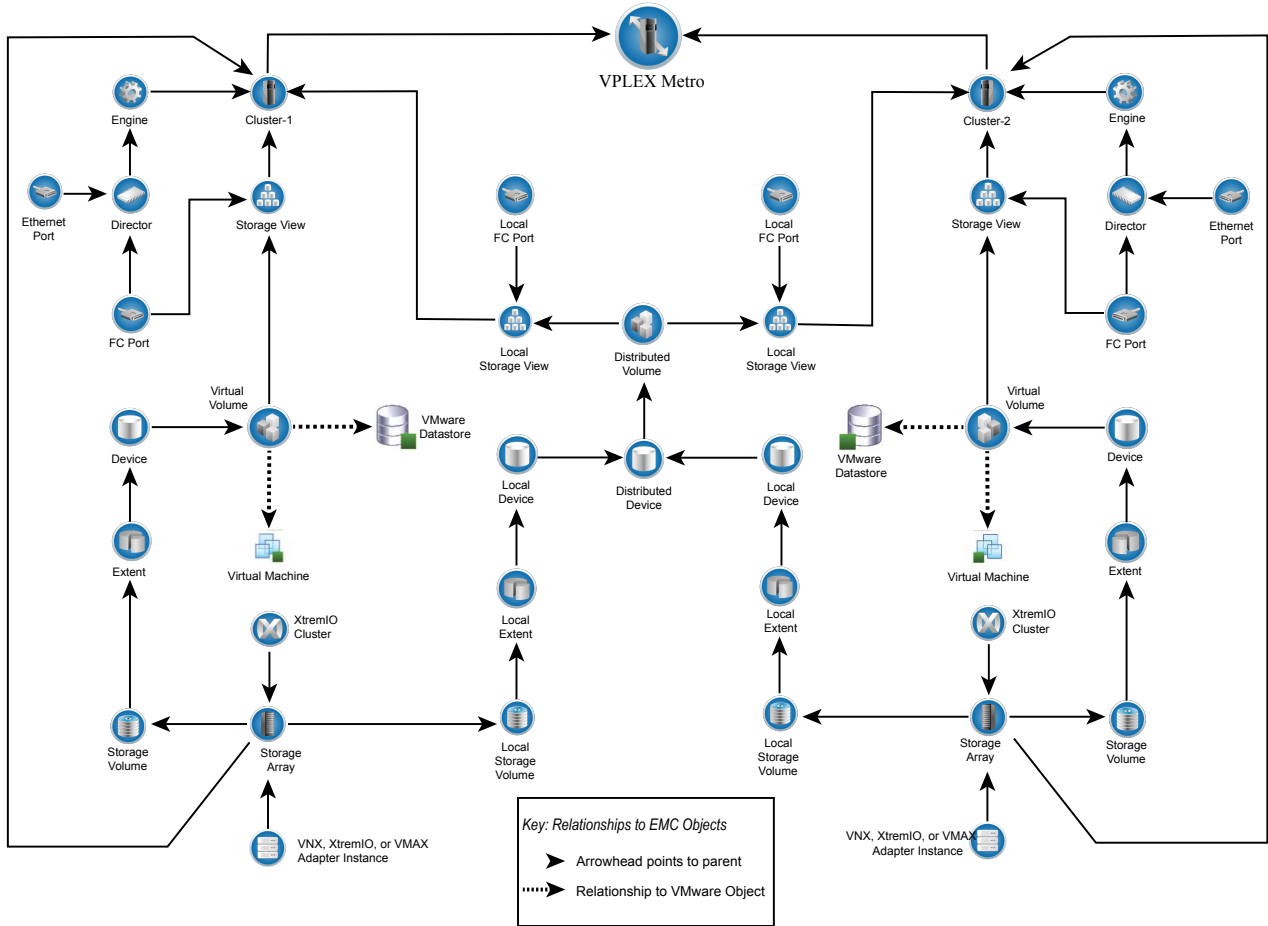
**Figure 29** VPLEX Local components



# VPLEX Metro topology

The drawing in this section shows the components of the VPLEX Metro topology.

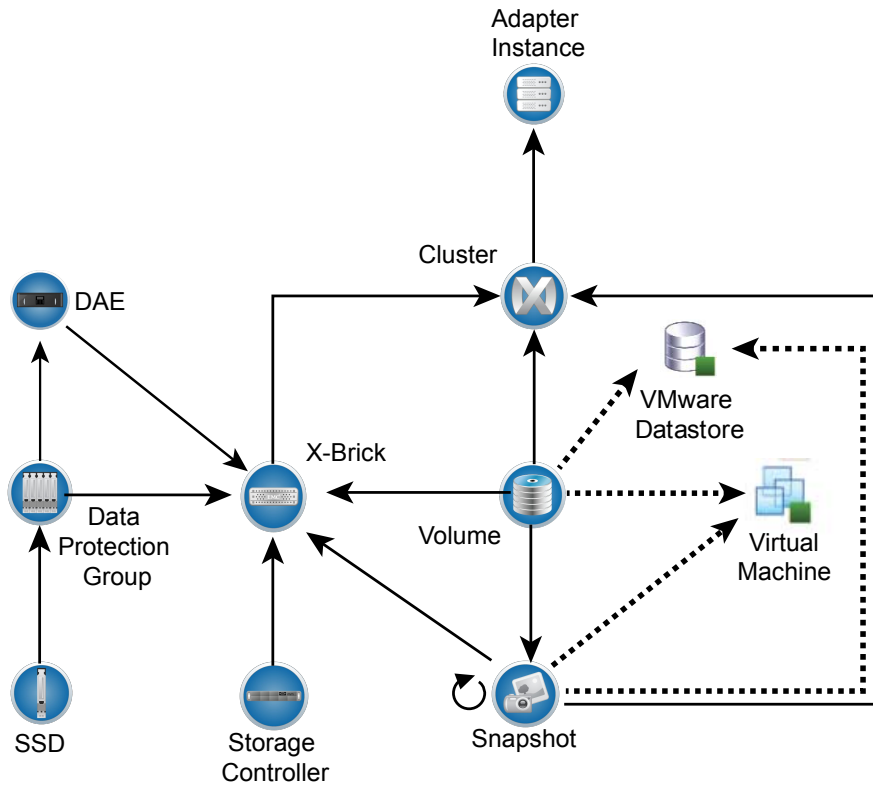
**Figure 30** VPLEX Metro components



# XtremIO topology

The drawing in this section shows the components of the XtremIO topology.

**Figure 31** XtremIO components



*Key: Relationships to EMC Objects*

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