Abstract
This white paper introduces Dell EMC® Unisphere Central™, a network application that enables administrators to remotely monitor multiple Dell EMC Unity™ Family, Dell EMC UnityVSA™, VNX™ Series, and VNZe™, EMC CLARiiON CX4™ Series and vVNX Series storage systems residing on a common network. This paper provides a detailed description of how to use this leading-edge application.

August 2019
Revisions

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2019</td>
<td>Unisphere Central V4.0 SP8 Release</td>
</tr>
</tbody>
</table>

The information in this publication is provided “as is.” Dell Inc. makes no representations or warranties of any kind with respect to the information in this publication, and specifically disclaims implied warranties of merchantability or fitness for a particular purpose.

Use, copying, and distribution of any software described in this publication requires an applicable software license.

Copyright © 2019 Dell Inc. or its subsidiaries. All Rights Reserved. Dell, EMC, Dell EMC and other trademarks are trademarks of Dell Inc. or its subsidiaries. Other trademarks may be trademarks of their respective owners. [8/1/19] [White Paper] [H13827.4]
# Table of contents

Revisions........................................................................................................................................2
Table of contents .............................................................................................................................3
Executive summary ............................................................................................................................5

1 Introduction .....................................................................................................................................6
   1.1 Audience ..................................................................................................................................6
   1.2 Terminology .............................................................................................................................6

2 Monitoring VNXe, CX4, vVNX, Dell EMC Unity, and Dell EMC Unity VSA Systems with Unisphere Central .............................................................7

3 Getting Started ..............................................................................................................................8
   3.1 System Requirements ...............................................................................................................8
   3.2 Storage Array Requirements ....................................................................................................8
   3.3 Download and Deploy the Unisphere Central OVF Template ..................................................9
   3.4 Configure Unisphere Central Server .......................................................................................9

4 Add VNXe, VNX, CX4, vVNX, Dell EMC Unity, and Dell EMC Unity VSA Systems to Unisphere Central ..........................................................11
   4.1 Verification of VNX AND CX4 Systems ..................................................................................11
   4.2 Verification of VNXe, vVNX, Dell EMC Unity, and Dell EMC Unity VSA Systems ..................12
   4.3 Alternative Method to Add VNXe, VVNX, Dell EMC Unity, and Dell EMC Unity VSA Systems to Unisphere Central ......................................................13
   4.4 Remove Storage Systems from Unisphere Central .................................................................14

5 Unisphere Central Graphical User Interface ..............................................................................16
   5.1 Dashboard Page ......................................................................................................................16
   5.2 Storage Systems Page ............................................................................................................19
   5.3 Tags .......................................................................................................................................20
   5.4 Profiles Page ..........................................................................................................................21
   5.5 Storage Menu ........................................................................................................................22
   5.6 Migration Sessions Page ........................................................................................................22
   5.7 Hosts Page .............................................................................................................................23
   5.8 Alerts Page .............................................................................................................................24
   5.9 Logs Page ...............................................................................................................................24
   5.10 Jobs Page ................................................................................................................................25
   5.11 Performance Page ................................................................................................................26
   5.12 Settings Menu ......................................................................................................................28
   5.13 Update Software Dialog .......................................................................................................30
   5.14 Preferences Dialog ...............................................................................................................30
   5.15 Support Dialog .....................................................................................................................31
### Table of contents

6  **Advanced Features** .............................................................................................................................. 33  
6.1  Predictive Pool Capacity Monitoring ................................................................................................. 33  
6.2  Single Sign-On (SSO) .......................................................................................................................... 34  
6.3  Profile-Based System Configuration .................................................................................................... 35  
6.4  Unified Search ...................................................................................................................................... 36  
6.5  Migration Support for Dell EMC Unity Systems .................................................................................. 37  
7  **Unisphere Central High Availability** .................................................................................................. 39  
8  **Conclusion** .......................................................................................................................................... 40  
A  **Technical support and resources** ........................................................................................................ 41  
A.1  Related resources .................................................................................................................................. 41  
B  **Performance Metrics** .......................................................................................................................... 42  
B.1  System Requirements with Metrics Collection Enabled .......................................................................... 42  
B.2  Metrics Configuration ........................................................................................................................... 42  
B.3  Performance Metrics ............................................................................................................................. 43
Executive summary

In the world of storage management, storage administrators need a way to access information quickly about their environment especially when it relates to critical systems. This can be a difficult task when an environment consists of multiple systems because navigating to each individual system would be time consuming and identifying the systems that need immediate attention is critical.

To address these concerns, Dell EMC® introduced Unisphere Central™, a network application that remotely monitors the status, activity, and resources of multiple VNX™ Series, VNXe™ Series, CLARiiON CX4™, vVNX, Unity™ Family and UnityVSA™ storage systems all from a central location. The Unisphere Central server obtains aggregated status, alerts, host details, performance and capacity metrics, and storage usage information from the systems. This allows administrators to take a quick look at their entire storage environment and rapidly access storage systems which are in need of attention or maintenance.
1 Introduction

This white paper describes the Unisphere Central interface and explains how storage administrators can easily monitor multiple VNXe, VNX, CLARiiON CX4™, vVNX, Dell EMC Unity and Dell EMC UnityVSA storage systems. Also, it describes the Unisphere Central features and provides general usage guidelines. For step-by-step instructions, refer to the Unisphere Central Online Help.

1.1 Audience

This white paper is intended for Dell EMC customers, partners, and employees who are considering using Unisphere Central to monitor VNXe, VNX, CLARiiON CX4™, vVNX, Dell EMC Unity (supported on both Flash and Hybrid) and Dell EMC UnityVSA storage systems. Dell EMC assumes the reader is at least an IT generalist with experience as a system or network administrator.

1.2 Terminology

- **Open Virtualization Format (OVF)** – A platform-independent, efficient, extensible, and open packaging and distribution format for virtual machines.
- **Unisphere** – An interface for managing individual storage systems like VNX, VNXe, vVNX, Dell EMC Unity and Dell EMC UnityVSA.
- **Unisphere Central** – A Unisphere virtual application that collects and aggregates status information from appropriately configured VNX, VNXe, CLARiiON CX4, vVNX, Dell EMC Unity, and Dell EMC UnityVSA systems on a network. The Unisphere Central server is deployed as an OVF template integrated within a VMware virtual environment.
- **Virtual Application (vApp)** – A container, such as a resource pool, that can contain one or more virtual machines. vApps also share some functionality with virtual machines in that they can be powered on and off, and be cloned.
Unisphere Central enables you to:

- Monitor up to 1000 VNXe, VNX, CX4, vVNX, Dell EMC Unity and Dell EMC UnityVSA systems for basic alerts and status information from a single interface.
- View aggregated alerts, system state, metrics storage, disk capacity, storage usage, and performance data for managed systems.
- Control access to the monitoring interface by setting up local Unisphere Central users or integrating existing Lightweight Directory Access Protocol (LDAP) enabled users and groups.
- Organize logical views of all system types based on user-defined tags; for example, by location, type, or department.
- Launch Unisphere for individual systems.
- Identify and display the hosts connected to these systems.
- Identify and display the storage resources used by hosts.
- Analyze storage capacity and performance metrics of monitored storage systems.
- Configure a single-stack (IPv4 or IPv6) or dual-stack (IPv4 and IPv6) network environment.
- Use Single Sign-On (SSO) functionality with VNXe3200 systems running code 3.1 or later, VNXe1600 systems, vVNX, Dell EMC Unity and Dell EMC UnityVSA systems.
- Initiate profile-based system configurations for VNXe3000 series systems running code 3.1.5 or later for VNXe1600 systems, and for VNXe3200, Dell EMC Unity and Dell EMC UnityVSA systems.
- View predictive capacity reports for storage pools.

The Unisphere Central environment consists of a Unisphere Central server running on an ESX/ESXi server (standalone or through vCenter), VNXe, VNX, CX4, vVNX, Dell EMC Unity and Dell EMC UnityVSA storage systems, and a remote system to access the Unisphere Central server (Figure 1).
3 Getting Started

3.1 System Requirements
The following resources are required for deploying and using Unisphere Central:

At least one 64-bit ESXi server that meets the following requirements:

<table>
<thead>
<tr>
<th>Component</th>
<th>Base Configuration</th>
<th>Recommended Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Memory</td>
<td>3 GB</td>
<td>&gt; 8 GB</td>
</tr>
<tr>
<td>Network Interfaces</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Storage</td>
<td>20 GB</td>
<td>&gt; 40 GB</td>
</tr>
</tbody>
</table>

The system requirements change when metrics collection is enabled in Unisphere Central. In this instance, please refer to Table 2 and Table 3 in the Performance Metrics section for more information.

Note: High Availability configurations are only available when using ESXi servers are managed by a vCenter server. A minimum of two ESXi servers are required.

- NTP server (optional but highly recommended).
- An HTML5 compatible web browser or compatible device like a tablet to view the Unisphere Central HTML5 GUI. Supported web browsers include:
  - Google Chrome (v33 or later)
  - Microsoft Internet Explorer (v10 or later)
  - Mozilla Firefox (v28 or later)
  - Apple Safari (v6 or later)

3.2 Storage Array Requirements
The following minimum code versions are required to add the storage arrays to Unisphere Central:

- VNXe systems running the following code versions:
  - VNXe OE MR2 2.2.0 and later
- VNX systems running the following code versions:
  - VNX Unified Systems:
    - VNX for Block OE 05.33 and VNX for File OE 7.1 and later
  - VNX Block-only Systems:
    - VNX for Block OE 05.33 and later
• CLARiiON CX4 systems running the following code versions:
  - Release 30 04.30.000.5.525
  - Release 30 04.30.000.5.526 and later

• vVNX systems running the following code versions:
  - vVNX OE 3.1.2 and later

• Dell EMC Unity systems running following code versions:
  - Dell EMC Unity OE 4.0.0 and later

• Dell EMC UnityVSA systems running the follow code versions:
  - Dell EMC Unity OE 4.0.0 and later

Note: VNX File-only systems and VNX Gateway systems are not supported.

3.3 Download and Deploy the Unisphere Central OVF Template
Unisphere Central is deployed as a virtual machine (VM) built from an OVF template in a VMware environment. You can download Unisphere Central from Dell EMC Online Support and assign the IP address of Unisphere Central while deploying the OVF template within vCenter or in the console of the VM when deploying the OVF template directly on an ESXi host.

The Dell EMC Unisphere Central Installation Guide, available from Dell EMC Online Support, provides detailed installation instructions for Unisphere Central.

3.4 Configure Unisphere Central Server
After you deploy Unisphere Central and power on the VM, point your browser to the IP address or domain name you specified during the installation.

Note: Unisphere Central installs with a default username, admin, and password, Password123#. When you first launch Unisphere Central, you are required to change the administrator password.

In the Settings dialog, you can configure the following components in the Management Settings section (Figure 2):

• Server Name (Network Settings Tab) – The name of the Unisphere Central server (optional).
• NTP servers (Time Servers (NTP) Tab) – A protocol used to synchronize the system clock with other nodes on the network (Highly recommended).
• DNS servers (DNS Servers Tab) – The network service that converts domain names to their corresponding IP addresses (Optional in IPv4 or IPv6 single-stack environments. Required in dual-stack IPv4/IPv6 environments).
• Security Policy (Security Policy Tab) – Select either manual verification (least secure) or automatic verification (most secure, default, and Dell EMC recommended). Security policy settings apply to VNXe, vVNX, Dell EMC Unity, and Dell EMC UnityVSA systems only.
  - For manual verification, only the IP address of the Unisphere Central server must be configured on the storage systems and the Unisphere Central administrator must verify the system manually before it can be monitored.
For automatic verification, the server hash and challenge phrase configured here are provided to the storage system and the identities of the Unisphere Central server and storage system are verified automatically when it connects to the Unisphere Central server. The Unisphere Central server and storage systems always communicate through SSL encrypted connections and authenticate each other by using X.509 certificates.
4  Add VNXe, VNX, CX4, vVNX, Dell EMC Unity, and Dell EMC UnityVSA Systems to Unisphere Central

Storage systems can be monitored by Unisphere Central without logging into each individual system. From the Systems > Storage Systems page, click the Add icon and select either Add VNXe, Add VNX, Add vVNX, Add CX4, Add Unity or Add UnityVSA depending on the model of your storage system. This opens the Add Storage System window (Figure 3). In this window, administrators can enter the IP address of one of their storage system’s storage processors (SPs), verify the SP certificate for initial communication, and provide admin credentials to add their storage system to Unisphere Central.

When adding a VNX or CX4 system, Unisphere Central discovers and adds all other systems included in the same local domain of the system being added. To keep track of Unisphere domains, Unisphere Central assigns system-defined tags. For more information on system-defined tags, please refer to the Tags section later in this document.

Administrators can also use the wizard to add Multiple Storage Systems of the same type to Unisphere Central consecutively. This is done by selecting the Multiple Storage Systems option, and browsing to a text file (*.txt) or a comma-separated value file (*.csv) containing a list of IP addresses (IPv4/IPv6). The list must be in the following format:

- <SP_IP1>
- <SP_IP2>
- <SP_IP3>
- <SP_IP4>

4.1  Verification of VNX AND CX4 Systems

For VNX and CX4 systems, after adding the system, verification is needed within Unisphere Central before the system is ready for monitoring. This is done by highlighting the added system in the Storage Systems list and clicking the Verify button in the task bar to display the Verify Storage Systems window (Figure 5). The verification process validates the certificates for every IP address associated with the system (i.e. SPA, SPB,
CS0, CS1). Once verification is complete, Unisphere Central starts to collect data pertaining to the selected system and monitors its activity.

### 4.2 Verification of VNXe, vVNX, Dell EMC Unity, and Dell EMC UnityVSA Systems

For VNXe, vVNX, Dell EMC Unity, and Dell EMC UnityVSA systems, verification of the system’s security certificate occurs automatically when Unisphere Central’s Security Policy (Figure 4) is set for **Automatic verification**, which means no manual configuration is required after the initial connection is established.

A challenge phrase is a string that the Unisphere Central server uses to identify VNXe, vVNX, Dell EMC Unity and, Dell EMC UnityVSA systems during the initial connection. This allows the Unisphere Central server to automatically confirm that this is a valid client request. When the initial SSL connection is made from the storage system to the Unisphere Central server, the server sends its certificate chain to the storage system. By providing this server hash string, the Unisphere Central server confirms its identity to the storage system.

In this way, the challenge phrase allows the Unisphere Central server to confirm the system’s identity, and the server hash allows the system to confirm the identity of the Unisphere Central server. This mutual identification is required only during the initial connection. After the initial connection, the server and the storage systems use standard X.509 certificates for mutual authentication.

![Configure Security Policy](image)

**Figure 4** Configure Security Policy

If the security policy is set for **Manual verification**, administrators must manually verify the storage system’s certificates just like for VNX and CX4 systems. An unverified system displays a padlock icon in the Storage Systems list. Selecting one or multiple unverified systems and clicking the Verify button brings up the Verify Storage Systems dialog (Figure 5).
Add VNXe, VNX, CX4, vVNX, Dell EMC Unity, and Dell EMC UnityVSA Systems to Unisphere Central

### 4.3 Alternative Method to Add VNXe, vVNX, Dell EMC Unity, and Dell EMC UnityVSA Systems to Unisphere Central

Storage systems can also be added to Unisphere Central using Unisphere.

- Log into the VNXe/vVNX/Unity/UnityVSA
  - For VNXe/vVNX – Select Settings > Management Settings, and click the Network tab.
  - For Unity/UnityVSA – Select Settings > Management > Unisphere Central.

- In the **Unisphere Central Configuration** section (Figure 6) for VNXe and (Figure 7) for Unity
  - For VNXe systems – Select the **Configure this VNXe (system) for Unisphere Central** checkbox, and type the Unisphere Central IP address.
  - For Dell EMC Unity systems – Select the **Configure this storage system for Unisphere Central** checkbox, and type the Unisphere Central IP address.

- If you set the security policy on the Unisphere Central server to Automatic, select the **Use additional security information from my Unisphere Central** checkbox.
  - Type the Unisphere Central **Server Hash**.
  - Type the Challenge Phrase.

- If you set the security policy on the Unisphere Central server to Manual, type only the IP address of Unisphere Central.
- Click **Apply changes** when finished.
Add VNXe, VNX, CX4, vVNX, Dell EMC Unity, and Dell EMC UnityVSA Systems to Unisphere Central

14 Unisphere Central Configuration

Unisphere Central Configuration
This VNXe system can be configured to use Unisphere Central, a network application that allows administrators to remotely monitor multiple VNXe systems through a single interface.

- Configure this VNXe for Unisphere Central
  - Unisphere Central IP: 
- Use additional security information from Unisphere Central
  - Where do I get this info?
  - Unisphere Central Server Hash: 
  - Challenge Phrase: 
  - Confirm Challenge Phrase: 

Figure 6  Unisphere Central Configuration in Unisphere for VNXe

4.4 Remove Storage Systems from Unisphere Central

To remove a VNXe, vVNX, CX4, VNX, Dell EMC Unity, and Dell EMC UnityVSA system from Unisphere Central, navigate to the Storage Systems page, select the system to be removed from the list, and click the Remove button (Figure 8).

Figure 7  Unisphere Central Configuration in Unisphere for Unity
Add VNXe, VNX, CX4, vVNX, Dell EMC Unity, and Dell EMC UnityVSA Systems to Unisphere Central

![Remove System Dialog]

Figure 8  Remove System Dialog
5 Unisphere Central Graphical User Interface

The following sections include details regarding the various pages that can be viewed in the Unisphere Central GUI.

5.1 Dashboard Page

The Dashboard page displays customizable view blocks for all monitored storage systems (Figure 9). Unisphere Central enables users to create, configure, and manage multiple dashboards. Each dashboard appears as a tab in the dashboard window and displays a set of views.

![Dashboard Page](image)

Figure 9  Dashboard Page

The Dashboard page can be configured to display multiple dashboards containing any combination of the following view blocks:

- **Alerts** – Displays a summary of alerts for all VNXe, vVNX, VNX, CX4, Dell EMC Unity, and Dell EMC UnityVSA systems that are monitored by Unisphere Central (Figure 10). Users can also customize the name of the view block, display the number of alerts within a specific time range, and display alerts with a specific tag. To customize, users need to hover over the view block and click **Configure** icon (gear icon). Clicking an alert icon brings the user to the **Alerts** page which is automatically filtered based on what is clicked.
Unisphere Central Graphical User Interface

![Alerts View Block](image1.png)

**Figure 10  Alerts View Block**

- **Capacity** – Provides a graphical summary of the storage capacity provisioned/used on the storage systems that Unisphere Central monitors (Figure 11). The storage capacity provisioned/used on the systems is represented as parts of a donut chart. Tooltips provide the value of each part of the chart by hovering over them. Users can also customize the name of the view block, display capacity of systems with a specific tag, as well as show capacity based on storage resource (i.e. File Systems, LUNs, etc).

![Capacity View Block](image2.png)

**Figure 11  Capacity View Block**

- **Pools** – Provides a snapshot view of 5 or 10 pools Unisphere Central monitors that have the most or least available size or percentage of available size (Figure 12). Users can change the name of the view block, customize how many pools are shown (5 or 10), show pools from systems with a specific tag, and change the chart type (most available, least available, most percentage, or least percentage). Users can also click a specific pool which brings them to the Pools page with the specified pool automatically highlighted.
• **Pools Running out of Space** – Provides a summary of the pools that are running out of space with an estimated time until each pool is full within a week, month, and quarter (Figure 13). Users can customize the name of the view block and display pools from systems with a specific tag. Note that users will only be able to see pool out of space information when Unisphere Central has metrics collection storage available and metrics collection is enabled on the storage systems. Clicking one of the categories brings the user to the Pools page which is filtered based on what is clicked.

• **Health & Inventory** – Shows the health state of all storage systems currently monitored by Unisphere Central including some of the resources available on the systems (Figure 14). Users can customize the name of the view block as well as display systems with a specific tag. Clicking a category brings the user to the specified page with applicable filters.
• **Tier Capacity** – Displays a summary of the free and used pool capacity in each tier of the storage pools (Figure 15). Users can customize the name of the view block and filter the systems by a specific tag.

![Tier Capacity View Block](image)

**Figure 15** Tier Capacity View Block

### 5.2 Storage Systems Page

The **Storage Systems** page under **Systems** provides a list of all monitored VNXe, vVNX, CX4, VNX, Dell EMC Unity, and Dell EMC UnityVSA systems (Figure 16). The list can be sorted in many different ways including severity status, name, model, and tags. In terms of basic functions, systems can be added, viewed (details), removed, verified, and tagged from this page. For advanced functionality, users may create configuration profiles for certain versions of VNXe, VNX, Dell EMC Unity, and Dell EMC UnityVSA systems. This is done using the profile-based system configuration feature which is explained in the Advanced Features section of this document.

The **Storage Systems** page also allows users to filter the list of managed systems by table column content by clicking the **Filter** icon. For example, users can filter systems based on certain severity levels like “Critical” and “Major Problem”. This is useful when there are hundreds of systems in an environment and an administrator wants to find the systems that need attention in a timely manner.

The **Export** icon allows users to export the list of systems to a CSV file. Lastly, the **Customize** icon allows users to add more columns of different categories for personalized reporting.
5.3 Tags

Storage systems monitored by Unisphere Central can have tags applied to them to help organize and identify the systems in a quick and efficient manner. This is done by highlighting one or multiple systems, clicking the Tags > Apply Tags button, creating/choosing the wanted tags, and clicking Apply. After a user assigns a tag to a managed system, they can filter systems by tags in the storage systems list or in the customizable view blocks on the Dashboard page.

To keep track of Unisphere domains for VNX and CX4 systems, Unisphere Central automatically assigns system-defined tags to every VNX and CX4 system. System-defined tags cannot be renamed, removed from any system, or deleted from Unisphere Central. These tags use the following format:

- VNX_domain_101, VNX_domain_102, VNX_domain_103, etc.

User-defined tags can be managed using the Tags > Manage Tags button. In the Manage Tags dialog, users can create new tags, rename tags, and delete tags (Figure 17).
5.4 Profiles Page

The Profiles page allows administrators to create configuration profiles of supported VNXe, Dell EMC Unity, and Dell EMC UnityVSA systems and push those profiles onto other VNXe, Dell EMC Unity, and Dell EMC UnityVSA systems so that they have the same settings (Figure 18). This is useful for administrators with many storage systems that are about to be deployed and need the same configuration. The page allows users to create, view, delete, apply, export, and import configuration profiles. Profiles can also be created and applied to systems through the Storage Systems page using the More Actions button.

For more information on the profile-based system configuration feature, see the Advanced Features section in this document.
5.5 Storage Menu

The **Storage** menu provides detailed information on storage use and configuration of the storage environment for the systems being monitored by Unisphere Central. The menu includes separate pages for each type of supported storage resource including Storage Pools, LUNs (Figure 19), LUN Groups, File Systems, VMware Datastores, Microsoft Hyper-V storage, and Microsoft Exchange storage. Each storage resource page has the ability to be filtered based on the available columns and can be exported to a CSV file.

![Figure 19 LUNs Page](image)

The frequency at which Unisphere Central collects storage and configuration data depends on the system type. For VNX and CX4 systems, Unisphere Central collects storage and configuration data once per hour unless it receives an alert, in which case Unisphere Central polls for alerts every 5 minutes. For VNXe, vVNX, Dell EMC Unity, and Dell EMC UnityVSA systems, data is collected once per hour regardless of alerts or health state changes. Data is retained until a monitored system or storage resource is removed.

Detailed information on each instance of a storage resource is also available in the following categories: general information, associated hosts, storage capacity, and storage pool utilization and associated disks.

5.6 Migration Sessions Page

The **Migration Sessions** page (Figure 20) allows the user to create, view, modify, and delete migration sessions of block resources from supported systems to Dell EMC Unity systems. This page and associated functions leverages the existing San Copy Pull feature on Dell EMC Unity systems to provide an easy migration user experience via Unisphere Central. Note that the initial connectivity setup including configuring systems connections are not orchestrated through Unisphere Central. Therefore, Unisphere Central assumes all initial setup work has been done successfully and provides an easy-to-follow GUI workflow to configure migration sessions to Dell EMC Unity systems.

More detailed information can be found in the *Migration Support for Dell EMC Unity Systems* section of this paper and step-by-step instructions to use the Migration Sessions page can be found in Unisphere Central Online Help.
5.7 Hosts Page

The Hosts page provides a list of hosts configured on the storage systems monitored by Unisphere Central (Figure 21). The information displayed for each host includes the health state, host name, system, description, network address, initiators, and operating system. Host data is collected once per hour and retained until a monitored host or storage system is removed. The host list can be filtered based on column content by clicking the Filter icon. Also, the list can be exported to a CSV file.
5.8 Alerts Page
The Alerts page provides a list of aggregated alerts from all storage systems being monitored by Unisphere Central (Figure 22). Users can use alerts to determine the source of an issue, symptoms and cause of the issue, and actions that can be done to resolve it. Any actions taken to resolve an alert must be performed directly on the system on which the alert was reported. The information displayed for each alert includes:

- Severity level
- Source storage system that generated the alert
- Log message
- Date and time
- Description

The alerts can be filtered by column content and the entire list can be exported to a CSV file by clicking the Export icon.

5.9 Logs Page
The Logs page provides a list of log messages/events that Unisphere Central generates to record errors, commands, and other information (Figure 23). The information displayed for each log includes:

- Severity level
- Date and time
- Source
- User that initiated the action
- Unique event identifier
- Description

The logs/events can be filtered by column content and the entire list can be exported to a CSV file.
5.10 Jobs Page

The Jobs page allows users to view information for Unisphere Central jobs including those that are active and those that are completed or failed (Figure 24). To quickly determine the number of active jobs (those queued or running) and view jobs progress, use the Jobs icon in the bottom status bar. The information displayed for each job includes:

- State
- Percentage complete
- Date and time started
- Action
- Description
- User of the server
- If applicable, date and time finished

The jobs can be filtered by column content and the entire list can be exported to a CSV file.
5.11 Performance Page

The **Performance** page allows users to view and interact with charts that display historical performance data for the storage systems currently being monitored by Unisphere Central. Figure 25 illustrates an example of a performance metrics chart. Users can use the charts to analyze storage system performance and diagnose any performance issues, such as:

- Compare changes in performance across multiple metrics like network traffic, bandwidth, and throughput
- Analyze data at both the aggregate and detailed levels
- Use preset or customized time ranges to view data collected within a specified time period
- Compare charts side-by-side in a 2 column layout

Before performance metrics can be seen, metrics collection must be enabled by allocating space for storing the collected metrics data. This is done using the **Create Metrics Storage** window available in the **Settings** dialog on the **Metrics** tab. Also, users can expand metrics storage by using the **Expand Metrics Storage** dialog. To display and analyze metrics data from VNX and CX4 systems, the system must have statistics logging enabled. The VNX Unisphere Online Help describes how to enable statistics logging. For additional metrics information and metrics storage sizing recommendations, refer to the **Performance Metrics** section.
Metrics are shown in Unisphere Central using line charts which display the aggregate information for a single metric statistic. The line chart shows the metric’s value along the y-axis and the user-specified time range on the x-axis. Users can hover over a data point on the line chart which displays a tool tip with the time, date, and measurement associated with that data point. Hovering over a data point on one chart enables tooltips for all other displayed charts (Figure 25).

The default time range displayed is All, and users can click other time range values (1 day, 1 week, 1 month, 6 months) using the links at the top of the page. A custom link is available to enter in specific start and end dates for viewing. Also, a navigator bar can be seen near the top of the page which allows ease of time control and affects all displayed charts. Lastly, next to the navigator bar is a refresh button which gathers the latest captured data to display in the charts.

Users can also break down the aggregated data into more detailed views by selecting applicable data contributors on the Configure dialog. The dialog can be found by clicking the gear icon when hovering over a specific chart. Figure 26 illustrates an Average CPU Utilization chart for which two contributors (SPA and SPB) have been selected. Each contributor shown is displayed as a different color line and users can quickly remove and add each contributor by clicking on its name in the legend. This filter process allows users to zero in on a subset of data. When a filter is applied to a line chart, the system redraws the chart to only show the metric values that reflect the filter criteria.
5.12 Settings Menu

The Settings menu, seen by clicking the Settings icon, allows users to configure Unisphere Central settings. The menu contains the following tabs under the Management Settings and Users & Groups tabs:

- **Network Settings** – Set up the server name and network settings for the Unisphere Central server.
- **Time Servers (NTP)** – Set up Network Time Protocol (NTP) settings to synchronize time with application hosts. The accuracy of time on the Unisphere Central server is important to proper function of Unisphere Central. It is highly recommended to configure an NTP server during the install process.
- **DNS Servers** – Set up Domain Name Servers (DNS) to resolve host names on a network. DNS Server(s) are required for dual-stack IPv4/IPv6 environments.
- **Security Policy** – Configure the security policy to specify how storage systems are verified when connecting to Unisphere Central. Automatic verification automatically verifies storage systems when they connect to Unisphere Central using a preconfigured security certificate hash and passphrase. Manual verification requires users to manually verify connected storage systems.
- **Metrics** – Configure and manage metrics storage (Figure 27). Use this tab to do the following:
  - Start metrics collection if collection was not automatically started after storage creation
  - Create, expand, and delete metrics storage
  - View current metrics storage usage
  - Monitor the status of storage allocation
  - Change the time schedule for data retention
• **Users & Groups** – Create, modify, and delete users and user groups. The user roles available for Unisphere Central are operator and administrator. Note that a user must have administrator privileges to see and manage the users and groups list.

• **Directory Services** – Configure and manage LDAP server certificates through this page. LDAP helps centralize the management of network authentication and authorization operations. Integrating Unisphere Central users into an existing LDAP environment provides a way to control management access based on established user and group accounts within the LDAP directory. When this is setup, a user can utilize an advanced feature called Single Sign-On (SSO). Please see the Advanced Features section for more information.
5.13 Update Software Dialog
The **Update Software** dialog, seen by clicking the **Settings** icon, lets users update Unisphere Central system software (Figure 28), configure available language packs, and view support system versions.

![Update Software Page](image)

Figure 28  Update Software Page

For upgrading system software, there can only be one update candidate file on the system at a time. Dell EMC highly recommends that users do not use the Unisphere Central server user interface during an update. Also, Unisphere Central may be temporarily disconnected during the update, but automatically reconnects after the update. Before upgrading, users can use vSphere to create a current snapshot of the Unisphere Central VM and use the snapshot to revert the Unisphere Central server to a previous version if needed.

5.14 Preferences Dialog
The **Preferences** dialog, seen by clicking the **Preferences** icon, allows users to modify user preference settings including:

- **Preferences** – Set graphical interface user language, optimize the server for remote management access, and clear user cache (0). Note that language packs need to be downloaded and installed before they can be chosen in this dialog.
- **Change Password** – Change the password of the currently logged in user account.
- **Logout** – Log out of the current user session. If Single-Sign On (SSO) is enabled, all other user sessions currently managed through SSO are logged out as well.
5.15 Support Dialog

The Support dialog, seen by clicking the Help icon, provides user access to the many support options available to Unisphere Central including:

- **Support** – Provides instant access to online support information and communities. It is a central location for self-help resources and it provides links to resources where users can learn about and get assistance with Unisphere Central.

- **Service EMC Unisphere Central** – Diagnose, troubleshoot, and repair the Unisphere Central server through this dialog (Figure 30). To access this dialog, users must type the service password which is configured during installation. The page provides tools to collect service information to assist a service provider with a service request, export metrics data, change the service password, enable/disable Secure Shell (SSH), and reboot the server.
- **Online Help** – Central repository for all help topics and procedures. From this repository, users can locate a wide variety of information including instructions for monitoring systems, detailed explanations, and instructions for servicing Unisphere Central.

- **Help for <Page>** – When navigating through the Unisphere Central interface, users can access this help link to be redirected directly to a page-specific help topic in the Unisphere Central Online Help. Also, window dialogs provides a help icon that serves the same purpose as the help link.

- **About** – Provides the current version number of the Unisphere Central server.
Advanced Features

Unisphere Central is a useful tool for monitoring VNXe, vVNX, Dell EMC Unity and Dell EMC Unity VSA storage systems in a customer’s environment. Beyond this basic functionality of the server, Unisphere Central offers administrators an extra feature set for different use cases. The advanced features available to Unisphere Central are:

- Predictive pool capacity monitoring
- Single Sign-On (SSO)
- Profile-based system configuration
- Unified search
- Migration support for Dell EMC Unity

6.1 Predictive Pool Capacity Monitoring

Within the Pools page, there is a column available to users called Days to Full (Figure 31). The column displays the predicted number of days until there is no more space in the configured pools on the monitored systems. The column can be displayed by clicking the Customize icon and selecting it for display in the table.

The feature helps users monitor the amount of space remaining on pools in their storage environment and plan for future capacity needs. On the Dashboard page, users can also display a Pools Running out of Space view block which predicts pools being full in the following ways:

- Within a week (7 days)
- Within a month (8-30 days)
- Within a quarter (31-90 days)

To use the feature, users must have metrics collection enabled and metrics storage available through the Create Metrics Storage wizard as well as metrics/statistics collection enabled on monitored storage systems. Also, Unisphere Central needs a minimum of 7 days of historical capacity metrics before making a prediction for a pool.
Advanced Features

Unisphere Central uses a forecasting algorithm that identifies repeated patterns to predict future events. The algorithm starts forecasting on the 8th day (after 7 days of historical capacity metrics data collection) with daily patterns and can identify future patterns as data accumulates. A full quarter forecast would be available after 15 months of collected data. The forecasting algorithm runs once per day.

6.2 Single Sign-On (SSO)

The Single Sign-On (SSO) feature provides an easy way to log into VNXe (version 3.1 or later), vVNX, Dell EMC Unity, and Dell EMC UnityVSA systems without requiring the user to re-authenticate. SSO eliminates the time needed to enter usernames and passwords to manage individual systems and brings ease of management to administrators. Using SSO, users can:

- Log into Unisphere Central, then select and launch Unisphere on a VNXe system, vVNX, Dell EMC Unity, or Dell EMC UnityVSA system without re-authenticating.
- Log into a storage system, open another browser window, and launch another Unisphere session for a different storage, by entering the URL of that system, without having to re-authenticate.

The following are the requirements to use SSO:

- Unisphere Central server version 4.0.1 or later.
- VNXe/vVNX systems (running version 3.1 or later) or Unity/UnityVSA system.
- Both Unisphere Central storage systems must be configured for the same AD/LDAP directory (Figure 32).
- LDAP user must be directly mapped to a Unisphere role for both Unisphere Central and storage systems.
- Each storage system must have SSO enabled.
- User must log in using an LDAP user.

Additionally, the feature provides a Single Sign-Off capability to users which allows the ability to log off of all systems in an SSO environment from a single system. For more information on enabling SSO, please see the *Unity Security Configuration Guide* on Dell EMC Online Support.
6.3 Profile-Based System Configuration

The profile-based system configuration feature allows users the ability to capture the system configuration of a VNXe/Unity/UnityVSA system monitored by Unisphere Central by creating a profile (Figure 33) and using that profile to apply (push) the same configuration to other storage systems of the same model. This feature is useful for administrators with many newly deployed storage systems in their environment that require the same configurations. Note that users will have to use the local admin account to create system profiles. Although, if SSO is enabled, users will have to use a configured LDAP admin user to create a system profile. Profile-based system configuration supports the following configuration settings:

- DNS
- NTP
- Alerts
- LDAP
- Security
- SMTP Server
- Support
- Location
- User

Depending on the configuration, the following additional tabs are displayed:

<table>
<thead>
<tr>
<th>System OE version</th>
<th>Additional tab or tabs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unity</td>
<td>Role, FAST Cache, FAST VP, Storage Pool</td>
</tr>
<tr>
<td>UnityVSA</td>
<td>Role, FAST VP, Storage Pool</td>
</tr>
<tr>
<td>VNXe 3.1.3</td>
<td>Role, FAST Cache</td>
</tr>
<tr>
<td>VNXe 3.1.x, Excluding 3.1.3</td>
<td>Role, FAST VP, Storage Pool</td>
</tr>
<tr>
<td>VNXe 2.4</td>
<td>DNS Configuration, Storage Pool</td>
</tr>
</tbody>
</table>

Configuration profiles can be created, deleted, applied, imported, and exported from the Profiles page under the Systems menu. Exported profiles are saved in a JSON format and can be imported to other Unisphere Central server instances. Profiles can also be created and applied through the Storage Systems page through the More Actions menu.

The following are the requirements to use the profile-based system configuration feature:

- Unisphere Central server version 4.0.1 or later.
- VNXe systems (running version 2.4 or later) or Unity/UnityVSA systems.
- To push FAST Cache settings, there must be available flash disks on the destination system.
- To push Storage Pool configurations, the following conditions must be met:
  - No Storage Pools can currently be configured on the destination system.
  - The destination system must have the available disks and necessary spare disks for the Storage Pool configurations.
Note: Storage Pool configuration capture is not supported for VNXe1600 systems.

6.4 Unified Search

Unisphere Central includes a unified search feature which allows users to search for objects based on string text criteria. This adds convenience when trying to find a particular object’s page or finding related objects for various purposes. The feature can be used by clicking the **Search** icon at the top right of the Unisphere Central interface and inputting the search criteria (Figure 34).
6.5 Migration Support for Dell EMC Unity Systems

In the release of Unisphere Central v4 SP8, the support for migration of block resources to Dell EMC Unity systems was introduced. This feature provides a user-friendly front-end mechanism to migrate block data to Dell EMC Unity systems from supported arrays like SC Series systems. The feature utilizes the existing SAN Copy Pull feature on Dell EMC Unity systems so the same feature restrictions and limitations apply, but since SAN Copy Pull is currently a CLI-only feature on Dell EMC Unity, Unisphere Central provides a more enhanced user experience by initiating migration sessions through an easy-to-follow GUI wizard. Note that Unisphere Central does not provide management capabilities for this feature so all pre-requisites for SAN Copy Pull and migration sessions must be completed prior to initiating a new migration session within Unisphere Central.

To utilize SAN Copy Pull for Dell EMC Unity systems to migrate block data, the Dell EMC Unity system must be running OE 4.4 or later and the system connections from the source array should be connected either via iSCSI or FC connections. For more detailed information and step-by-step instructions on initial system connection setup, see the white paper titled Dell EMC Unity Migration Technologies and the user guide titled Dell EMC Unity Family Third-Party System Migration using SAN Copy Pull on Dell EMC Online Support.

Once system connectivity is established between a Dell EMC Unity system and source array and the destination resource has been created successfully, then a new migration session can be initiated directly from Unisphere Central instead of through Unisphere CLI. Note that the Dell EMC Unity system must be added as a monitored system within Unisphere Central, but the source array does not need to be monitored. To start a new migration session, go to the Migration Sessions page and click on the Add button. The corresponding wizard (as seen in Figure 35) then guides the user to initiate the new migration session and provides different session options like “I/O Rate” for migration data transfer speed throttling and “Session Tag” for session tracking purposes.

![Create Migration Session Wizard](image-url)
Once the session is running successfully, the corresponding properties window displays detailed information like Size Remaining for data transfer and Estimated Time of Completion (as seen in Figure 36). Migration session(s) information within the **Migration Sessions** page is automatically updated every 5 minutes. To manually refresh and pull the latest migration session information for a specific session, should close and reopen the properties window for that session.

![Migration Session Details Page](image-url)
Unisphere Central High Availability

Unisphere Central Server software runs on a dedicated virtual machine. This is hosted on a VMware ESXi host. High availability (HA) configurations are only available when using ESX servers are being managed by a VMware vCenter server. A minimum of two ESX servers are required.

To achieve HA, Unisphere Central takes advantage of VMware HA support provided by the VMware vSphere environment. VMware HA is a feature of the host cluster. The vSphere environment provides several levels of high availability:

- **Host-level High Availability** – For the highest level of HA, Unisphere Central runs in a cluster of (at least) two hosts. This is the recommended HA level for Unisphere Central services. At any given moment, the Unisphere Central Server VM runs on a single host. When vSphere detects failure of the current Unisphere Central host (loss of heartbeat), or the failure of the Unisphere Central VM, the Unisphere Central VM is restarted on the other host in the cluster. For this level of HA, the Unisphere Central VM must reside on storage shared by both hosts.

- **VM-level High Availability** – When only a single host is available for Unisphere Central, HA still can be configured; however, it does not protect against ESX failures. In this case, the Unisphere Central host must still be a part of the single-host cluster, which is configured properly for HA. When vSphere detects a VM failure (loss of heartbeat), the VM is restarted on the same host.

- **Application-level High Availability** – Application-level HA in the Unisphere Central virtual machine is handled internally. No user setup is required. However, if the Unisphere Central virtual machine fails more than three times in 10 minutes, it is not restarted anymore. In that situation, the administrator needs to reboot the Unisphere Central virtual machine using the vSphere GUI. If that does not help, the VM is apparently corrupted and needs to be restored from a previously backed-up virtual machine snapshot.

The *Dell EMC Unisphere Central Installation Guide*, located on the Dell EMC Online Support website, provides more information about HA configurations in vSphere.
Conclusion

Unisphere Central was designed with the philosophy of “keep it simple.” It provides remote monitoring of the status, activity, and resources of multiple VNXe, VNX, CX4, vVNX, Dell EMC Unity, and Dell EMC UnityVSA systems and the hosts connected to those resources making it easier for administrators to oversee their environment.

Unisphere Central’s support ecosystem puts a world of resources at the administrator’s fingertips. Comprehensive online documentation, help, training, and how-to videos are provided to expand the user’s knowledgebase and answer questions. All these features make Unisphere Central a powerful and easy-to-use tool.
A  Technical support and resources

Dell.com/support is focused on meeting customer needs with proven services and support.

Storage technical documents and videos provide expertise that helps to ensure customer success on Dell EMC storage platforms.

A.1  Related resources

The following resources can be found on Dell EMC Online Support:

- Introduction to the EMC VNX2 Series – A Detailed Review
- Introduction to the EMC VNXe1600 – A Detailed Review
- Introduction to the EMC VNXe3200 – A Detailed Review
- Introduction to the VNX Series – VNX5100, VNX5300, VNX5500, VNX5700, and VNX7500
- Dell EMC Unity: Introduction to Platform
- Dell EMC Unity XT: Introduction to the Platform
- Dell EMC Unity: Operating Environment (OE) Overview
- Dell EMC UnityVSA
- Unisphere Central 4.0 Installation Guide
B Performance Metrics

Unisphere Central gathers metrics from the monitored VNXe, VNX, CX4, vVNX, Dell EMC Unity and Dell EMC UnityVSA storage systems and displays them in the Performance page.

The metrics functionality requires additional storage space to store the data collected from the storage systems. This storage space is allocated from a VMware Datastore to the Unisphere Central vApp using a simple wizard.

Note: To display and analyze metrics data from VNX systems, the VNX system must have statistics logging enabled. The VNX Unisphere Online Help describes how to enable statistics logging.

B.1 System Requirements with Metrics Collection Enabled

Due to the increased processing power required by Unisphere Central when metrics collection is enabled, the ESX server must meet the requirements listed in Table 3 and Table 4.

<table>
<thead>
<tr>
<th>SYSTEM REQUIREMENTS</th>
<th>SMALL</th>
<th>MEDIUM</th>
<th>LARGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISKS</td>
<td>5000</td>
<td>10000</td>
<td>20000</td>
</tr>
<tr>
<td>VCPU</td>
<td>2</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>MEMORY (GB)</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>RECOMMENDED STORAGE SIZE (GB)</td>
<td>25</td>
<td>65</td>
<td>120</td>
</tr>
</tbody>
</table>

Table 4 Metrics Collection Enabled

<table>
<thead>
<tr>
<th>STORAGE ENVIRONMENT SIZE</th>
<th>SMALL</th>
<th>MEDIUM</th>
<th>LARGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYSTEMS (VNX AND CX4)</td>
<td>10</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>SYSTEMS (VNXE)</td>
<td>75</td>
<td>150</td>
<td>300</td>
</tr>
<tr>
<td>SYSTEMS (DELL EMC UNITY)</td>
<td>75</td>
<td>150</td>
<td>300</td>
</tr>
<tr>
<td>STORAGE RESOURCES (LUNS, FILE SYSTEMS)</td>
<td>10000</td>
<td>25000</td>
<td>50000</td>
</tr>
</tbody>
</table>

The total number of objects in small, medium, or large VNXe/Unity environments is substantially lower than the number of objects in the corresponding VNX or CX4 environments. As a result, the recommended storage size provides more than enough metrics storage for VNXe/Unity environments.

B.2 Metrics Configuration

Before users can use the metrics functionality, metrics collection must be enabled and users must allocate an initial amount of space for storing the collected metrics using the Create Metrics Storage wizard located in the Metrics tab of the Settings dialog. During the wizard, users can set the metrics data retention period.
Unisphere Central allocates approximately 10 GB of storage immediately and the remainder of the storage in a background process.

**Note:** You must allocate storage space before you can enable metrics collection.

Users can monitor metrics storage space utilization using the **Metrics** tab. If needed, users can expand the metrics storage by using the **Expand Metrics Storage** dialog.

### Table 5  Metrics Data Retention Period

<table>
<thead>
<tr>
<th>SAMPLING INTERVAL</th>
<th>DEFAULT RETENTION PERIOD</th>
<th>MAXIMUM RETENTION PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 MINUTES</td>
<td>2 weeks</td>
<td>4 weeks</td>
</tr>
<tr>
<td>1 HOUR</td>
<td>12 weeks</td>
<td>12 weeks</td>
</tr>
<tr>
<td>1 DAY</td>
<td>52 weeks</td>
<td>104 weeks</td>
</tr>
</tbody>
</table>

### B.3 Performance Metrics

The Performance page allows users to view performance metrics for monitored VNXe, VNX, CX4, vVNX, Dell EMC Unity, and Dell EMC UnityVSA systems in the environment. Table 6 and Table 7 list out the available VNXe 3.x/Unity and VNX performance metrics that are available, respectively. For a complete list of metrics that can be collected by Unisphere Central, see Unisphere Central Online Help.

#### Table 6  Available VNXe /Unity Performance Metrics

<table>
<thead>
<tr>
<th>RESOURCE</th>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CACHE*</td>
<td>Cache Dirty Size</td>
<td>Amount of data in the write cache, in MB, that has not yet been flushed out to disks.</td>
</tr>
<tr>
<td></td>
<td>FAST Cache Dirty Pages</td>
<td>Ratio of dirty pages to total pages in the storage processor FAST Cache, expressed as a percent.</td>
</tr>
<tr>
<td></td>
<td>Total SP Cache Throughput</td>
<td>Total number of I/O requests, in I/O per second, passing through the storage processor cache.</td>
</tr>
<tr>
<td>CIFS</td>
<td>Average CIFS I/O Size</td>
<td>Average size of CIFS I/O requests, in KB, across all ports in the storage system.</td>
</tr>
<tr>
<td></td>
<td>Total CIFS Bandwidth</td>
<td>Total amount of CIFS I/O requests, in KB/s, across all ports in the storage system.</td>
</tr>
<tr>
<td></td>
<td>Total CIFS Throughput</td>
<td>Total number of CIFS I/O requests, in I/O per second, across all ports in the storage system.</td>
</tr>
<tr>
<td>CPU</td>
<td>Average CPU Utilization</td>
<td>Total amount of processing cycles, as a percentage, across all cores in the storage system SPs.</td>
</tr>
<tr>
<td>DISK*</td>
<td>Average Disk Queue Length</td>
<td>Average number of disk I/O requests in the system queue, across all disks in the storage system.</td>
</tr>
<tr>
<td></td>
<td>Average Disk Response Time</td>
<td>Average time spent completing disk I/O requests, in microseconds, across all disks in the storage system, including time spent in the queue.</td>
</tr>
<tr>
<td></td>
<td>Average Disk Service Time</td>
<td>Average time spent completing disk I/O requests, in ms, across all disks in the storage system, not including time spent in the queue.</td>
</tr>
<tr>
<td></td>
<td>Total Disk Bandwidth</td>
<td>Total amount of disk I/O requests, in KB/s, across all disks in the storage system.</td>
</tr>
<tr>
<td></td>
<td>Total Disk Throughput</td>
<td>Total number of disk I/O requests, in I/Os per second, across all disks in the storage system.</td>
</tr>
</tbody>
</table>
### Performance Metrics

<table>
<thead>
<tr>
<th><strong>FC</strong></th>
<th><strong>FILE SYSTEM</strong></th>
<th><strong>DESCRIPTION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Fibre Channel Bandwidth</td>
<td>Total amount of Fibre Channel I/O requests, in KB/s, across all ports in the storage system</td>
<td></td>
</tr>
<tr>
<td>Total Fibre Channel Throughput</td>
<td>Total number of Fibre Channel I/O requests, in I/O per second, across all ports in the storage system</td>
<td></td>
</tr>
<tr>
<td>Average File System I/O Size</td>
<td>Average size of file system I/O requests, in KB, across all file systems in the storage system</td>
<td></td>
</tr>
<tr>
<td>Total File System Bandwidth</td>
<td>Total amount of file system I/O requests, in KB/s, across all file systems in the storage system</td>
<td></td>
</tr>
<tr>
<td>Total File System Throughput</td>
<td>Total number of file system I/O requests, in I/O per second, across all file systems in the storage system</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>ISCSI</strong></th>
<th><strong>DESCRIPTION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total iSCSI Bandwidth</td>
<td>Total amount of iSCSI I/O requests, in KB/s, across all ports in the storage system</td>
</tr>
<tr>
<td>Total iSCSI Throughput</td>
<td>Total number of iSCSI I/O requests, in I/O per second, across all ports in the storage system</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>LUN</strong></th>
<th><strong>DESCRIPTION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average LUN I/O Size</td>
<td>Average size of LUN I/O requests, in KB, across all LUNs in the storage system</td>
</tr>
<tr>
<td>Average LUN Queue Length</td>
<td>Average number of LUN I/O requests in the system queue across all LUNs in the storage system</td>
</tr>
<tr>
<td>Average LUN Response Time</td>
<td>Average time spent completing LUN I/O requests, in microseconds, across all LUNs in the storage system</td>
</tr>
<tr>
<td>Total LUN Bandwidth</td>
<td>Total amount of LUN I/O requests, in KB/s, across all LUNs in the storage system</td>
</tr>
<tr>
<td>Total LUN Throughput</td>
<td>Total number of LUN I/O requests, in I/Os per second, across all LUNs in the storage system</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>NFS</strong></th>
<th><strong>DESCRIPTION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average NFS I/O Size</td>
<td>Average size of NFS I/O requests, in KB, across all ports in the storage system</td>
</tr>
<tr>
<td>Total NFS Bandwidth</td>
<td>Total amount of NFS I/O requests, in KB/s, across all ports in the storage system</td>
</tr>
<tr>
<td>Total NFS Throughput</td>
<td>Total number of NFS I/O requests, in I/O per second, across all ports in the storage system</td>
</tr>
</tbody>
</table>

*Not available on Dell EMC UnityVSA*

### Table 7  Available VNX Performance Metrics

<table>
<thead>
<tr>
<th><strong>RESOURCE</strong></th>
<th><strong>METRIC</strong></th>
<th><strong>DESCRIPTION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CACHE</strong></td>
<td>Cache Dirty</td>
<td>Ratio of cache, as a percentage, written but not flushed to disk</td>
</tr>
<tr>
<td></td>
<td>Cache Hit</td>
<td>Total number of read requests, as a percentage</td>
</tr>
<tr>
<td><strong>CPU</strong></td>
<td>CPU Utilization</td>
<td>Total processing cycles, as a percentage, across all cores in the storage processors utilized by the storage system</td>
</tr>
<tr>
<td><strong>DISK</strong></td>
<td>Disk Bandwidth</td>
<td>Total amount of disk I/O requests, in bytes per second, across all disks in the storage system</td>
</tr>
<tr>
<td></td>
<td>Disk Errors</td>
<td>Total number of disk errors encountered by all disks in the storage system</td>
</tr>
<tr>
<td></td>
<td>Disk Response Time</td>
<td>Average time, in ms, required for one request to pass through a system component, including its waiting time</td>
</tr>
<tr>
<td></td>
<td>Disk Queue Length</td>
<td>Average number of disk I/O requests in the system queue, in MB/s, across all disks in the storage system</td>
</tr>
<tr>
<td></td>
<td>Disk Service Time</td>
<td>Average time spent completing disk I/O requests, in ms, across all disks in the storage system, not including time spent in the queue</td>
</tr>
<tr>
<td></td>
<td>Disk Throughput</td>
<td>Total number of disk I/O requests, in I/Os per second, across all disks in the storage system</td>
</tr>
<tr>
<td><strong>LUN/SP</strong></td>
<td>LUN Bandwidth</td>
<td>Total amount of LUN I/O requests, in bytes per second, across all LUNs in the storage system</td>
</tr>
<tr>
<td></td>
<td>LUN Response Time</td>
<td>Average time, in ms, required for one request to pass through a system component, including its waiting time</td>
</tr>
</tbody>
</table>
### Performance Metrics

<table>
<thead>
<tr>
<th>Category</th>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LUN Queue Length</td>
<td>Average number of LUN I/O requests in the system queue across all LUNs in the storage system</td>
<td></td>
</tr>
<tr>
<td>LUN Throughput</td>
<td>Total number of LUN I/O requests, in I/Os per second, across all LUNs in the storage system</td>
<td></td>
</tr>
<tr>
<td><strong>PORT</strong></td>
<td>Port Bandwidth</td>
<td>Total amount of I/O requests, in bytes per second, across all ports in the storage system</td>
</tr>
<tr>
<td></td>
<td>Port Throughput</td>
<td>Total number of I/O requests, in packets per second, across all ports in the storage system</td>
</tr>
<tr>
<td><strong>PROTOCOL/OPERATION/VERSION/MOVER</strong></td>
<td>Protocol Throughput</td>
<td>Total number of protocol I/O requests, in I/Os per second, handled by the storage system</td>
</tr>
<tr>
<td><strong>VOLUME/MOVER</strong></td>
<td>File System Bandwidth</td>
<td>Total amount of I/O requests, in bytes per second, across all hosts associated with the storage system</td>
</tr>
<tr>
<td></td>
<td>File System Throughput</td>
<td>Total amount of I/O requests, in packets per second, across all hosts associated with the storage system</td>
</tr>
</tbody>
</table>