DELL Technologies

Technical White Paper

Dell EMC Unity: Unisphere Central

Next-generation storage monitoring

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, Dell EMC SC Series, VNX Series, and VNXe, and vVNX Series storage systems residing on a common network. This paper provides a detailed description of how to use this leading-edge application.

December 2021

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Revisions

Date	Description
July 2019	Unisphere Central V4.0 SP8 release updates
July 2021	Unisphere Central V4.0 SP9 release updates. Removal of CLARiiON CX4.
December 2021	Unisphere Central V4.0 SP9.1 release updates. Added support for monitoring SC Series.

Acknowledgments

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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 Dell EMC SC Series, VNX Series, VNXe Series, vVNX, Dell EMC 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 need attention or maintenance.

1 Introduction

This white paper describes the Unisphere Central interface and explains how storage administrators can easily monitor multiple VNXe, VNX, vVNX, SC Series, 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, vVNX, SC Series, 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, vVNX, SC Series, 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.

2 Monitoring VNXe, vVNX, SC Series, Dell EMC Unity, and Dell EMC UnityVSA Systems with Unisphere Central

Unisphere Central enables you to:

- Monitor up to 1000 VNXe, VNX, vVNX, SC Series, 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 ESXi server (stand-alone or through vCenter), VNXe, VNX, vVNX, SC Series, Dell EMC Unity and Dell EMC UnityVSA storage systems, and a remote system to access the Unisphere Central server (Figure 1).

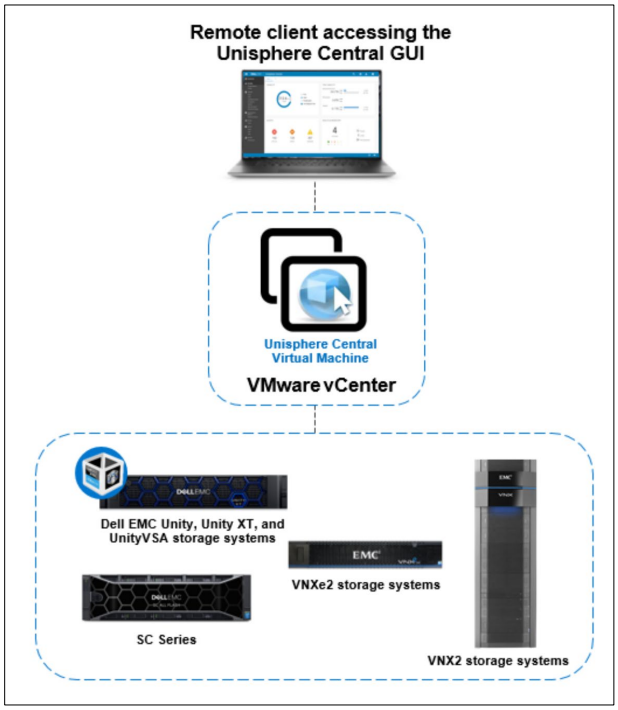

Figure 1 Example of a Unisphere Central environment

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 running ESXi version 6.0, 6.5, or 6.7 that meets the following requirements:

Table 1 ESXi System Requirements

Component	Base Configuration	Recommended Configuration
CPU	2	4
Memory	3 GB	> 8 GB
Network Interfaces	1	1
Storage	20 GB	> 40 GB

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).
- DNS server (optional in IPv4 or IPv6 single-stack environments. Required in dual-stack IPv4/IPv6 environments).
- 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
> **Note**: VNX1 and VNXe1 are supported up to Unisphere Central V4.0 SP8

- 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
- Dell EMC SC Series systems running the following code versions:
  - SCOS version 7.2 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.

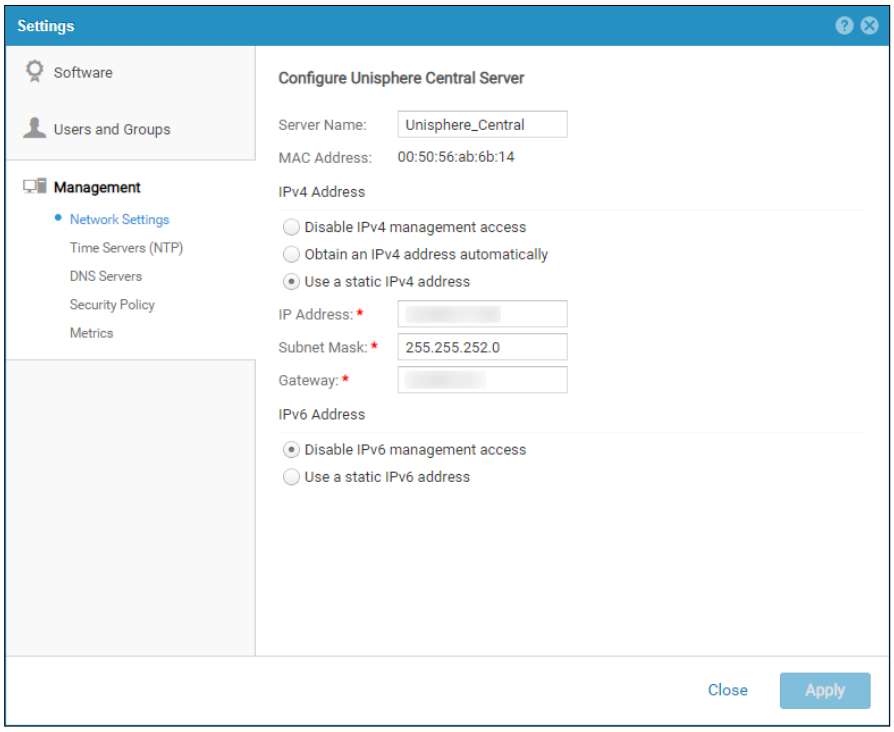

Figure 2 Settings Dialog

4 Add VNXe, VNX, vVNX, SC Series, 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 SC**, **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 system, Unisphere Central discovers and adds all other systems 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 about 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>

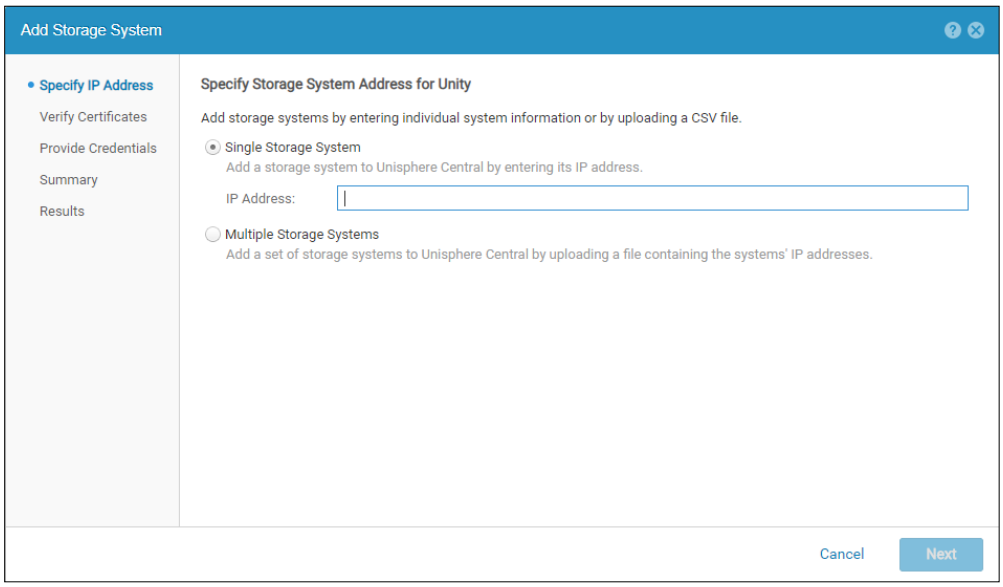

Figure 3 Add Storage System Window

4.1 Verification of VNX Systems

For VNX 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 (that is 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, SC Series, 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**. This means that no manual configuration is required after the initial connection is established.

For SC Series, no additional verification steps are required.

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. 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.

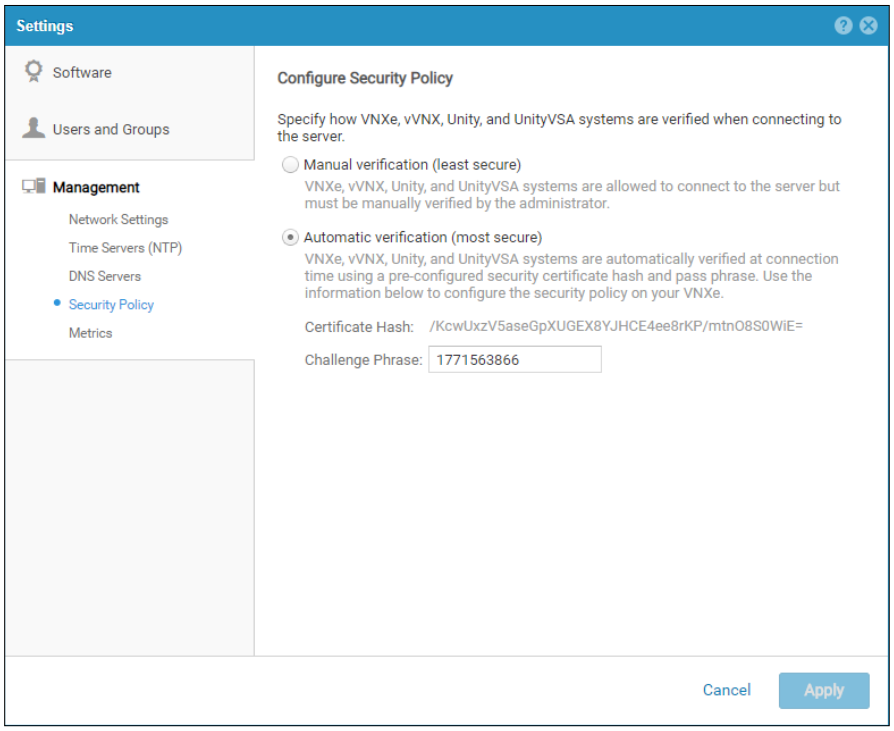

Figure 4 Configure Security Policy

If the security policy is set for **Manual verification**, administrators must manually verify the storage system's certificates just as for VNX 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).

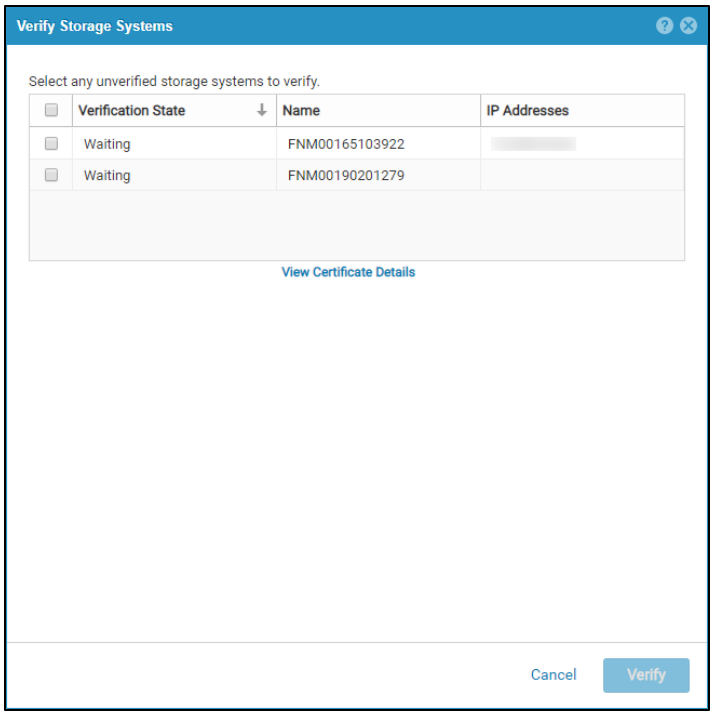

Figure 5 Verify Storage Systems Dialog

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 in to 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.

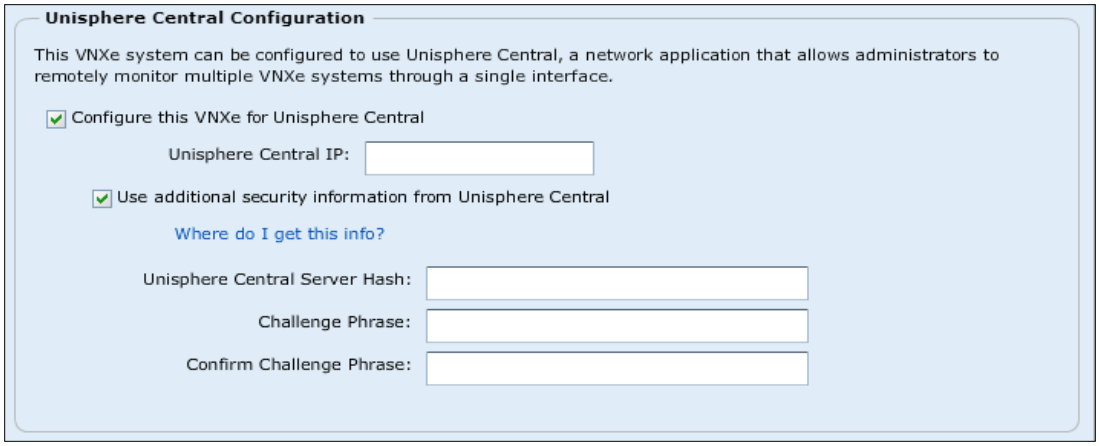

Figure 6 Unisphere Central Configuration in Unisphere for VNXe

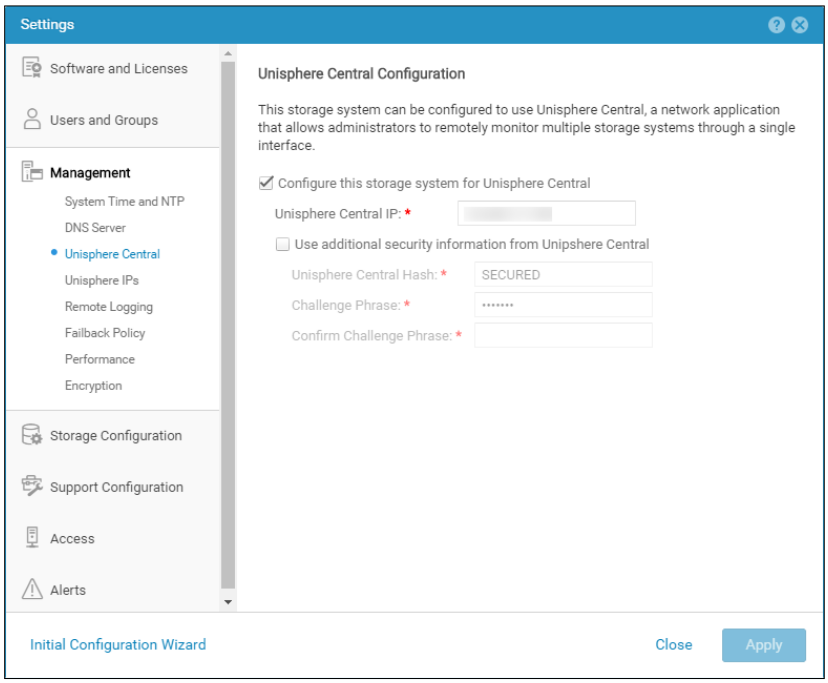

Figure 7 Unisphere Central Configuration in Unisphere for Unity

4.4 Remove Storage Systems from Unisphere Central

To remove a VNXe, vVNX, VNX, SC Series, Dell EMC Unity, and Dell EMC UnityVSA system from Unisphere Central, go to the **Storage Systems** page, select the system to be removed from the list, and click the **Remove** button. Then confirm the removal by clicking **Yes** in the *Remove System* pop-up window. (Figure 8).

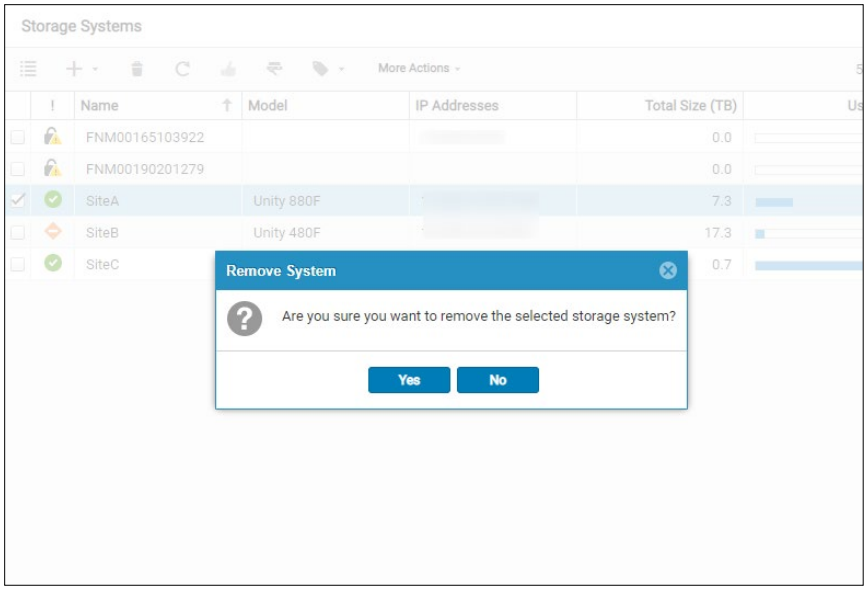

Figure 8 Remove System Dialog

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.

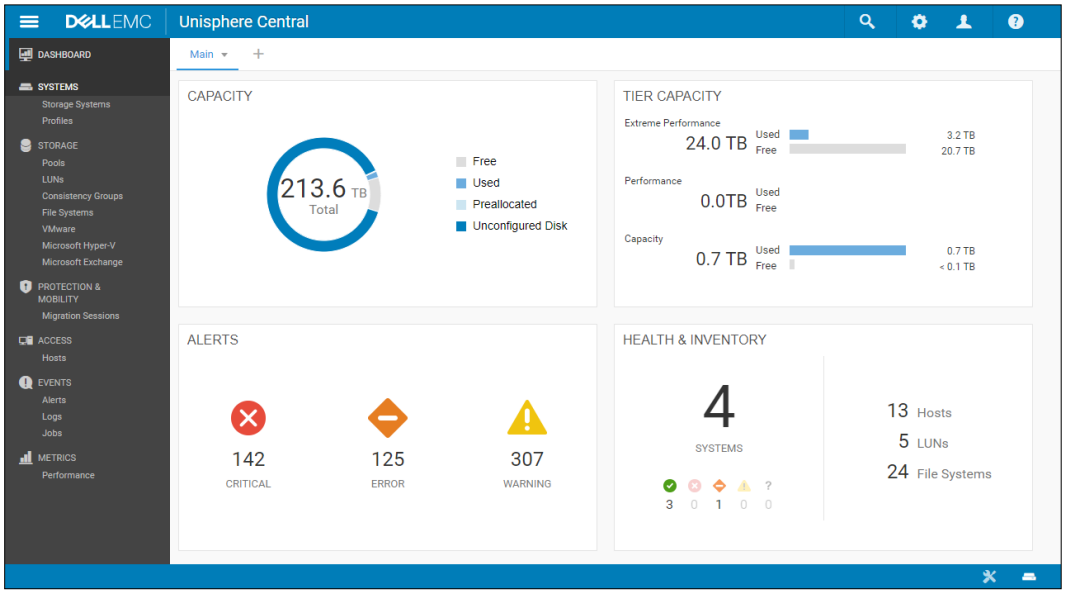

Figure 9 Dashboard Page

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, SC Series, 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.

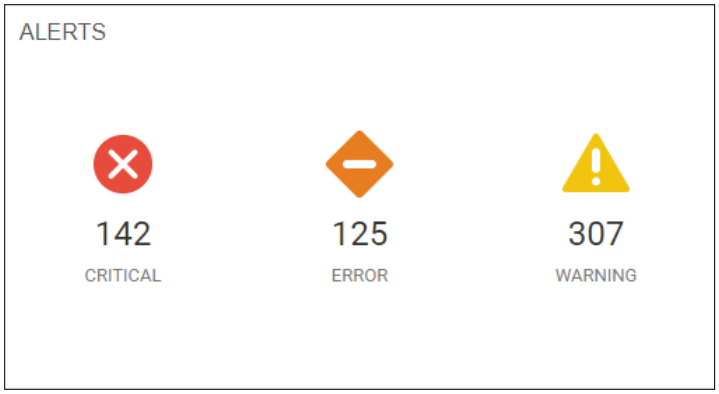

Figure 10 Alerts View Block

- **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 doughnut or circle 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, and show capacity based on storage resource (that is File Systems, LUNs, and so on).

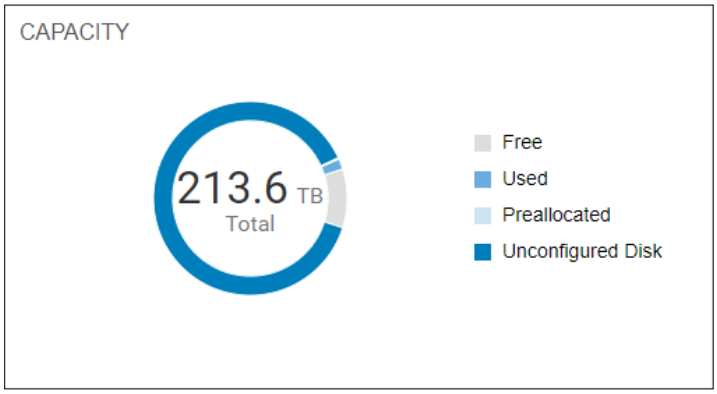

Figure 11 Capacity View Block

- **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.

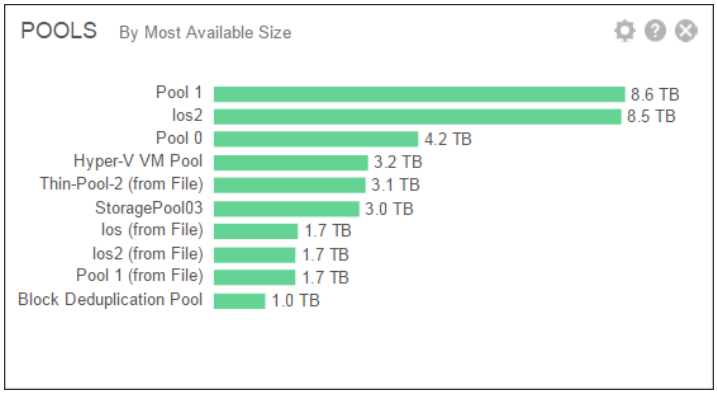

Figure 12 Pools View Block

- **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. 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.

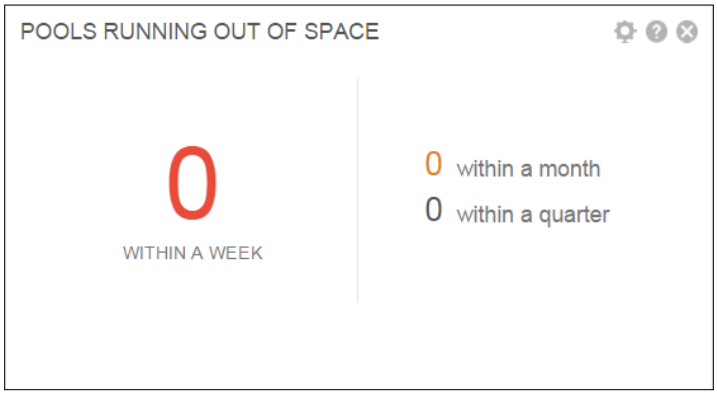

Figure 13 Pools Running out of Space View Block

- **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 and display systems with a specific tag. Clicking a category brings the user to the specified page with applicable filters.

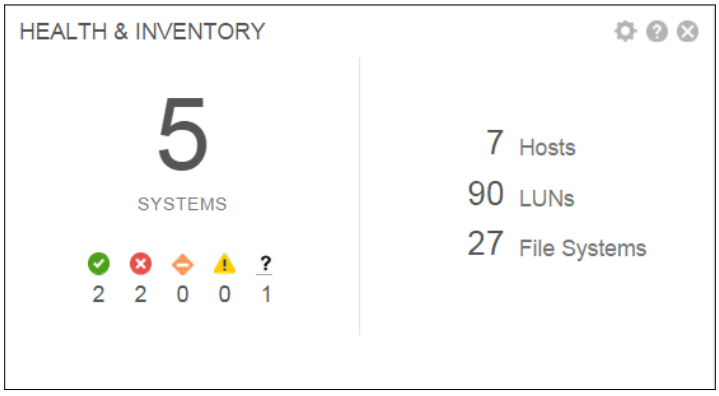

Figure 14 Health & Inventory View Block

- **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.

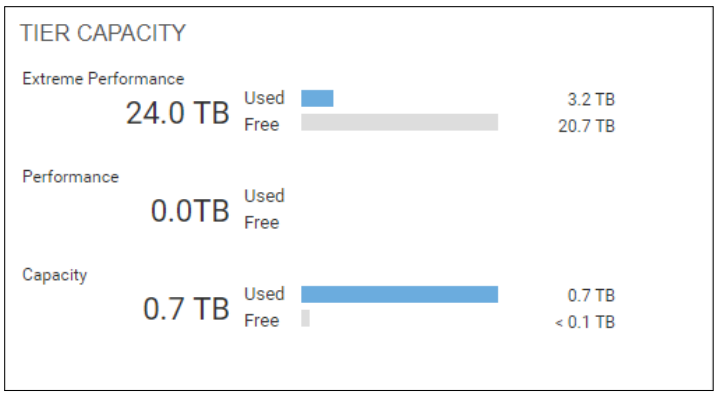

Figure 15 Tier Capacity View Block

5.2 Storage Systems Page

The **Storage Systems** page under **Systems** provides a list of all monitored VNXe, vVNX, VNX, SC Series, 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, SC Series, 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.

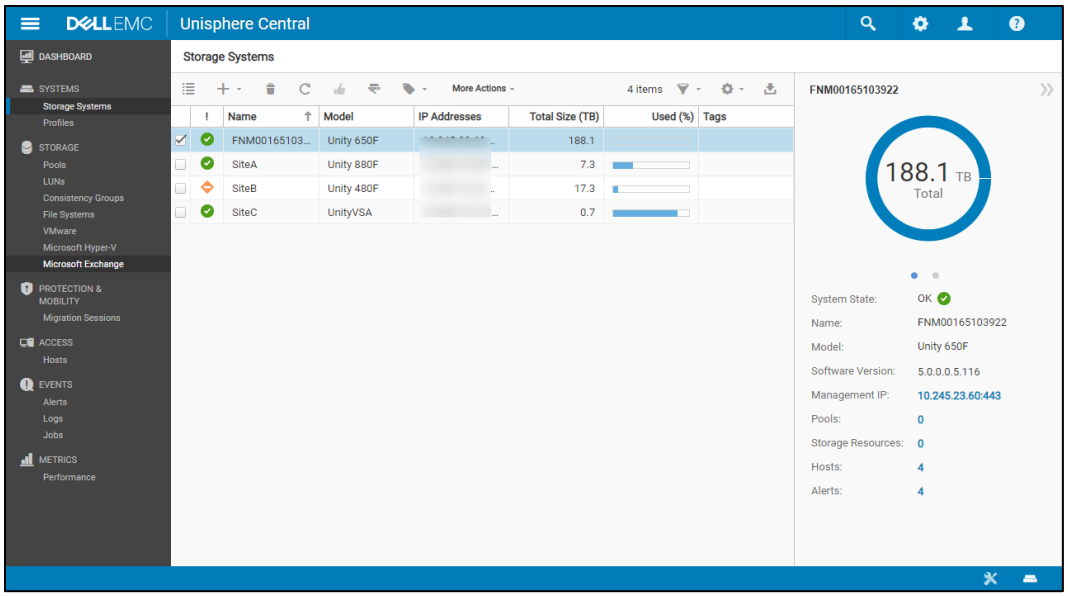

Figure 16 Storage Systems Page

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 systems, Unisphere Central automatically assigns system-defined tags to every VNX 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, and so on.

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

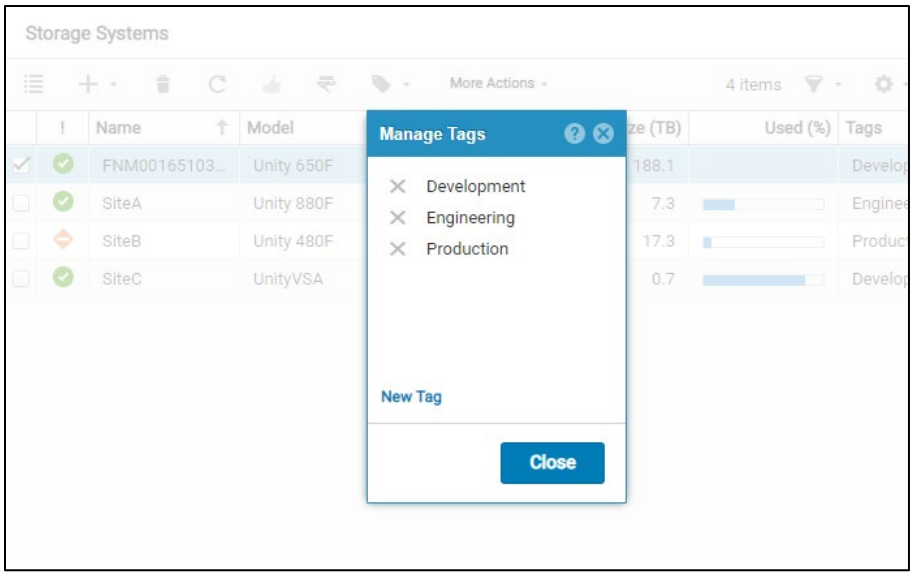

Figure 17 Manage Tags Dialog

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, SC Series, 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 about the profile-based system configuration feature, see the Advanced Features section in this document.

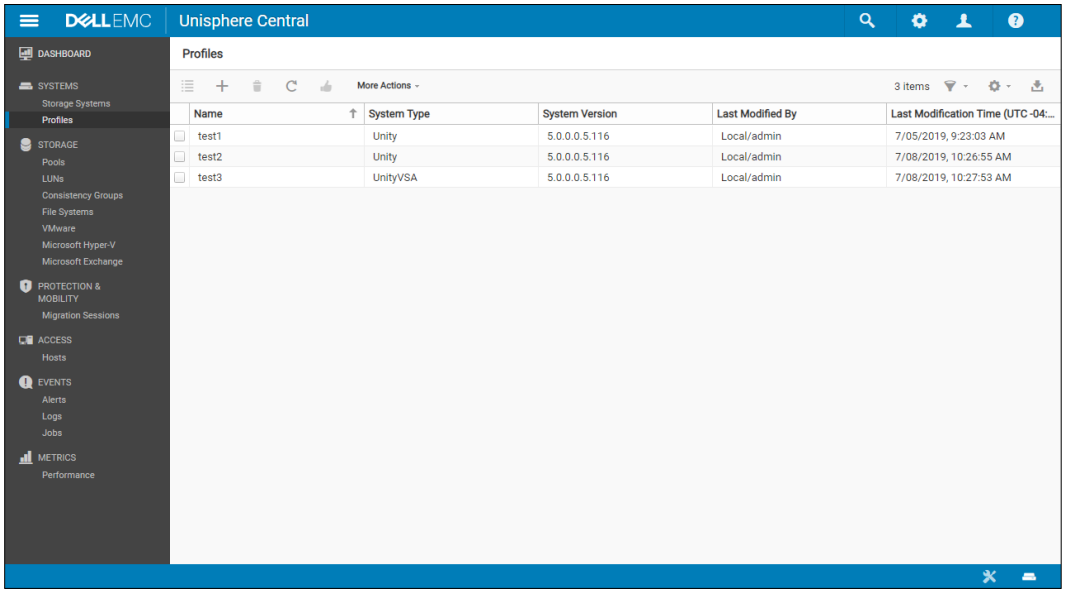

Figure 18 Profiles Page

5.5 Storage Menu

The **Storage** menu provides detailed information about 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), Consistency Groups, File Systems, VMware Datastores, Microsoft Hyper-V storage, and Microsoft Exchange storage. Each storage resource page can be filtered based on the available columns and can be exported to a CSV file.

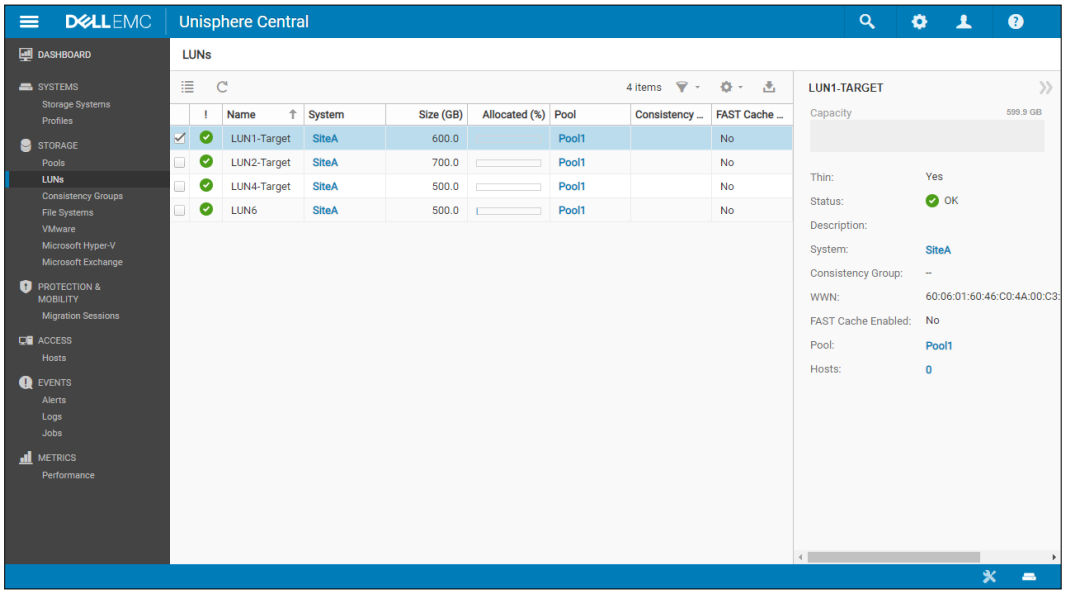

Figure 19 LUNs Page

The frequency at which Unisphere Central collects storage and configuration data depends on the system type. For VNX 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, SC Series, 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 about 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 Menu

The **Migration Sessions** menu has the **SAN Copy Pull Sessions** and **VNX Sessions** pages. The **SAN Copy Pull Sessions** (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 leverage the existing SAN Copy Pull feature on Dell EMC Unity systems to provide an easy migration user experience using Unisphere Central. The initial connectivity setup including configuring systems connections is 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.

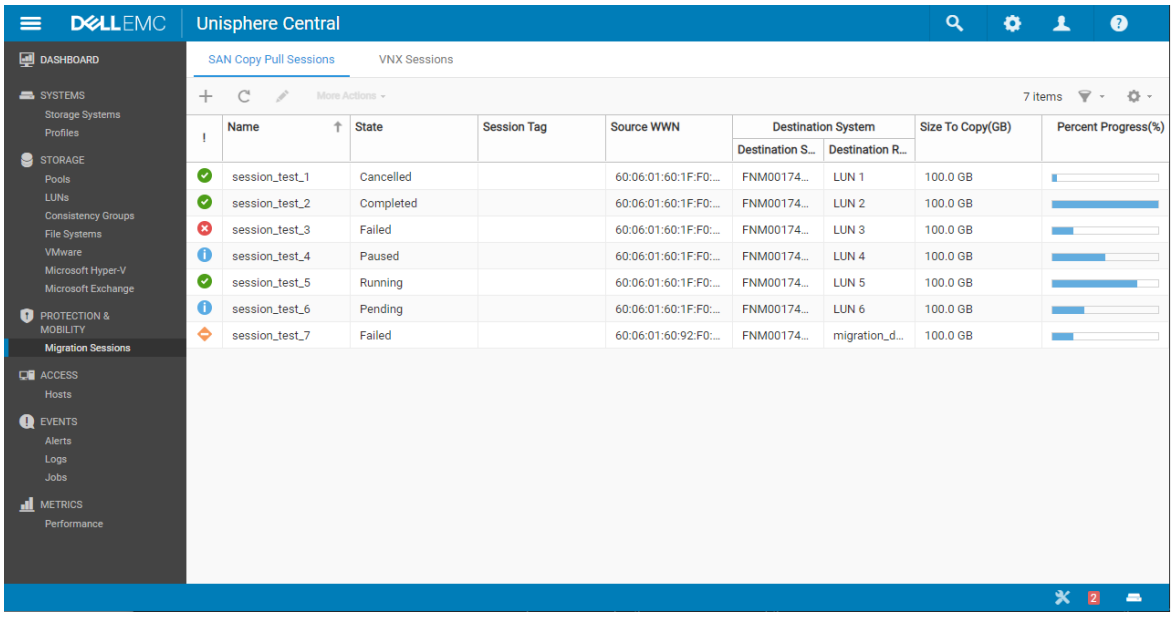

Figure 20 SAN Copy Pull Sessions Page

In the release of Unisphere Central v4 SP9, the support for migration of block resources from VNX to Dell EMC Unity systems with SAN Copy Push was introduced. The **VNX Sessions** page (Figure 21) allows the user to create, view, and modify the migration sessions of storage resources from VNX systems to Dell EMC Unity systems. The page also includes the import sessions created with the Dell EMC Unity Native Import.

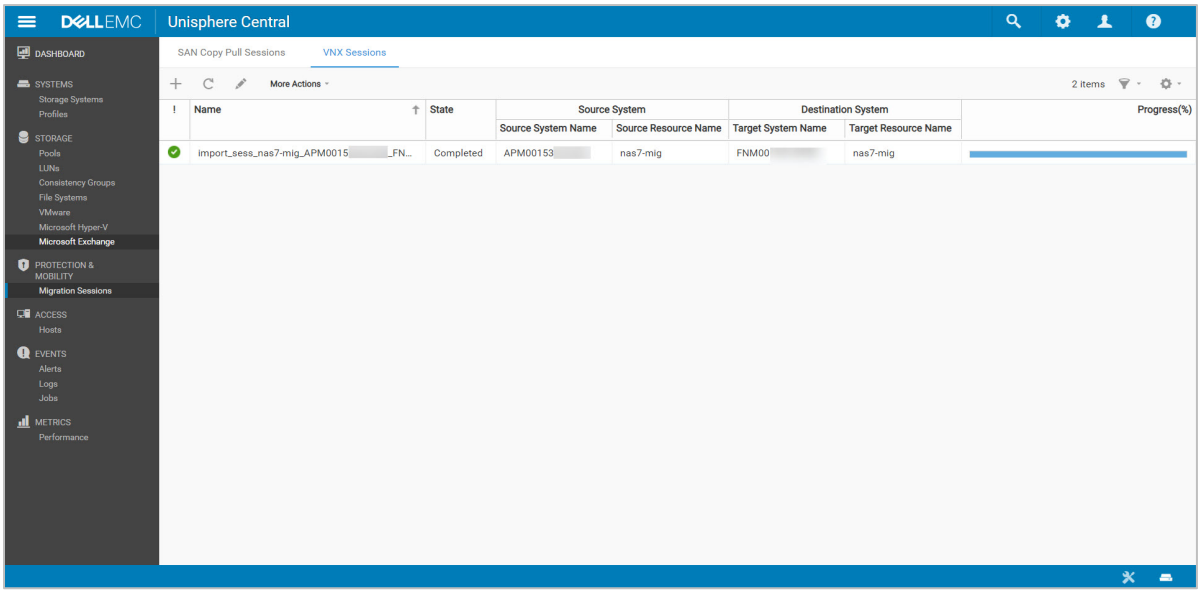

Figure 21 VNX Sessions Page

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 22). The information displayed for each host includes the health state, host's 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.

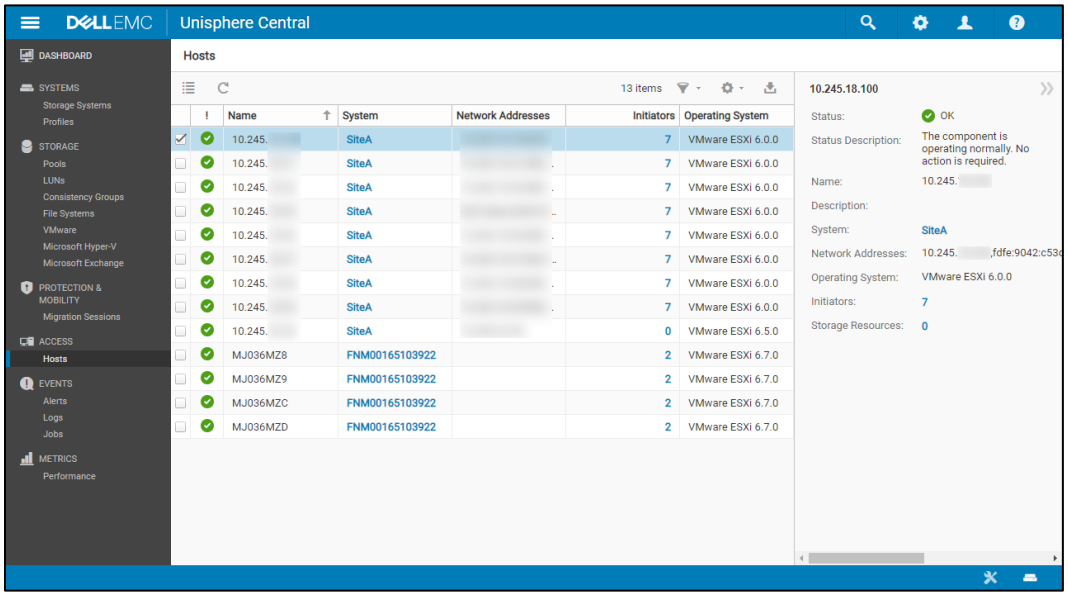

Figure 22 Hosts Page

5.8 Alerts Page

The **Alerts** page provides a list of aggregated alerts from all storage systems being monitored by Unisphere Central (Figure 23). 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.

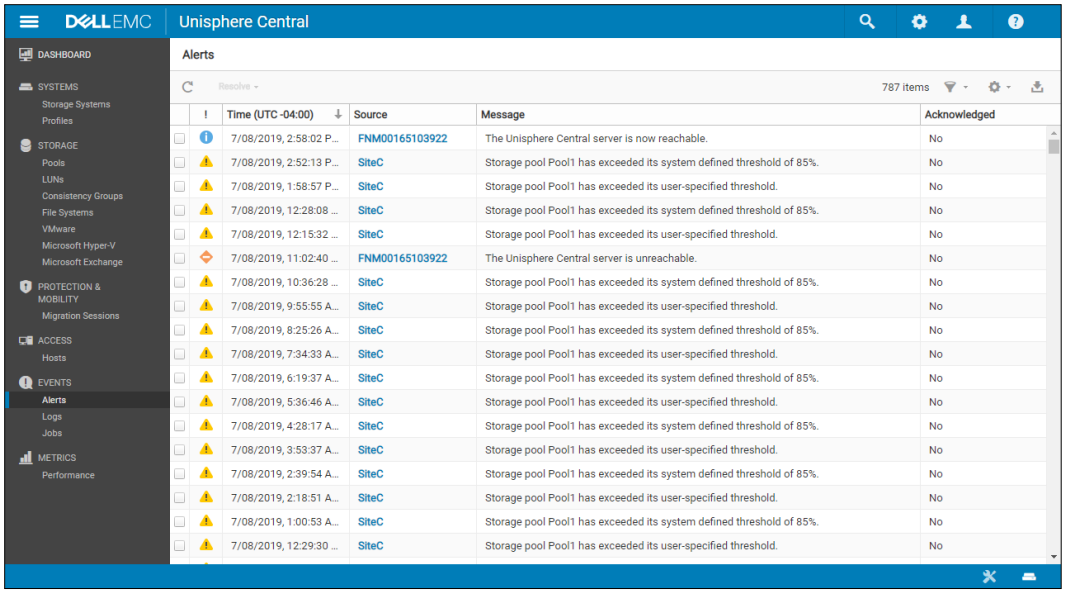

Figure 23 Alerts Page

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 24). 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 entire list can be exported to a CSV file.

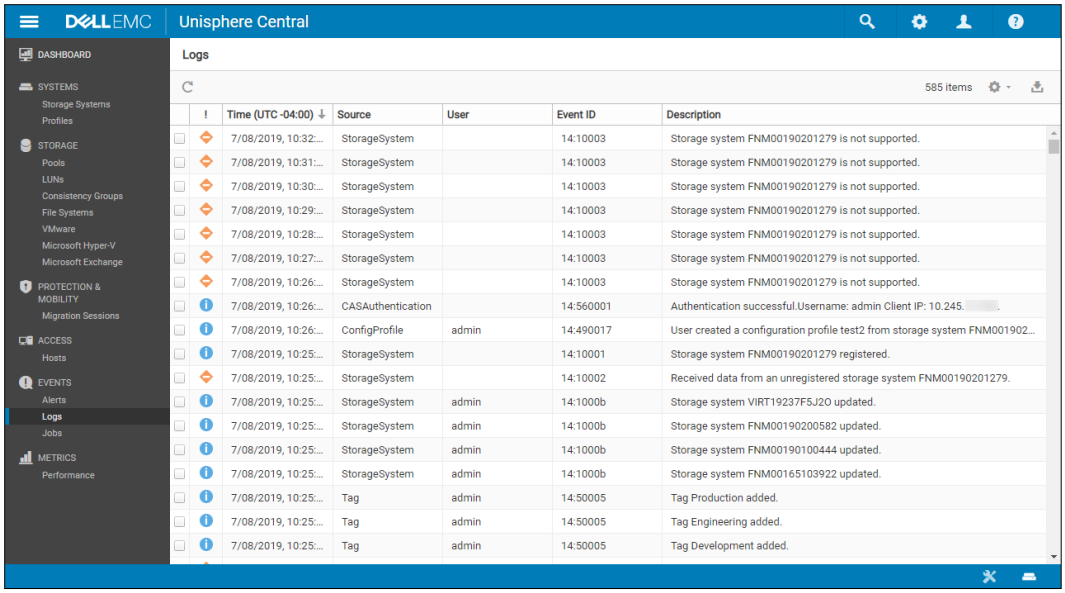

Figure 24 Logs Page

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 25). 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.

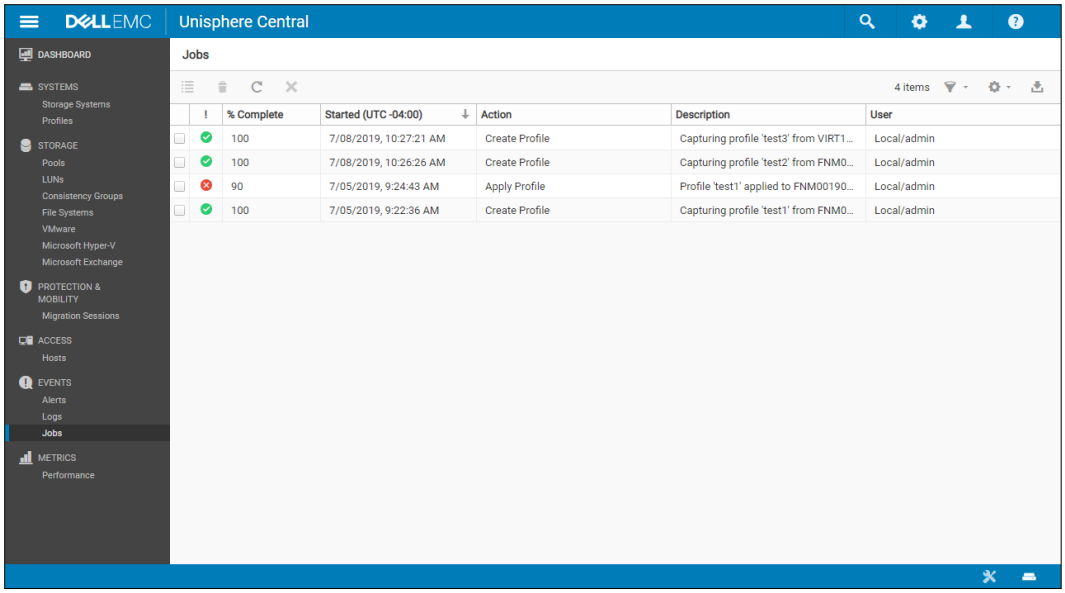

Figure 25 Jobs Page

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 26 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 two 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 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.

Figure 26 Performance Metrics Page (Average CPU Utilization Chart)

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 tooltip 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 26).

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 27 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 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.

SP9.1 added support for monitoring SC Series but support for metrics is not available.

Figure 27 Average CPU Utilization Chart with Selected Contributors

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 **Software**, **Users and Groups,** and **Management**.

Under **Software,** the following tabs are shown:

- **Software Updates** – The **Software Updates** dialog (Figure 28) lets users view current Unisphere Central system software version, upload candidate software, and install candidate software.

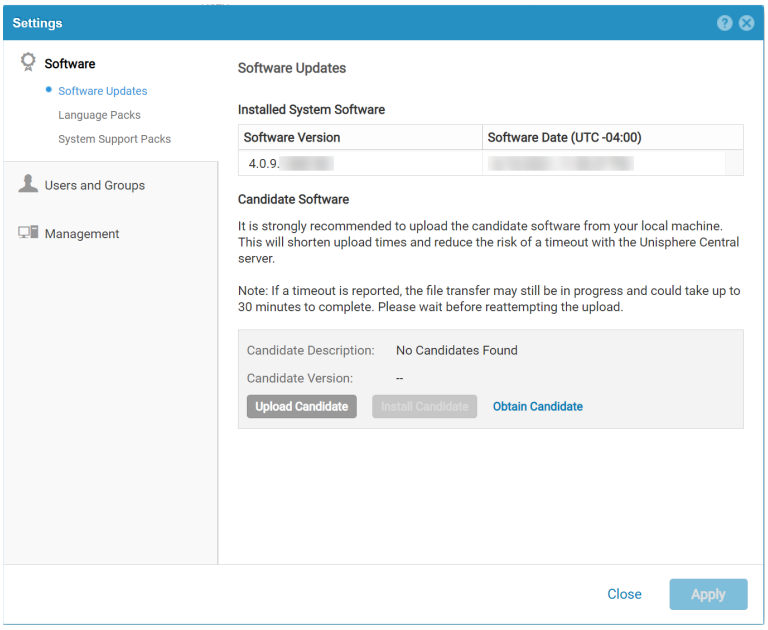

Figure 28 Software Dialog

To upgrade the 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.

- **Language Packs** – View and install language packs.
- **System Support Packs** – View supported system versions, and update Unisphere Central to support later releases of the systems it monitors by installing system support packs.

Under **Users and Groups**, the following tabs are shown:

- **User Management** – Create, modify, and delete users and user groups. The user roles available for Unisphere Central are operator and administrator. 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 set up, a user can use an advanced feature called Single Sign-On (SSO). See the Advanced Features section for more information.

Under **Management**, the following tabs are shown:

- **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. One or more DNS Servers 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 29). 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

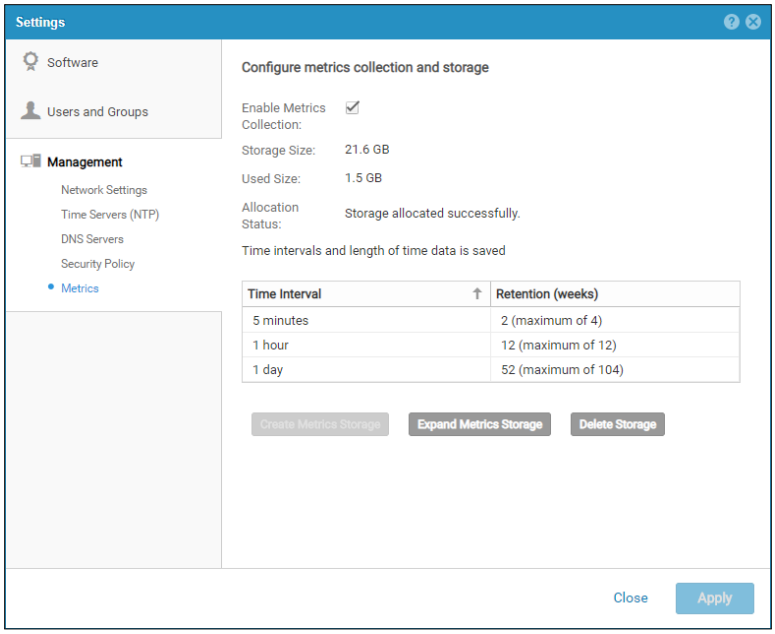

Figure 29 Metrics Configuration Tab

5.13 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 (Figure 30). 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.

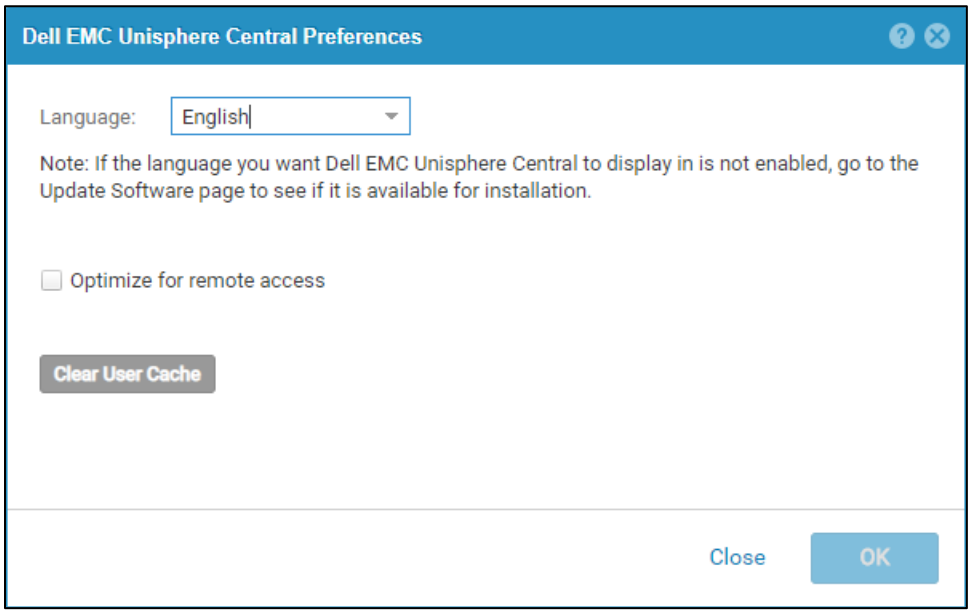

Figure 30 Unisphere Central Preferences

5.14 Help Dialog

The help options are 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 Dell EMC Unisphere Central** – Diagnose, troubleshoot, and repair the Unisphere Central server through this dialog (Figure 31). 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. The Unisphere Central V4 SP9 release adds support to configure the TLS mode. The user can set which TLS protocols are allowed for both inbound and outbound SSL connections with Unisphere Central (Figure 32).

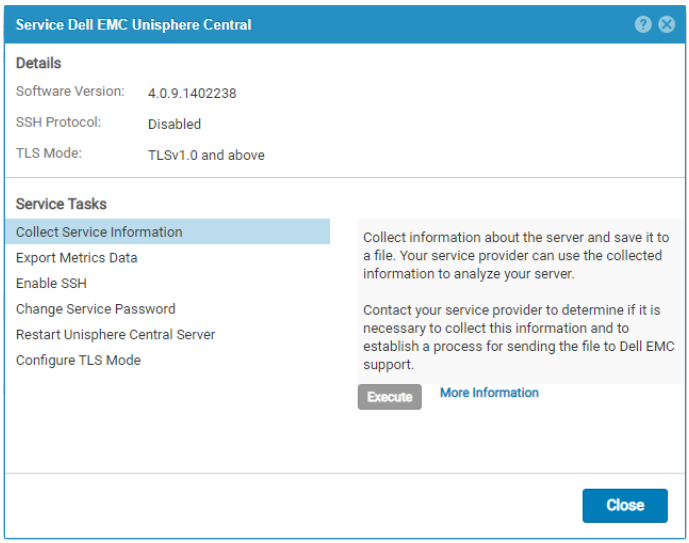

Figure 31 Service Dell EMC Unisphere Central Dialog

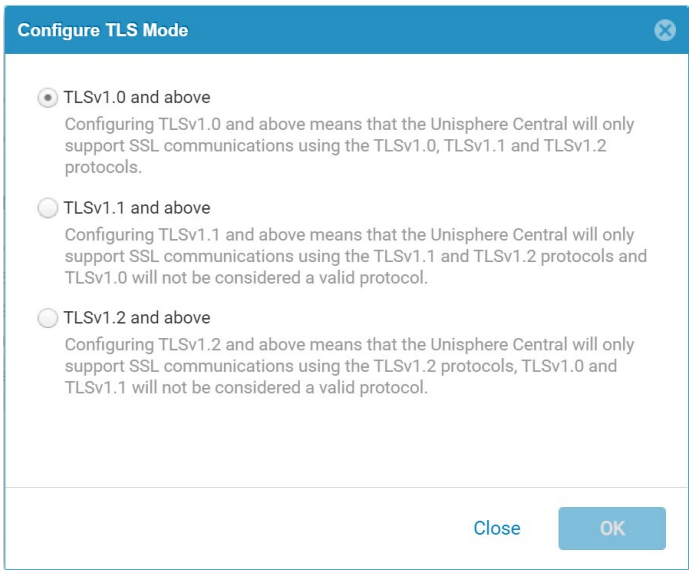

Figure 32 Configure TLS Mode Dialog

- **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 provide a help icon that serves the same purpose as the help link.
- **About** – Provides the current version number of the Unisphere Central server.

6 Advanced Features

Unisphere Central is a useful tool for monitoring VNXe, vVNX, SC Series, Dell EMC Unity and Dell EMC UnityVSA 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 33). 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.

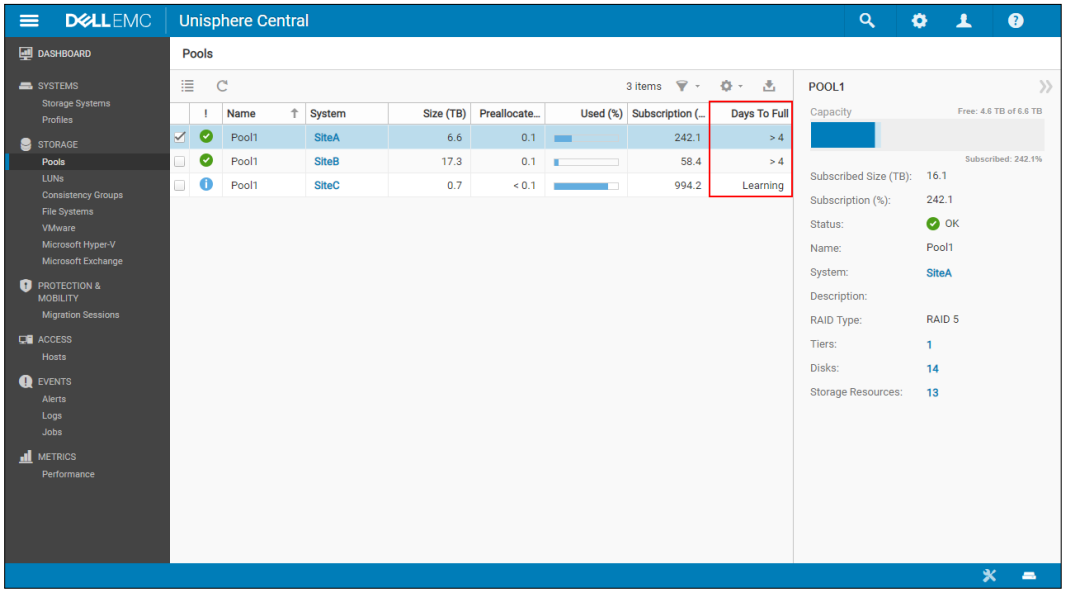

Figure 33 Days to Full Column on the Pools Page

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 **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 and 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.

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 in to VNXe (version 3.1 or later), vVNX, Dell EMC Unity, and Dell EMC UnityVSA systems without requiring the user to reauthenticate. 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 in to Unisphere Central, then select and launch Unisphere on a VNXe system, vVNX, Dell EMC Unity, or Dell EMC UnityVSA system without reauthenticating.
- Log in to 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 reauthenticate.

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 34).
- 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.

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

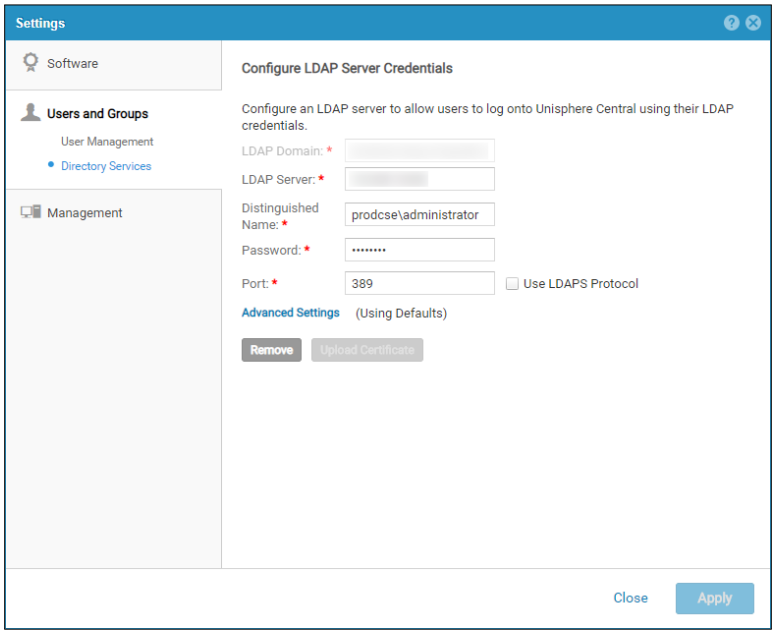

Figure 34 LDAP Server Settings Tab

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 35) 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. 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 2 Systems Configuration

System OE version	Additional tab or tabs
Dell EMC Unity	Role, FAST Cache, FAST VP, Storage Pool
Dell EMC UnityVSA	Role, FAST VP, Storage Pool
VNXe 3.1.3	Role, FAST Cache
VNXe 3.1.x, Excluding 3.1.3	Role, FAST VP, Storage Pool
VNXe 2.4	DNS Configuration, Storage Pool

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.

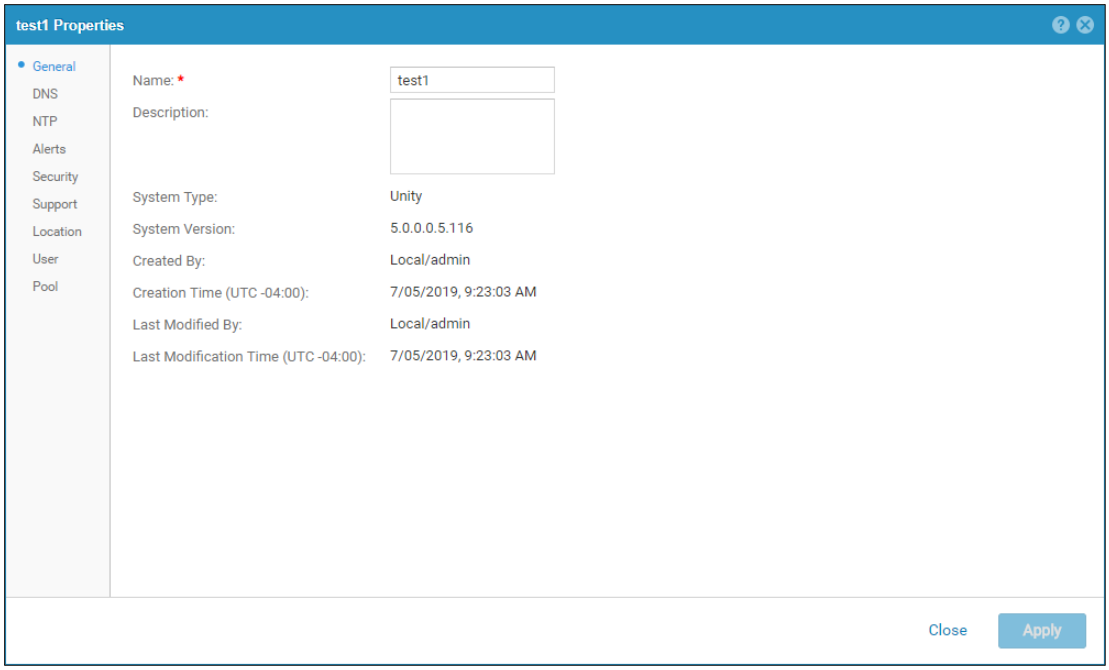

Figure 35 Configuration Profile

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 upper right of the Unisphere Central interface and inputting the search criteria (Figure 36).

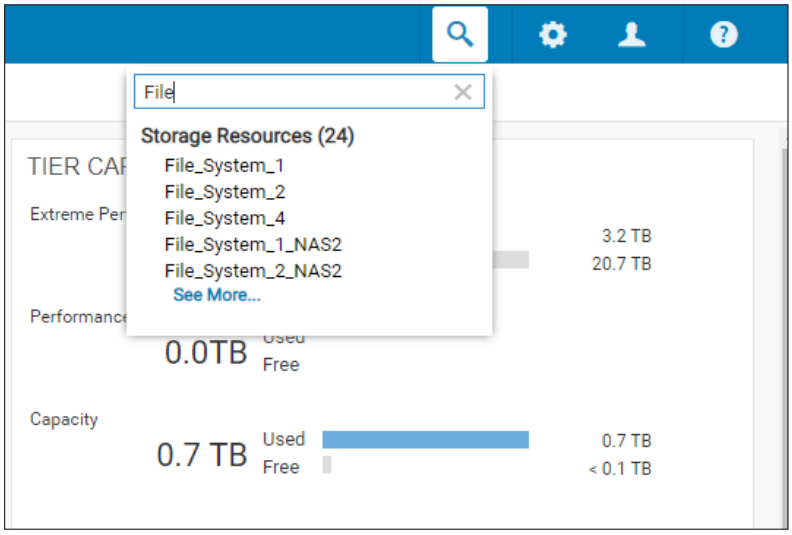

Figure 36 Unified Search

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 uses 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 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. 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 use 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 over 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 **SAN Copy Pull Sessions** page under **Migration Sessions** and click the **Add** button. The corresponding wizard (as seen in Figure 37) 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.

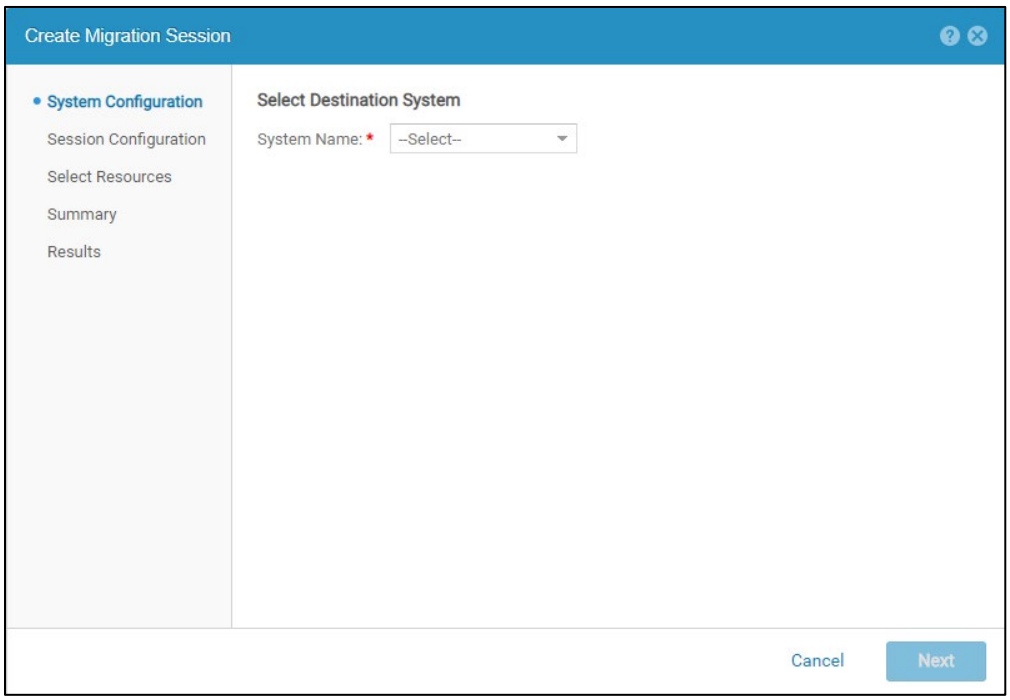

Figure 37 Create Migration Session Wizard – SAN Copy Pull

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 38). 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.

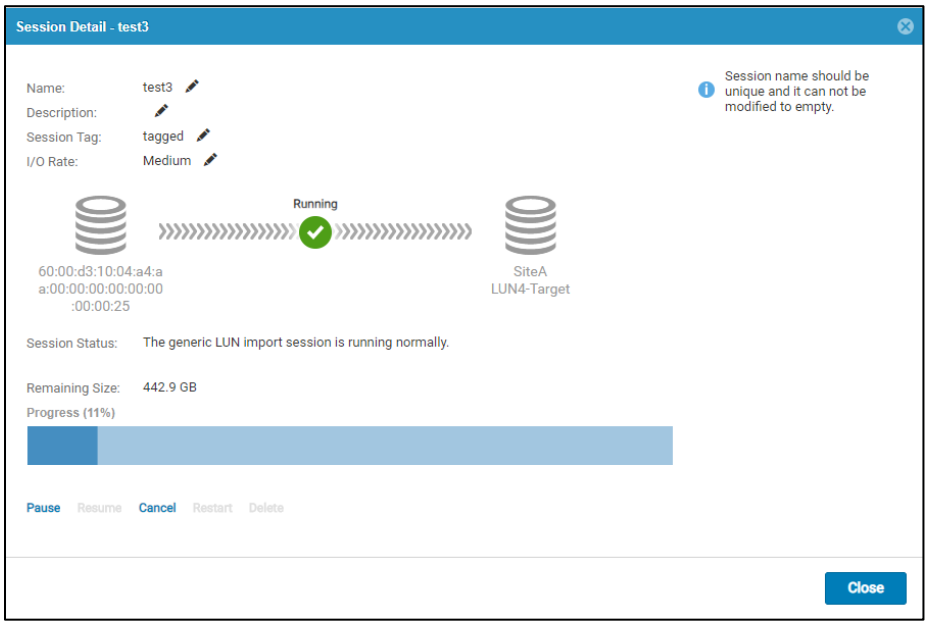

Figure 38 Migration Session Details Page

6.5.1 SAN Copy Push Detailed steps

In the release of Unisphere Central v4 SP9, the support for migration of block resources from VNX to Dell EMC Unity systems with SAN Copy Push was introduced. Like the SAN Copy Pull feature above, Unisphere Central provides the creation of the migration sessions through an easy-to-follow GUI wizard. A new migration session can be created from the **VNX Sessions** page under **Migration Sessions** and click **Add** which opens the **Create Migration Session** wizard as seen in Figure 39. See section 6.5.1 for pre-requisites and detailed steps.

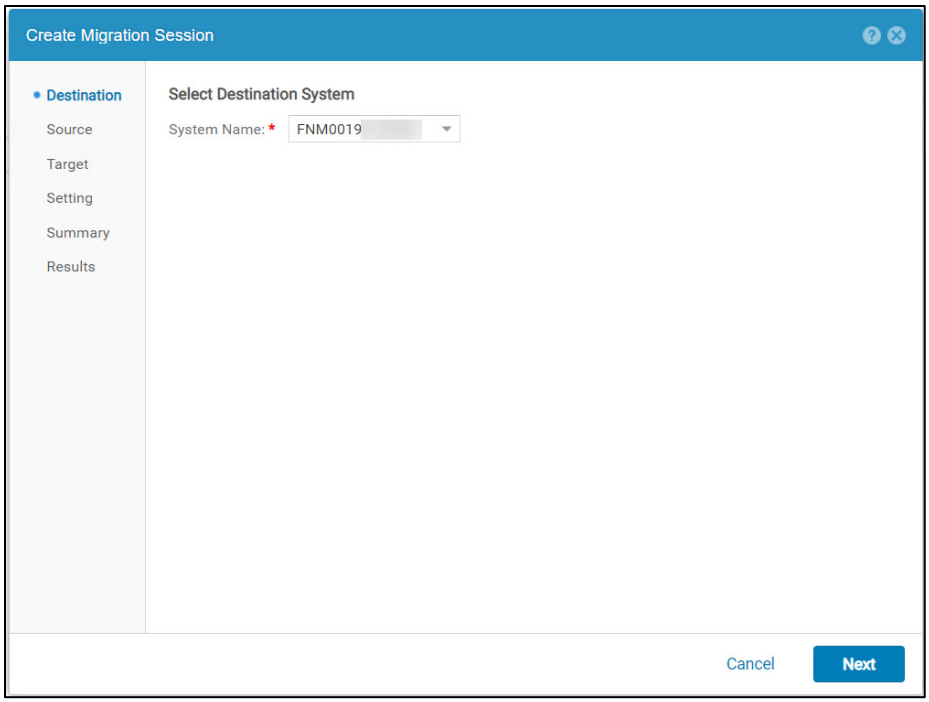

Figure 39 Create Migration Session Wizard – SAN Copy Push

1. As a pre-requisite, check if the SANCopy and SnapView enablers are already installed on the source VNX. Navigate to the **Software** tab within the **Storage System Properties** window that shows which enablers are installed on the system. In Figure 40 below, the enablers have been installed, which is denoted by the -SnapView and -SANCopy entries in the Packages list. If the enablers are not installed, install them by using Unisphere Service Manager.

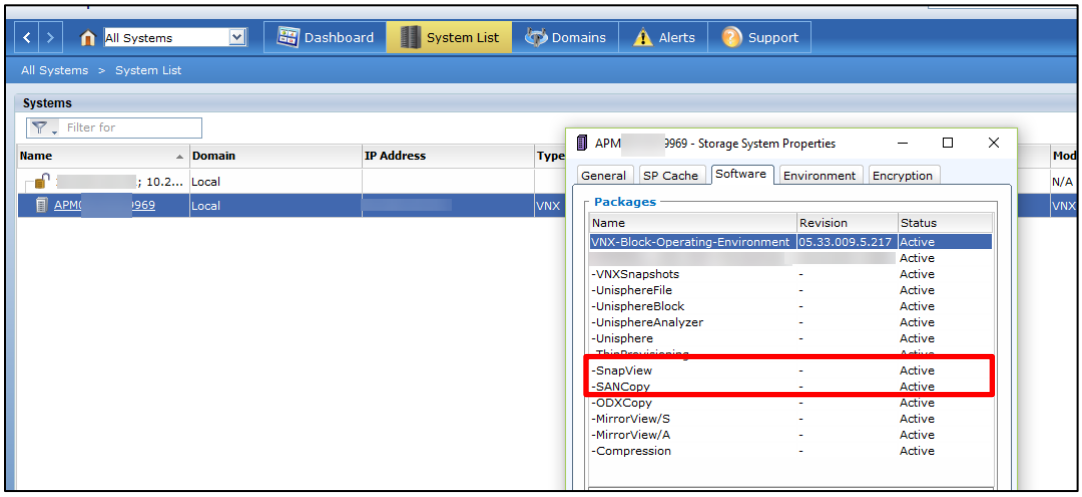

Figure 40 SANCopy and SnapView enablers

2. In this example, we will be leveraging iSCSI. Configure two iSCSI interfaces (for SPA and SPB) on Dell EMC Unity from **Storage** > **Block** > **iSCSI Interfaces**.
3. Configure two iSCSI interfaces (for SPA and SPB) on VNX from **Settings** > **Network** > **Settings for Block** (**Systems** > **Hardware** > **Storage Hardware** for Block only systems).
    a. Notes: Do not use the MirrorView port. Check the port status before configuration, making sure to choose the links that are up.

To check the port status, use the following command:

```
naviseccli -h 10.0.1.1 -User sysadmin -Scope 0 port -list
```

4. Create a connection between Dell EMC Unity and VNX as shown below:

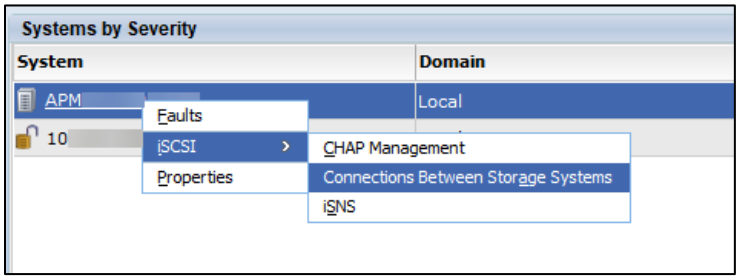

Figure 41 Right-click the system > iSCSI > Connection Between Storage Systems

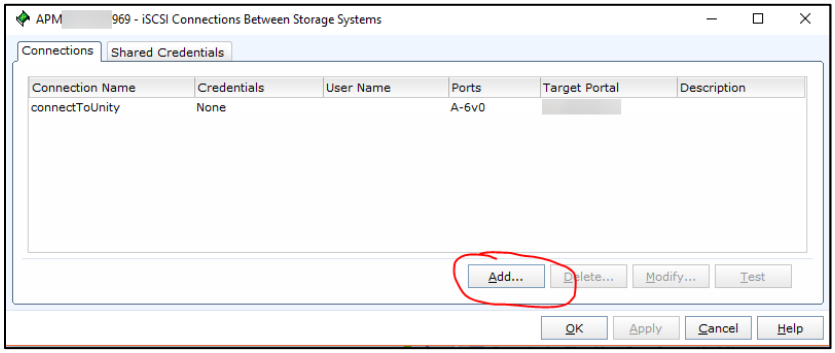

Figure 42 Connection Between Storage Systems > Add…

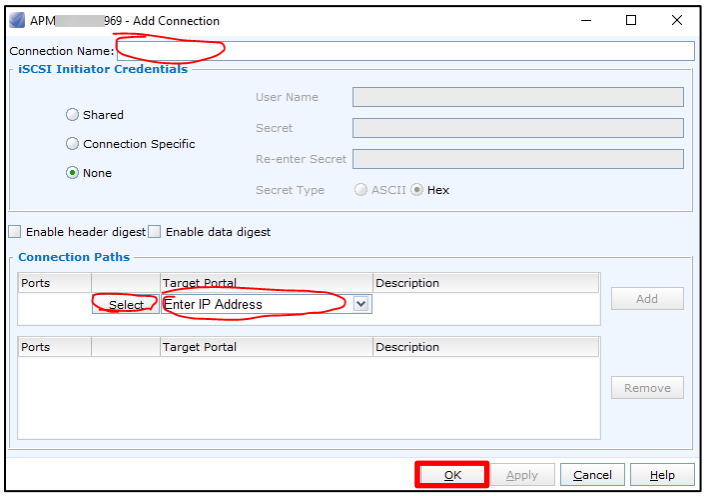

Figure 43 Add Connection

5. Update the SAN Copy connections from **Storage** > **Data Migration** > **SAN Copy** and from the right task pane under **Data Migration** click **Update SAN Copy Connections** as shown in Figure 44.

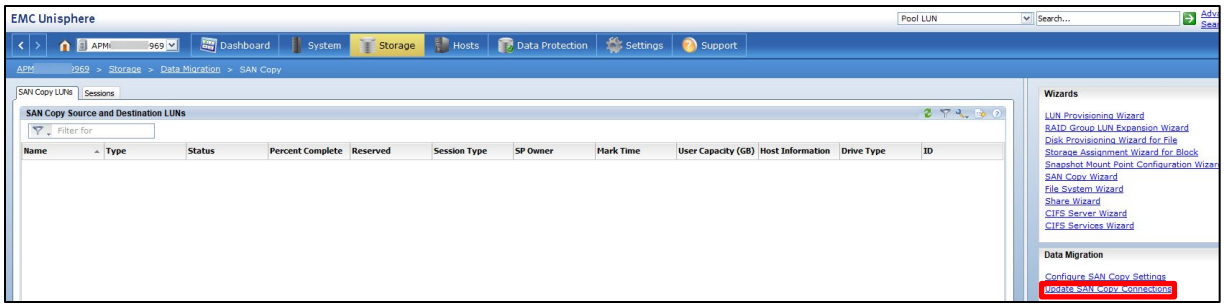

Figure 44 Update SAN Copy Connections

6. From VNX, test that the iSCSI connections are working.

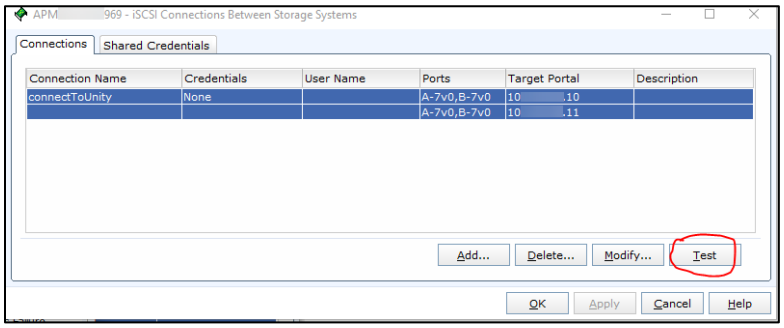

Figure 45 Test Connection

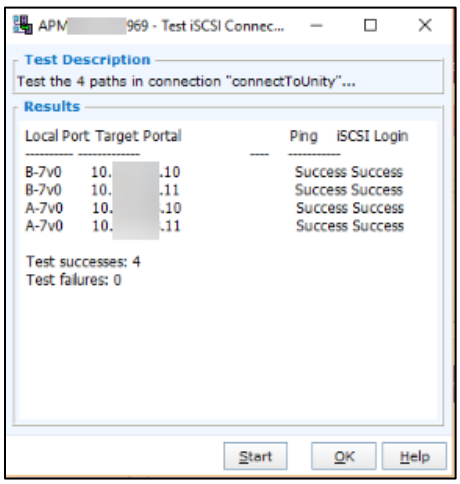

Figure 46 Test iSCSI Connection Results

7. From Dell EMC Unity, confirm that the initiators are shown from the **Access** > **Initiators** page.

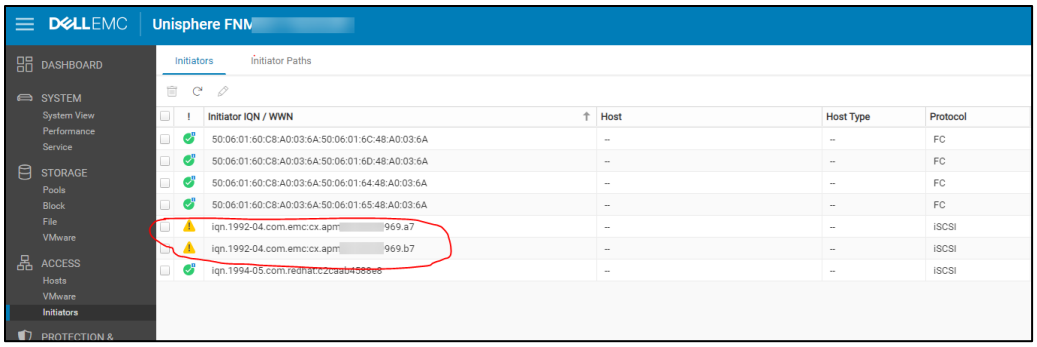

Figure 47 Access > Initiators

8. Confirm that the initiator paths are shown from the **Access** > **Initiator Paths** page.

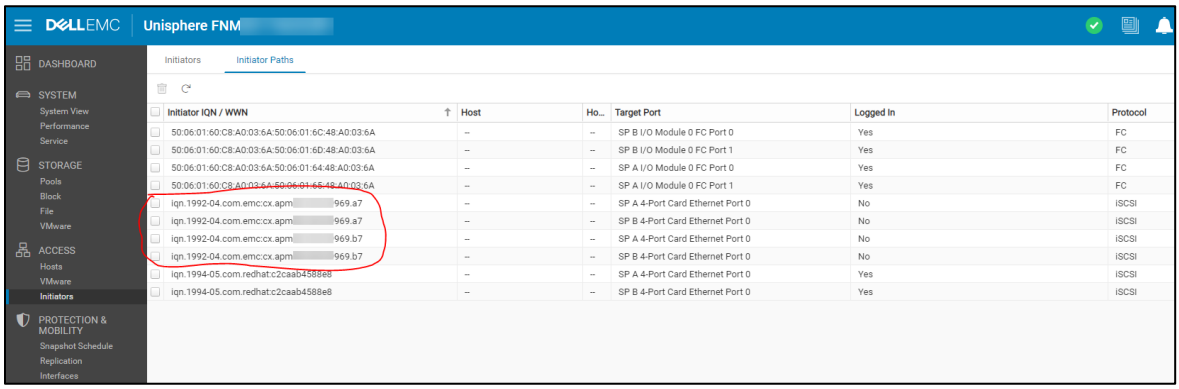

Figure 48 Access > Initiator paths

9. If none are available, add import interfaces from **Protection & Mobility** > **Interfaces**.

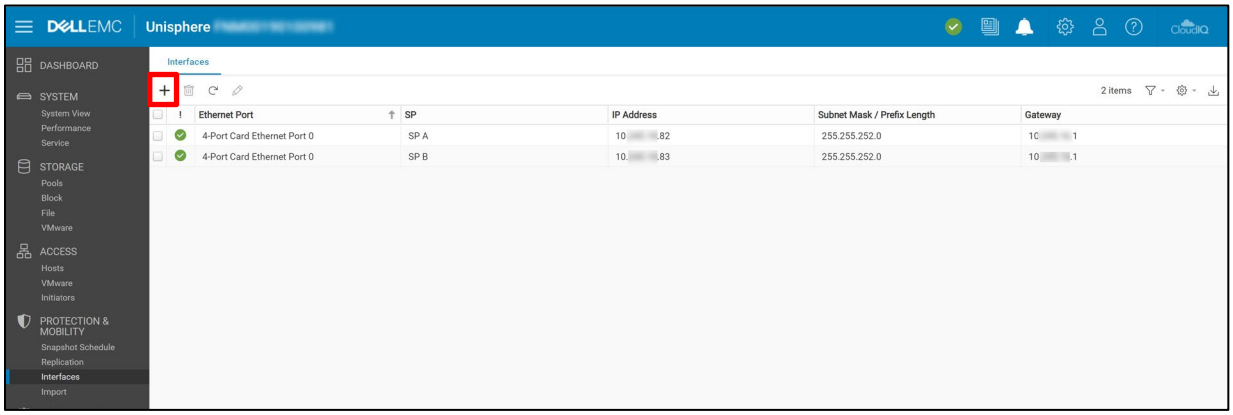

Figure 49 Protection & Mobility > Interfaces

10. Navigate to **Protection & Mobility** > **Import** > **Connections**. Click Create Import Connection, as shown in Figure 50, to create a new remote connection.

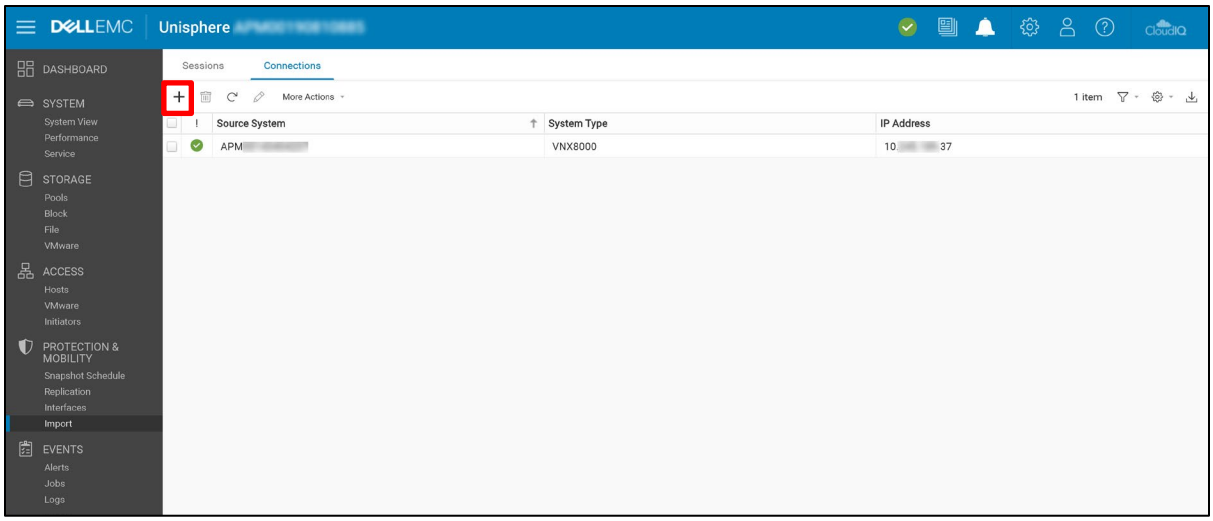

Figure 50 Protection & Mobility > Import > Connections

11. Go to the Unisphere Central GUI, navigate to the **VNX Sessions** page under **Protection & Mobility** > **Migration Sessions**. Click **Create Import Session**, as shown in Figure 51, to create a migration session. Follow the **Create Migration Session** wizard as shown in Figure 39.

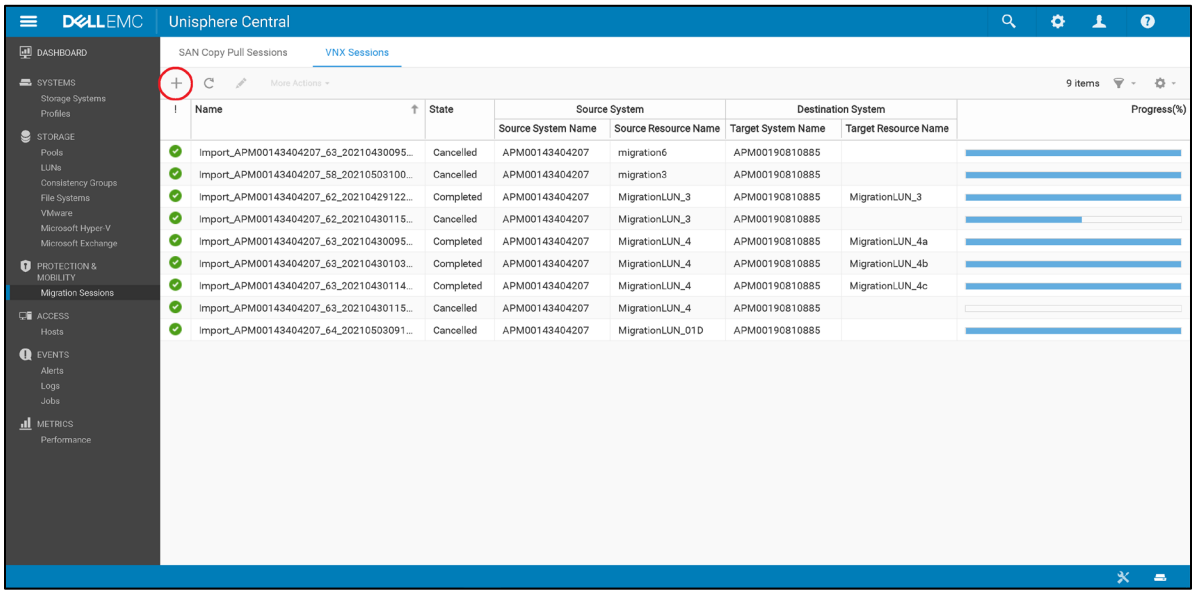

Figure 51 Protection & Mobility > Migration Sessions > VNX Sessions

7 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 ESXi servers are being managed by a VMware vCenter server. A minimum of two ESXi 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 ESXi 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* on Dell EMC Online Support provides more information about HA configurations in vSphere.

8 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, vVNX, SC Series, 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.

The Dell EMC Unity Family Info Hub provides detailed documentation on a variety of topics.

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
- Dell Storage Manager 2020 R1 Administrator's Guide

B Performance Metrics

Unisphere Central gathers metrics from the monitored VNXe, VNX, 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 ESXi server must meet the requirements listed in Table 3 and Table 4.

Table 3 System Requirements

System Requirements	Small	Medium	Large
Disks	5000	10000	20000
vCPU	2	4	8
Memory (GB)	4	6	8
Recommended Storage Size (GB)	25	65	120

Table 4 Metrics Collection Enabled

Storage Environment Size	Small	Medium	Large
Systems (VNX)	10	25	50
Systems (VNXe)	75	150	300
Systems (Dell EMC Unity)	75	150	300
Storage Resources (LUNs, File Systems)	10000	25000	50000

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 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

Sampling Interval	Default Retention Period	Maximum Retention Period
5 minutes	2 weeks	4 weeks
1 hour	12 weeks	12 weeks
1 day	52 weeks	104 weeks

B.3 Performance Metrics

The Performance page allows users to view performance metrics for monitored VNXe, VNX, 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

Resource	Metric	Description
Cache*	Cache Dirty Size	Amount of data in the write cache, in MB, that has not yet been flushed out to disks.
	FAST Cache Dirty Pages	Ratio of dirty pages to total pages in the storage processor FAST Cache, expressed as a percent.
	Total SP Cache Throughput	Total number of I/O requests, in I/O per second, passing through the storage processor cache.

CIFS	Average CIFS I/O Size	Average size of CIFS I/O requests, in KB, across all ports in the storage system.
	Total CIFS Bandwidth	Total amount of CIFS I/O requests, in KB/s, across all ports in the storage system.
	Total CIFS Throughput	Total number of CIFS I/O requests, in I/O per second, across all ports in the storage system.
CPU	Average CPU Utilization	Total number of processing cycles, as a percentage, across all cores in the storage system SPs.
Disk*	Average Disk Queue Length	Average number of disk I/O requests in the system queue, across all disks in the storage system.
	Average Disk Response Time	Average time spent completing disk I/O requests, in microseconds, across all disks in the storage system, including time spent in the queue.
	Average Disk Service Time	Average time spent completing disk I/O requests, in millisecond, across all disks in the storage system, not including time spent in the queue.
	Total Disk Bandwidth	Total amount of disk I/O requests, in KB/s, across all disks in the storage system.
	Total Disk Throughput	Total number of disk I/O requests, in I/Os per second, across all disks in the storage system.
FC*	Total Fibre Channel Bandwidth	Total amount of Fibre Channel I/O requests, in KB/s, across all ports in the storage system
	Total Fibre Channel Throughput	Total number of Fibre Channel I/O requests, in I/O per second, across all ports in the storage system.

File System	Average File System I/O Size	Average size of file system I/O requests, in KB, across all file systems in the storage system.
	Total File System Bandwidth	Total amount of file system I/O requests, in KB/s, across all file systems in the storage system.
	Total File System Throughput	Total number of file system I/O requests, in I/O per second, across all file systems in the storage system.
iSCSI	Total iSCSI Bandwidth	Total amount of iSCSI I/O requests, in KB/s, across all ports in the storage system.
	Total iSCSI Throughput	Total number of iSCSI I/O requests, in I/O per second, across all ports in the storage system.
LUN	Average LUN I/O Size	Average size of LUN I/O requests, in KB, across all LUNs in the storage system
	Average LUN Queue Length	Average number of LUN I/O requests in the system queue across all LUNs in the storage system.
	Average LUN Response Time	Average time spent completing LUN I/O requests, in microseconds, across all LUNs in the storage system.
	Total LUN Bandwidth	Total amount of LUN I/O requests, in KB/s, across all LUNs in the storage system.
	Total LUN Throughput	Total number of LUN I/O requests, in I/Os per second, across all LUNs in the storage system.
NFS	Average NFS I/O Size	Average size of NFS I/O requests, in KB, across all ports in the storage system.
	Total NFS Bandwidth	Total amount of NFS I/O requests, in KB/s, across all ports in the storage system.
	Total NFS Throughput	Total number of NFS I/O requests, in I/O per second, across all ports in the storage system.

*Not available on Dell EMC UnityVSA

Table 7 Available VNX Performance Metrics

Resource	Metric	Description
Cache	Cache Dirty Size	Ratio of cache, as a percentage, written but not flushed to disk
	Cache Hit Ratio	Total number of read requests, as a percentage, fulfilled by retrieval from cache
CPU	Average CPU Utilization	Total processing cycles, as a percentage, across all cores in the storage processors used by the storage system
Disk	Disk Bandwidth	Total amount of disk I/O requests, in bytes per second, across all disks in the storage system
	Disk Errors	Total number of disk errors encountered by all disks in the storage system
	Disk Response Time	Average time, in millisecond, required for one request to pass through a system component, including its waiting time
	Disk Queue Length	Average number of disk I/O requests in the system queue, in MB/s, across all disks in the storage system
	Disk Service Time	Average time spent completing disk I/O requests, in millisecond, across all disks in the storage system, not including time spent in the queue
	Disk Throughput	Total number of disk I/O requests, in I/Os per second, across all disks in the storage system

LUN	LUN Bandwidth	Total amount of LUN I/O requests, in bytes per second, across all LUNs in the storage system
	LUN Response Time	Average time, in millisecond, required for one request to pass through a system component, including its waiting time
	LUN Queue Length	Average number of LUN I/O requests in the system queue across all LUNs in the storage system
	LUN Throughput	Total number of LUN I/O requests, in I/Os per second, across all LUNs in the storage system
Port	Port Bandwidth	Total amount of I/O requests, in bytes per second, across all ports in the storage system
	Port Throughput	Total number of I/O requests, in packets per second, across all ports in the storage system
Protocol	Protocol Throughput	Total number of protocol I/O requests, in I/Os per second, handled by the storage system
File System	File System Bandwidth	Total amount of file system I/O requests, in KB/s, across all file systems in the storage system
	File System Throughput	Total number of file system I/O requests, in I/O per second, across all file systems in the storage system