Dell EMC Unity: Operating Environment (OE) Overview

Software overview for Dell EMC Unity Family (Unity & Unity XT)

Abstract

This white paper introduces the software related features for the Dell EMC Unity Family which includes Unity X00/F, X50F models as well as Unity XT X80/F models. Each software section includes links to other white papers that provide additional details on the feature functionality and usage.

For details on the hardware platform for X00/F and x50F Dell EMC Unity models, please refer to the *Dell EMC Unity: Introduction to the Platform* white paper available on Dell EMC Online Support.

For details on the hardware platform for X80/F Dell EMC Unity models, please refer to the *Dell EMC Unity XT: Introduction to the Platform* white paper available on Dell EMC Online Support.

June 2021

Revisions

Date	Description
May 2016	Initial release – Unity OE 4.0
December 2016	Updated for Unity OE 4.1
July 2017	Updated for Unity OE 4.2
March 2018	Updated for Unity OE 4.3
August 2018	Updated for Unity OE 4.4
January 2019	Updated for Unity OE 4.5
June 2019	Updated for Unity OE 5.0
January 2021	Metro node updates
June 2021	Updated for Unity OE 5.1

Acknowledgments

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Introduction

This white paper provides an overview of the Dell EMC Unity Family available software features. Step-by-step instructions for using features within Dell EMC Unity can be found in the Unisphere Online Help. The paper also explains other product integration into the Dell EMC Unity platform with references to other white papers for additional information.

1.1 Audience

This white paper is intended for IT administrators, storage architects, partners, Dell EMC employees and any other individuals involved in the evaluation, acquisition, management, operation, or design of a Dell EMC networked storage environment utilizing the Dell EMC Unity family of storage systems.

1.2 Terminology

- **Dynamic Host Configuration Protocol (DHCP)**: A protocol used to handle the allocation and administration of IP address space from a centralized server to devices on a network.
- **Fibre Channel Protocol**: A protocol used to perform Internet Protocol (IP) and Small Computer Systems Interface (SCSI) commands over a Fibre Channel network.
- **File System**: A storage resource that can be accessed through file sharing protocols such as SMB or NFS.
- **Fully Automated Storage Tiering for Virtual Pools (FAST VP)**: A feature that relocates data to the most appropriate disk type depending on activity level to improve performance while reducing cost.
- **FAST Cache**: A feature that allows Flash drives to be configured as a large capacity secondary cache for the Pools on the system.
- **Internet Small Computer System Interface (iSCSI)**: Provides a mechanism for accessing block-level data storage over network connections.
- **Logical Unit Number (LUN)**: A block-level storage device that can be shared out using a protocol such as iSCSI.
- **Network Attached Storage (NAS) Server**: A file-level storage server used to host file systems. A NAS Server is required in order to create file systems that use SMB or NFS shares, as well as VMware NFS Datastores and VMware Virtual Volumes (File).
- **Network File System (NFS)**: An access protocol that allows data access from Linux/UNIX hosts located on a network.
- **Pool**: A repository of drives from which storage resources such as LUNs and file systems can be created.
- **REpresentational State Transfer (REST) API**: A lightweight communications architecture style that enables the execution of discrete actions against web services.
- **Server Message Block (SMB)**: A network file sharing protocol, sometimes referred to as CIFS, used by Microsoft Windows environments. SMB is used to provide access to files and folders from Windows hosts located on a network.
- **Snapshot**: A point-in-time view of data stored on a storage resource. A user can recover files from a snapshot, restore a storage resource from a snapshot, or provide access to a host.
- **Software Defined Storage**: A storage architecture where the software storage stack is decoupled from the physical storage hardware.
- **Storage Policy Based Management (SPBM)**: Using storage policies to dictate where a VM will be stored, as opposed to choosing a datastore manually.

- **Storage Processor (SP)**: A storage node that provides the processing resources for performing storage operations as well as servicing I/O between storage and hosts.
- **Unisphere**: An HTML5 graphical user interface that's used to manage Dell EMC Unity systems.
- **Unisphere Command Line Interface (UEMCLI)**: An interface that allows a user to perform tasks on the storage system by typing commands instead of using the graphical user interface.
- **Virtual Storage Appliance (VSA)**: A storage node that runs as a virtual machine instead of on purpose-built hardware.
- **vSphere API for Array Integration (VAAI)**: A VMware API that allows storage-related tasks to be offloaded to the storage system.
- **vSphere API for Storage Awareness (VASA)**: A VMware API that provides additional insight about the storage capabilities in vSphere.
- **Virtual Volumes (vVols)**: A VMware storage framework which allows VM data to be stored on individual Virtual Volumes. This allows for data services to be applied at a VM-granularity level while utilizing Storage Policy Based Management (SPBM).

2 Dell EMC Unity Family Overview

Dell EMC Unity Family Hybrid and All Flash storage systems implement an integrated architecture for block, file, and VMware vVols with concurrent support for native NAS, iSCSI, and Fibre Channel protocols based on the powerful family of Intel processors. Each system leverages dual storage processors, full 12-Gb SAS back-end connectivity and patented multi-core architected operating environment to deliver unparalleled performance & efficiency. Additional storage capacity is added via Disk Array Enclosures (DAEs). Unity successfully meets many storage requirements of today's IT professionals:

Unity is Simple

Unity solutions set new standards for storage systems with compelling simplicity, modern design, affordable prices, and flexible deployments - to meet the needs of resource-constrained IT professionals in large or small companies.

Unity is Modern

Unity has a modern 2U architecture designed for all-flash, designed to support the high-density SSD's including 3D NAND TLC (triple level cell) drives. Unity includes automated data lifecycle management to lower costs, integrated copy data management to control local point-in-time snapshots, built-in encryption and remote replication, and deep ecosystem integration with VMware and Microsoft.

Unity is Affordable

Our dual-active controller system was designed to optimize the performance, density, and cost of your storage to deliver all-flash or hybrid configurations for much less than you thought possible.

Unity is Flexible

Unity is available as a virtual storage appliance, purpose-built all flash or hybrid configurations, or as converged systems - with one Unity operating environment that connects them all together.

For a full workflow on installing a brand-new Dell EMC Unity system in a datacenter, please see the Unity Quick Start Installation video on Unity InfoHub (bit.ly/unityinfohub)

3 Software Overview

This section provides a high-level overview of some of the software features available on the Dell EMC Unity platform. Note that not all features are available on all Dell EMC Unity deployment types (UnityVSA, UnityVSA HA, All Flash, Hybrid). These distinctions will be made when appropriate.

3.1 Software Operating Environment

The Dell EMC Unity Operating Environment, or OE, refers to the software running on the Dell EMC Unity All Flash, Hybrid, or UnityVSA system. Non-disruptive upgrades to a newer version of the Dell EMC Unity OE are supported on all physical Dell EMC Unity systems and Dell EMC UnityVSA HA. This is accomplished by upgrading one SP at a time and ensuring all resources are running on the SP not undergoing the upgrade. Upgrading to a newer version of Dell EMC Unity OE provides access to all new functionality that is supported on that system, and is easily initiated and monitored through Unisphere, UEMCLI, or REST API.

The Dell EMC Unity OE version software scheme breaks the version number into either four or six separate fields, depending on major version. Fields are separated by a period. In versions up to 4.4, there are four fields (ex: 4.3.1.1525703027). From left to right, the first field indicates the major release number, the second indicates the minor release number, the third indicates the service pack number, and the fourth field indicates the build iterator.

In Dell EMC Unity OE version 4.5 and later, the number scheme to track different versions has been changed, making it easier to identify a certain build. The version number is now broken into six fields, each field is defined below, including example build 4.5.0.0.5.009:

Table 1. Software Version Numbering Schema

Field #	1	2	3	4	5	6
Value	Major release number	Minor release Number	Service pack number	Branch Version Identifier	Distribution type	3 Digit iterator
Example	4	5	0	0	5	009

The two primary changes are the addition of a branch version identifier and distribution type field. The branch version identifier will be 0 for any customer deliverable branch, and some value 1 through 9 for internal domain or development builds. The distribution type represents four different distribution possibilities, defined below:

- 0-3 = Internal
- 4 = Early access or beta
- 5 = General availability
- 6 = Special distribution or hotfix

For physical systems when upgrading to Dell EMC Unity OE version 5.0 and later, the drive firmware bundle is included in the OE upgrade package downloaded from Dell EMC Online Support. The drive firmware package will be staged within the system as part of the upgrade process. The drive firmware bundle will still be available as a separate download. The software OE and drive firmware upgrade operations via Unisphere and Unisphere CLI remain the same. If the system was upgraded using an OE upgrade package that includes a drive firmware bundle, the user is prompted to upgrade any drives which are not running the latest firmware. For which case, the user can opt-out and skip the drive firmware upgrade operation or proceed with the Upgrade Drive Firmware wizard as it is automatically opened.

3.2 Initial Configuration

After installing and powering on the purpose-built Dell EMC Unity system for the first time, the operating environment will boot. After the system boot is complete, the system will be placed in a discovery mode in order for a management address to be assigned. If a DHCP server exists in the environment where the Dell EMC Unity system is installed, it will obtain an IP address from the DHCP server. The management IP address can be set using Connection Utility (see Figure 1), available for Windows. Both IPv4 and/or IPv6 are supported by Dell EMC Unity for management. The Connection Utility application can be obtained from Dell EMC Online Support.
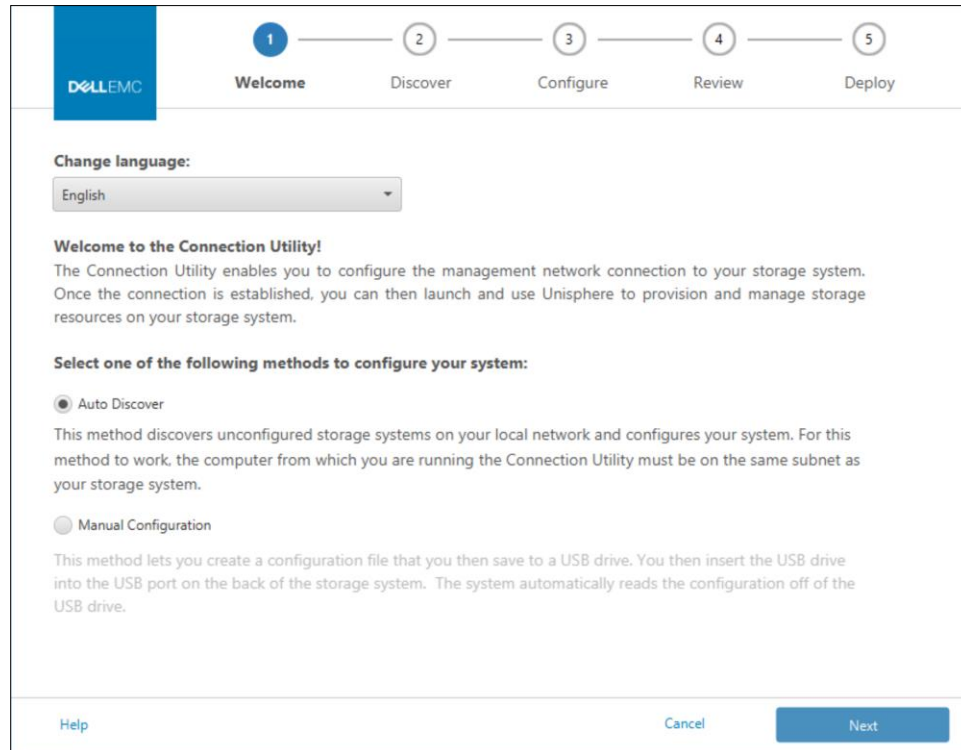
Figure 1. Connection Utility

Connection Utility will discover and configure any configurable Dell EMC Unity systems on the same subnet as the host Connection Utility is being run from. Connection Utility can also be used to save an IP configuration to a USB drive, which can be inserted into the Dell EMC Unity system and applied automatically. This is useful in situations where Connection Utility cannot be run from the same subnet as the Dell EMC Unity system.

Once an IP has been set, Unisphere can be accessed using the assigned IP address from a web browser. On first login to the Dell EMC Unity system, the Initial Configuration Wizard will be presented. The Initial Configuration Wizard assembles frequently accessed configuration settings into a step-by-step workflow in order to quickly license and configure the Dell EMC Unity system for immediate use.

More information about the Initial Configuration Wizard can be found in the white paper *Dell EMC Unity: Unisphere Overview* available on Dell EMC Online Support.

3.3 Management

Dell EMC Unity was developed with the intention of making management operations simple and accessible. To accomplish this, Dell EMC Unity offers three methods to manage your system: Unisphere, Unisphere CLI, and REST API. Each of these access methods offer full functionality for provisioning storage, managing hosts, monitoring performance, performing service actions, and more.

3.3.1 Unisphere

Unisphere is Dell EMC Unity's web-based Graphical User Interface used to manage and provision storage on the Dell EMC Unity system. Unisphere is built on an HTML5 platform, making it compatible with most modern browsers without the need for additional plug-ins. System status and performance information can also be displayed in Unisphere, with a graphical representation of the Dell EMC Unity system provided and highlighted for areas of interest – drive faults, network link failures, etc. Within Unisphere are a number of options for support, including Unisphere Online Help and the Support page where FAQs, videos, white papers, chat sessions, and more can be accessed.

In Dell EMC Unity OE Version 4.3, TLS enhancements were introduced. TLS 1.2 support was added on Dell EMC Unity, and TLS 1.0 can be disabled. In OE version 5.1 TLS 1.1 can also be disabled. This complies with security regulations being introduced in different industries. The `/sys/security set` Unisphere CLI command is used to specify the lowest version of the TLS protocol the system supports for SSL communications. If the TLS mode is set to TLSv1.0, then connections to Dell EMC Unity will be allowed from TLS 1.0, TLS 1.1, and TLS 1.2. If the TLS mode is set to TLSv1.1, then connections to Dell EMC Unity will be restricted to TLS 1.1 and TLS 1.2 only. Reference the *Unisphere Command Line Interface User Guide* on Dell EMC Online Support for more detail on disabling TLS 1.0 or TLS 1.1.
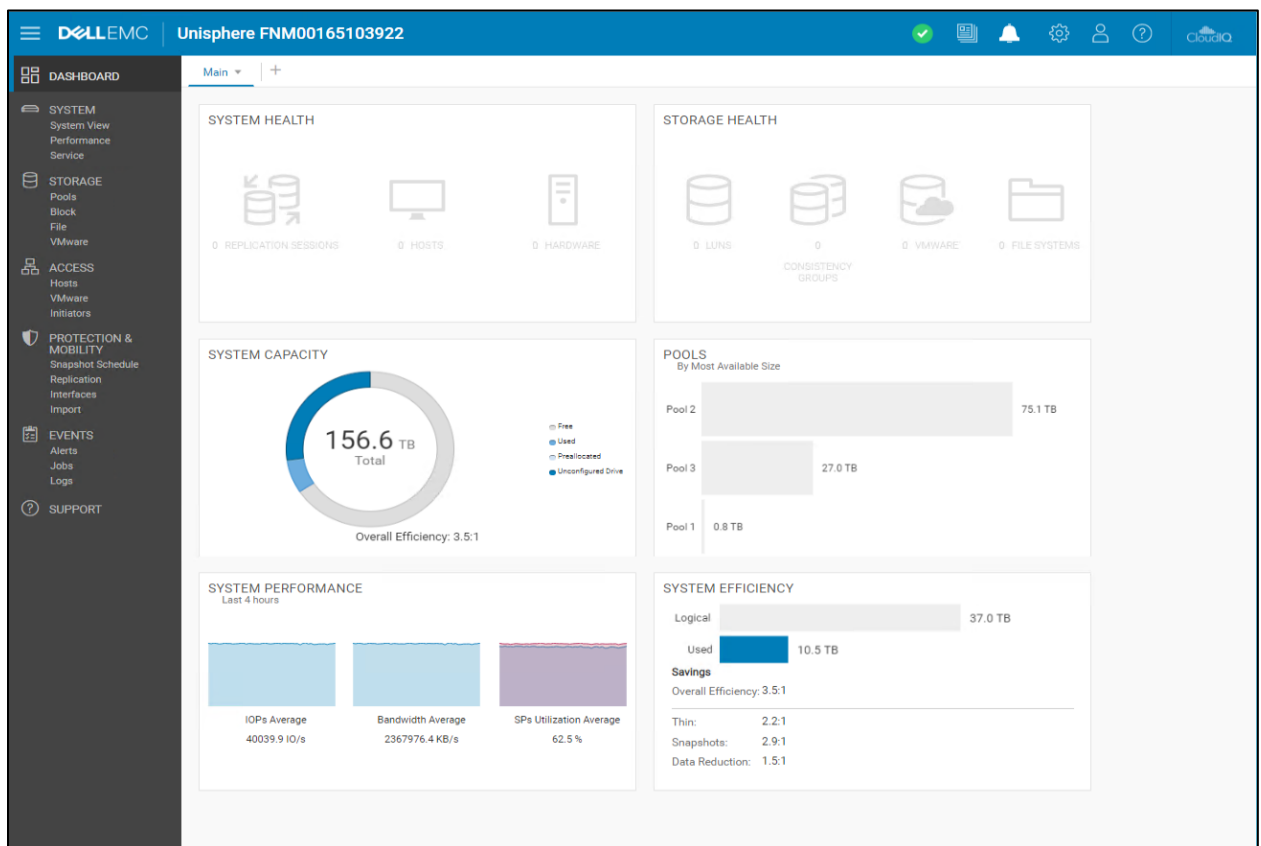

Figure 2. Unisphere

Disabling TLS 1.0 may impact existing client applications which are not compatible with TLS 1.1 or TLS 1.2 protocols. In this case, TLS 1.0 support should remain enabled. The following functionality will not work when TLS 1.0 is disabled: Technical advisories, software upgrade notifications, drive firmware upgrade notifications, language pack upgrade notifications, and replication from Dell EMC Unity OE versions earlier than 4.3 to Dell EMC Unity OE versions 4.3 or later. Replication is supported between Dell EMC Unity OE versions earlier than 4.3 to Dell EMC Unity OE versions 4.3 or later, but only if TLS 1.0 is enabled.

For additional information about Unisphere, please refer to the paper titled *Dell EMC Unity: Unisphere Overview* available on Dell EMC Online Support.

3.3.2 Unisphere CLI (UEMCLI)

Unisphere CLI (UEMCLI) is a command-line interface for managing a Dell EMC Unity system. UEMCLI may be run directly from the Dell EMC Unity system, by establishing an SSH session to the system. Alternatively, UEMCLI may be run from a Windows host after installing the Unisphere CLI client. Use the UEMCLI client to quickly run commands across multiple Dell EMC Unity systems. UEMCLI may also be used in the creation of scripts to automate portions of the management process. In Dell EMC Unity OE Version 4.3 and later, UEMCLI will accept references to objects by their friendly name in addition to their ID. This improves usability and allows for easier scripting and management of multiple or net-new systems. Consult the UEMCLI guide for a completed list of the objects which can be referenced by their friendly name.

For more information about UEMCLI along with descriptions and syntax of available commands, please see the document titled *Unisphere Command Line Interface User Guide* on Dell EMC Online Support.

3.3.3 REST API

Another method of performing management operations on the Dell EMC Unity system is over REST API. REST API is an industry-recognized communication architecture that is used in the development of and interaction with web services. Dell EMC Unity's support of REST API makes it easy for environments with an existing REST API orchestration layer to adapt applications and services to Dell EMC Unity. A full list of API calls, as well as a Programmer's Guide is available on the Dell EMC Unity system. In Dell EMC Unity OE Version 4.3 and later, REST accepts references to all objects by their friendly name in addition to their ID. This improves usability and allows for easier scripting and management of multiple or net-new systems.

For more information about REST API for Dell EMC Unity, please see the document titled *Unisphere Management REST API Programmer's Guide* on Dell EMC Online Support. The *REST API Programmer's Guide* explains REST and JSON concepts and how to make REST requests to the Unisphere Management Rest API. This guide can also be accessed using the management IP of your Dell EMC Unity system by browsing to https://<Management_IP>/apidocs/programmers-guide/index.html.

A second reference is the *REST API Reference Guide* which describes the resource types, operations, attributes, and arguments in the REST API, along with other information, such as data types and enumerations. This guide can also be accessed using the management IP of your Dell EMC Unity system by browsing to https://<Management_IP>/apidocs/index.html.

3.4 Storage Provisioning

Dell EMC Unity offers both block and file provisioning in the same enclosure. Drives are provisioned into Pools that can be used to host both block and file data. Connectivity is offered for both block and file protocols. For block connectivity, iSCSI and/or Fibre Channel may be used to access LUNs, Consistency Groups, Thin Clones, VMware Datastores (VMFS), and VMware Virtual Volumes. For file connectivity, NAS

Servers are used to host File Systems that can be accessed via SMB Shares or NFS Shares. NAS Servers are also used to host VMware NFS Datastores and VMware Virtual Volumes.

Unity supports two different types of Pools: Traditional and Dynamic Pools. Due to differences in usage/behavior for each type of Pool, each will be discussed in separate sections.

3.4.1 Traditional Pools

All storage resources are provisioned from Pools, whether Traditional or Dynamic. In general, a Pool is a collection of physical drives arranged into an aggregate group, with some form of RAID applied to the drives to provide redundancy. On purpose-built hybrid systems, only Traditional Pools can be created and Pools can consist of drives of varying types. These drives are sorted into one of three tiers: Extreme Performance (Flash), Performance (SAS), and Capacity (NL-SAS). For hybrid systems, Pools can be configured to contain multiple tiers of drives. This is known as a heterogeneous Pool. When combined with FAST VP, heterogeneous Pools can provide efficient balancing of data between tiers without requiring user intervention. In another available configuration, Pools can contain just a single tier of drives. This is known as a homogeneous Pool (Figure 3).
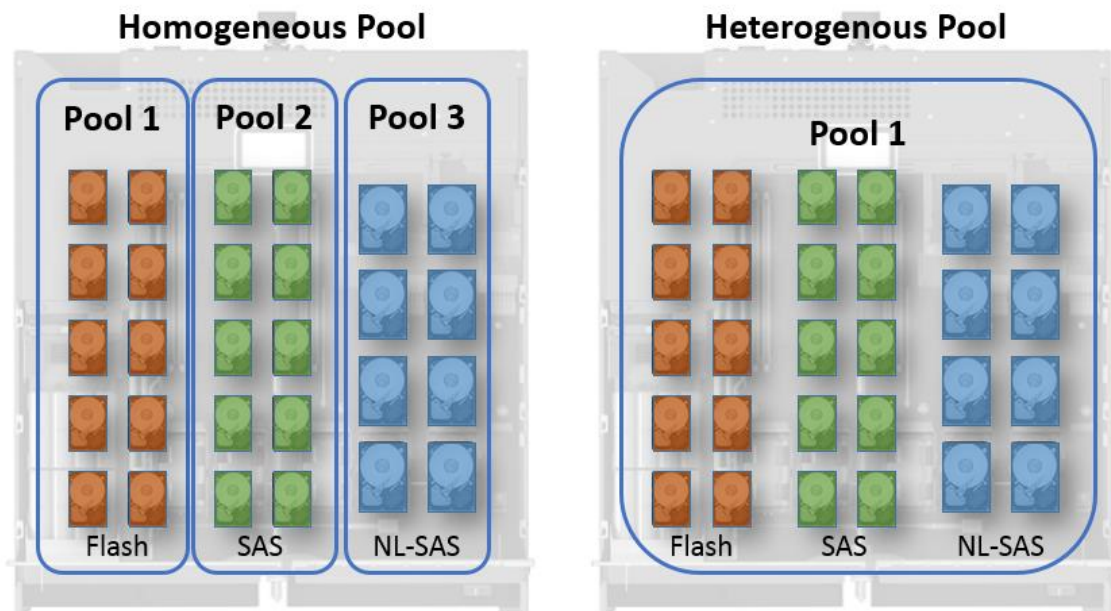
Figure 3. Pool Layouts

Each tier in a Pool can have a different RAID configuration set. The list of supported RAID configurations for each tier is listed in the *Dell EMC Unity Family – Configuring Pools* technical paper on Dell EMC Online Support. Another consideration for Pools is the Hot Spare Policy. The Dell EMC Unity system reserves 1 spare drive per 31 drives to serve as a spare for the system. In other words, given 31 drives of the same type on a Dell EMC Unity system, 1 of those drives will be marked as a hot spare and will not be permitted to be used in a Pool. If a 32nd drive is added to the system, the policy is updated and a second drive will be reserved as a hot spare. A spare drive can replace a faulted drive in a Pool if it matches the drive type of the faulted disk. Any unbound drive can serve as a spare, but Dell EMC Unity will enforce the "1 per 31" rule at all times.

In the event of a drive failure, the Dell EMC Unity system will try to locate a spare. The system has four criteria for selecting a drive replacement: Type, Bus, Size, and Enclosure. The system will start by finding all spares of the same drive type, then look for a drive on the same bus. If a drive on the same bus is found, the

system will locate any drives that are the same size or greater than the faulted drive. Finally, if any valid drives are in the same enclosure as the faulted drive, one will be chosen. If during this search a valid drive cannot be located, the system will widen its search in reverse order until a suitable replacement is found.

For more information about how drive sparing is handled, please see the *Dell EMC Unity: High Availability* white paper and the Drive Sparing Matrix on Dell EMC Online Support.

3.4.2   Dynamic Pools

Dynamic Pools, released in Dell EMC Unity OE version 4.2.x for Dell EMC Unity All Flash systems, increases the flexibility of configuration options within a Dell EMC Unity system with an entirely redesigned Pool structure. Dynamic Pools replace the existing Pool technology, now called Traditional Pools, in this release as the default Pool type created within Unisphere for Dell EMC Unity All Flash systems. Dynamic Pools, as with Traditional Pools, can be created, expanded, and deleted, but include other improvements.

When expanding a Dynamic Pool, as the RAID width multiple does not apply, the user can also expand by a specific target capacity. In most cases, the user can add a single drive to the Pool to increase its capacity. These features provide completely flexible deployment models which improves the planning and provisioning process. The total cost of ownership of the configuration is also reduced as there is no restriction of adding additional drives based on RAID width multiples.

As Dynamic Pools are created without using fixed width RAID groups, rebuild operations are completely different than rebuilds occurring within a Traditional Pool. When a drive is failing or has failed with a Traditional Pool, a Hot Spare is engaged and used to replace the bad drive. This replacement is one-to-one, and the speed of the proactive copy or rebuild operation is limited by the fixed width of the private RAID group and the single targeted Hot Spare. With Dynamic Pools, regions of RAID as well as regions within the Pool which will be utilized for drive replacement are spread across the drives within the Pool. In this design, multiple regions of a failing or failed drive can be worked on simultaneously. As the space for the replacement is spread across the drives in the Pool, the proactive copy or rebuild operations are also targeted to more than one drive. With these features, the amount of time to replace a failed drive is significantly reduced.

In Dell EMC Unity OE version 4.2.x or later, for All-Flash systems, all new pools are Dynamic Pools when created in the Unisphere GUI. To create Traditional Pools, you can use Unisphere CLI or REST API.

For more information about Dynamic Pools, please see the *Dell EMC Unity: Dynamic Pools* on Dell EMC Online Support.

3.4.3   LUNs

LUNs are block-level storage resources that can be accessed by hosts over iSCSI or Fibre Channel connections. A user is able to create, view, manage, and delete LUNs in any of the management interfaces – Unisphere, Unisphere CLI, and REST API. A Pool is required to provision LUNs. LUNs may be replicated in either an asynchronous or synchronous manner, and snapshots of LUNs may be taken.

With multi-LUN create, a user can create multiple LUNs at a time in a single wizard. However, certain settings such as the replication configuration must be manually added after the fact. Multi-LUN create is intended to create multiple independent resources at once. Users looking to configure similar host access, snapshot, and replication settings on a group of LUNs can leverage Consistency Groups. In Dell EMC Unity OE version 4.5 or later, multi-LUN create will allow users to specify a starting point for the appended number, allowing users to continue the numbering scheme for preexisting LUNs.

In Dell EMC Unity OE version 4.4 or later, Unisphere will prevent the user from deleting a block resource that has host access assigned to it. To delete the host-accessible block resource, the user needs to first remove the host access. Host access can be removed by selecting a LUN in the Block page and using the More Actions dropdown, or via the LUN properties window. Additionally, in Dell EMC Unity OE version 4.4, Unisphere allows the user to set a custom Host LUN ID during creation of LUNs and VMware VMFS Datastores. Once the resource is created, the user can modify the Host LUN IDs from the block resource's properties page under the Access tab or the host properties page.

In Dell EMC Unity OE version 5.1 users can logically group hosts and block resources within a host group. Host groups can be created and managed from the Host Groups tab under the Hosts page and help to streamline host/resource access operations. A host group can be one of two types, General and ESX, which is persistent for the life of the group. A General type host group allows one or more non-ESXi hosts and LUNs to be grouped together. ESX host groups allow VMware ESXi hosts to be grouped with LUNs and/or VMFS datastores. For more information about host groups, refer to the *Dell EMC Unity: Unisphere Overview* white paper found on Dell EMC Online Support.

3.4.4 Consistency Groups

A Consistency Group arranges a set of LUNs into a group. This is especially useful for managing multiple LUNs that are similar in nature or interrelated, as management actions taken on a Consistency Group will apply to all LUNs in the group. For example, taking a snapshot of a Consistency Group will take a snapshot of each LUN in the Consistency Group at the same point in time. This can ensure backup and crash consistency between LUNs. Consistency Groups can be replicated using asynchronous or synchronous means, and operations on the Consistency Group replication session, such as failover and failback, will be performed on all the LUNs in the Consistency Group.

3.4.5 VMware Datastores

VMware Datastores are storage resources pre-configured to be used with VMware vCenter™ and ESXi® hosts. Creating VMware Datastores in Unisphere and assigning host access to your VMware resources will create your datastore on the Dell EMC Unity system and automatically configure the datastore in your VMware environment. VMware VMFS Datastores are block storage objects that are connected via iSCSI or Fibre Channel.

In Dell EMC Unity OE version 4.3 or later, users are able to create version 6 VMware VMFS Datastores from Unisphere CLI or REST API. In Dell EMC Unity OE version 4.5 or later, users are able to create version 5 or version 6 VMware VMFS Datastores from Unisphere.

3.4.6 Thin Clones

A Thin Clone is a read/write copy of a block storage resources' (LUNs, LUNs within Consistency Group or VMware VMFS Datastores) snapshot. Thin Clone shares the sources of block storage resources. Instantly, on creation of Thin Clone all the data will be available on the Thin Clone. Ongoing changes data on the Thin Clones will not affect the Base resource and vice versa. Any changes to the Thin Clone will not affect the snapshot source.

Thin Clones can be refreshed to return to a previous image or to the original snapshot image. In Dell EMC Unity OE version 4.2.1 and later, a LUN can be refreshed by any snapshot created under the Base LUN, including snapshots of related Thin Clones. This allows a user to push changes made on a Thin Clone back to the Base LUN.

3.4.7 VMware Virtual Volumes (Block)

Dell EMC Unity provides support for VMware Virtual Volumes served over a block Protocol Endpoint. The Protocol Endpoint serves as a data path on demand from an ESXi host's Virtual Machines to the Virtual Volumes hosted on the Dell EMC Unity system. The Protocol Endpoint may be defined using iSCSI or Fibre Channel.

For more information about VMware datastores, Virtual Volumes, and other virtualization technologies related to Dell EMC Unity, please see the white paper titled *Dell EMC Unity: Virtualization Integration* on Dell EMC Online Support.

3.5 Dell EMC Unity File System

The Dell EMC Unity File System addresses the growing demand for larger file systems and protocol flexibility. Dell EMC Unity File System is a 64-bit file system architecture that offers large-scale limits on the number of files per directory, the number of sub directories per directory, and a maximum capacity of 256TB. More information about the scale of Dell EMC Unity File System is offered in Table 2.

For a full list of available Dell EMC Unity File System limits and other system limits, see the Dell EMC Unity Simple Support Matrix on the Dell EMC website.

Table 2. Dell EMC Unity File System Limits

MAX FILE SYSTEM SIZE	256 TB
SUBDIRECTORIES PER DIRECTORY	~100 Million
FILES PER FILE SYSTEM	~32 Billion
FILE NAMES PER DIRECTORY	~10 Million
ACL IDS	4 Million

To provision a Dell EMC Unity File System, a NAS Server is required. Dell EMC Unity File Systems can be accessed via SMB or NFS protocols and can be shared to both protocols simultaneously by using a Multiprotocol file system.

3.5.1 NAS Servers

NAS Servers host file systems on the Dell EMC Unity storage system. NAS Servers use virtual interfaces to enable host connectivity to SMB, NFS, and Multiprotocol file systems, as well as VMware NFS Datastores and VMware Virtual Volumes. Depending on what is enabled on the NAS Server, SMB file systems and NFS file systems can be created either separately or in a multiprotocol configuration. File systems and virtual interfaces are isolated to a single NAS Server, allowing for multi-tenancy over multiple NAS Servers. NAS Servers are hosted on a Storage Processor and will automatically fail over in the event the SP becomes faulted. Any associated file systems will also be failed over .

Dell EMC Unity OE version 4.5 introduces the ability to create shares for writable and read-only snapshots on the destination NAS Server. This feature is designed to enable DR testing without any impact to the ongoing replication. It allows customers to confirm that an application can be successfully brought online and write to a share hosted on the destination system. This feature works with both asynchronous and synchronous replication. This feature leverages a Proxy NAS Server and Proxy share created on the destination system to provide access to the snapshot.

Starting with Dell EMC Unity OE version 4.4, ports can be configured for a custom MTU size 1280 through 9216. Previously, the MTU sizes were limited to either 1500 or 9000. The custom MTU size can be configured on ports that are used for NAS Server, replication, and import interfaces. Note that any ports that have iSCSI interfaces created must still use 1500 or 9000.

Dell EMC Unity OE version 4.4 also included a number of NFS enhancements; NFS share names can contain the "/" character. Previously, using the "/" character in the share name is prohibited as it is reserved to indicate a directory on UNIX systems. By allowing the use of the "/" character in the share name, this enables administrators to create a virtual namespace that is different from the actual path used by the share. Dell EMC Unity OE version 4.4 also introduces the ability to allow or prevent clients from setting the `setuid` and `setgid` bits on any files and directories residing on the NFS share. By default, this is allowed and can be changed when creating or modifying an NFS share. Dell EMC Unity OE version 4.4 also introduces the ability to configure the anonymous UID and GID attributes.

In Dell EMC Unity OE version 4.3 LDAP enhancements were added, such as the ability to run LDAP lookups from the NAS Server. This is useful for confirming the mappings are configured properly and also for troubleshooting purposes. Dell EMC Unity OE version 4.3 also introduced dynamic LDAP. Dynamic LDAP provides the ability to automatically obtain the LDAP server IP addresses and ports when configuring or editing a NAS Server. Additional enhancements in this release include improvements to unmapped users, automatic mapping for unmapped windows accounts, secmap cache management, and read-only proxy NAS Servers. Read-only proxy NAS Servers provide the ability to access all the file system and snapshot data on the destination NAS Server through SMB and NFS.

In Dell EMC Unity OE version 4.2.1, enhancements to Link Aggregation and the introduction of Fail-Safe Networking (FSN) improved NAS Server high availability. Link Aggregation combines multiple network connections into a logical link, increasing throughput by distributing traffic across multiple connections and providing redundancy in case one connection fails. If a connection loss is detected, the link is immediately disabled and traffic is automatically moved to the surviving links in the aggregate. Dell EMC Unity OE version 4.2.1 improved Link Aggregation, allowing ports from different I/O Modules or on-board Ethernet ports to be aggregated together. Fail-Safe Networking is a high availability feature that extends link failover into the network by providing switch-level redundancy. FSN is created from Ethernet ports, link aggregations, or any combination of the two, and appears as a single link with a single MAC address and potentially multiple IP addresses. FSN does not require any configuration from the switch side, this allows a single FSN to be connected to multiple switches, providing availability in the event of a switch failure.

Dell EMC Unity OE version 4.2 added the ability to modify NAS Server parameters at a NAS Server level. In prior releases, only global NAS Server parameters could be modified. Modifying parameters at a per-NAS Server level gives greater flexibility in environments where not all NAS Servers need the same configuration. These parameters can be modified using the "svc_nas" command.

Dell EMC Unity OE version 4.1 introduces IP Multi-Tenancy, which adds the ability to provide network isolation for tenants. This feature separates network traffic at the kernel level on the SP, enabling the ability to provide dedicated network resources for each tenant. Each tenant has its own dedicated network namespace including VLAN domain, routing table, firewall, interfaces, DNS, and more. This also enables the ability for multiple tenants to use the same IP network configuration, so IPs can be duplicated across tenants. This avoids network interference between tenants and also enhances security. This feature is only available on purpose-built Dell EMC Unity systems, it is not available on Dell EMC UnityVSA.

On a NAS server, interfaces can be configured to enable communication between the NAS Server, client, and external services. In addition, starting with Dell EMC Unity OE version 4.1, static routes can also be configured to determine where to forward a packet so that it can reach its destination. Static routes can either

be a host or network route. A host route is the most specific type of route, which is only used when traffic is sent to a specific IP address. A network route is less specific and is used when sending traffic to a specific subnet. The system uses the most specific route available. If no host or network routes are defined, the default route is used (if configured).

Packet Reflect, available in Dell EMC Unity OE version 4.1 or later, is a feature that ensures outbound (reply) packets are sent back to the same host or router as the inbound (request) packet. This enables the NAS Server to bypass routing and ARP table lookups when replying to a packet, so no routing configuration is required.

In Dell EMC Unity OE version 4.1, for multi-protocol NAS Servers, users can use local files to resolve UNIX user identities for their Unix Directory Service (UDS) configuration. This is useful in cases where an external NIS or LDAP server is not available for UDS configuration, but multi-protocol is still needed thereby providing an easy alternative without requiring an external service. Local files can be used to resolve UNIX user records in multiple ways including by passwd, group, hosts, netgroup, and/or home directories. Dell EMC Unity provides the ability to perform operations such as failover, failback, pause, and resume on individual NAS Servers and file systems with replication enabled. For example, in order to initiate a failover, you must first failover the NAS Server and then failover the individual file systems afterwards to enable access on the destination system. Dell EMC Unity OE version 4.2 and newer provides an enhancement to this process which automatically fails over all of the associated file systems once a failover is initiated on the NAS Server.

For more information about NAS Servers, see the white paper titled *Dell EMC Unity: NAS Capabilities* available on Dell EMC Online Support.

3.5.2 Common Event Enabler (CEE)

Dell EMC Unity allows users to connect to a Common Anti-Virus Agent (CAVA) which can be used to identify and eliminate known viruses before they infect files on a system. CAVA is enabled by the Dell EMC Common Event Enabler (CEE) framework which is available for download and install for Windows or Linux environments. CAVA is for CIFS/SMB protocol and does not support NFS protocol.

Starting in Dell EMC Unity OE version 4.1, the system can connect to a Common Event Publishing Agent (CEPA) using the existing CEE framework. CEPA is a mechanism that allows applications to receive file event notifications (i.e. receive notifications when a file is created, opened, edited, renamed, etc.). CEPA is available for CIFS/SMB protocol and is configurable in a NAS Server's properties.

For more information about CEE, CAVA, and CEPA, see the technical papers titled *Using the Common Event Enabler for Windows* and *Using the Common Event Enabler for Linux* on Dell EMC Online Support. For a full list of supported Anti-Virus products, see the *Dell EMC Unity Simple Support Matrix* on the Dell EMC website.

3.5.3 File System Access

File systems are file-based storage resources that are hosted on NAS Servers. They are accessed through Shares, which can be provisioned for SMB access or NFS access. This provides access for Windows hosts and/or UNIX hosts. Depending on what protocol is selected for your file system, only shares of that type can be provisioned. For example, if an SMB file system is created, SMB Shares (not NFS) can be provisioned. In order to provision both SMB and NFS Shares from a file system, the SMB and NFS protocols in the NAS Server must be enabled or a multiprotocol file system must be used.

Starting with Dell EMC Unity OE version 4.4, NFS host registration is made optional. Instead, host access can be managed by specifying a comma separated string. This is designed to simplify management and improve

ease of use. If replication is configured, this string is also replicated to the destination so no reconfiguration of host access is required in the event of a failover.

Dell EMC Unity supports up to SMB 3.02 including older CIFS versions and NFS v3, 4.0, and 4.1. In Dell EMC Unity OE version 4.2 and later, the system supports SMB 3.1.1, which adds reliability enhancements for Continuous Availability for Hyper-V Cluster Client Failover and improved security and encryption traffic performance. Secure NFS using Kerberos is also supported. FTP and SFTP can be enabled on a NAS Server, providing access to provisioned file systems over these protocols. File systems can be extended and shrunk in size, and allocated space is automatically taken and reclaimed based on file system usage patterns. Finally, file systems can be configured with quotas to better regulate file system space usage. Tree quotas and user quotas are supported on file systems, and can be used in combination.

3.5.4   Multiprotocol File Systems

Multiprotocol file systems are created on multiprotocol NAS Servers. A multiprotocol NAS Server must utilize Active Directory services and either NIS or LDAP. A multiprotocol file system relies on the directory services running in each of the Windows and UNIX environments, by matching the username in one environment to the identical username in the other. For discrepancies between usernames in each environment, an ntxmap may be uploaded to the multiprotocol NAS Server. Additionally, a default user may be assigned for each environment so that a username who does not have an equivalent account in the other environment can still access the file system.

For more information about Dell EMC Unity file systems, see the white paper titled *Dell EMC Unity: NAS Capabilities* available on Dell EMC Online Support.

3.5.5   File-Level Retention (FLR)

Dell EMC Unity OE version 4.5 introduces File-Level Retention (FLR). FLR enables the ability to lock files, preventing them from being modified or deleted until a specified retention date. This functionality is also known as Write Once, Read Many (WORM). FLR is available on the physical Dell EMC Unity family as well as Dell EMC UnityVSA systems. This feature is only available for file systems and is not available for VMware NFS datastores.

There are two versions of FLR available – Enterprise (FLR-E) and Compliance (FLR-C). FLR-E prevents file modification and deletion by users through access protocols such as SMB, NFS, and FTP. However, an authorized storage administrator can delete the entire file system even if it contains locked files. FLR-C prevents administrators from deleting a file system that contains locked files. The administrator must wait all files to expire before the file system can be deleted. FLR-C also has other differences including a data integrity check, hard infinite retention, and snapshot restrictions. FLR-C is designed to meet the requirements of SEC Rule 17a-4(f).

For more information about File Level Retention, reference the *Dell EMC Unity: File-Level Retention* white paper on Dell EMC Online Support.

3.5.6   VMware NFS Datastores

ESXi and Linux hosts can be given access to VMware NFS Datastores. VMware NFS Datastores, similar to VMware VMFS Datastores, are storage resources that will be automatically formatted and added to a VMware vCenter environment, allowing for efficient deployment of resources in a VMware environment. As the name implies, VMware NFS Datastores are accessed over the NFS protocol. Accordingly, a NAS Server with NFS protocol support must be available to configure VMware NFS Datastores. Also, starting with Dell

EMC Unity OE version 4.2, VMware NFS datastores can be mounted using NFSv4 protocol. When creating NFS datastores on earlier versions of Dell EMC Unity OE, the NFSv3 protocol is always used.

3.5.7 VMware Virtual Volumes (File)

VMware Virtual Volumes are also available to be served over a file protocol. NFS mount points may be defined via a Protocol Endpoint for a VMware environment to receive vVol Datastore access. A NAS Server with NFS protocol support must be available to configure VMware Virtual Volumes over file.

For more information about VMware datastores, Virtual Volumes, and other virtualization technologies related to Dell EMC Unity, please see the white paper titled *Dell EMC Unity: Virtualization Integration* on Dell EMC Online Support.

3.6 Storage Efficiency

Dell EMC Unity offers an assortment of storage efficiency features that can help you maximize the utilization and performance of your system. Dell EMC Unity's operating environment was built with attention given to the capability of multicore processors and their increasing scale. With the use of Flash media in hybrid system configurations, FAST Cache and FAST VP can ensure data is readily accessible and is being stored in right location on the Dell EMC Unity system. Lastly, Host I/O Limits can be implemented to manage host activity and control noisy neighbors.

3.6.1 Multicore Optimization

A set of multicore optimizations is offered on the Dell EMC Unity system:

- **Multicore Cache** – With Multicore Cache, read and write cache space is shared and dynamically manipulated based on the read/write activity being served by the system. This ensures a proper distribution of cache resources to best serve incoming requests. The arrival rates of incoming requests are tracked and weighed against the ability of the backend drives to write the data out of cache. Based on this information Multicore Cache will throttle arrival rates so that forced flushing does not need to occur. Multicore Cache is fully automated, requiring no user interaction to be enabled or manipulated.
- **Multicore RAID** – Multicore RAID handles the RAID-based protection on Pools. With Multicore RAID, any unassigned drives are marked as potential spares for use in the case of a drive fault. In the event a drive becomes faulted, a potential spare is selected and becomes a permanent part of the Pool. Another feature provided by Multicore RAID is the ability to move a disk within the physical locations of a system. For example, a disk may be moved from one enclosure to another to better balance activity between enclosures and buses. Both assigned and unassigned drives may be relocated within a 5-minute window. Note that moving an assigned disk will temporary result in a degraded Pool. Similarly, DAEs connected to a Dell EMC Unity system can be moved to a different bus or bus position, though this requires the system to be powered off. Lastly, RAID 6 groups that suffer double drive failures will employ a parallel rebuild in order to restore full redundancy as quickly as possible. Spares will be selected and begin the rebuild process immediately following a drive fault.

Multicore optimizations are also found in the implementation of FAST Cache, among other areas within the Dell EMC Unity operating environment.

3.6.2   FAST Cache

FAST Cache leverages the performance of Flash media to improve workloads that are interfacing with spinning disk media. FAST Cache is only available for Dell EMC Unity Hybrid systems. FAST Cache is configured on a system-level and can be applied to individual Pools across both block and file resources. Flash drives used by FAST Cache must be of "SAS Flash 2" type and are configured in mirrored pairs. The maximum capacity of FAST Cache will depend on the system model. For the Pools utilizing FAST Cache, frequently read data from spinning drives (SAS and NL-SAS media) will be copied to FAST Cache so that subsequent accesses will be sourced from the faster Flash drives. Similarly, frequently rewritten data can be sent from Multicore Cache to FAST Cache, where FAST Cache serves as a secondary, high-capacity cache for the system. FAST Cache is available on purpose-built hybrid Dell EMC Unity systems.

For more information about FAST Cache, refer to the white paper *Dell EMC Unity: FAST Technology Overview* available on Dell EMC Online Support.

3.6.3   FAST VP

Fully Automated Storage Tiering for Virtual Pools (FAST VP) ensures your data is distributed effectively across the various media types in a multi-tier pool. FAST VP defines three tiers of drive types:

- **Extreme Performance Tier**: Flash drives
- **Performance Tier**: Serial Attached SCSI (SAS) drives
- **Capacity Tier**: Near-Line SAS (NL-SAS) drives

On a purpose-built Hybrid Dell EMC Unity system, for a Pool with multiple tiers, block and file resources created on that Pool are subject to FAST VP policies. FAST VP policies can specify where the initial data populated to a storage resource should be placed (ex. highest tier, lowest tier). As the data is manipulated, FAST VP will relocate data across the tiers based on usage (Figure 4).
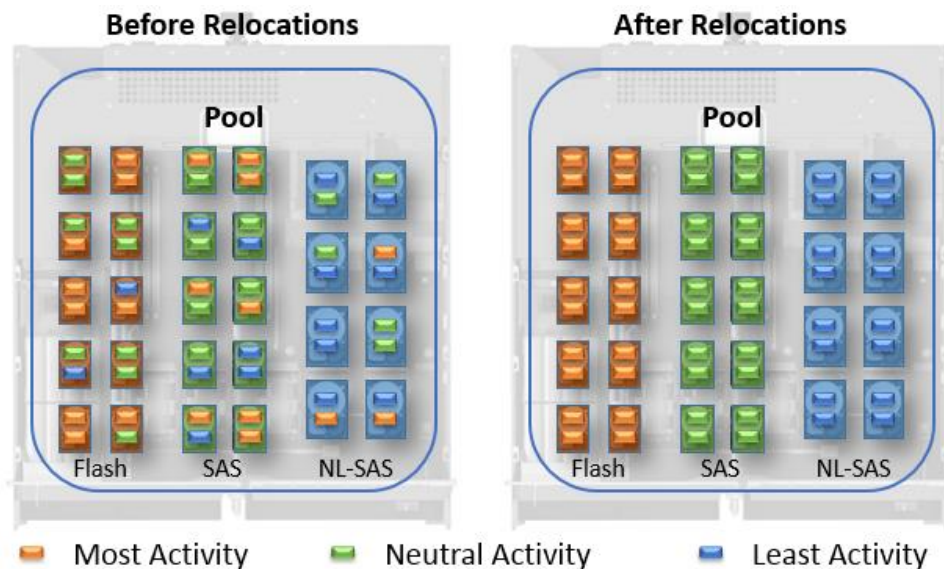

Figure 4. FAST VP Relocation

Data that is being accessed frequently will be placed on the best performing tier, while data that has gone "cold" will be moved to the high capacity tiers. Data is relocated at a 256 MB granularity and can be a scheduled recurring event. Combined with FAST Cache and the other multicore optimizations, FAST VP ensures your drives are being used efficiently.

3.6.4   Host I/O Limits

The ability to limit the amount of I/O activity that is serviced by the Dell EMC Unity system is known as Host I/O Limits. Host I/O Limits can be applied on LUNs, VMware VMFS Datastores, Thin Clones, and their associated attached snapshots. Use Host I/O Limits to limit incoming host activity based on IOPS, Bandwidth, or both. Limits can be enforced on individual resources, or a limit can be shared among a set of resources.

There are several use cases where Host I/O Limits can be effective. Configure Host I/O Limits on LUNs or datastores that are consuming a large portion of the system's resources and reducing the performance of other resources on the system. This could be the result of "noisy neighbor" who overruns the provisions set for the multiple tenants accessing data on a system. Another use case for Host I/O Limits is placing limits on attached snapshots. In case attached snapshots are being used for backup and testing purposes, Host I/O Limits can be applied to the snapshots to effectively prioritize host activity towards the parent LUNs and datastores.

In Dell EMC Unity OE version 4.1, density-based Host I/O Limits can be created which limits host activity based on the size of the block resource. For example, a density based I/O limit of 100 IOPS/GB for a 200GB LUN would result in an overall limit of 20,000 IOPS for the entire LUN. If sometime later the 200GB LUN was expanded to be a 250GB LUN, the I/O limit would automatically update to 25,000 IOPS for the LUN, saving the administrator managerial tasks and time. Like absolute I/O limits, density based I/O limits can also be shared among multiple resources. Another feature in Dell EMC Unity is burst policies for Host I/O Limits. This option is available for any Host I/O Limit policy and allows host activity/traffic to exceed the base policy limit by a user-specified percentage. The user specifies parameters of amount (percentage), duration, and frequency of the I/O limit burst allowance.

In Dell EMC Unity OE version 4.2, Host I/O Limits were expanded to support Virtual Volumes (vVols). vVols support either an absolute based limit or a density-based Host I/O limits, defined by IOPS or IOPS per GB respectively. Host I/O Limits are supported on data vVols specifically. Host I/O Limits cannot be applied to config, swap, or memory vVols. While the implementation of Host I/O Limits is the same for vVols and Block resources, the management of vVol Host I/O Limits is done entirely through vSphere. Host I/O Limits can be created in vSphere as a rule for a Storage Policy and then assigned at either the VM or vVol level. Unisphere can be used to monitor the vVol, with the capability to display any I/O Limits associated with the vVol as well as real time performance metrics.

3.6.5   Dell EMC Unity Compression / Data Reduction

To help reduce the total cost of ownership and increase the efficiency of a Dell EMC Unity storage system, Dell EMC Unity OE version 4.1 introduced Dell EMC Unity Compression for Block resources, and Dell EMC Unity OE version 4.2 expanded compression to File resources. With Dell EMC Unity Compression, the amount of space required to store a dataset for compression enabled storage resources is reduced when savings are achieved. This space savings reduces the amount of physical storage required to store a given dataset, which can lead to cost savings. Dell EMC Unity Compression is available for All Flash pools on either All-Flash or Hybrid Dell EMC Unity systems.

In Dell EMC Unity OE version 4.3, Dell EMC Data Reduction was introduced which replaces Dell EMC Compression. Dell EMC Data Reduction includes deduplication and compression logic within the space savings algorithm. Dell EMC Data Reduction is supported on all resources which support Dell EMC Compression.

In Dell EMC Unity OE version 4.5 and later, Advanced Deduplication is included as an optional feature to the Data Reduction algorithm for the Dell EMC Unity 450F, 550F, 650F, and Dell EMC Unity XT systems. Advanced Deduplication is supported on all resources in a Dynamic Pool that supports Data Reduction and

requires Data Reduction to be enabled on the resource, but can be enabled or disabled independently to the Data Reduction setting. Local LUN Move can be leveraged to move a resource's data into an Advanced Deduplication enabled resource within an All Flash Pool.

Dell EMC Unity Data Reduction is enabled at the resource-level so storage resources with and without data reduction enabled can exist in the same pool on a system. Also, data reduction savings can be seen at multiple levels including system-level, pool-level, and resource-level thereby providing varying levels of granularity in reporting for management purposes and helps show the business value of using the advanced data feature.

For more information about Dell EMC Unity Data Reduction or Dell EMC Unity Compression, see the white papers titled *Dell EMC Unity: Data Reduction* or *Dell EMC Unity: Compression* on Dell EMC Online Support.

3.7 Data Protection

A suite of local and remote protection methods are available on the Dell EMC Unity system. Unified Snapshots provides point-in-time copies of storage resources and offers consistent functionality across block and file resources. Native Asynchronous Replication leverages the technology of Unified Snapshots to offer protection of block and file resources on an interval basis using a single Dell EMC Unity system or between systems. Native Synchronous Replication provides zero data loss protection of your block and file resources between a source and remote purpose-built Dell EMC Unity system. NDMP backup for file is supported as well to protect file systems through backup to a remote tape library or other supported backup devices. Finally, Data at Rest Encryption can be enabled on the purpose-built Dell EMC Unity system to provide security against drive theft.

The following sections overview each of the data protection features. For more information about the data protection offerings on Dell EMC Unity platform, please refer to the white papers titled *Dell EMC Unity: Replication Technologies, Dell EMC Unity: MetroSync, Dell EMC Unity: NAS Capabilities* and *Dell EMC Unity: Data at Rest Encryption* available on Dell EMC Online Support.

3.7.1 Unified Snapshots

Taking point-in-time views of your block and file data has never been easier. Unified Snapshots is supported on block resources (LUNs, Consistency Groups, Thin Clones, VMware VMFS Datastores and Virtual Volumes) and file resources (File Systems, VMware NFS Datastores and Virtual Volumes). Unified Snapshots utilizes Redirect on Write technology. After a snapshot is taken, Redirect on Write routes incoming writes to the storage resource a new location on the same Pool. As a result, the snapshot only begins to consume space from the Pool when new data is written to the storage resource. Snapshots can be attached (block) or mounted (file) and written to in the same manner as their parent resources.

With Dell EMC OE version 4.4, MetroSync is available. MetroSync is a file synchronous replication solution which replicates data to a remote system over Fibre Channel. Included with MetroSync is Snapshot replication and Snapshot Schedule replication. Only Read-Only snapshots can be replicated. If a user creates Read-Write snapshots on the source, it will not be replicated to the destination system. When a replicated snapshot gets deleted on the source, it will automatically get deleted on the destination. Also, any modification on the snapshot at the source is going to be changed on the destination. Modifying the snapshot on the destination system however, does not make any changes on the source.

Additionally, with MetroSync, a Snapshot Schedule can be replicated and applied to file resources that are synchronously replicated. To replicate a Snapshot Schedule, the user has to check the box "Synchronize snapshot schedule to remote system" during creation. During the creation of a File System, a user can select

a synchronously replicated snapshot schedule. Once a replicated Snapshot Schedule is selected, the destination system is assigned the same schedule. The snapshot schedule cannot be modified on the destination; however, a user can modify the replicated Snapshot Schedule on the source, and the changes will be reflected on the destination system. If a local snapshot schedule is configured on the source resources, the destination will not have a snapshot schedule associated with it and cannot be modified.

With the Dell EMC Unity OE version 4.2 code release, asynchronous replication supports the replication of read-only snapshots to either a local or a remote site along with the resource data. Both scheduled snapshots and user created snapshots can be replicated. Snapshot replication is supported for all resources that support asynchronous replication (that is, LUNs, Consistency Groups, Thin Clones, File Systems, VMware VMFS datastores, and VMware NFS datastores). To support snapshot replication, both the source and destination systems must be running Dell EMC Unity OE version 4.2 or later. Only read-only snapshots are eligible for replication, and they can only be replicated to the disaster recovery site where the replication destination storage resource is located. Any snapshots that are writable, such as attached block snapshots or file snapshots with shares or exports, are not replicated.

Starting with Dell EMC Unity OE version 5.0, asynchronously replicated file resources can also be configured in advanced replication topologies. This allows for configurations such as fan-out and cascading replication at the granularity of a NAS Server and its associated file resources. With advanced replication configured, snapshot replication is also supported. In OE versions prior to the 5.1 release snapshot replication can only be enabled on one session at a time when using advanced replication. In Dell EMC Unity OE version 5.1 and later, snapshot replication is supported on all replication sessions within an advanced File replication environment.

In Dell EMC Unity OE version 4.1, multiple snapshots of a single LUN can be attached to a host simultaneously, enabling more snapshot use cases in customer environments. In addition, an attached snapshot can have two options: Read-Only or Read/Write. Read-Only access disallows any writes to the snapshot data while Read/Write access allows changes to be made.

Also, in Dell EMC Unity OE version 4.1, a refresh functionality is available for block snapshots. When refreshing a snapshot, the snapshot replaces its data with the latest source resource's data without changing its mount point. A user can refresh a snapshot of a block resource whether or not it is attached to a host. Snapshot refresh is available for LUNs, Consistency Groups, Thin Clones, and VMware VMFS Datastores. In OE version 5.1 and later, file system Read/Write (shares) and VMware NFS Datastore snapshots can be refreshed.

Storage resources can be configured with a snapshot schedule, which will automatically take a snapshot of the specified resource on the given interval (Figure 5). Additionally, snapshots can be configured to automatically expire after a given time interval or when the parent Pool nears full capacity. This can free up valuable resources to ensure continued access to production resources.

For more information about Unified Snapshots on Dell EMC's Unity platform, please refer to the white paper titled *Dell EMC Unity: Unified Snapshots and Thin Clones* available on Dell EMC Online Support.

Figure 5. Snapshot Scheduling

3.7.2 Thin Clones

In Dell EMC Unity OE version 4.2 and newer, Thin Clones are supported. A Thin Clone is a read/write copy of a Block level storage resource (LUN, LUN within Consistency Group or VMware VMFS Datastores) and is provisioned from the block resource or a snapshot. Thin Clones share the same blocks as their parent block level storage resources. On creation of a Thin Clone, the data will be available to present to a host as needed. Any changed data on the Thin Clone will not affect the base resource and vice versa. Also, any changes to the Thin Clone will not affect the snapshot source.

Users can create, view, modify, refresh and delete thin clones. In addition, users are able to utilize data services for Thin Clones from the Unisphere, UEMCLI and REST API. Thin clone is based on pointer-based technology, which means Thin Clones only consume space from the storage pool when there is changed data from the original source.

For more information about Thin Clones on Dell EMC's Unity platform, please refer to the white paper titled *Dell EMC Unity: Snapshots and Thin Clones* available on Dell EMC Online Support.

3.7.3 Native Asynchronous Replication

Provide local and remote protection for your block and file resources using Native Asynchronous Replication. Asynchronous replication utilizes Ethernet protocol to transfer data between Dell EMC Unity systems. Block and file resources can be configured for replication between the Pools of a system, or to a remote system. Native Asynchronous Replication uses Unified Snapshots technology to track the changed data from the source resource and transfer only the altered data to the destination, saving on bandwidth and disk activity. A Recovery Point Objective (RPO) is specified to define the interval at which data is synced from source to destination. Native Asynchronous Replication is supported on purpose-built Dell EMC Unity systems as well as on Dell EMC UnityVSA. This makes Dell EMC UnityVSA a viable candidate for serving as a low-cost backup and/or disaster recovery site. Furthermore, native block asynchronous replication to the Dell EMC VNXe1600 and VNXe3200 products is also supported.

3.7.4   Native Synchronous Replication

Native synchronous replication is supported on block resources (LUNs, Consistency Groups, and VMware VMFS Datastores). Native Synchronous Replication utilizes the Fibre Channel protocol to transfer data between two purpose-built Dell EMC Unity systems. Two purpose-built Dell EMC Unity systems may be connected for both asynchronous and synchronous replication sessions. In this configuration, mission-critical block resources can be replicated synchronously while lower priority block and file resources can be replicated asynchronously.

3.7.5   MetroSync

MetroSync is available on systems running Dell EMC Unity OE version 4.4 or later. This feature provides the ability to create remote synchronous replication sessions for file storage resources including NAS Servers, file systems, and VMware NFS datastores. Synchronous replication is a zero RPO (Recovery Point Objective) data protection solution which ensures each block of data is saved locally and also to a remote image before the write is acknowledged to the host. This ensures that in the event of a disaster, there is zero data loss. In synchronous replication solutions, there are also trade-offs. As each write needs to be saved locally and remotely, added response time occurs during each transaction. This response time increases as distance increases between remote images. Synchronous replication has a distance limitation based on latency between systems. This limitation is generally 60 miles or 100 kilometers between sites. To support synchronous replication, the latency of the link must be less than 10 milliseconds.

Synchronous replication uses the first Fibre Channel (FC) port configured on the system to replicate both the NAS Server and file system data. The synchronous replication management virtual port is used to send management and orchestration commands between systems. Since there is no Fibre Channel support on Dell EMC UnityVSA systems, synchronous replication cannot be configured on the virtual storage appliance.

Synchronous replication requires two separate physical Unity systems, meaning it cannot be used to replicate file resources locally within the same system. Both the source and the destination systems must be running Dell EMC Unity OE version 4.4 or later in order to support synchronous replication.

In order to synchronously replicate a file resource, the associated NAS Server must be synchronously replicated first. After this is configured, synchronous replication can be configured on its associated file systems. When MetroSync is configured, the following functionality is also available:

- Snapshot Replication: Synchronous replication of read-only snapshots to the destination system. Snapshot replication occurs automatically while the session is in sync.
- Snapshot Schedule Replication: Synchronous replication of snapshot schedules to the destination system. This ensures the destination system has the same snapshot schedules applied as the source system in case of failover.
- Cabinet Level Failover: Single command to initiate a simultaneous failover of all synchronously replicated NAS Servers and their associated file systems. This should only be used if the source system is offline and unavailable.
- Asynchronous Replication to a Third Site: With synchronous replication configured between the two primary sites, this enables the ability to add asynchronous replication to a third site for backup purposes. In case of failover between the two primary sites, the asynchronous replication sessions to the third site can incrementally restarted without requiring a full sync.

In Dell EMC Unity OE version 4.5 and later, support for MetroSync Manager (MSM) was added. MetroSync Manager is a standalone Windows application that can be configured to monitor the system statuses of two systems ("Site A" and "Site B") participating in file synchronous replication. This optional tool enables automatic failover in the event of a critical failure, for example, an entire site going offline due to power outage

or entire network outage. Without MSM, users would need to manually initiate the cabinet level unplanned failover command. MSM utilizes the same cabinet level failover feature, but does not require a user to manually run it and instead automatically initiates the failover if it senses a critical failure. The overall benefit of this is the reduction of overall downtime in the event of a disaster to ensure production resources can continue accessing data without issue from the destination site. MSM can monitor a one-way configuration with one site replicating exclusively to another site or can monitor both systems in a bi-directional configuration with some source objects replicating in one direction and other source objects replicating in the opposite direction.

For more information about Dell EMC Unity MetroSync or MetroSync Manager, reference the *Dell EMC Unity: MetroSync* white paper on Dell EMC Online Support.

3.7.6 Data At Rest Encryption (D@RE)

The on-board SAS ports as well as the 12Gb SAS I/O Module include hardware that contains the capability of encrypting all data written to the Dell EMC Unity system. With D@RE enabled, all user data will be encrypted as it is written to the backend drives and decrypted during departure. Because encryption and decryption are handled via a dedicated hardware piece on the SAS interface, there is minimal system impact when D@RE is enabled. Furthermore, offering encryption at the controller level eliminates the need for specially made self-encrypting drives. A keystore file holding information about the encrypted data is mirrored between the SPs and can also be saved to an external device for off-site backup. Note that D@RE must be enabled at time of initialization during licensing to use the feature and it cannot be turned off once it is enabled.

As of Dell EMC Unity OE version 4.2, the system supports external key management through use of the Key Management Interoperability Protocol (KMIP). This allows the system to offload an encrypted system ignition key to an external key management application ensuring additional protection in case an entire system is lost or stolen whereby unauthorized access is prevented without the ignition key.

For more information about the Data at Rest Encryption feature, please refer to the white paper titled *Dell EMC Unity: Data at Rest Encryption* available on Dell EMC Online Support.

3.7.7 NDMP

Dell EMC Unity systems support 2-way and 3-way NDMP, allowing administrators to protect file systems by backing up to a tape library or other supported backup device. 3-way NDMP transfers the backup data over the network while 2-way NDMP transfers the data over Fibre Channel. Eliminating backup data on the network by backing it up directly to the backup device can decrease network congestion and reduce backup times. In order to use 2-way NDMP, the system must be running Dell EMC Unity OE version 4.4 or later. A 2-way NDMP configuration is shown in the figure below.
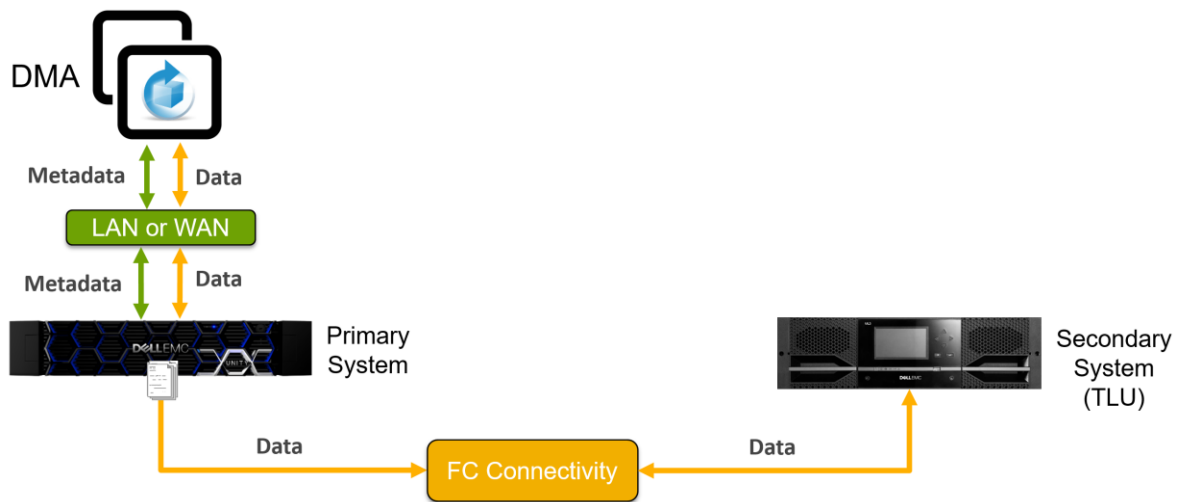
Figure 6. 2-way NDMP

When configuring 2-way NDMP, the backup device should be connected to a switch and zoned to the Fibre Channel ports on the Dell EMC Unity system. Directly connecting the backup device to the storage system is not supported. When cabling and zoning the system, the Synchronous Replication port, which is the first Fibre Channel port on the system, is not supported for the backup device.

Dell EMC Unity supports taking NDMP full backups, incremental backups, restores, and tape cloning. Both dump and tar backups are supported but VBB type backups are not. The backup application can specify the parameters below when running an NDMP backup. It is recommended to enable all of these parameters when running an NDMP backup.

- HIST: Allows the backup application to request the file history from the storage system
- UPDATE: Allows the backup application to request the file history for incremental backups
- DIRECT: Enables the ability to restore a single file from a backup
- SNAPSURE: Allows the backup application to request a snapshot of the file system for backup purposes

Combining NDMP, local snapshots, and remote protection enable Dell EMC Unity storage systems to be deployed with a wide array of data protection capabilities, including the ability to replicate to or from multiple arrays in a multisite topology. In addition, the NDMP backups can be taken on the destination NAS Server, alleviating the backup load from the production system.

3.7.8   Cloud Tiering Appliance (CTA)

Cloud Tiering Appliance (CTA) enables the ability to move data from Dell EMC Unity to the cloud based on user-configured policies. An example of this includes moving any files that are larger than 50MB and has not been accessed in 30 days to the cloud. After a file is moved off the primary storage, an 8-16KB stub is left which points to the actual location of the data. Any requests to read the data that has been moved can be passed through or recalled from the cloud. From the end-user point of view, this process is seamless since the stub resembles the actual file and the data continues to be accessible on demand.

Starting with Dell EMC Unity OE version 4.1 and CTA version 11, CTA is available on Dell EMC Unity for file tiering. When using CTA with Dell EMC Unity as the source, only tiering to Microsoft Azure, and S3 cloud repositories are supported. To use CTA, Dell EMC Unity must be running Dell EMC Unity OE version 4.1 or later. When tiering file data to a cloud repository, CTA can also leverage compression and/or encryption.

With Dell EMC Unity OE version 4.2 and CTA version 12, the system additionally supports block archiving to Microsoft Azure, Amazon S3, and IBM Cloud Object Storage (Cleversafe) public clouds, and Dell EMC Elastic Cloud Storage (ECS) S3 private clouds. CTA leverages the native snapshot differentials API in order to efficiently take backups of the block data, including LUNs, Consistency Groups, and Thin Clones, to the cloud. Block archiving keeps the source block resource unaltered, it only reads the data and makes a copy in the cloud. Once archived, the source block resource can be deleted. If ever needed, the block resource can be restored from the cloud into a new block resource.

Using CTA helps customers achieve many benefits including reducing capital expenses by reclaiming capacity on primary storage, lowering operating expenses by reducing number of administrative tasks, and improved performance by reducing backup times. An illustration of the benefits of CTA can be seen in Figure 7.
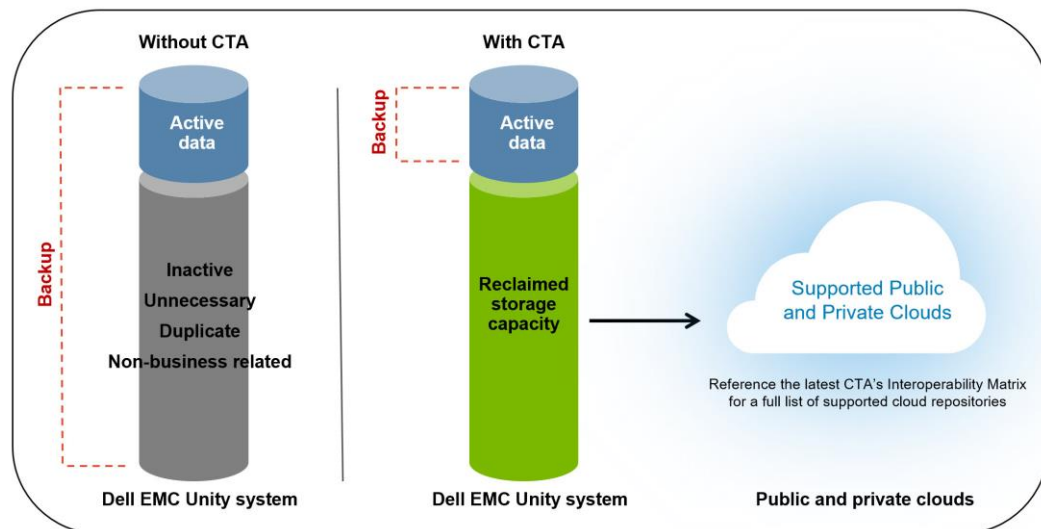

Figure 7. Cloud Tiering Appliance

With Dell EMC Unity OE version 4.2 and later, and CTA version 12 SP1 and later, the CTA file migration feature is supported with Dell EMC Unity systems. CTA supports SMB (CIFS), NFS, and multi-protocol source File Systems. When having a Dell EMC Unity as a target, the supported source platforms are VNX and NetApp. For file migration, CTA acts as a policy engine by interacting with the source VNX or NetApp storage system and the target Dell EMC Unity storage system. CTA identifies files in the source system that fit an administrator-defined criteria and moves them from the source system to the target system. For source files that had been tiered to a cloud repository, the movement is stub aware, meaning that it maintains the stubs without recalling the files to the target.

For more information about CTA support with Dell EMC Unity, see the white paper titled *Dell EMC Unity: Cloud Tiering Appliance (CTA)* on Dell EMC Online Support.

3.8   Migration

3.8.1   Import

Dell EMC Unity OE version 4.1 introduces the ability to natively import data from an existing VNX1 or VNX2 storage system to a Dell EMC Unity system allowing for greater ease of use and simplicity for customers looking to refresh their storage platforms. For Block data import, Dell EMC Unity utilizes the existing SAN

Copy capabilities on the VNX series to copy over LUNs, LUN Groups, and VMFS Datastores with a simple setup and workflow. SAN Copy license must be enabled on the VNX system for the block import sessions. The Unity Native File Import feature provides a native option for file migration to Unity from a VNX1 or VNX2 system. NFS import was added in OE version 4.1, CIFS (SMB) in OE version 4.2, and multiprotocol import in OE version 5.1. For File import, users can import VDMs from VNX1 or VNX2 systems on Dell EMC Unity storage systems which are translated to NAS Servers in the File page. The Import page, as shown in Figure 8, helps the user through the workflow needed to setup an import session including setting up interfaces, system connections, and finally configuring import sessions. This step-by-step process makes for a smooth user experience of configuring import sessions and helps to provide an easier path to import data directly from the system instead of having to utilize a host-based copy service to move data from one system to another.
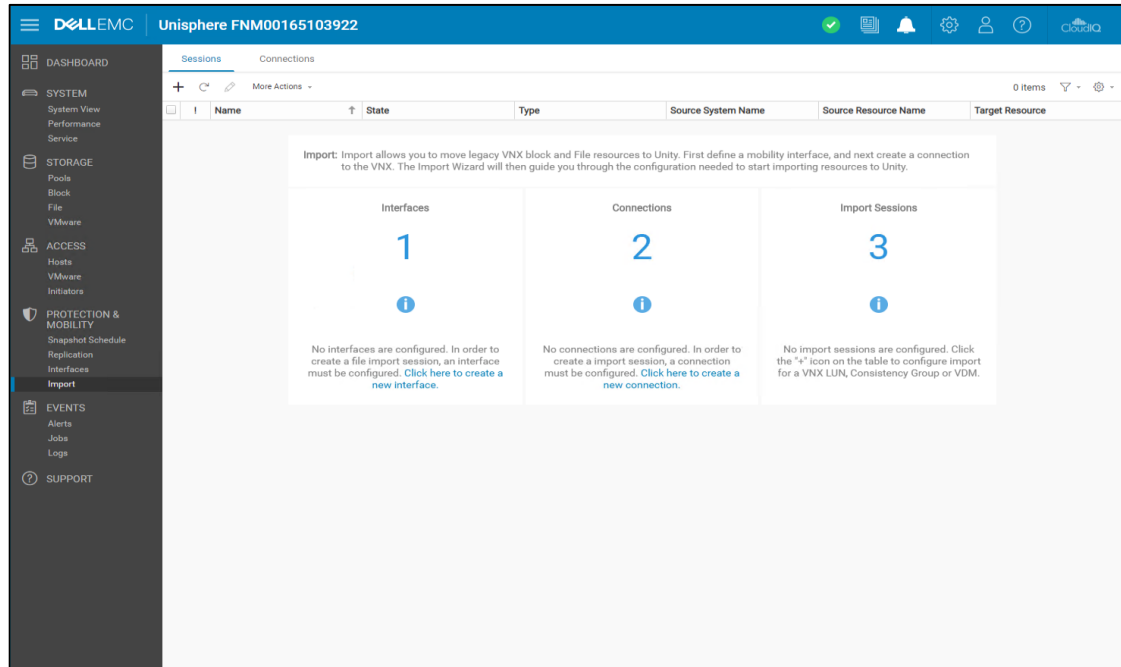

Figure 8. Import Page

3.8.2   LUN Move

As of Dell EMC Unity OE version 4.1, the system allows the ability to relocate local block resources to different pools on the system. This gives users the option to balance resources across pools in case certain pools are being over-/under-utilized.

For more information about migration technologies, see the white paper titled *Dell EMC Unity: Migration Technologies* on Dell EMC Online Support.

3.8.3   SAN Copy Pull

In Dell EMC Unity OE version 4.4, SAN Copy Pull is introduced. SAN Copy Pull, a feature which exists in other Dell EMC midrange products, allows a user to migrate data to a Dell EMC Unity system from Block resources residing on non-Dell EMC Unity systems. The Dell EMC Unity system acts as a host and reads the data from the source storage resource and writes it to the destination volume. The transfer of data from the source system can be completed over iSCSI or Fibre Channel, depending on the connectivity options on the source and destination systems. During the migration no host connectivity on the source resource is allowed, as changes on the source are not tracked. Once the migration is complete, host access can be configured and application I/O can resume to the Dell EMC Unity system.

For more information about SAN Copy Pull, please refer to the white paper titled *Dell EMC Unity: Migration Technologies* on Dell EMC Online Support.

3.9   VMware Integration

The Dell EMC Unity product builds on Dell EMC's industry-leading VMware integration with support for VMware technology old and new alike. VMware vStorage APIs for Array Integration enable the Dell EMC Unity system to handle offloaded VMware operations, improving performance and reducing network overhead. VMware Aware Integration (VAI) and VMware vStorage APIs for Storage Awareness (VASA) enable inter-communication between the storage and virtualization layers so that administration of one layer can be performed from the other. This can enable more efficient workflows for those familiar with one interface. Furthermore, the VASA protocol forms the basis on which VMware Virtual Volumes are constructed.

The following sections will briefly discuss the various points of integration with VMware. For more information about these topics, please see the white paper titled *Dell EMC Unity: Virtualization Integration* available on Dell EMC Online Support.

3.9.1   vStorage APIs for Array Integration (VAAI)

VMware vStorage APIs for Array Integration (VAAI) improves the utilization rates of ESXi hosts in a VMware environment by offloading tasks to the Dell EMC Unity system. For both block and file datastores as well as Virtual Volumes, various storage operations are processed by the Dell EMC Unity system. This includes clone and snapshot operations, as well as hardware-assisted moves.

3.9.2   VMware Aware Integration (VAI)

Within Unisphere, the VMware Access page helps you to easily import VMware vCenter and ESXi host information into Unisphere (Figure 9). vCenter Server and ESXi hosts are added as entries, and their associated Virtual Machines and Virtual Disks are also listed. These VMs and disks also include resources that are not hosted by the Dell EMC Unity system. Using VAI, discovery and registration of a VMware environment is simple and efficient. The information imported provides relevant detail for the user, who no longer has to switch between VMware vSphere and Unisphere to obtain a clear picture of their environment.
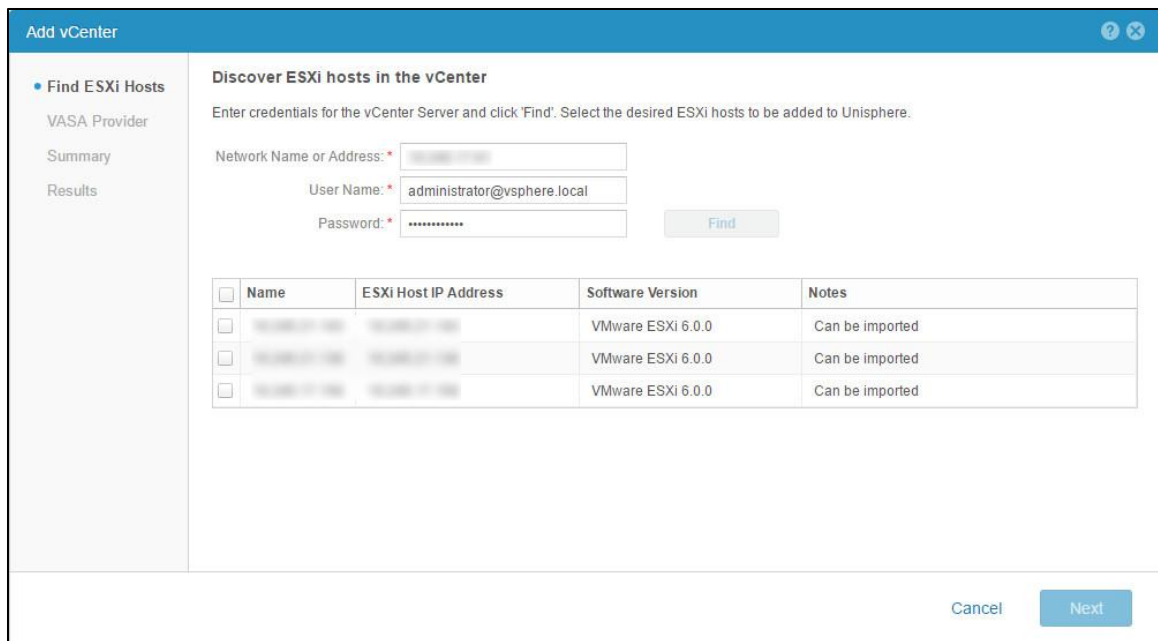
Figure 9. Importing vCenter and ESXi Host Information

3.9.3 vStorage APIs for Storage Awareness (VASA)

Dell EMC Unity has been developed to interact with the capabilities of VASA 2.0 from Day 1. VASA provides a framework for storage systems to communicate their details to a VMware vSphere environment. Traditionally this has resulted in providing compliance information to a virtualization administrator and their VMs' underlying datastores' properties.

3.9.4 VMware Virtual Volumes (vVols)

VASA 2.0 and later takes this a step further by interacting with VMware Virtual Volumes. A Virtual Machine's Virtual Volumes are provisioned based on user-defined Storage Policies that interact with a storage system that supports the VASA 2.0 protocol or later. Dell EMC Unity provides a storage administration the ability to define properties and use cases for the underlying storage via Capability Profiles. This information is communicated over the VASA protocol. VASA 1.0, 2.0, and 3.0 protocols are supported by Dell EMC Unity and no additional plug-ins are required.

vVols enables storing VM data on individual virtual volumes, which reside on a datastore. Data services, such as snapshots and clones, can be applied at a VM-level granularity and are offloaded to Dell EMC UnityVSA. Also, policies and profiles can be leveraged ensure VMs are stored on compliant storage. Any VMs that become noncompliant result in an alert to the administrator.

For more information about VMware Virtual Volumes, refer to the white paper titled *Dell EMC Unity: Virtualization Integration* available on Dell EMC Online Support.

3.10 Serviceability

In creating an easy to use and easy to install price-competitive storage system, Dell EMC Unity had to be easy to service. Dell EMC Unity offers easy access to information about your system and where to find help when it is needed. Multiple methods of service access are available on the Dell EMC Unity platform. The focus in this section will be towards the purpose-built Dell EMC Unity system.

For more information about the serviceability features on Dell EMC UnityVSA, refer to the white paper titled *Dell EMC UnityVSA* white paper available on Dell EMC Online Support.

3.10.1   System Security

In Dell EMC Unity OE version 4.5 and later, security updates were implemented in order to defend Dell EMC Unity from industry wide vulnerabilities such as Spectre and Meltdown. Unprivileged users are restricted from loading and running untrusted commands and software locally on Dell EMC Unity by implementing restricted shell (rbash) for the service user. This allows Dell EMC Unity to remove these vulnerabilities without impacting performance, modifying the operating system kernel, or updating the CPU BIOS.

Rbash is a Unix/Linux shell that restricts some of the capabilities available to an interactive user session. Rbash cannot be permanently disabled by service personnel, however it can be temporarily disabled by a Unisphere admin user via UEMCLI. Rbash can be disabled using the `uemcli /sys/security -restrictedShellEnabled` command and is only supported when the system is fully functional. Once disabled, rbash will be automatically re-enabled after 24 hours, and automatically re-enabled if a Storage Processor reboots. Users may see an impact when trying to run scripts via an SSH session while rbash is not disabled.

For a current, up to date list of approved commands, please reference KB528422 on Dell EMC Online Support.

3.10.2   Secure Remote Services

Secure Remote Services (formerly known as ESRS) is a highly secure, bi-directional remote connection between customer's Dell EMC storage environment and Dell EMC. This feature-rich connectivity solution helps customers keep pace with the growing challenges of rapidly growing footprints and modern technologies by anticipating customer needs and delivering the right resources at the right time. Once an ESRS connection is made, many benefits can be taken advantage of including automated health checks, 24x7 predictive wellness monitoring, and remote issue analysis and diagnosis through Dell EMC's award-winning service and support.

ESRS can be enabled on Dell EMC Unity systems through the Initial Configuration Wizard the first time a system is configured or through the Service page as seen in Figure 10. The same ESRS configuration can be found on the Support Configuration tab in the Settings menu. Before enabling ESRS, both EMC Support Credentials must be provided as well as customer Contact Information.
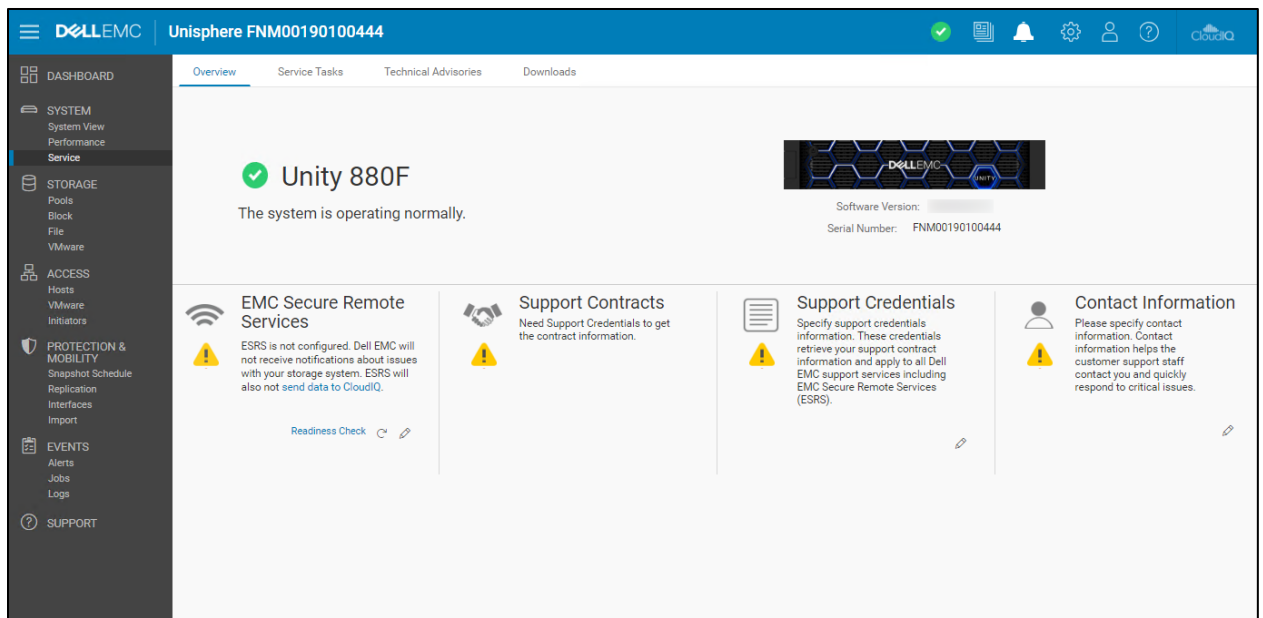
Figure 10. Service Page - ESRS Configuration

With the Dell EMC Unity version 5.0, Dell EMC personnel can use their RSA SecurID credentials to configure ESRS on a system. When configuring ESRS with RSA credentials, a configured and verified support account is not required. The Readiness Check can be run without entering support credentials on the system and the system must be registered in the install base. Additionally, with the Dell EMC Unity OE version 5.0, two gateway server IPs can be entered when enabling ESRS thus adding support for ESRS VE cluster configurations with Dell EMC Unity.

For more information about requirements and configuration of ESRS, please see the *Dell EMC Unity Secure Remote Services Requirements and Configuration* technical paper on Dell EMC Online Support.

3.10.3   Health and Alerts

In Unisphere, a visual depiction of your Dell EMC Unity system is provided on the System View page (Figure 11). Views are provided for both the DPE and any DAEs, from the front and rear as well as the top (DPE). This can be useful for easily diagnosing issues with physical components on your system. For example, a port that has lost communication to the network will be highlighted in yellow, while a faulted disk will be highlighted in red. This makes it easy to realize that a port or disk has faulted and understand where in the system it is located. Selecting a part reveals additional information about the device.
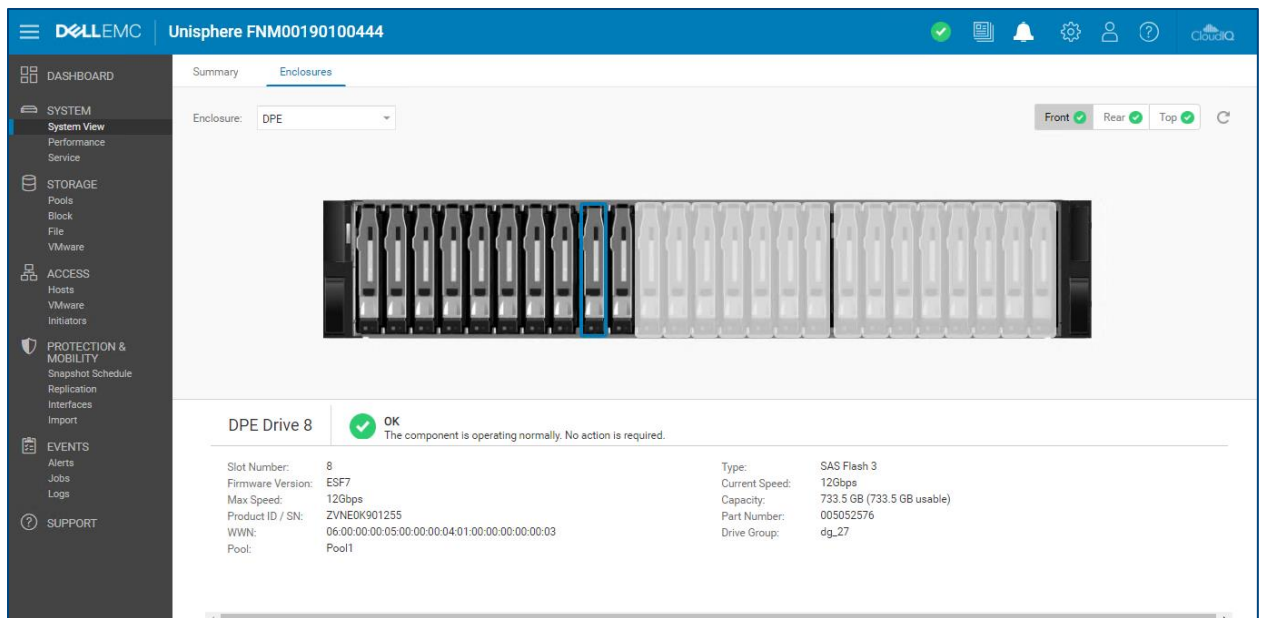
Figure 11. System View Page

The Alerts page presents all the system errors, warnings, and notifications that have been generated by the Dell EMC Unity system. It is easily sortable by the different columns available so that the information can be reviewed and acted upon. Alerts will include relevant information, including the system resources referenced, as well as recommendation on remedial action.

3.10.4   Serial Over LAN

The service port on the rear of the DPE is used to access a shell prompt to the Dell EMC Unity system. This port can be used to send commands to the system when Unisphere is not responding. A Windows host with an IPMI tool is used to establish a serial connection. After a connection is established to the Dell EMC Unity system, a command prompt equivalent to connecting to the system over SSH is provided. UEMCLI and service commands can be performed from this interface.

3.10.5   Secure Shell (SSH)

Another way to run commands on Dell EMC Unity systems is through SSH access over the management port. Administrators can enable SSH access from the Service > Service Tasks page in Unisphere. Once SSH is enabled, users can log in to the system using an available SSH client and login using service credentials. UEMCLI and service commands can be performed from this interface.

3.10.6   Support Ecosystem

The Support page in Unisphere provides helpful links and access to resources for obtaining more help (Figure 12). Options include links to ordering replacement parts, viewing support forums, and obtaining helpful documentation and videos. At the bottom, the Contact Us section provides helpful pointers to chatting with a Dell EMC representative, opening a Service Request, and accessing Dell EMC Support account information.
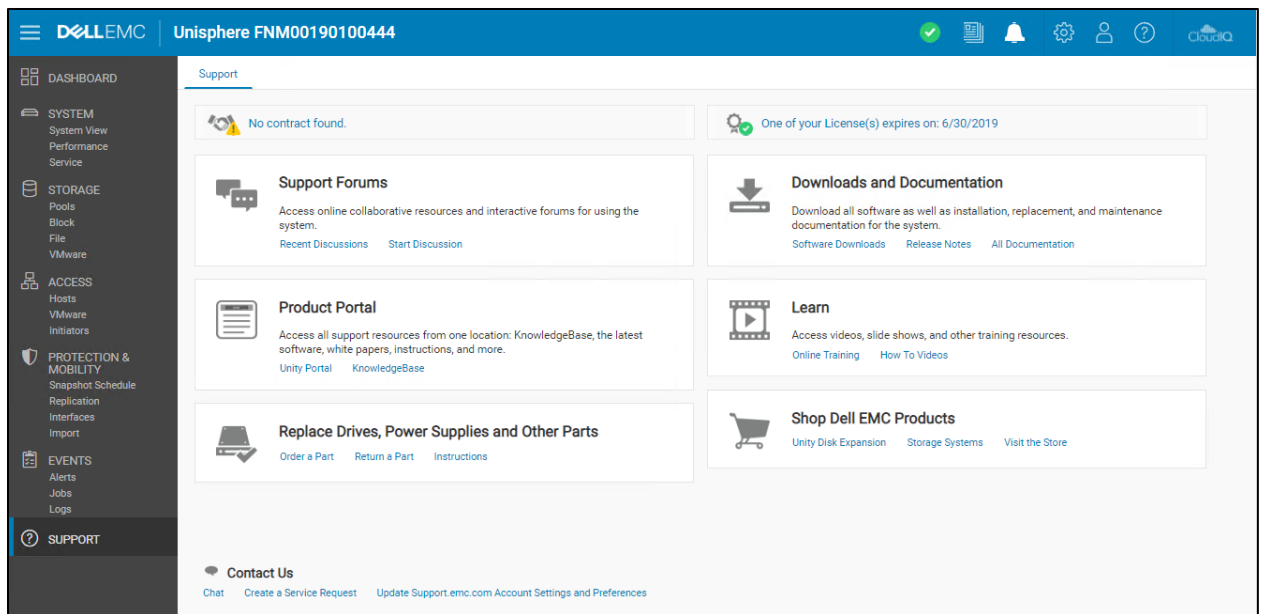
Figure 12. Support Page

The Service page contains information about your Dell EMC Support credentials and configured contact information. Details about EMC Secure Remote Services (ESRS) is included, and any information about support contracts. Useful information such as the software version and serial number of the system are also provided on this page.

Throughout Unisphere, the circular "question mark" icon can be used to launch Unisphere Online Help. In most cases Unisphere Online Help is context-sensitive and will direct you to the help page most relevant to the view from which the help was accessed. Use Unisphere Online Help as a quickly available resource and seek out the other support options if there are additional questions.

3.10.7 User Management

Dell EMC Unity provides options for configuring user access to Unisphere. Individual user accounts may be created and given differing levels of privilege. This allows for an appropriate level of access for each user based on their responsibilities, whether that be monitoring the array, configuring storage, or managing new users. Reference Table 3 below for more detail on the type of user accounts available and associated privileges. Alternatively, an LDAP server may be used to handle authentication and user management.

Table 3. User Roles

USER ROLE	PRIVILEGES
ADMINISTRATOR	Can view status and performance information. Can also modify all Unity settings, including configure new storage hosts and manage local user, LDAP user, and LDAP group accounts.
STORAGE ADMINISTRATOR	Can view status and performance information and can modify most system settings, but cannot configure new storage hosts or manage local user, LDAP user, or LDAP group accounts.
OPERATOR	Can only perform monitoring activities. Read-only access.
VM ADMINISTRATOR	Can only establish a VASA connection from the vCenter to the storage system.
SECURITY ADMINISTRATOR	Can modify the security settings including domain operations, but read-only access on storage system settings.

With the Dell EMC Unity OE version 4.4 or later, when configuring the Directory Services under Users and Groups, the user can select the **Auto Discover** checkbox to automatically lookup the LDAP servers from the DNS. Additionally, the system can have multiple LDAP servers configured and supports Forest Level Authentication. With Forest Level Authentication, the system can authenticate LDAP users at the forest level of the domain. For more information about how to configure LDAP and LDAPS, reference the *Dell EMC Unity Security Configuration Guide* on Dell EMC Online Support.

3.11 Dell EMC Product Integration

Dell EMC Unity offers support with multiple products in the Dell EMC ecosystem. Captured below are a couple of highlights for product integration.

3.11.1 CloudIQ

CloudIQ is a cloud-based SaaS (Software as a Service) storage system monitoring solution provided by Dell EMC. This free service requires the configuration of ESRS (EMC Secure Remote Services) and the user must allow the storage system to send data to CloudIQ in system settings. CloudIQ, as shown in Figure 13, provides a holistic view of multiple systems regardless if they are on the same network, allowing for a potential global view of datacenter environments as it relates to storage. CloudIQ monitors not only the health of systems and storage resources configured, but as well as performance metric data in near real-time. CloudIQ supports both All-Flash and Hybrid Dell EMC Unity systems as well as Dell EMC UnityVSA Professional Editions.

In additional to an aggregated dashboard view across Dell EMC Unity systems in a customer's environment, CloudIQ provides the benefit of displaying a proactive health score for each system which automatically identifies potential issues along with recommended remedies to help identify needed administrative tasks. Other benefits of using CloudIQ include reducing total cost of ownership (TCO) by faster remediation of issues, minimizing risk by identifying potential vulnerabilities, and higher uptime by optimizing performance and capacity usage of monitored systems.
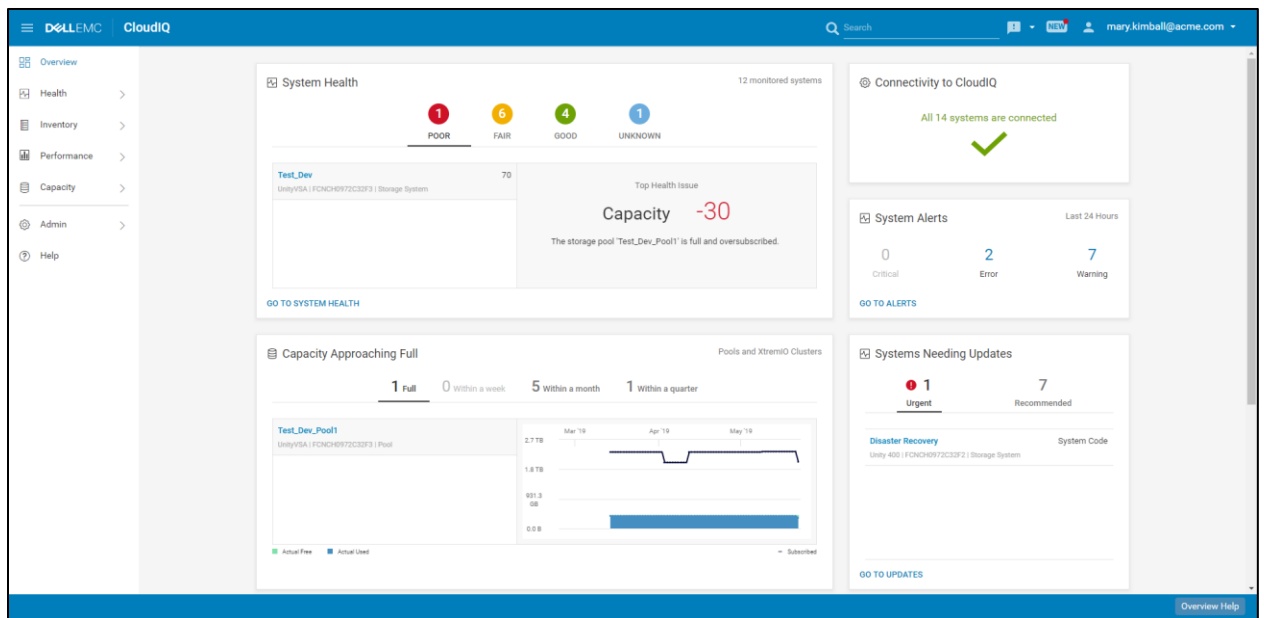
Figure 13. CloudIQ Dashboard page

For more information about CloudIQ, please see the white paper titled *CloudIQ Overview* on Dell EMC Online Support.

3.11.2 Unisphere Central

Unisphere Central allows users to organize and monitor up to 1000 VNX, VNX2, VNXe, and Dell EMC Unity systems from a centralized interface (Figure 14). Unisphere Central allows users to enjoy a single location for retrieving health and alert status for all the storage systems in your data center and be able to archive performance data for your systems. Additionally, Single Sign-On may be enabled for VNXe systems running OE version 3.1 or later, as well as purpose-built Dell EMC Unity systems and Dell EMC UnityVSA systems. This allows Unisphere sessions to individual systems to be launched directly from Unisphere Central. Unisphere Central is deployed as a VM on ESXi hosts and does not require an external network connection to be used.

For more information about Unisphere Central, see the latest *Unisphere Central V4* white paper on Dell EMC Online Support.
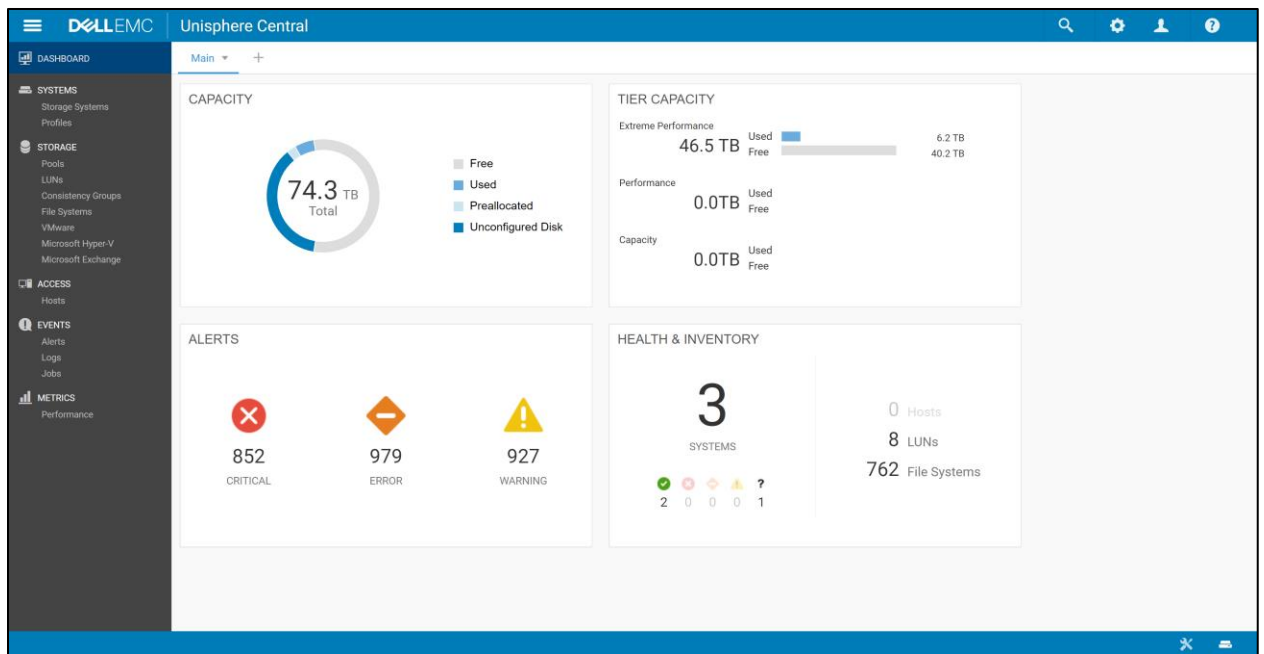
Figure 14. Unisphere Central

3.11.3 RecoverPoint

Dell EMC RecoverPoint is an appliance-based solution for achieving local and remote protection of data. RecoverPoint may be used to perform asynchronous and/or synchronous block replication to any Dell EMC Unity system supported by RecoverPoint. Purpose-built Dell EMC Unity systems and Dell EMC UnityVSA systems are compatible with RecoverPoint. When RecoverPoint replication is configured on a Dell EMC Unity system, writes to the system are split. Writes are sent through the Dell EMC Unity system to be processed, and also sent to the RecoverPoint Appliance (RPA). The RPA facilitates the data transfer to the destination resource. RecoverPoint replication can leverage additional storage efficiencies, such as compression and deduplication.

3.11.4 Metro node

Metro node is an external hardware/software add-on feature for Unity XT for which it provides active/active synchronous replication as well as standard local use cases. Additionally, it also provides a solution locally with the Local mirror feature to protect data from a potential array failure. Both use cases provide solutions for true continuous availability with zero downtime.

Unity XT is viewed by metro node as ALUA array based on SCSI response data and therefore is required to follow the four active, four passive path connectivity rules. This rule states that both nodes of the metro node must each have four active and four passive paths to all volumes provisioned from the array. For additional information about Metro node, go to Dell Support and reference the Metro node best practices white paper.

4 Conclusion

The Dell EMC Unity product family sets a new standard for storage by delivering compelling simplicity, a modern design, and enterprise features at an affordable price and compact footprint. Dell EMC Unity meets the needs of resource-constrained IT professionals in both large and small companies. The purpose-built Dell EMC Unity system is offered in All Flash and Hybrid models, providing flexibility for differing use cases and budgets. The converged offering through the Converged Infrastructure Portfolio delivers industry-leading converged infrastructure powered by Dell EMC Unity. The Dell EMC UnityVSA offers a dynamic deployment model that allows you to start for free and grow as business needs evolve.

The Dell EMC Unity system was designed with ease-of-use at the forefront. The modern design of the management interfaces are built with best practices in mind, making it easy to provision storage intelligently without having to micromanage every detail. A software feature set built with the same mindset allows for automation and "set it and forget it" style upkeep. Truly, an IT generalist can set up, configure, and manage a Dell EMC Unity system without needing to become a storage expert. A strong support ecosystem offers a variety of media for learning and troubleshooting, backed by the quality support model of the Dell EMC brand. Lastly, users looking to refresh their existing Dell EMC infrastructure can utilize the easy-to-use native migration capabilities of the Dell EMC Unity platform.

With simplified ordering, all-inclusive software, new differentiated features, internet-enabled management, and a modern design, Dell EMC Unity is where powerful meets simplicity.

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 documents can be found on Dell EMC Online Support:
- Dell EMC Unity: Best Practices Guide
- Dell EMC Unity: Cloud Tiering Appliance (CTA)
- Dell EMC Unity: Compression
- Dell EMC Unity: Compression for File
- Dell EMC Unity: Data at Rest Encryption
- Dell EMC Unity: Data Integrity
- Dell EMC Unity: Data Reduction
- Dell EMC Unity: DR Access and Testing
- Dell EMC Unity: Dynamic Pools
- Dell EMC Unity: FAST Technology Overview
- Dell EMC Unity: File-Level Retention (FLR)
- Dell EMC Unity: High Availability
- Dell EMC Unity: Introduction to the Platform
- Dell EMC Unity XT: Introduction to the Platform
- Dell EMC Unity: NAS Capabilities
- Dell EMC Unity: MetroSync
- Dell EMC Unity: MetroSync and Home Directories
- Dell EMC Unity: MetroSync and VMware vSphere NFS Datastores
- Dell EMC Unity: Migration Technologies
- Dell EMC Unity: OpenStack Best Practices for Ocata Release
- Dell EMC Unity: Performance Metrics
- Dell EMC Unity: Replication Technologies
- Dell EMC Unity: Snapshots and Thin Clones
- Dell EMC Unity: Unisphere Overview
- Dell EMC Unity: Virtualization Integration
- Dell EMC UnityVSA
- Dell EMC Unity Cloud Edition with VMware Cloud on AWS
- Dell EMC Unity Data Reduction Analysis
- Dell EMC Unity: Migrating to Dell EMC Unity with SAN Copy
- Dell EMC Unity Storage with Microsoft Hyper-V
- Dell EMC Unity Storage with Microsoft SQL Server
- Dell EMC Unity Storage with Microsoft Exchange Server
- Dell EMC Unity Storage with VMware vSphere
- Dell EMC Unity Storage with Oracle Databases
- Dell EMC Unity 350F Storage with VMware Horizon View VDI
- Dell EMC Unity: 3,000 VMware Horizon Linked Clone VDI Users
- Dell EMC Storage with VMware Cloud Foundation