FlashBlade User Guide

Version 3.2.0

PURESTORAGE®

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Chapter 1
About this Guide

The Pure Storage FlashBlade® User Guide is written for array administrators who view and manage the Pure Storage FlashBlade storage system. FlashBlade arrays are administered through the Purity for FlashBlade (Purity//FB) graphical user interface (GUI) or command line interface (CLI). Users should be familiar with system, storage, and networking concepts, and have a working knowledge of Windows or UNIX.

This guide provides information about the FlashBlade and its features and how to use them.

For full information about the CLI commands referenced in this document, refer to the *FlashBlade CLI Reference*.

Organization of this Guide

This guide is organized as follows:

Purity//FB Overview - Defines FlashBlade array naming and numbering conventions.

Purity//FB GUI Overview and (subsequent topics) - Describes the use of the browser-based Purity//FB graphical user interface (GUI) to administer a FlashBlade array.

Choosing an Active Directory Account or Directory Services Configuration - Provides an overview of Active Directory and Directory Services configurations for array and file management and accessibility, as well as configuration instructions for each.

Replication and Recovery - Provides step-by-step instructions on how to set up file and object replication, as well as how to perform failover and failback, using the Purity//FB GUI and CLI.

A Note on Format and Content

FlashBlade technology is evolving rapidly. As with all advanced information technologies, once basic architecture is in place, implementation develops at different rates in its different facets, each preceded by feature-by-feature detailed design.

This edition of the guide describes the properties and behavior of arrays that run the latest Purity//FB release. It may include information about planned capabilities whose external form has been specified at the time of the release. Such material is included to provide users of this release with information for design planning purposes, and is subject to change as new functionality is implemented. Material relating to not-yet-implemented functionality is identified as such in the text.

Documentation and Support

All related guides are or will soon be available in the Pure Storage Knowledge Base, which is located at *http://support.purestorage.com*.

Contact Us

We welcome your feedback about Pure Storage documentation and encourage you to send your questions and comments to *documentfeedback@purestorage.com*.

Product Support

If you are a registered Pure Storage user, log in to *http://support.purestorage.com* to browse our knowledge base, view the status of your open support cases, and view the details of past support cases.

You can also contact Pure Technical Services at *support@purestorage.com*.

Chapter 2
Purity//FB Overview

Purity for FlashBlade (Purity//FB) is the operating environment that queries and manages the FlashBlade hardware, networking, and storage components. The Purity//FB software is distributed with the FlashBladearray.

Purity//FB provides two ways to administer the FlashBladearray: through the browser-based graphical user interface (Purity//FB GUI), and through the command line interface (Purity//FB CLI).

Purity//FB Conventions

Purity//FB follows certain conventions.

Object Names

Valid characters are letters (A-Z and a-z), digits (0-9), and the hyphen (-) character. File system names can also include the underscore (_) character. The first and last characters of a name must be alphanumeric, and a name must contain at least one letter.

Most objects in Purity//FB that can be named, including file systems, data vips, and subnets can be 1-63 characters in length.

Array names can be 1-56 characters in length. The array name length is limited to 56 characters so that the names of the individual controllers, which are assigned by Purity//FB based on the array name, do not exceed the maximum allowed by DNS.

Purity allows the use of lowercase and uppercase in names and preserves capitalization in command output. However, duplicate naming with different capitalization is not allowed. Additionally, search ignores capitalization differences.

Array and File System Sizes

Array and file system sizes are specified as integers followed by one of the suffix letters `K`, `M`, `G`, `T`, `P`, representing `KiB`, `MiB`, `GiB`, `TiB`, and `PiB`, respectively, where " `Ki` " denotes 2^10, " `Mi` " denotes 2^20, and so on.

Time Zones

Purity//FB GUI dates and times are displayed in the user's local time zone, which is determined by the browser's local time. The user's local time zone appears at the bottom of the navigation pane of the Purity//FB GUI.

Purity//FB CLI dates and times are displayed in the time zone of the array, which is set during FlashBlade installation. The array time zone appears and can be edited in the **Time** panel of the **System** > **Settings** page.

IP Addresses

FlashBlade supports two versions of the Internet Protocol: IP Version 4 (IPv4) and IP Version 6 (IPv6). IPv4 and IPv6 addresses follow the addressing architecture set by the Internet Engineering Task Force.

An IPv4 address consists of 32 bits and is entered in the form `ddd.ddd.ddd.ddd`, where `ddd` is a number ranging from `0` to 255 representing a group of 8 bits. Here are some examples:

```
puredns setattr --domain mydomain.com --nameservers 192.0.2.10
purenetwork setattr --address 192.0.2.0 DataVip01
puresubnet create --prefix 192.0.2.0/24 --vlan 100 Sub01
```

An IPv6 address consists of 128 bits and is written in in the form `xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx`, where `xxxx` is a hexadecimal number representing a group of 16 bits. Colons separate each 16-bit field. Leading zeros can be omitted in each field. Furthermore, consecutive fields of zeros can be shortened by replacing the zeros with a double colon (`::`) . For example, IPv6 address `2001:0db8:85a3:0000:0000:8a2e:0370:7334` becomes `2001:db8:85a3::8a2e:370:7334`.

To use an IPv6 address in a URL or URI, enclose the entire address in square brackets (`[]`) . When specifying a URL or URI with a port number, append the port number after the end of the entire address. Here are some examples:

```
puredns setattr --domain mydomain.com --nameservers 2001:db8:85a3::8a2e:370:7334
purenetwork setattr --address 2001:db8:85a3::8a2e:370:7334 DataVip01
puresubnet create --prefix 2001:db8:85a3::/64 --vlan 100 Sub01
```

SMB Port Assignments

This section provides the minimum ports required on each VLAN for SMB to function successfully. This information should be provided to your network team who configures the firewall.

Management Network Ports

The following table provides the ports required on the management network. Without these ports opened, SMB and LDAP will not be able to authenticate. These ports must be open between the FlashBlade management VIP and the LDAP/Active Directory (AD) server(s).

Port	TCP	UDP	Purpose
53	Yes	Yes	DNS used to locate the AD hosts and services.
123	Yes	Yes	NTP to avoid time skews, which needs to be limited for authentication.
389	Yes	Yes	Used to manage array integration with a directory service using LDAP. Active Directory requires both TCP and UDP. LDAP only requires TCP.
636	Yes	Yes	Used to manage array integration with a directory service using LDAPS (LDAP over TLS/SSL).
445	Yes	No	Used by SMB join/unjoin AD and perform all authentication/ authorization via the management network.

Firewall Ports

The following table lists the required firewall ports for FlashBlade access. These ports are outgoing traffic from the FlashBlade to the public network.

Port	TCP	UDP	Purpose
443	Yes	No	Used for both HTTPS and SSH over HTTPS for IPv4. Use the following IP block and hostnames: • IP block 52.40.255.224/27 • Hostname: cloud-support.purestorage.com Static IPs are not supported for IPv6. Use the hostname: .cloud-support.purestorage.com Add all items above to your whitelist.

Data Network Ports

The following table describes the required ports on the data network. These ports must be open between the FlashBlade data VIP and SMB hosts.

Port	TCP	UDP	Purpose
53	Yes	Yes	Share name resolution.
445	Yes	No	SMB data traffic. SMB 2.1 is supported; therefore port 139 is not needed.

Pure File SafeMode

Pure File SafeMode is configured during installation and is designed to protect the system from accidental changes. File SafeMode prevents users from performing some operations such as file system snapshot restore and file system snapshot eradication. For more information, contact Pure Technical Services.

About NFSv4.1 Support

In the current implementation of the NFSv4.1 protocol, FlashBlade supports the following subset of core NFSv4.1 protocol features, which are compliant with Linux clients:

- Native byte-range locking semantics required by Linux clients
- All NFS traffic through single secure port (2049)
- Top level root mountable with file systems as directories
- Exportable to NFSv3 and NFSv4.1 clients simultaneously
- Client qualification: CentOS/RedHat OS
- Management support using the FlashBlade GUI, CLI, and REST API
- Kerberos

The following features of the NFSv4.1 protocol are currently unavailable:

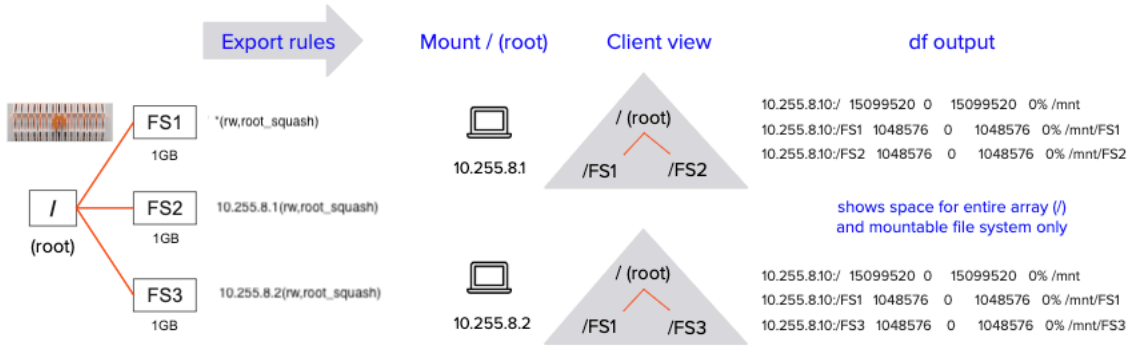
- pNFS
- Delegation
- Referrals
- Shared reservation

⚠ **Important note!** NFSv4.0 is not supported.

Top Level Mounting

In the current implementation of NFSv4.1, hosts can mount at the top level root (`/`) with file systems as directories. File systems can be exported to different clients with different export rules and permissions. Note that issuing `ls` on `/` displays the file system that is mountable to that host, and issuing `df` on `/` displays space information for `/` and any mountable, actively used (accessed within the last 60 seconds) file systems.

Figure 2.1 Top Level Mounting



Troubleshooting

Help! Who do I contact about problems with the FlashBlade Array?

Contact a member of your Pure Storage® account team, visit us at *http://support.purestorage.com*, or email Pure Technical Services at *support@purestorage.com*.

If you are contacting Pure Technical Services about a technical issue, they may ask you to open an RA session so that they can help you diagnose the issue.

Error Messages

The following error messages may appear when you perform operations through the Purity//FB GUI or CLI:

Service Temporarily Unavailable

An internal service is currently unavailable. This is a temporary issue. Wait a few minutes and then try the Purity//FB GUI or CLI operation again. If you still get the error message, contact Pure Technical Services at *support@purestorage.com*.

Unexpected Error

The Purity//FB GUI or CLI operation that you performed generated an unexpected error. Contact Pure Technical Services at *support@purestorage.com*.

Chapter 3
Purity//FB GUI Overview

The Purity//FB graphical user interface (GUI) is a web application used to view and administer the FlashBlade array.

The screens of the Purity//FB GUI differ slightly depending upon if your FlashBlade array is a single-chassis or is a multi-chassis configuration. The following figure displays the GUI for a single-chassis configuration.

Figure 3.1 Purity//FB GUI

The Purity//FB GUI contains the following pages:

Dashboard

Represents a graphical overview of the array, including hardware status, recent alerts, storage capacity, replication bandwidth, and input/output (I/O) performance metrics.

Storage

Displays summary array details including connection and replication information. In addition, quick links are provided to access file systems, snapshots, object store user, account, bucket, and object information, and export rules. Additionally, a **File Systems** tab provides a list of file systems on the array and its attributes, including provisioned size, capacity usage details, and export rules. An **Object Store** tab is provided to quickly access object store accounts, buckets, and users.

Protection

Displays backup and replication information. A list of file system snapshots, their source array, source file system, replication policy, and creation date is displayed. Tabs for **Policies**, **File Replica Links**, and **Object Replica** links are provided to view details about replication policies and file and object replication link information.

Analysis

Displays historical array information, including space and I/O performance metrics, from various viewpoints. Latency, IOPs, and bandwidth data for file systems and the object store can be viewed from the **File Systems** and **Object Store** tabs.

Health

Displays array health including alerts, hardware status, and parity.

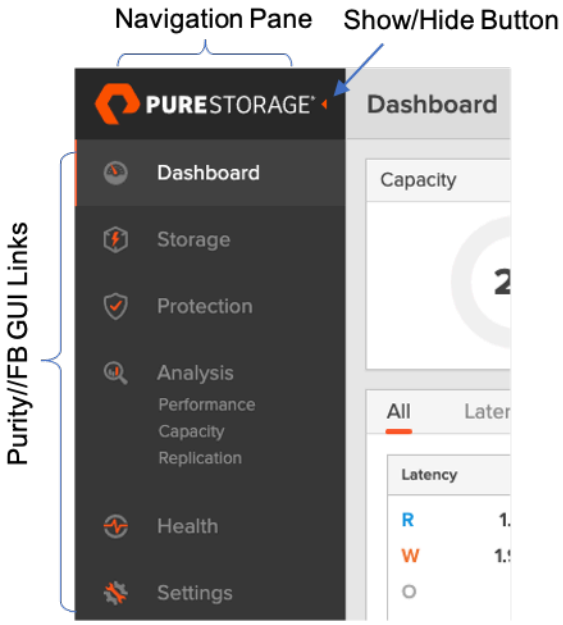
Settings

Displays array-wide system and network settings. Manage array-wide components, including network interfaces, system time, connectivity and connection configurations, directory services, support settings, SSL certificates, and alert settings.

Purity//FB GUI Navigation

The dark gray navigation pane that appears along the left side of the Purity//FB GUI contains links to the Purity//FB GUI pages.

Figure 3.2 Purity//FB GUI - Navigation Pane



Click a link in the navigation pane to analyze or configure the information that appears in the page to its right. For example, click the **Storage** link to view information about the FlashBlade array, file systems, and object store..

Click the **show/hide** button to toggle between the expanded and collapsed views of the navigation pane. The show/hide button appears to the right of the Pure Storage logo.

The navigation pane also includes links to the following external sites:

Help

Launches the FlashBlade user guide, FlashBlade CLI Reference, REST API guide, community and support websites.

End User Agreement

Launches the Pure Storage End User Agreement pop-up window.

Terms

Launches the Pure Storage Legal Terms, Programs, and Product Information web page.

Log Out

Logs the current user out of the Purity//FB GUI.

The bottom of the navigation pane displays FlashBlade array name and Purity//FB version information, the name of the user who is currently logged into the Purity//FB GUI, and the user's local time zone. The dates and times that appear in the Purity//FB GUI are based on the user's local time zone, which is determined by the browser's local time.

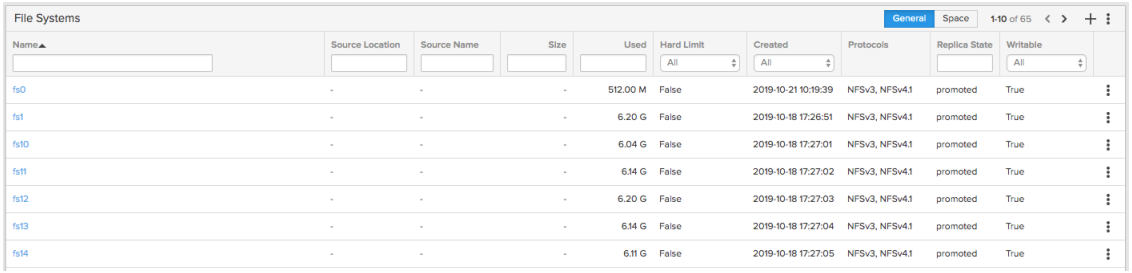
The page to the right of the navigation pane displays the information and configuration options for the selected Purity//FB GUI link. The information on each page is organized into panels, charts, and lists.

Figure 3.3 Purity//FB GUI - Page and Buttons

The alert icons that appear to the far right of the title bar indicate the number of open **Warning** and **Critical** alerts. Alerts in the `open` and `closing` states are included in the alert count displayed by the icons.

When an alert is in the `closing` state, it is still considered open. If after 24 hours there is no recurrence or increase in severity, the alert will close. However, if there is a recurrence or increase in severity, the alert will move from the `closing` state back to the `open` state. To analyze alerts in more detail, click the **Health** link.

Various panels, such as **Storage > File Systems** and **Health > Alerts**, contain lists of information. The total number of rows in a list output is displayed in the upper-right corner of the list. Some lists can be very large, extending beyond hundreds of rows.



Pagination divides a large list output into discrete pages. Pagination is in effect if the number of lines in the list output exceeds 25 rows for tabs displaying a single table, or 10 rows for tabs displaying multiple

tables. To move through a paginated list, click < to go to the previous page, or click > to go to the next page.

Purity//FB GUI Login

Logging in to the Purity//FB GUI requires the management virtual IP address or fully-qualified domain name (FQDN) and an Purity//FB login username and password; this information is provided during the FlashBlade installation.

FlashBlade is installed with one administrative account with the username `pureuser`. .

As a best practice, for security purposes Pure Storage recommends that the password for the account be changed immediately upon first log in using the `pureadmin` CLI command. Refer to the `pureadmin` command in the *FlashBlade CLI Reference* for details.

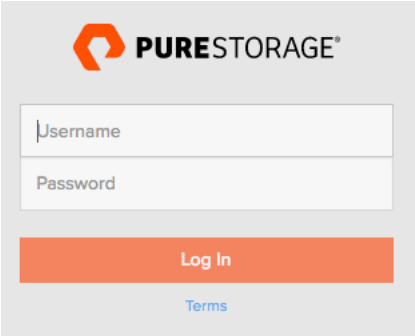
Note: Upon initial log in, a password alert will be generated asking you to change the `pureuser` account password. This alert will appear as a weekly reminder until the password is changed. Once the password is changed, you cannot change it back to the default value.

Pure Storage tests the Purity//FB GUI with the most recent version of the following web browsers:

- Apple Safari
- Google Chrome
- Mozilla Firefox

To launch the Purity//FB GUI login screen, open a browser and type the virtual IP address or FQDN into the address bar, and press **Enter**.

Figure 3.4 Purity//FB GUI - Login Screen



Logging in to the Purity//FB GUI

Log in to the Purity//FB GUI to view and administer the FlashBlade array.

To log in to the Purity//FB GUI:

1. Open a web browser.
2. Type the virtual IP address or fully-qualified domain name of the FlashBlade in the address bar and press **Enter**. The Purity//FB GUI login screen appears.
3. In the **Username** field, type the FlashBlade user name. For example, `pureuser`.
4. In the **Password** field, type the password for the FlashBlade user. For example, `pureuser`.
5. Click **Log In** to log in to the Purity//FB GUI.

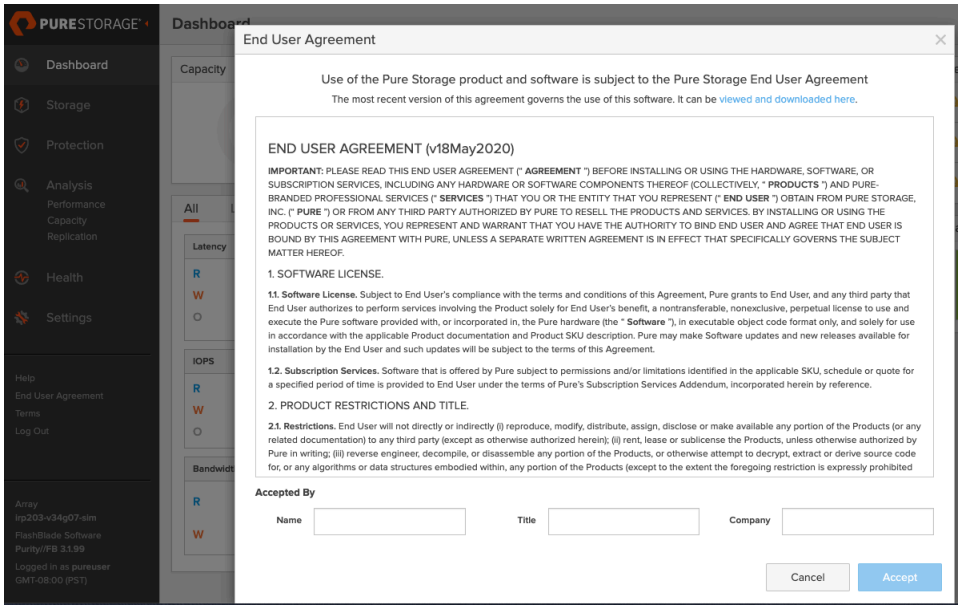
Viewing and Managing the End User Agreement

Once the FlashBlade array has been installed, you can view the End User Agreement (EUA) and accept it.

Note: Only users with array_admin permissions can accept and update the EUA. Users without array_admin permissions can only view the EUA.

Clicking **End User Agreement** from the navigation pane opens a pop-up window that displays the EUA. Carefully review the EUA before proceeding.

Figure 3.5 Viewing the End User Agreement



To accept the EUA, enter a name, title, and company information in the fields provided at the bottom of the pop-up window and then click **Accept**.

Once the EUA has been accepted, the next time that the EUA is accessed, the **Accept** button is replaced with an **Update** button with the acceptance date and time displayed.

If you wish to edit the name, title, or company information, enter the new information in the fields and click **Update**.

Chapter 4
The Purity//FB GUI Dashboard Page

The **Dashboard** page displays a running graphical overview of the array 's storage capacity, performance, and hardware status.

Figure 4.1 Dashboard

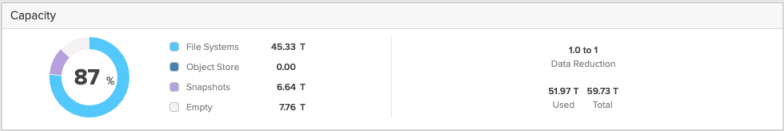
The **Dashboard** page contains the following panels and charts:

- **Capacity**
- **Performance Charts**
- **Recent Alerts**
- **Replication Bandwidth** (only for replication setups)
- **Hardware Health**

Capacity

The **Capacity** panel displays array size and storage consumption details. All capacity values are rounded to two decimal places.

Figure 4.2 Dashboard - Capacity Panel



The capacity wheel displays the percentage of array space occupied by file system data. The percentage value in the center of the wheel is calculated as **Used** capacity/ **Total** capacity.

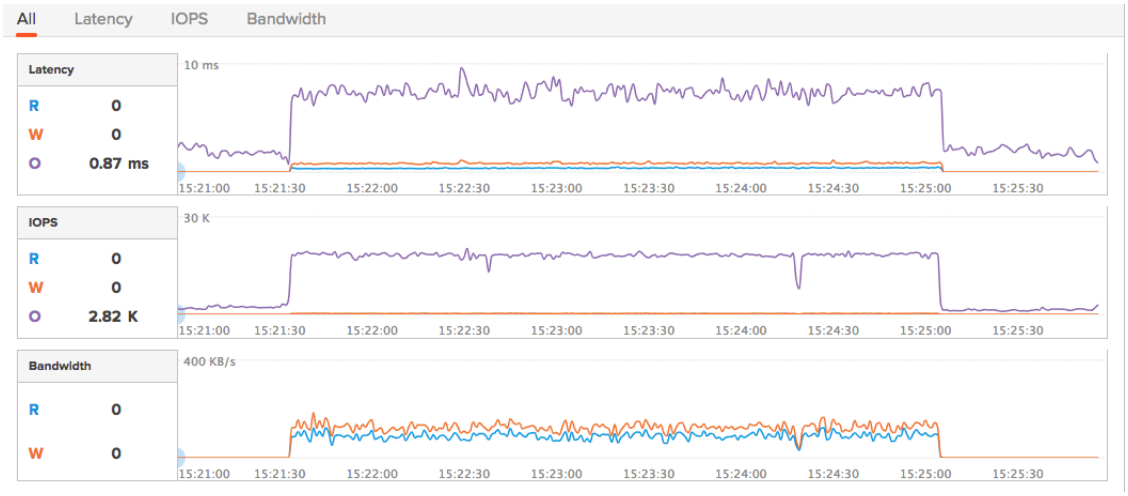
The capacity data is broken down into the following components:

- **File Systems**: Amount of space that the written data occupies on the array 's file systems after reduction via data compression.
- **Object Store**: Amount of space that the written data occupies on the array 's buckets after reduction via data compression.
- **Snapshots**: Amount of space that the array 's snapshots occupy after data compression.
- **Empty**: Unused space.
- **Used**: Amount of space that the written data occupies on the array after reduction via data compression.
- **Total**: Total usable capacity of the array.
- **Data Reduction**: Ratio of the size of the written data (i.e. Used) versus the amount of space the data occupies after data compression (i.e. Physical).

Performance

The performance panel displays latency, IOPS, and bandwidth values in real time.

Figure 4.3 Dashboard - Performance Charts



The performance metrics are displayed along a scrolling graph; incoming data appears along the right side of each graph every second as older data drops off the left side after 5 minutes. Each performance chart includes R, W, and O (if applicable) values, representing the most recent data samples.

Hover over any of the charts to display metrics for a specific point in time. The values that appear in the point-in-time tooltips are rounded to two decimal places.

The performance panel includes Latency, IOPS, and Bandwidth charts. The **All** chart displays all three performance charts in one view.

Latency

The **Latency** chart displays the average latency times for various operations.

- **Read Latency (R)** - Average arrival-to-completion time, measured in milliseconds, for a read operation.
- **Write Latency (W)** - Average arrival-to-completion time, measured in milliseconds, for a write operation.
- **Other Latency (O)** - Average arrival-to-completion time, measured in milliseconds, for all other metadata operations.

IOPS

The **IOPS** (Input/output Operations Per Second) chart displays I/O requests processed per second by the array. This metric counts requests per second, regardless of how much or how little data is transferred in each.

- **Read IOPS (R)** - Number of read requests processed per second.
- **Write IOPS (W)** - Number of write requests processed per second.

- **Other IOPS (O)** - Number of metadata operations processed per second.
- **Average IO Size** - Average I/O size per request processed. Requests include reads and writes.

Bandwidth

The **Bandwidth** chart displays the number of bytes transferred per second to and from the array (both file systems and buckets) . The data is counted in its expanded form rather than the reduced form stored in the array to truly reflect what is transferred over the storage network. Metadata bandwidth is not included in these numbers.

- **Read Bandwidth (R)** - Number of bytes read per second.
- **Write Bandwidth (W)** - Number of bytes written per second.

By default, the performance charts display performance metrics for the past 5 minutes. To display more than 5 minutes of historical data, select **Analysis > Performance**.

Note about the Performance Charts

The **Dashboard** and **Analysis** pages display the same latency, IOPS, and bandwidth performance charts, but the information is presented differently between the two pages.

In the **Dashboard** page:

- The performance charts are updated once every second.
- The performance charts display up to 5 minutes of historical data.

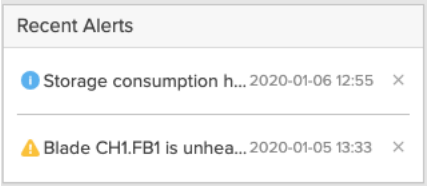
In the **Analysis** page:

- At its shortest range (5m), the performance charts are updated once every second. As the range increases, the update frequency (and resolution) decreases.
- The performance charts display up to 1 year of historical data.
- The performance charts can be filtered to display metrics by protocol.

Recent Alerts

The **Recent Alerts** panel displays a list of alerts that Purity//FB saw that is both flagged and not in the closed state. The list contains recent alerts of all severity levels. If no alerts are logged, the panel displays **No recent alerts**.

Figure 4.4 Dashboard - Recent Alerts Panel



To view the details of an alert, click the alert message.

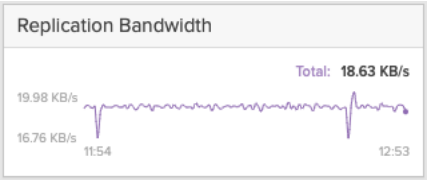
To remove an alert from the **Recent Alerts** panel, click the clear flag (**X**) button. The alert will no longer be displayed in the **Recent Alerts** panel, but will still appear on the **Health** page.

To view a list of all alerts, including ones that are in no longer open, go to the **Health** page.

Replication Bandwidth

The **Replication Bandwidth** panel provides a graph that displays the total replication bandwidth. Note that this panel appears only if replication has been set up.

Figure 4.5 Dashboard - Replication Bandwidth Panel



Clicking the graph opens the **Analysis > Replication** page where finer detail about bandwidth usage can be viewed (see *Replication*).

Hardware Health

The **Hardware Health** panel displays the operational state of the FlashBlade array chassis, blades, and fabric modules. Hover over the image to view the component details.

Depending on the configuration of your array, the **Hardware Health** panel displays either a single or multi-chassis FlashBlade graphic.

Figure 4.6 Hardware Health Panel - Single chassis

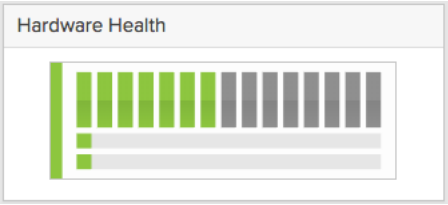
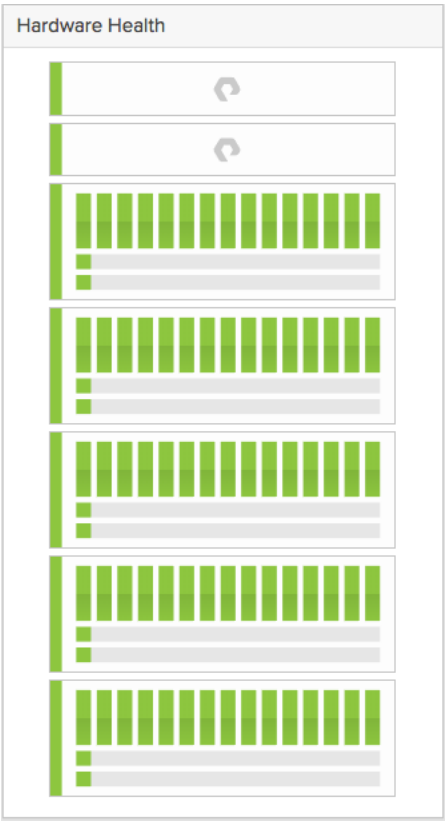


Figure 4.7 Hardware Health Panel - Multi-chassis



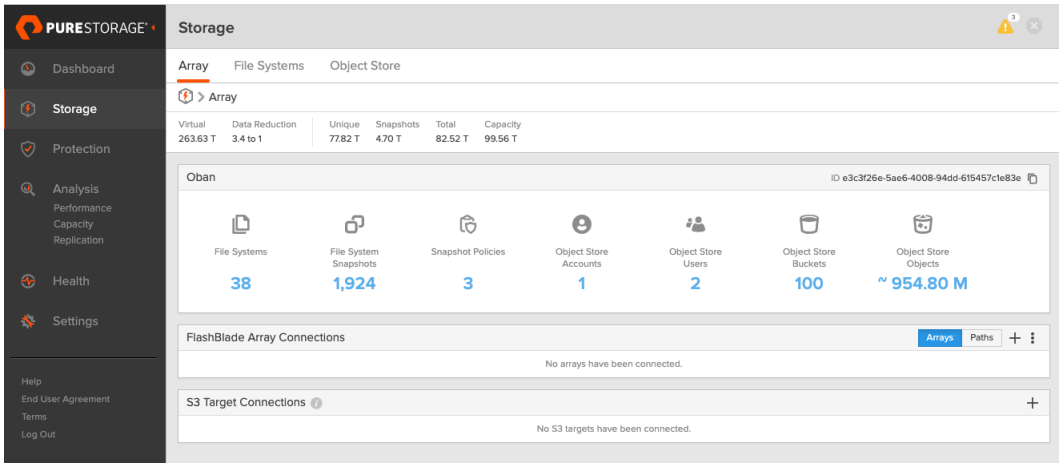
To analyze the hardware components in more detail, click the **Health** link.

Chapter 5
The Purity//FB GUI Storage Page

The **Storage** page displays and manages the array 's file systems and object store accounts, which contain users and buckets.

Accessing a file system or bucket requires at least one valid data virtual IP address (data vip). Data vips are configured through the **Settings** > **Network** page.

Figure 5.1 Purity//FB Storage Page

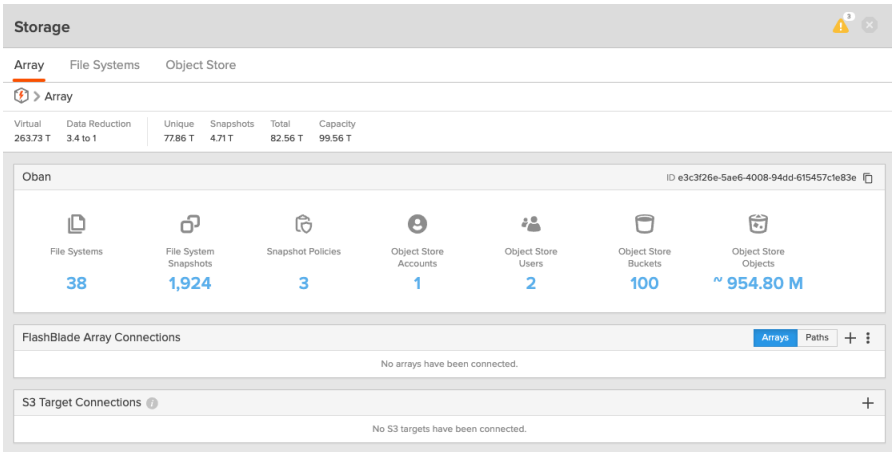


Array

By default the **Array** tab is displayed when navigating to the **Storage** page.

The **Array** tab displays an array summary pane, a **FlashBlade Array Connections** pane, and an **S3 Target Connections** pane.

Figure 5.2 Array Tab



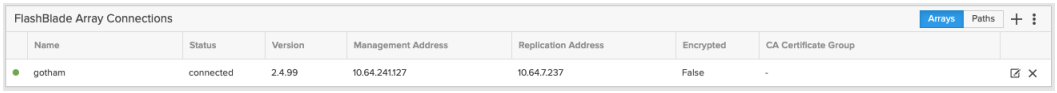
The array summary panel displays counts of various types of metadata objects. Click a count to jump to the page containing the details for associated objects. For example, clicking the **File System Snapshots** count opens the **Protection** > **Snapshots** tab in the GUI.

Note that the number of objects displayed under **Ojbect Store Objects** is approximate. The units used for the approximate object count are **K** (thousands), **M** (millions), **B** (billions), and **T** (trillions).

Array attributes such as array time and the array name are configured through the **Settings** > **System** page.

The **FlashBlade Array Connections** panel displays all arrays connected to the current FlashBlade array for replication.

Figure 5.3 FlashBlade Array Connections Panel



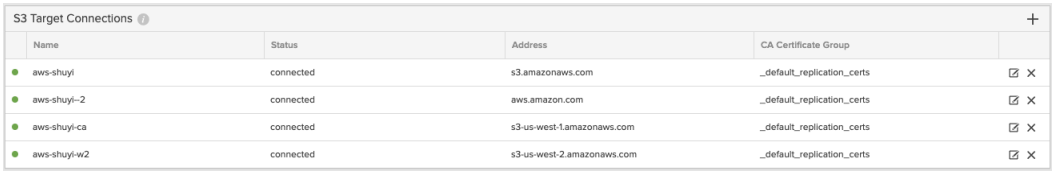
A connection must be established between two arrays in order for data replication to occur. FlashBlade supports asynchronous replication, which allows data to be replicated from one array to another. When two arrays are connected for asynchronous replication, the array where data is being transferred from is called the local (source) array, and the array where data is being transferred to is called the remote (target) array. For more information, see *The Purity//FB GUI Protection Page*.

Details about the array connection are provided including the current connection status, Purity software version, management and replication IP addresses, encryption status, and applied CA certificate group (if any). If you click **Paths**, the connected array and all connection paths (source and destination IP address) are displayed.

If the array connection is not healthy, the **Paths** view can be useful in determining which network paths are having problems.

The **S3 Target Connections** panel displays all S3 targets connected to the current FlashBlade array for object replication.

Figure 5.4 S3 Target Connections Panel



The names of connected S3 targets, connection status, connection address, and applied CA certificate groups are displayed. For more information, see *The Purity//FB GUI Protection Page*.

In addition to displaying details about connected S3 targets, this panel also allows you to rename existing S3 targets and connect new S3 targets.

Connecting Arrays

In order to connect two arrays to perform replication, you must have the following:

- Replication network interfaces on the source and target arrays.
- A network path from the source array to the target array's management vip.

Connecting two arrays is performed in the **FlashBlade Array Connections** panel of the **Array** page.

Note: Data can be optionally encrypted. However, file replication is not supported over an encrypted connection.

⚠ **Important note!** When connecting the source array to the target array, a secure connection is required even if encryption is not enabled. Certificates with small key sizes, weak signature algorithms, or that only support weak TLS algorithms are not supported.

⚠ **Important note!** It is highly recommended that you add the `pure:policy/full-access` access policy to the user (whose credentials are used for replication) on the target cluster, otherwise replication may fail due to denied access. See *Adding Access Policies* for instructions on how to add access policies to users.

To connect two arrays, perform the following:

1. From the **Storage** > **Array** page, click the add (+) button in the **FlashBlade Array Connections** panel. The **Connect FlashBlade Array** pop-up window appears.

2. Enter the target array's hostname or management address (unless using NAT) in the **Management Address** field. The address can be located from the **Subnets** table by navigating to the **Settings** > **Network** page.

3. Enter a connection key for the target array in the **Connection Key** field.

   a. On the target array, create the connection key (see *Creating a Connection Key*).

   b. Copy the new connection key.

   c. On the source array, paste the connection key in the **Connection Key** field in the **Connect FlashBlade** pop-up window.

4. The replication address is auto-discovered unless using NAT. The source and target arrays each need a replication network interface. If not already created, create the replication network interfaces on the source and target arrays (see *Creating a Network Interface*). Enter the target array's replication network address in the **Replication Address** field.

5. (Optional) Enable encryption by setting the **Encrypted** toggle to on. If set, the `_default_replication_certs` CA certificate group is applied. Before toggling, make sure to import the CA certificate to the source array if the target array's array-certificate is signed by a CA and add it to the certificate group. Note that encryption is set on the source array only. If enabled, the encryption setting displays as enabled on the target array.

   Warning: Use of CA certificates to establish trust and secure communication for object replication is the recommended configuration. If the target array's array-certificate is self-signed, directly importing the target array certificate to the source and adding it to the certificate group will not provide as strict validation around aspects of the peer, such as certificate expiry.

6. Click **Connect**.

7. If using NAT, enter the source array's replication address on the target array.

   a. On the target array, in the **FlashBlade Array Connections** panel on the **Storage > Array** page, click the edit button at the end of the row displaying the connected source array. The **Edit Connected Array** pop-up window appears.

   b. Enter the replication address for the source array in the **Replication Address** field and click **Save**.

Creating a Connection Key

In order to connect two arrays for replication, a connection key must be created on the target array to be used on the source array during array connection.

Connection keys are created from the **FlashBlade Array Connections** panel of the **Array** page.

To create a connection key, perform the following:

1. On the target array, navigate to the **Storage** > **Array** page.
2. In the **FlashBlade Array Connections** pane, click **More Options** > **Create Connection Key**. The **Connection Key** pop-up window appears displaying the new connection key.

Once created, the key is active for two hours. If the source and target arrays have not been connected within that two hour period, a new connection key must be created.

Editing a Connected Array

A connected array must be edited if its management or replication address information has changed, or if you wish to enable or disable encryption (for object replication).

Editing a connected array is performed in the **FlashBlade Array Connections** panel of the **Array** page.

To edit a connected array, perform the following:

1. On the source array, navigate to the **Storage** > **Array** page.
2. In the **FlashBlade Array Connections** pane, click the **Edit** button located at the end of the row of the array you wish to edit. The **Edit Connected Array** pop-up window appears displaying the new connection key.
3. Enter a new management and/or replication address as needed.
4. Enable (blue) or disable (gray) encryption.
5. Click **Save**.

Disconnecting a Connected Array

Disconnecting an array is performed in the **FlashBlade Array Connections** panel of the **Array** page.

To disconnect a connected target array, perform the following:

1. On the source array, navigate to the **Storage** > **Array** page.
2. In the **FlashBlade Array Connections** pane, click the Disconnect (**x**) button located at the end of the row of the array you wish to disconnect. The **Disconnect FlashBlade Array** pop-up window appears.
3. Click **Disconnect**.

Connecting an S3 Target

A FlashBlade array can be connected to an S3 target for object replication.

Connecting a FlashBlade to an S3 target is performed in the **S3 Target Connections** panel of the **Array** page.

To connect an S3 target, perform the following:

1. From the **Storage** > **Array** page, click the add (**+**) button in the **S3 Target Connections** pane. The **Connect S3 Target** pop-up window appears.
2. Enter the name of the S3 target and its address.
3. Click **Connect**.

Updating an S3 Target

The names and addresses S3 targets can be updated in the **S3 Target Connections** panel of the **Array** page.

To update an S3 target, perform the following:

1. On the source array, navigate to the **Storage** > **Array** page.
2. In the **S3 Target Connections** pane, click the **Edit** button located at the end of the row of the S3 target you wish to update. The **Edit S3 Target** pop-up window appears.
3. Enter a new name and/or new address.
4. Click **Save**.

Disconnecting an S3 Target

Disconnecting an S3 target from a FlashBlade array is performed in the **S3 Target Connections** panel of the **Array** page.

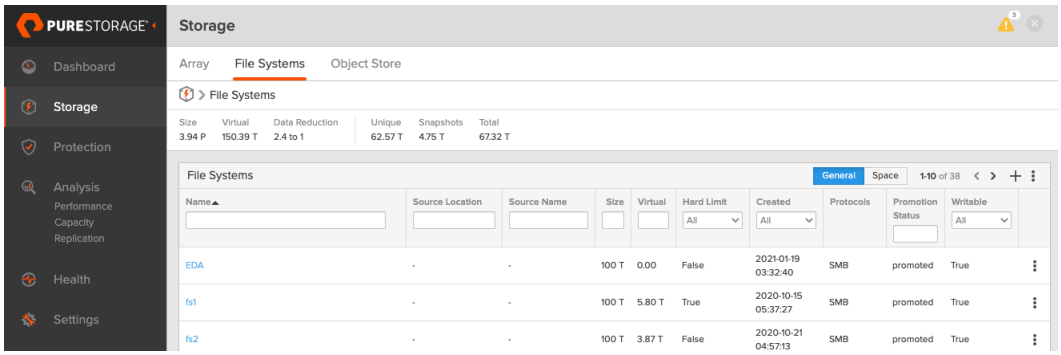
To disconnect an S3 target, perform the following:

1. On the source array, navigate to the **Storage** > **Array** page.
2. In the **S3 Target Connections** pane, click the Disconnect (**x**) button located at the end of the row of the S3 target you wish to disconnect. The **Disconnect S3 Target** pop-up window appears.
3. Click **Disconnect**.

File Systems

The **File Systems** tab displays information for all file systems on the array.

Figure 5.5 File Systems Tab



The **File Systems** panel displays configured file system information while the **Destroyed File Systems** panel displays destroyed file systems that are pending eradication.

File Systems Panel

By default general information about each file system is displayed, which includes the following information:

- **Name**: File system name. Clicking a file system name displays any snapshots belonging to that file system, and also provides the option of creating snapshots.
- **Source Location:** The location where the file system was created.
- **Source Name:** If created on the target array, the name of the source file system.
- **Size**: Provisioned size of the file system. If not set, the provisioned size is unlimited.
- **Used**: Total amount of pre-compressed data written to the file system.
- **Hard Limit**: Whether the file system's provisioned size has a hard limit (true) or not (false).
- **Created**: The file system creation date.
- **Protocols**: One or more protocols configured for the file system. A dash (-) means the file system has no protocols assigned.
- **Promotion Status**: Whether the source or replicated file system is promoted or demoted.

- **Writable**: Whether the file system is writeable (true) or not (false).

The size, rules, and protocols of each file system can be configured.

You can alternately click **Space** to view file system space information. The columns in the **File Systems** panel display the following information:

- **Name**: File system name. Clicking a file system name displays any snapshots belonging to that file system, and also provides the option of creating snapshots.
- **Size**: Provisioned size of the file system. If not set, the provisioned size is unlimited.
- **Used**: Total amount of pre-compressed data written to the file system.
- **% Used**: Percentage of provisioned size occupied by uncompressed system data. The percentage value is calculated as `Used/Size`.
- **Data Reduction**: Ratio of the size of the written data (i.e. Used) versus the amount of space the data occupies after data compression (i.e. Physical).
- **Physical**: Amount of space that the written data occupies on the array after reduction via data compression.
- **Snapshots**: Amount of space occupied by snapshots after reduction from data compression.
- **Total**: The total used space (physical space and snapshots).

You can search the file systems list by entering search criteria in the search box under each column.

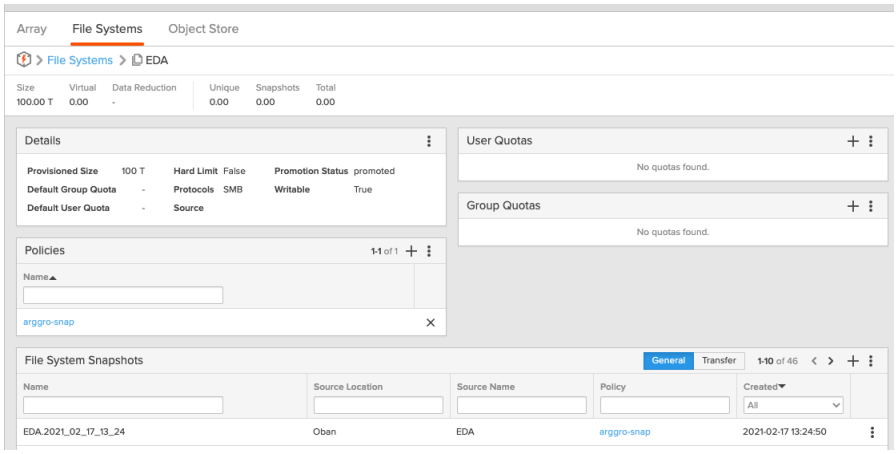
Clicking any file system directs you to that file system's details page.

In addition to displaying file systems, the **File Systems** panel allows you to create and maintain file systems.

File System Details

A file system's details page is accessed by clicking a file system from the **File Systems** panel.

Figure 5.6 File System Details Page



The file systems detail page provides the following panels:

- **Details**: Provides an overview of the file system's configured parameters, including: the file system's provisioned size, default group and quota sizes, if hard limits is enabled (True or False), export protocols, if ACLs safeguarding is enabled (True or False), the applied access control style, the file system's promotion status, if the file system is writable, and its source (for replication setups).
- **Policies**: Lists all policies applied to the file system and provides management of policies.
- **User Quotas**: Lists all configured user quotas and provides management of user quotas.
- **Group Quotas**: Lists all group quotas and provides management of group quotas.
- **File System Snapshots**: Lists all file system snapshots and provides management of snapshots.
- **Destroyed Snapshots**: Lists all destroyed snapshots and allows you to recover or eradicate destroyed snapshots.

Destroyed File Systems Panel

The **Destroyed File Systems** panel is located directly below the **File Systems** panel. Clicking the arrow beside the **Destroyed** heading expands the panel.

Once a file system has been destroyed, it is moved to the **Destroyed File System** panel making it inaccessible to clients. This is also known as an eradication pending period. During this period the file system and snapshot is left intact for 24 hours. If the destroyed file systems are not recovered within the 24-hour period, they will be eradicated and their space will be reclaimed by the array. If you need to reclaim space before the 24 hour expiration, file systems can be manually eradicated.

- **Name**: File system name.
- **Time Remaining**: Indicates the file systems expiration period in the eradication pending period. Time is represented in hours (**h**) and minutes (**m**) . When time expires the file systems will be eradicated and their space will be reclaimed by the array.

If a file system is destroyed, its snapshots are also destroyed and will appear in the **Destroyed Snapshots** panel. Those snapshots cannot be recovered unless the file system is recovered.

About Creating and Exporting File Systems

Creating and exporting a file system involves creating the file system and enabling protocol support for the file system. FlashBladefile systems support the Hypertext Transfer Protocol (HTTP), the Network File system (NFS), and Server Message Block (SMB) protocols.

Exporting a file system requires at least one data virtual IP address (data vip). The data vip can be created before or after creating the file system. Data vips are managed through the **Settings** > **Network** > **Subnets** panel. For more information about data vips, refer to *Subnets*.

For more information about using directory services with file system protocols, refer to *Directory Services Overview*.

When creating a file system, consider which protocol(s) you want to configure:

- **NFS**. File sharing over NFS requires that you configure the NFS export rules and then enable the protocol. Per NFS limitations, each user can belong to a maximum of 16 groups. If users belong to more than 16 groups and a directory service contains the group information, configure file sharing over NFS with a directory service.

  Follow these steps to set up file sharing over NFS without a directory service:

  1. Create the data vip. Data vips are managed through the **Settings** > **Network** > **Subnets** panel.
  2. Create the file system. Optionally set a provisioned size for the file system.
  3. Define the NFS export rules.
  4. Enable the NFS protocol.

- **NFS with a directory service**. For file sharing over NFS where a user might belong to more than 16 groups, configure the FlashBlade directory service to integrate with a directory server. This assumes that you already have a directory service, such as OpenLDAP or Active Directory set up.

Follow these steps to set up file sharing over NFS with a directory service:

1. Configure the directory service for protocol support. The directory service is managed through the **Settings** > **Security** > **Directory Service** panel.
2. Create the data vip. Data vips are managed through the **Settings** > **Network** > **Subnets** panel.
3. Create the file system. Optionally set a provisioned size for the file system.
4. Define the NFS export rules.
5. Enable the NFS protocol.

- **SMB with Active Directory**. FlashBlade offers the following SMB authentication modes:
  - **AD RFC2307.** Recommended for customers where the same data needs to be accessed over SMB and NFS, and where access control is required. For more information, refer to the RFC 2307 specifications set by the Internet Engineering Task Force.
  - **AD Auto.** Recommended for customers with SMB-only clients or when SMB and NFS clients never access the same file systems.
  - **SMB Native**. Recommended for customers requiring Kerberos authentication. Note that Native mode must be enabled by Pure Technical Services.

  Before you enable the SMB protocol adapter, consider the following limitations:

  - Due to the nature of the SMB protocol, disruptions occur when a blade is added or removed, an upgrade is performed, or the system encounters network connectivity issues. Therefore, your applications must be able to tolerate I/O errors and disruptions.
  - File system permissions default to traditional UNIX-like permissions with an option to select the `native` ACL mode to include support for Windows ACLs. The SMB Access Control List (ACL) is restricted to the following three entries: the file **owner**, the primary **group** to which the file owner belongs, and **others**.
  - For file sharing over SMB, the FlashBlade array must be integrated with an Active Directory service. Before creating the file system, configure the directory service. For more information about the directory service, refer to *Active Directory Overview*.

  The default SMB authentication mode is AD RFC2307. To configure file sharing over SMB in other authentication modes, such as AD Auto mode or Native mode, contact Pure Storage Support.

Follow these steps to set up file sharing over SMB in AD RFC2307 mode:

1. Prepare Active Directory for multi-protocol support.

   Prepare Active Directory for multi-protocol support by setting the `gidNumber` and `uidNumber` attributes for each domain user and group that will be accessing the SMB shares. The `gidNumber` and `uidNumber` attributes can be set through the Microsoft Identity Management for UNIX service or PowerShell.

2. Configure the directory service for protocol support.

   The FlashBlade array must be integrated with an Active Directory service. The directory service is managed through the **Settings** > **Security** > **Directory Service** page. For more information about the directory service, refer to *Directory Services Overview*.

3. Create the data vip.

   Data vips are managed through the **Settings** > **Network** > **Subnets** panel.

4. Create the file system. Optionally set a provisioned size for the file system.

5. Enable the embedded SMB protocol adapter.

- **HTTP access**. Enabling the HTTP protocol turns on HTTP and HTTPS access to a file system.

  Before you enable the HTTP protocol, consider the following access control limitations:

  - All HTTP APIs by default are executed on behalf of a root user.
  - Certain HTTP APIs provide the ability to specify a user by specifying the UID as part of the request.
  - Access checking in HTTP is based solely on the client's crafted request. Any user can read, modify, and delete any files on a file system when HTTP is enabled.
  - The use of HTTP connections, as opposed to HTTPS connections, potentially gives unauthenticated users access to the file system. Anyone with network access to the data vip has access to the file system.

  Follow these steps to set up file system for HTTP access:

1. Create the data vip. Data vips are managed through the **Settings** > **Network** > **Subnets** panel.
2. Create the file system. Optionally set a provisioned size for the file system.
3. Enable the HTTP protocol.

File System Size

File system size represents the provisioned size allocated to a file system. The size is a quota of space that is set to help gauge the fullness of a file system.

When the amount of data written to the file system reaches a certain percentage of its quota, alerts are generated notifying administrators of the threshold reached. For example, Purity//FB generates a `WARNING` alert when the amount of data written to the file system reaches 90% and then 100% of its provisioned size. This behavior differs slightly if a hard limit is set on the file system. When the file system usage reaches 90% of its provisioned size, the system generates a `WARNING` alert. When the file system usage reaches 100% of its provisioned size, the system generates a `CRITICAL` alert. See **File System Usage Limits** for more information. To view alert details, select **Health** > **Alerts**.

The file system size can be blank or set to any value between `0` and `8191` petabytes. If the field is left blank or set to `0`, the provisioned size will default to an unlimited size.

Purity//FB does not enforce any restrictions nor does it take any further action when space consumption reaches or exceeds the provisioned size. To address the issue, decrease the percentage of storage space used by either deleting files or increasing the size of the file system. In contrast, if a hard limit is set for the file system, all writes are halted once the provisioned size is reached. See **File System Usage Limits** for details.

File system sizes can be changed at any time.

File System Usage Limits

⚠ **Important note!** File system hard limits cannot be enabled for file systems with unlimited sizes.

To help manage resource usage, a hard limit can be enabled on the provisioned size of a file system. Enabling a hard limit effectively limits writes of the file system to its provisioned size. The hard limit can be enabled when creating or editing a file system.

When the system detects the file system has exceeded its provisioned size, all future writes are halted until usage decreases below the provisioned size. This occurs within minutes of the provisioned size

being reached. Note that the provisioned size can be exceeded during this detection period when a hard limit is enabled. For example, a 5G write is in-process for a file system whose provisioned size is 10G and current usage is 9G. When the system halts the write, the file system ’s provisioned size will be slightly exceeded. Data writes only resume after data has been managed (deleted or truncated) to below the file system's provisioned size.

A hard limit cannot be enabled if the file system usage has already exceeded its provisioned size unless forced. You can force the hard limit by using the **Edit File System** dialog box from the **File Systems** screen

Additionally, if a hard limit is enabled, the file system ’s size cannot be reduced to a value less than its current space usage. You can force shrink the file system ’s size by using the **Edit File System** dialog box from the **File Systems** screen.

You can disable a hard limit from the **Edit File System** dialog box on the **File Systems** screen.

User and Group Usage Limits

Similar to file system hard limits, hard limits (quotas) can be set for users and groups on a per- file system basis to help manage file system resource usage.

When the system detects that a user or group has exceeded its quota, all future writes to the file system are halted until usage decreases below the set quota size via deletion or truncation of that user or group's data from the file system. Note that a quota can be exceeded during this detection period. For example, if a user is writing a large file that causes them to exceed the quota, their write will fail, but their total usage may have slightly exceed their set quota.

During file system creation, a default group quota and/or user quota can be set, which is applied to all users and/or groups in the file system. Additionally, once a file system has been created, quotas can be set per individual user ID or group ID (quotas can be set explicitly) for that file system. Note that explicit quotas take priority over default quotas. For example, if a file system was created with default user or group quota and then an explicit quota was set for a specific group or user of that file system, the explicit quota is used. If that explicit quota is later deleted, the default quota then takes effect.

User and group quotas are displayed on the **Details**, **User Quotas**, and **Group Quotas** panels from a file system 's detail screen. To access the detail screen, from the **File Systems** panel, click the file system whose details you wish to view.

NFS Export Rules

The NFS export rules define the access rights and privileges that an NFS client has to the file system. An NFS client's access rights and privileges include rules for users and groups. Any NFS export rule changes will be synchronously applied to all currently mounted clients. Note that NFS rules apply to both NFSv3 and NFSv4.1. The NFS export rules of a file system can be changed at any time.

Note that User and Group IDs that are zero (0) have root privilege and IDs that are non-zero do not have root privilege.

The default export rules will be applied to NFS clients if none are specified:

- `ro`
- `root_squash`
- `no_all_squash`
- `no_fileid_32bit`
- `anonuid=65534`
- `anongid=65534`
- `atime`
- `insecure`

Rules are applied in the form of `host(options)`, where `host` is an IP address or netmask and `options` are export rules enclosed in parenthesis.

The RULES argument represents the export rules that apply to the file system. Options can be applied to a single or multiple IP addresses, Netmasks, or LDAP group. See the syntax examples:

- Options applied to a single client: `'host(options)'`
- Options applied to multiple clients: `'-options host1 host2…'`
- Represent all clients with an asterisk: *

The `host` parameter must belong to one of the following categories:

- IPv4 IP address: `ddd.ddd.ddd.ddd`

  IPv4 Netmask: `ddd.ddd.ddd.ddd/dd`

- IPv6 IP address: `xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx`

  IPv6 Netmask: `xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx/ddd`

Valid export rules are listed below:

Export Rules	Rules Description
`ro`	Read-Only grants an NFS client and their users or groups the privilege to read the file system.
`rw`	Read-Write grants an NFS client and their users or groups the privilege to read and write to the file system.
`sec=sys`	No cryptographic protection. This is the default.
`sec=krb5`	Enable Kerberos security authentication.
`fileid_32bit`	Allows 32-bit inode support for clients.
`nofileid_32bit`	Disables 32-bit inode support for clients.
`root_squash`	Prevents client users and groups with root privilege from mapping their rootprivilege to a file system. All users with UID 0 will have their UID mapped to **`anonuid`**. All users with GID 0 will have their GID mapped to **`anongid`**.
`no_root_squash`	Allows root users and groups to access the file system with root privilege.
`all_squash`	Maps all UIDs (including root) to anonuid and all GIDs (including root) to anongid.
`no_all_squash`	Prevents the remapping of user and group IDs to **`anonuid 65534`** or **`anongid 65534`**. All users and groups will retain their IDs unless **`root_squash`** is also specified.
`anonuid`	Any user whose UID is affected by **`root_squash`** or **`all_squash`** will have their UID mapped to **`anonuid`**. The default **`anonuid`** is **`65534`**.

Export Rules	Rules Description
`anongid`	Any user whose GID is affected by `root_squash` or `all_squash` will have their GID mapped to `anongid`. The default `anongid` is `65534`.
`atime`	After a read operation has occurred, the inode access time is updated only if any of the following conditions is true: the previous access time is less than the inode modify time, the previous access time is less than the inode change time, or the previous access time is more than 24 hours ago.
`noatime`	Disables the update of inode access times after read operations.
`secure`	Prevents NFS access to client connections coming from non-reserved ports. Applies to NFSv3, NFSv4.1, and auxiliary protocols MOUNT and NLM.
`insecure`	Allows NFS access to client connections coming from non-reserved ports. Applies to NFSv3, NFSv4.1, and auxiliary protocols MOUNT and NLM.

Multiple rules may be specified by separating each rule with a space. For example,

```
10.60.50.83/32(rw,root_squash) 2620::/16(ro)
```

The following guidelines apply when creating NFS export rules:

- If rules are not defined before enabling the NFS protocol, then all clients will have `rw` access and `no_root_squash` privileges to the file system. This is equivalent to specifying export rule `*(rw,no_root_squash)`.
- Omitting the `(options)` portion of a rule is equivalent to specifying `(ro,root_squash)`. For example, an export rule that is defined as `*` will have `read-only, root_squash` access. This is equivalent to specifying export rule `*(ro,root_squash)`.
- If the rule is defined but one or more export options are not specified, then the undefined option(s) will default to `ro` access and `root_squash` privileges. For example, an export rule that is defined as `*(rw)` will have `root_squash` privileges. Likewise, an export rule that is defined as `*(no_root_squash)` will have `ro` access.

- A rule cannot include conflicting options. For example, `ro` and `rw` cannot be included in the same rule. Likewise, `root_squash` and `no_root_squash` cannot be included in the same rule.
- If a client IP address matches multiple rules, Purity//FB uses the first rule it encounters in priority based on rule category. IP address rules have the highest priority. Specifically, the priority of matching rules is as follows: IP address > Netmask > Wildcard.
- If an address matches multiple rules in the same category, then the first (leftmost) rule applies.
- By default, the FlashBlade file systems use 64-bit inode numbers. If your environment contains clients that can only support 32-bit inode numbers, add a third export option named `fileid_32bit` to the NFS export rule of the file system that requires 32-bit inode support. For example, `*(rw,no_root_squash,fileid_32bit)`

Here is an example of a file system list output taken from the Purity//FB CLI with various NFS export rules set for each file system:

```
purefs list --protocol-specific nfs
Name    Protocols Rules
File1   nfs       *
File2   nfs       *()
File3   nfs       -
File4   nfs       10.20.225.2(rw)
File5   nfs       2620::/16(no_root_squash)
File6   nfs       *(rw,no_root_squash)
File7   nfs       *(rw,root_squash,fileid_32bit)
File8   nfs       10.20.30.40(root_squash,anonuid=7777,anongid=8888)
```

In the list output above, the NFS export rules are described as follows:

Export Rules	Rules Description
`*`	All clients have default `ro` access and `root_squash` privileges to the file system.
`*()`	All clients have default `ro` access and `root_squash` privileges to the file system.
`-`	Export rules have been deleted, rendering the file system inaccessible.
`10.20.225.2(rw)`	Client `10.20.225.2` has `rw` access and `root_squash` (default) privileges.

Export Rules	Rules Description
`2620::/16(no_root_squash)`	Client `2620::/16` has `ro` (default) access and `no_root_squash` privileges.
`*(rw,no_root_squash)`	All clients have `rw` access and `no_root_squash` privileges. This is the default rule used when creating a file system.
`*(rw,root_squash,fileid_32bit)`	All clients have `rw` access and `root_squash` privileges. The file system also supports clients that require 32-bit inode support.
`10.20.30.40` `(root_squash,anonuid=7777,anongid=8888)`	Client 10.20.30.40 has `rw` access. Any access attempts with UID 0 will be mapped to UID 7777. Any access attempts with GID 0 will be mapped to GID 8888.

Netgroups

Purity//FB supports netgroups with LDAP and NIS.

Netgroups allows a set of hosts to be referenced as a single entity, or a *netgroup*.

Netgroups are used in export rules to grant NFS mount attributes to an entire set of hosts within a netgroup. This allows you to change the netgroup membership and affect every reference to that netgroup.

Netgroups are stored in LDAP as objects with the class nisNetgroup. Each netgroup has a name and may contain an unlimited number (or none) of member netgroups (sub-netgroups), as well as an unlimited number (or none) of tuples.

On a network using NIS, the ***`netgroup`*** input file on the master NIS server is used for generating the ***`netgroup`*** map. The ***`netgroup`*** map contains the basic information in the ***`netgroup`*** input file, which includes information in a format that speeds lookups of netgroup information among hosts.

FlashBlade queries directory service for a given netgroup, following any member netgroups and reading every tuple until the client attempting to mount the NFS file system is encountered within the netgroup, or until all referenced hosts are exhausted.

Referencing a netgroup with an export group must be expressed in the format `@<netgroup_name>(<export_rule>)`. The `@` indicates the specified `netgroup_name` is a netgroup. `(<export_rule>)` specifies the export rule to which the netgroup is referenced. Multiple export rules can be specified in a comma-separated list. Parentheses are required.

For example, `@netgroup1(rw,no_root_squash)` indicates that every host mentioned in the netgroup (`netgroup1`), may mount the given file system with read-write (`rw`) and root privilege (`no_root_squash`) attributes for that file system.

File System Snapshots

A file system snapshot is an immutable, point-in-time image of a file system. A snapshot can be created for any file system at any time. Snapshots are named after the file system it is copying with an assigned suffix to differentiate it from the source file system. A suffix is automatically assigned to a snapshot if one is not given at the time of creation.

Each file system has special directories named `.snapshot` that by default are enabled at file system creation to provide access to stored snapshots at the root and sub-directory level of that file system. The `.snapshot` directory provides a virtual repository for snapshots of a specified file system. By enabling a file system 's snapshot directory, the `.snapshot` directory will be visible in the root directory and accessible at the sub-directory level of that file system. The `.snapshot` directories allow access to their parent-level directories. All snapshots for a file system will be accessible in the `.snapshot` directory at the root level. The `.snapshot` directories at the sub-directory level allow access to snapshots taken after those sub-directories were created. For example, all snapshots are accessible through the root `/.snapshots` directory because it was created before any snapshots were taken (during the creation of the file system) . At the `/lolcats/.snapshot` sub-directory, snapshots taken before `/lolcats/` was created are not accessible.

The `.snapshot` directory can be optionally disabled. Once disabled, historical snapshots cannot be viewed and will not be accessible from the mount points until the directory feature is re-enabled. Disabling the directory will not destroy any snapshots, they must be manually destroyed.

The `.snapshot` directories cannot be renamed, deleted, or moved into other directories. The directory name is reserved and you cannot create a regular directory with the `.snapshot` name, regardless of the enabled/disabled status.

ACLs

An Access Control List (ACL) is a list of security permissions associated with a directory or file. Specific rules can be added to the ACL to define who can access the file and what actions they can perform.

When an ACL is applied to a directory or file, then that directory or file will reference its list of rules to determine whether to grant or deny access, including which actions are allowable, such as; read, write, and execute.

ACEs

An ACL consists of up to 1,820 Access Control Entries (ACEs), plus three OGE (owner, group, everyone) entries. Note that certain clients may have lower limits from what the server supports.

Each ACE contains detailed permissions information. ACEs consist of four fields separated by colons — type, flag, principal, and permissions.

- **type** - if the defined permissions are allowed (A) or denied (D).
- **flag** - defines both child object inheritance and if the ACE is defining group permissions.
- **principal** - defines to whom the permissions apply.
- **permissions** - defines the permissions that the specified principle will be allowed or denied.

For example, the ACE `A:d:user@purestorage.com:R` means that the user `user@purestorage.com` is allowed (A) read permissions (R) and that new sub-directories will inherit this ACE (d).

Access Control Styles

For implementations where more than one file system export protocol is enabled, Purity//FB 3.1.1 and later allows you to set the file system's access control style to dictate how the protocols will interact.

The following access control styles are available:

- **Shared** - NFS and SMB clients are both able to set permissions on, and access files and directories over any protocol.
- **NFS** - Only NFS clients can set permissions on files and directories; however, files and directories can be accessed over any protocol.
- **SMB** - Only SMB clients can set permissions on files and directories; however, files and directories can be accessed over any protocol.

- **Independent** - NFS and SMB clients are both able to set permissions on files and directories and can access files and directories created over any protocol. Permissions set by SMB clients will not affect NFS clients and vice versa. NFS clients will be restricted to only using mode bits to set permissions.
- **Mode Bits** - NFS and SMB clients are both able to set permissions on files and directories, but permissions are enforced in mode bits-only format. When SMB clients set an ACL it will be converted to mode bits.

Note the following behaviors and restrictions:

- If you set the access control style to **SMB** and then disable the SMB protocol, the access control style is automatically reset to **Shared**.
- If you set the access control style to **NFS** and then disable both NFSv3 and NFSv4.1, the access control style is automatically reset to **Shared**.
- If neither the NFSv3 or NFSv4.1 protocols are enabled, the access control style cannot be set to **NFS**.
- If the SMB protocol is not enabled, the access control style cannot be set to **SMB** or **Independent**.

File system attributes that were set prior to Purity//FB 3.1.1 will be transitioned to the following access control styles as described in the following table with Purity//FB 3.1.1 and later:

Table 5.3 Access Control Style Transitions

Pre Purity//FB 3.1.1 File System Attribute	Purity//FB 3.1.1 and Later Access Control Style
n/a	SMB
n/a	NFS
n/a	Shared
SMB native, NFSv3, NFSv4.1	Independent
SMB shared	Mode Bits

ACL Safeguarding

If using the **Shared** or **NFS** access control styles, consider enabling ACL safeguarding.

When using the SMB access control style, ACL safeguarding is automatically enabled.

ACL safeguarding controls how a mode bit change will impact the ACL on the file or directory. When disabled, modification of mode bits will result in the removal of any existing ACL. When enabled, modification of mode bits will result in the modification of the existing ACL to merge the permissions from the mode bits with the permissions in the ACL.

Note: ACL safeguarding is not available for **Independent** or **Mode Bits** access control styles.

Setting the access control style and enabling ACL safeguarding are performed when creating a file system and can be modified at a later date.

NFS and File Locking

The Network Lock Manager (NLM) protocol works with the NFS protocol to ensure file locks are visible across all NFS clients for I/O coordination and to help clients coordinate access to files. The NLM protocol allows all NFS clients mounting the same NFS shared file system to see file locks set by other clients.

NLM locks are considered advisory locks in that an NFS client application must check for the existence of a lock in order to coordinate access; the NFS service itself does not automatically prevent a client from accessing a file if it has the security permission to do so, and the service does not check for the existence of or try to obtain a lock on a file ahead of time.

The NLM service is enabled by default with the NFS protocol service and cannot be disabled.

Fast Remove

When a directory and its contents are no longer required, they can be removed to reclaim space.

Removing the contents of a directory recursively by running the `rm -r` command causes the client to delete files one at a time. This can be a time consuming and expensive operation.

The fast remove feature allows you to quickly remove large directories by offloading this work onto the server. When the fast remove feature is enabled, a special pseudo-directory named `.fast-remove` is created in the root directory of the NFS mount. To remove a directory and its contents, run the `mv` command to move the directory into the `.fast-remove` directory.

In the following example, from the root directory of the NFS mount, a directory called `big_dir` is being moved into the `.fast-remove` directory.

```
mv big_dir/.fast-remove/
```

Once a directory has been moved into the `.fast-remove` directory, it is immediately destroyed, and through background operations, the space it occupied will be freed.

The fast remove feature can be enabled or disabled at any time. Fast remove is disabled by default.

After you enable the fast remove feature, view the contents of the root directory of the NFS mount to verify that the `.fast-remove` directory has been created.

For example,

```
//Run on the NFS mount to view the content of the root directory.
ls -al
drwxrwxrwx   1  root  root      0 Oct 30 10:46 .
drwxrwxrwx  25  root  root  12288 Jun 30 16:44 ..
drwxr-xr-x   1  root  root      0 Oct 30 11:27 .fast-remove
…
```

The `.fast-remove` directory cannot be renamed, deleted, or moved into other directories. The `.fast-remove` directory name is a reserved name, so you cannot create a regular directory named `.fast-remove`, regardless of the fast remove enabled/disabled status.

You cannot move individual files to the `.fast-remove` directory. To remove a file, either use the `rm` command or move the directory enclosing the file to the `.fast-remove` directory.

The `.fast-remove` directory can only be removed by disabling the fast remove feature.

The fast remove feature is powerful and comes with the following cautionary notes:

- Once a directory has been moved into the `.fast-remove` directory, it is no longer recoverable.
- With fast remove, users can remove any files that are contained in a directory that they can rename, even if they do not have read, write, or execute permissions on the child directories. This breaks from the standard UNIX permissions model. To restrict access to the `.fast-remove` directory, set the directory permissions.

By default, the `.fast-remove` directory permissions are set to `drwxr-xr-x`. These permissions can be changed to grant or restrict access to the `.fast-remove` directory. Disabling and then re-enabling the fast remove feature will reset the settings to the default permissions.

File Replication Failover, Reprotect, and Failback

In file system replication setups you can stop writes to the local file system and redirect writes to the target file system (failover). Failover can be used if there is an issue with the local file system. During failover, replication stops until you reprotect.

Failover requires promotion of the target file system and redirection of all clients to the target array to return to operation.

Note that when demoting the local file system, any writes performed since the last replication will be discarded. If a local snapshot was taken since last replication, demoting the file system requires that snapshot be destroyed and eradicated. You must remove any data since the last snapshot of the file system was taken. The file system must either have no snapshots, or the most recent snapshot must be the last replicated snapshot. Additionally, it is suggested that any policies attached to the local file system and replica link be removed in order to expedite failover.

Once the local file system comes back up, re-enable the scheduled replication policy that was disabled before demoting the file system. Replication resumes as scheduled between the promoted remote file system and the demoted local file system. Data is written to the promoted remote file system, which is then replicated to the demoted local file system.

To resume the original replica link direction (failback), manually stop writes on the remote file system and send the remaining data to the local file system. Once data is sent to the local file system, promote the local file system and demote the remote file system.

Creating and Exporting a File System

Creating and exporting a file system involves creating the file system and configuring protocol support for the file system. A file system can support multiple protocols.

Before you create and export a file system, verify that a data vip has been created. Clients connect to the file system via the data vip. Data vips are managed through the **Settings** > **Network** > **Subnets** panel.

If you are integrating the FlashBlade array with a directory service, also verify that the directory service has been properly configured and enabled. The directory service is managed through the **Settings** > **Security** > **Directory Service** panel.

If you are enabling the SMB protocol in AD RFC2307 (default) mode, prepare Active Directory for multi-protocol support by setting the `gidNumber` and `uidNumber` attributes for each domain user and group that will be accessing the SMB shares. The `gidNumber` and `uidNumber` attributes can be set through the Microsoft Identity Management for UNIX service or PowerShell.

To create and export a file system:

1 Create the file system.

a From the **Storage** > **File Systems** page, click the add (+) button in the heading of the **File Systems** list. The **Create File System** pop-up window appears.

b In the **Name** field, type the name of the directory to be exported.

c In the **Provisioned Size** field, specify the provisioned size allocated to the file system. The size is a quota of space that helps gauge the fullness of the file system. If left blank, the provisioned size will default to an unlimited size. To enable a hard limit for the file system to prevent exceeding the file system's provisioned space, set the **Hard Limit** toggle button to enable (blue).

For more information about the provisioned size, refer to the **File System Size** section.

⚠ **Important note!** File system hard limits cannot be enabled for file systems with unlimited sizes.

d (Optional) In the **Default User Quota** field, specify the user quota size.

e (Optional) In the **Default Group Quota** field, specify the group quota size.

f To enable the ability to quickly remove large directories using the fast remove feature, set the **Fast Remove** toggle button to enable (blue). For more information about the fast remove feature, refer to the **Fast Remove** section.

g To enable the ability to access stored snapshots in a snapshot directory, set the **Snapshots** toggle button to enable (blue).

2 Perform the following protocol-specific configurations:

- **NFS**. Define the NFS export rules so the file system is accessible to the appropriate clients.

  a From the **Create File System** pop-up window, click **NFS** in the **Protocols** section.

  b Click the **NFSv3** or **NFSv4.1** toggle button to enable (blue).

  c In the **Export Rules** field, configure the NFS export rules to define the access rights and privileges a client has to the file system.

  The format is `host(options)`.

  For IPv4 addresses, `host` represents `ddd.ddd.ddd.ddd` for IP address, `ddd.ddd.ddd.ddd/dd` for netmask, or `*(options)` for all clients.

  For IPv6 addresses, `host` represents `xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx` for IP address, `xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx/xxx` for netmask, or `*(options)` for all clients.

  The `options` within parenthesis represents a comma-separated list of NFS export options. Valid export options are `rw`, `ro`, `root_squash`, `no_root_squash`, and `fileid_32bit`. For example, `10.20.225.2(ro,root_squash)`.

For more information about export rules, refer to *NFS Export Rules*.

- **SMB**. By default, file sharing over SMB is configured in AD RFC2307 mode for mixed Windows/ UNIX environments. The mode is displayed under the SMB toggle button. To configure file sharing over SMB in AD Auto mode or Native mode, contact Pure Technical Services.

  a From the **Create File System** pop-up window, click **SMB** in the **Protocols** section.

  b Click the **SMB** toggle button to enable (blue) the SMB protocol adapter.

- **HTTP**. Enable HTTP and HTTPS access to a file system.

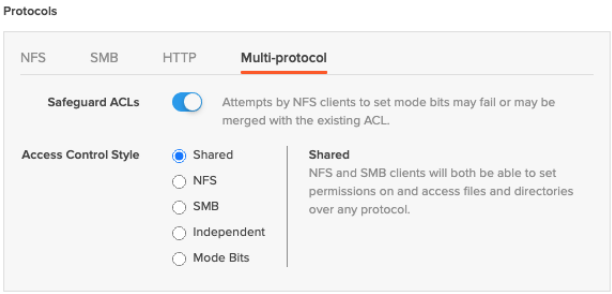
  a From the **Create File System** pop-up window, click **HTTP** in the **Protocols** section.

  b Click the **HTTP** toggle button to enable (blue) the HTTP protocol.

3 If you selected multiple export protocols, set the access control style. The access control style governs the interactions between protocols. From the **Create File System** pop-up window, click **Multi-protocol** in the **Protocols** section.

Note: With Purity//FB 3.1.1 and later, by default, all new file systems created are created with the **Shared** access control style with ACL safeguarding enabled.

Figure 5.7 Selecting an Access Control Style



Available access control styles are:

- **Shared** - NFS and SMB clients are both able to set permissions on, and access files and directories over any protocol.
- **NFS** - Only NFS clients can set permissions on files and directories; however, files and directories can be accessed over any protocol.
- **SMB** - Only SMB clients can set permissions on files and directories; however, files and directories can be accessed over any protocol.
- **Independent** - NFS and SMB clients are both able to set permissions on files and directories and can access files and directories created over any protocol. Permissions set by SMB clients will not affect NFS clients and vice versa. NFS clients will be restricted to only using mode bits to set permissions.
- **Mode Bits** - NFS and SMB clients are both able to set permissions on files and directories, but permissions are enforced in mode bits-only format. When SMB clients set an ACL it will be converted to mode bits.

Note the following behaviors and restrictions:

- If you set the access control style to **SMB** and then disable the SMB protocol, the access control style is automatically reset to **Shared**.
- If you set the access control style to **NFS** and then disable both NFSv3 and NFSv4.1, the access control style is automatically reset to **Shared**.
- If neither the NFSv3 or NFSv4.1 protocols are enabled, the access control style cannot be set to **NFS**.
- If the SMB protocol is not enabled, the access control style cannot be set to **SMB** or **Independent**.

(Optional) If **Shared** or **NFS** are selected, you can click the Safeguard ACLs toggle to enable (blue) ACLs safeguarding.

ACL safeguarding controls how a mode bit change will impact the ACL on the file or directory. When disabled, modification of mode bits will result in the removal of any existing ACL. When enabled, modification of mode bits will result in the modification of the existing ACL to merge the permissions from the mode bits with the permissions in the ACL. Note the following:

- If the access control style was set to **SMB**, ACL safeguarding is automatically enabled. Disabling ACL safeguarding is not allowed.
- ACL safeguarding is not available for **Independent** or **Mode Bits** access control styles.

4 Click **Create**.

If you wish to edit a file system at a later date, perform the following:

1. Locate the file system you wish to edit in the **File Systems** list.
2. Click the **More Options** button in the same row as the file system and select **Edit**. The **Edit File System** pop-up window appears. All configuration parameters set during creation can be edited except the file system's name.
3. Click **Save** when you have completed editing.

Changing the NFS Export Rules of a File System

NFS export rule changes will be synchronously applied to all currently mounted clients.

To change the NFS export rules of a file system:

1. From the **Storage** > **File Systems** page, click the **More Options** button in the row of the file system you want to edit and select **Edit**.. The **Edit File System** pop-up window appears.
2. Click **NFS** in the **Protocols** section.
3. In the **Export Rules** field, configure the NFS export rules to define the access rights and privileges a client has to the file system.

   The format is `host(options)`.

   For IPv4 addresses, `host` represents `ddd.ddd.ddd.ddd` for IP address, `ddd.ddd.ddd.ddd/dd` for netmask, or `*(options)` for all clients.

   For IPv6 addresses, `host` represents `xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx` for IP address, `xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx/xxx` for netmask, or `*(options)` for all clients.

   The `options` within parenthesis represents a comma-separated list of NFS export options. Valid export options are `rw`, `ro`, `root_squash`, `no_root_squash`, `all_squash`, `no_all_squash`, `anonuid`, `anongid`, `fileid_32bit`, and `no_fileid_32bit`. For example, `10.20.225.2(ro,root_squash)`.
4. Click **Save**.

Changing the Provisioned Size of a File System

To change the provisioned size of a file system:

⚠ **Important note!** If you are reducing a file system's provisioned size, but had previously enabled the hard limit for the file system and have already exceeded the new size, a warning will appear indicating subsequent data writes will fail. You must click **Update** to proceed with the operation.

1. From the **Storage** > **File Systems** page, click the **More Options** button in the row of the file system you want to edit and select **Edit**. The **Edit File System** pop-up window appears.
2. In the **Provisioned Size** field, set the size to any value between `0` and `8191` petabytes. If the field is left blank or set to `0`, the provisioned size will default to an unlimited size and a hard limit cannot be set.
3. Click **Save**.

Modifying the Default User and Group Quotas

1. From the **Storage** > **File Systems** page, click the **More Options** button in the row of the file system you want to edit. and click **Edit** The **Edit File System** pop-up window appears.
2. In the **Default User Quota** field, enter a new user quota size.
3. In the **Default Group Quota** field, enter a new group quota size.
4. Click **Save**.

Creating an Explicit User Quota

⚠ **Important note!** If a default user quota was created during file system creation, the explicit user quota will take priority over the default quota and will be used for that file system.

1. From the **Storage** > **File Systems** page, click the file system for which you wish to set an explicit user quota. The file system's details page appears.
2. In the **User Quotas** panel, click the add button (+) . The **Add User Quota** pop-up window appears.
3. Enter the user ID or user name, and quota size.
4. Click **Add**.

Modifying an Explicit User Quota

1. From the **Storage** > **File Systems** page, click the file system whose explicit user quota(s) you wish to modify. The file system's details page appears.
2. From the **User Quotas** panel, click the **Edit** button on the same row as the explicit user quota you wish to modify. The **Edit User Quota** pop-up window appears.

If you wish to modify multiple explicit user quotas, click **More Options** > **Edit Quotas**. The **Edit User Quotas** pop-up window appears. From the **Existing Quotas** list, select the user quotas you wish to modify. You can optionally enter a partial name in the search box to filter the list. You can also optionally select all user quotas by clicking the checkbox next to the search box. All selected user quotas appear in the **Selected Quotas** list.

3 Enter a new quota size.

4 Click **Save**.

Deleting an Explicit User Quota

⚠ **Important note!** If a default user quota was created during file system creation, the default user quota will take effect once the explicit user quota is deleted.

1 From the **Storage** > **File Systems** page, click the file system whose explicit user quota(s) you wish to delete. The file system's details page appears.

2 From the **User Quotas** panel, click the trash can icon on the same row as the explicit user quota you wish to delete. The **Delete User Quota** pop-up window appears.

If you wish to delete multiple explicit user quotas, click **More Options** > **Delete Quotas**. The **Delete User Quotas** pop-up window appears. From the **Existing Quotas** list, select the user quotas you wish to delete. You can optionally enter a partial name in the search box to filter the list. You can also optionally select all user quotas by clicking the checkbox next to the search box. All selected user quotas appear in the **Selected Quotas** list.

3 Click **Delete**.

Creating an Explicit Group Quota

⚠ **Important note!** If a default group quota was created during file system creation, the explicit group quota will take priority over the default quota and will be used for that file system.

1 From the **Storage** > **File Systems** page, click the file system for which you wish to set an explicit group quota. The file system's details page appears.

2 In the **Group Quotas** panel, click the add button (+) . The **Add Group Quota** pop-up window appears.

3 Enter the group ID or group name, and quota size.

4 Click **Add**.

Modifying an Explicit Group Quota

1. From the **Storage** > **File Systems** page, click the file system whose explicit group quota(s) you wish to modify. The file system's details page appears.
2. From the **Group Quotas** panel, click the **Edit** button on the same row as the explicit group quota you wish to modify. The **Edit Group Quota** pop-up window appears.

   If you wish to modify multiple explicit group quotas, click **More Options** > **Edit Quotas**. The **Edit Group Quotas** pop-up window appears. From the **Existing Quotas** list, select the group quotas you wish to modify. You can optionally enter a partial name in the search box to filter the list. You can also optionally select all group quotas by clicking the checkbox next to the search box. All selected group quotas appear in the **Selected Quotas** list.
3. Enter a new quota size.
4. Click **Save**.

Deleting an Explicit Group Quota

⚠ **Important note!** If a default group quota was created during file system creation, the default group quota will take effect once the explicit group quota is deleted.

1. From the **Storage** > **File Systems** page, click the file system whose explicit group quota(s) you wish to delete. The file system's details page appears.
2. From the **Group Quotas** panel, click the trash can icon on the same row as the explicit group quota you wish to delete. The **Delete Group Quota** pop-up window appears.

   If you wish to delete multiple explicit group quotas, click **More Options** > **Delete Quotas**. The **Delete Group Quotas** pop-up window appears. From the **Existing Quotas** list, select the group quotas you wish to delete. You can optionally enter a partial name in the search box to filter the list. You can also optionally select all group quotas by clicking the checkbox next to the search box. All selected group quotas appear in the **Selected Quotas** list.
3. Click **Delete**.

Enabling and Disabling the Hard Limit of a File System

⚠ **Important note!** File system hard limits cannot be enabled for file systems with unlimited sizes.

1. From the **Storage** > **File Systems** page, click the **More Options** button in the row of the file system you want to edit and select **Edit**. The **Edit File System** dialog box appears.
2. Set the **Hard Limit** toggle button to enable (blue) or disable (gray) the feature.

Creating a File System Snapshot

Snapshots are immutable, point-in-time images of the contents of one or more file systems. Snapshot tasks include creating and deleting file system snapshots. Snapshots can be created or destroyed using the Purity//FB GUI (**Storage** > **File Systems**) or the CLI using the **`purefs`** command. They can also be created using policies.

1 To create a snapshot of a file system:

1 Select **Storage** > **File Systems**.

2 Click the file system. The snapshot list appears for that file system.

3 Click add (+) on the right. The **Create Snapshot** pop-up window appears.

4 Enter a suffix name for the snapshot. A suffix will be automatically assigned if this field is left empty.

5 Click **Create**.

Enabling and Disabling the Snapshot Directory

A snapshot directory is a special directory that can be enabled or disabled to store snapshots. By default, snapshot directories are enabled at file system creation.

1 To enable or disable the snapshot directory:

1 Select **Storage** > **File Systems**.

2 Click the **More Options** button in the row of the file system you want to edit and select **Edit**. The **Edit File System** pop-up window appears.

3 Click the **Snapshot** toggle button to switch between enabled (blue) and disabled (gray) status.

4 Click **Save**.

5 If you are enabling the snapshot directory, in the root directory of the NFS mount, confirm that a pseudo-directory named `.snapshot` has been created.

The `.snapshot` directory name is reserved. You cannot create a directory with the `.snapshot` name, regardless of the enabled/disabled status. The directory cannot be renamed, deleted, or moved into other directories. It can only be removed by disabling the directory.

Removing a Policy from a Snapshot

Policies can be removed from snapshots at any time.

Note: If a policy is removed from a snapshot, that snapshot is no longer managed by that policy and must be destroyed manually.

You can remove a policy from a snapshot from either the **Storage** or **Protection** page.

The **Storage** page allows you to view snapshots per specific file system. The **Protection** page allows you to view all file system snapshots on the array.

To remove a policy from a snapshot, perform the following:

1. If you are on the **Storage** page, select **Storage** > **File Systems** and then click the file system from the table in the **File Systems** panel to access that file system's snapshots.
2. If you are on the **Protection** page, select **Protection** > **Snapshots**.
3. From the table in the **File System Snapshots** panel, locate the file system snapshot from which you wish to remove a policy.
4. Click the **More Options** button located at the end of that snapshot's row and select **Remove Policy**. The **Remove Policy from Snapshot** pop-up window appears.
5. Click **Remove**.

Destroying File System Snapshots

You can destroy a snapshot from either the **Storage** or **Protection** page.

The **Storage** page allows you to view snapshots per specific file system. The **Protection** page allows you to view all file system snapshots on the array.

To destroy one or more file system snapshots, perform the following:

1. If you are on the **Storage** page, select **Storage** > **File Systems** and then click the file system from the table in the **File Systems** panel to access that file system's snapshots. If you are on the **Protection** page, select **Protection** > **Snapshots**.
2. From the table in the **File System Snapshots** panel, locate the file system snapshot you either wish to destroy, or is the point from which earlier snapshots are to be destroyed.
3. If you wish to destroy the snapshot, perform the following:
   a. Click the **More Options** button located at the end of that snapshot's row and select **Destroy**. The **Destroy Snapshot** pop-up window appears.
   b. Click **Destroy**
4. If you wish to destroy multiple snapshots, perform the following:

a Click **More Options** > **Destroy** in the **File System Snapshots** panel title bar. The **Destroy File System Snapshots** pop-up window appears.

b From the **File System Snapshots** list, select the snapshots you wish to destroy. You can optionally enter a partial name in the search box to filter the snapshot list. You can also optionally select all snapshots by clicking the check box next to the search box. All selected snapshots appear in the **Selected File System Snapshots** list.

c Click **Destroy**.

5 If you wish to use the snapshot as the point from which earlier snapshots are destroyed, perform the following:

a Click the **More Options** button located at the end of that snapshot's row and select **Destroy older**. The **Destroy Snapshots older than...** pop-up window appears.

b Select the snapshots you wish to destroy from the **Older File System Snapshots** pane. You can optionally enter a partial name in the search box to filter the snapshot list. You can also optionally select all snapshots by clicking the check box next to the search box. All selected snapshots appear in the **Selected File System Snapshots** list.

c Click **Destroy**.

The destroyed file system snapshot appears under the **Destroyed Snapshots** panel on the **Snapshots** tab. Destroyed snapshots can be recovered within a 24-hour period. Once the 24-hour period has passed, the snapshot is permanently destroyed (eradicated).

Restoring a File System to a Snapshot

Purity//FB allows you to restore a file system to a given point in time from a snapshot (via file system rollback). Restoring a file system to a snapshot overwrites the contents of that file system with data from the snapshot.

File system rollback is available for snapshots created on a FlashBlade array running Purity//FB 3.0.0 or later.

CAUTION: If Pure File SafeMode is enabled, contact Pure Technical Services to perform this action.

CAUTION: When restoring to a snapshot, the file system's configured quota, as well as any configured user/group quotas, do not change to reflect the limit when the snapshot was taken. This can cause the live space usage to increase, resulting in subsequent write failures due to exceeding the quota. You may need to re-adjust your quota settings accordingly.

Note: It is highly recommended that there be no I/O on the file system when performing a restore.

You can restore a file system from a snapshot from either the **Storage** or **Protection** page.

Note: If there are snapshots that are newer than the snapshot you wish to use as the restore point, the newer snapshots must be first destroyed and eradicated before you can proceed with the file system restoration. See *Destroying and Eradicating Newer Snapshots*.

The **Storage** page allows you to view snapshots per specific file system. The **Protection** page allows you to view all file system snapshots on the array.

To restore a file system from a snapshot, perform the following:

1. If you are on the **Storage** page, select **Storage** > **File Systems** and then click the file system from the table in the **File Systems** panel to access that file system's snapshots. If you are on the **Protection** page, select **Protection** > **Snapshots**.
2. From the table in the **File System Snapshots** panel, locate the file system snapshot to be used to restore the file system.
3. Click the **More Options** button located at the end of row of the snapshot to be used for restore and select **Restore**. The **Restore File System from Snapshot** pop-up window appears.
4. Click **Restore**.

Destroying and Eradicating Newer Snapshots

Note: Destroyed snapshots can be recovered within a 24-hour period. Once the 24-hour period has passed, the snapshot is permanently destroyed (eradicated).

When restoring a file system from a snapshot, if there are snapshots that are newer than the snapshot you wish to use as the restore point, the newer snapshots must be first destroyed and eradicated before you can proceed with the file system restoration.

You can destroy and eradicate snapshots from either the **Storage** or **Protection** page.

The **Storage** page allows you to view snapshots per specific file system. The **Protection** page allows you to view all file system snapshots on the array.

1. If you are on the **Storage** page, select **Storage** > **File Systems** and then click the file system from the table in the **File Systems** panel to access that file system's snapshots. If you are on the **Protection** page, select **Protection** > **Snapshots**.
2. From the table in the **File System Snapshots** panel, locate the file system snapshot to be used to restore the file system.
3. Click the **More Options** button located at the end of that snapshot's row and select **Destroy newer**. The **Destroy Snapshots newer than...** pop-up window appears.

4 In the **Newer File System Snapshots** pane, select all snapshots by clicking the check box next to the search box. All selected snapshots appear in the **Selected File System Snapshots** list.

5 Click **Destroy**. The snapshot(s) appear in the **Destroyed Snapshots** panel (directly below the **File System Snapshots** panel).

6 Click **More Options** > **Eradicate** in of the **Destroyed Snapshots** panel. The **Eradicate File System Snapshots** pop-up window appears.

7 From the **Destroyed File System Snapshots** list, select the snapshots you wish to eradicate. You can optionally enter a partial name in the search box to filter the snapshot list. You can also optionally select all snapshots by clicking the checkbox next to the search box. All selected snapshots appear in the **Selected File System Snapshots** list.

8 Click **Eradicate**.

Recovering File System Snapshots

When a file system snapshot is destroyed, you have 24 hours to recover the data. This is known as the eradication pending state. When the eradication pending state expires, the snapshot will be eradicated and you will no longer be able to retrieve the snapshot data.

You can recover a snapshot from either the **Storage** or **Protection** page.

The **Storage** page allows you to view snapshots per specific file system. The **Protection** page allows you to view all file system snapshots on the array.

To recover a previously destroyed file system snapshot, perform the following:

1 If you are on the **Storage** page, select **Storage** > **File Systems** and then click the file system from the table in the **File Systems** panel to access that file system's snapshots. If you are on the **Protection** page, select **Protection** > **Snapshots**.

2 If you wish to recover a single snapshot:

   a From the **Destroyed Snapshots** panel, locate the file system snapshot you wish to recover.

   b Click **More Options** > **Recover** at the end of the row of the file system snapshot you wish to recover.

   c Click **Recover**.

3 If you wish to recover multiple file system snapshots:

a Click **More Options** > **Recover** in the **Destroyed Snapshots** panel title bar. The **Recover File System Snapshots** pop-up window appears.

b From the **Destroyed File System Snapshots** list, select the snapshots you wish to recover. You can optionally enter a partial name in the search box to filter the snapshot list. You can also optionally select all snapshots by clicking the check box next to the search box. All selected snapshots appear in the **Selected File System Snapshots** list.

c Click **Recover**.

Eradicating File System Snapshots

During the eradication pending period, you can manually eradicate the destroyed file system to reclaim physical storage space occupied by the destroyed snapshot. Once reclamation starts, the destroyed snapshots can no longer be recovered.

You can eradicate a snapshot from either the **Storage** or **Protection** page.

The **Storage** page allows you to view snapshots per specific file system. The **Protection** page allows you to view all file system snapshots on the array.

CAUTION: If Pure File SafeMode is enabled, contact Pure Technical Services to perform this action.

To eradicate a destroyed snapshot:

1 If you are on the **Storage** page, select **Storage** > **File Systems** and then click the file system from the table in the **File Systems** panel to access that file system's destroyed snapshots. If you are on the **Protection** page, select **Protection** > **Snapshots**.

2 If you wish to eradicate a single snapshot:

a In the **Destroyed Snapshots** panel under **File System Snapshots**, click **More Options** > **Recover** at the end of the row of the snapshot you want to eradicate. The **Eradicate Snapshot** pop-up window appears.

b Click **Eradicate**. The array will begin reclaiming the eradicated space of the snapshot.

3 If you wish to eradicate multiple snapshots:

a Click **More Options** > **Eradicate** in of the **Destroyed Snapshots** panel. The **Eradicate File System Snapshots** pop-up window appears.

b From the **Destroyed File System Snapshots** list, select the snapshots you wish to eradicate. You can optionally enter a partial name in the search box to filter the snapshot list. You can also

optionally select all snapshots by clicking the checkbox next to the search box. All selected snapshots appear in the **Selected File System Snapshots** list.

c Click **Eradicate**. The array will begin reclaiming the eradicated space of the snapshots.

Enabling and Disabling Fast Remove

⚠ **Important note!** The fast remove feature is available for removing directories only, not individual files.

Enable the fast remove feature to quickly remove large directories.

To enable or disable fast remove:

1. From the **Storage** > **File Systems** page, click the **More Options** button in the row of the file system you want to edit and select **Edit**. The **Edit File System** pop-up window appears.
2. Click the **Fast Remove** toggle button to switch between enabled (blue) and disabled (gray) status.
3. Click **Save**.
4. In the root directory of the NFS mount, confirm that a pseudo-directory named `.fast-remove` has been created.

   By default, the `.fast-remove` directory permissions are set to `drwxr-xr-x`. Optionally use `chown` or `chmod` to set the desired access permissions.

   To remove a directory, run the `mv` command to move the directory into the `.fast-remove` directory.

   ⚠ **Important note!** Once a directory has been moved into the `.fast-remove` directory, it is immediately destroyed and unrecoverable.

Promoting and Demoting File Systems

Promoting and demoting file systems is required when performing file system failover and failback. In a file replication setup, data is written to the promoted local file system and then that data is replicated to the demoted remote file system on a remote array. During failover, the local file system is demoted and the remote file system is promoted. During failback, the original promoted/demoted filesystem designations are restored.

⚠ **CAUTION:** If Pure File SafeMode is enabled, contact Pure Technical Services to demote a file system.

For complete failover and failback instructions, see *Performing File Replication Failover and Reprotect* and *Performing File Replication Failback*.

To promote and demote file systems, perform the following:

1 Fom the **Storage** > **File Systems** page, locate the file system that you wish to promote or demote from the **File Systems** panel.

2 Click **More Options** > **Promote** or **More Options** >**Demote** at the end of the row in which the remote file system appears.

3 Click **Promote** or **Demote** when prompted for confirmation.

Destroying a File System

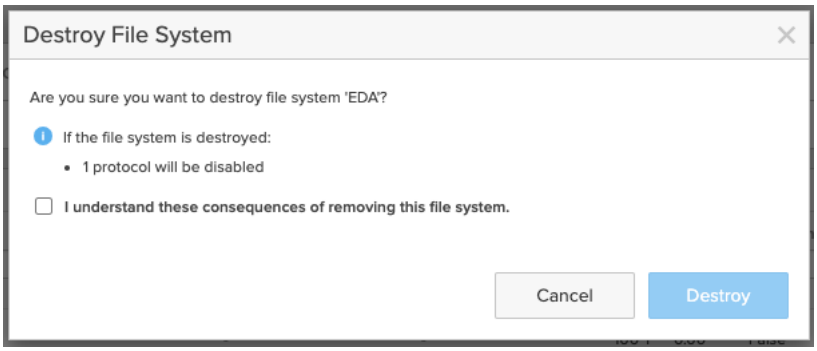
Destroying a file system will also destroy all related snapshots. All protocols of a file system must be disabled before it can be destroyed; disabling protocols terminates all client connections to the file system. Any enabled protocols will be disabled by Purity//FB when destroying a file system.

To destroy a file system, perform the following:

1 Select **Storage** > **File Systems**.

2 To destroy a single file system:

a Click the **More Options** button in the row of the file system you want to destroy and select **Destroy**. The **Destroy File System** pop-up window appears. A message displaying the number of protocols that will be disabled and number of snapshots that will be destroyed is displayed.



b Select the confirmation checkbox.

c Click **Destroy**.

3 If you wish to destroy multiple file systems:

a Click the **More Options** button in the header of the **File Systems** panel and select **Destroy**. The **Destroy File Systems** pop-up window appears.

b From the **Destroyable File Systems** list, select the file systems you wish to destroy. You can optionally enter a partial name in the search box to filter the list. You can also optionally select all file systems by clicking the checkbox next to the search box. All selected file systems appear in the **Selected File Systems** list. If protocols are enabled on a file system, that file system will not appear in the **Destroyable File Systems** list.

c Click **Destroy**.

The destroyed file system appears in the **Destroyed File Systems** panel and begins its 24-hour eradication pending period.

During the eradication pending period, you can recover the file system to bring it back from its previous state, or manually eradicate the destroyed file system to reclaim the physical storage space occupied by the file system.

When the 24-hour eradication pending period has lapsed, Purity//FB starts reclaiming the physical storage occupied by the file system. Once reclamation starts, either because you have manually eradicated the destroyed file system, or because the eradication pending period has lapsed, the destroyed file system can no longer be recovered.

Recovering a File System

Destroyed file systems have 24 hours to be recovered. When a file system is recovered, all related snapshots will be also be recovered unless the snapshot was explicitly destroyed. When the 24 hour eradication pending state expires, the file system and its implicitly destroyed snapshots will be eradicated and you will no longer be able to retrieve the data.

To recover a destroyed file system:

1 Select **Storage** > **File Systems**.

2 In the **Destroyed File System** panel, click the clock icon in the row of the file system you want to recover. The **Restore File System** pop-up window appears.

If you wish to recover multiple file systems, click **More Options** > **Recover** in the **Destroyed File Systems** panel under the **File Systems** panel. The **Recover File Systems** pop-up window appears. From the **Destroyed File Systems** list, select the file systems you wish to recover. You can optionally enter a partial name in the search box to filter the list. You can also optionally select all file systems by clicking the checkbox next to the search box. All selected file systems appear in the **Selected File Systems** list.

3 Click **Recover**. The recovered file system appears in the **File Systems** panel.

Eradicating a File System

During the eradication pending period, you can manually eradicate the destroyed file system to reclaim physical storage space occupied by the destroyed file system. Eradicating a file system will also eradicate all of its related snapshots. Once reclamation starts, the destroyed file system and snapshots can no longer be recovered.

⚠ **CAUTION:** If Pure File SafeMode is enabled, contact Pure Technical Services to perform this action.

To eradicate a destroyed file system:

1 Select **Storage** > **File Systems**.

2 In the **Destroyed File Systems** panel, click the trash icon at the end of the row of the file system you want to eradicate. The **Eradicate File System** pop-up window appears.

If you wish to eradicate multiple file systems, click **More Options** > **Eradicate** in the **Destroyed File Systems** panel under the **File Systems** panel. The **Eradicate File Systems** pop-up window appears. From the **Destroyed File Systems** list, select the file systems you wish to eradicate. You can optionally enter a partial name in the search box to filter the list. You can also optionally select all file systems by clicking the checkbox next to the search box. All selected file systems appear in the **Selected File Systems** list.

3 Click **Eradicate**. The array will begin reclaiming the eradicated space of the file system.

Performing File Replication Failover and Reprotect

To initiate failover in a file replication setup:

- The target file system must first be promoted.
- All clients must then be directed to the target array.
- To reprotect, the local file system is then demoted. Note that when a file system is demoted, any writes performed since the last replication will be discarded.

To initiate failover, perform the following:

1 On the target array, from the **Storage** > **File Systems** page, locate the remote file system that you wish to promote from the **File Systems** panel.

2 Click **More Options** > **Promote** at the end of the row in which the remote file system appears.

3 Click **Promote** when prompted for confirmation.

4 Manually redirect clients to the target array.

To reprotect, you must remove snapshots since the last replicated snapshot. This can be difficult if the policy engine is creating new snapshots. You can stop the policy engine from creating new snapshots by removing the policies form the file system and replica link.

5 On the local array, remove policies attached to the to-be-demoted local file system and replica link.

To remove the policy from the local file system:

a From the **Storage** > **File Systems** page, locate and click local file system that you wish to demote from the **File Systems** panel. The file system's details page appears.

b In the **Policies** panel, click the remove button (**X**) in the same row as the policy you wish to remove.

c Click **Remove** when prompted for confirmation.

To remove the policy from the replica link:

a From the **Protection** > **File Replica Links** page, click **More Options** > **Remove Policies** at the end of the row of the replica link you wish to edit. The **Remove Policies** pop-up window appears.

b Select the policy or policies you wish to remove from the replica link from the **Available Policies** list.

c Click **Remove**.

6 Navigate back to the **Storage** > **File Systems** page and locate the local file system that you wish to demote from the **File Systems** panel.

7 Click **More Options** > **Demote** at the end of row in which the local file system appears.

8 Click **Demote** when prompted for confirmation.

Writes to the local file system are stopped and are redirected to the promoted remote file system.

9 If you removed policies in step 5, add the removed policy or policies back to the file system and replica link.

To add the policy to the file system:

a From the **Storage** > **File Systems** page, locate and click the file system from the **File Systems** panel. The file system's details page appears.

b In the **Policies** panel, click the add button (+). The **Add Policies** pop-up window appears.

c Select the policy or policies you wish to add to the file system from the **Available Policies** list.

d Click **Add**.

To add the policy to the replica link:

a From the **Protection** > **File Replica Links** page, click **More Options** > **Add Policies** at the end of the row of the replica link you wish to edit. The **Add Policies** pop-up window appears.

b Select the policy or policies you wish to add back to the replica link from the **Available Policies** list.

c Click **Add**.

Once the local file system comes back up, replication resumes as scheduled between the newly promoted target file system and demoted local file system because the policy was re-added to the replica link. Because clients have been redirected to the target, data is written to the promoted remote file system, which is then replicated to the demoted local file system.

Performing File Replication Failback

Note: This procedure continues from the previous failover procedure. During the failover procedure, the remote file system was promoted and the local file system was demoted.

As noted in the failover procedure, if the replication schedule policy was re-added to the replica link in the replication setup, once the local file system comes back up, replication resumes as scheduled between the promoted target file system and demoted local file system. Performing failback restores the original local/target relationship between arrays and file systems in a replication setup. During failback, once the remote file system is demoted and the local file system is promoted and clients redirected to the local file system, the original replication setup resumes; data is written to the local file system and then replicated to the remote file system.

To initiate failback in a file replication setup:

- Stop writes on the remote file system and send the remaining data to the local file system.
- Promote the local file system.
- Add back any removed policy to the local file system.

- Demote the remote file system.

To initiate failback, perform the following:

1. On the target array, from the **Storage** > **File Systems** page, locate the remote file system that is to be demoted from the **File Systems** panel.
2. Click **More Options** > **Disable Writes** at the end of row in which the remote file system appears.
3. Click **Disable** when prompted for confirmation.
4. Ensure all writes are sent to the source file system by creating a snapshot on the target and send it to the source.
5. On the local array, from the **Storage** > **File Systems** page, locate the local file system that you wish to promote from the **File Systems** panel.
6. Click **More Options** > **Promote** at the end of row in which the local file system appears.
7. Manually redirect clients back to the to the local array.
8. Remove policies attached to the to-be-demoted remote file system and replica link.

   To remove the policy from the file system:

   a. From the **Storage** > **File Systems** page, locate and click local file system that you wish to demote from the **File Systems** panel. The file system's details page appears.

   b. In the **Policies** panel, click the remove button (**X**) in the same row as the policy you wish to remove.

   c. Click **Remove** when prompted for confirmation.

   To remove the policy from the replica link:

   a. From the **Protection** > **File Replica Links** page, click **More Options** > **Remove Policies** at the end of the row of the replica link you wish to edit. The **Remove Policies** pop-up window appears.

   b. Select the policy or policies you wish to remove from the replica link from the **Available Policies** list.

   c. Click **Remove**.
9. On the target array, from the **Storage** > **File Systems** page, locate the remote file system that you wish to demote from the **File Systems** panel.
10. Click **More Options** > **Demote** at the end of row in which the remote file system appears.
11. Click **Demote** when prompted for confirmation.

    Writes to the remote file system are stopped and are redirected to the promoted local file system.

12 If you removed policies in step 8, add the removed policy or policies back to the file system and replica link.

To add the policy to the file system:

a From the **Storage > File Systems** page, locate and click the file system from the **File Systems** panel. The file system's details page appears.

b In the **Policies** panel, click the add button (+). The **Add Policies** pop-up window appears.

c Select the policy or policies you wish to add to the file system from the **Available Policies** list.

d Click **Add**.

To add the policy to the replica link:

a From the **Protection > File Replica Links** page, click **More Options > Add Policies** at the end of the row of the replica link you wish to edit. The **Add Policies** pop-up window appears.

b Select the policy or policies you wish to add back to the replica link from the **Available Policies** list.

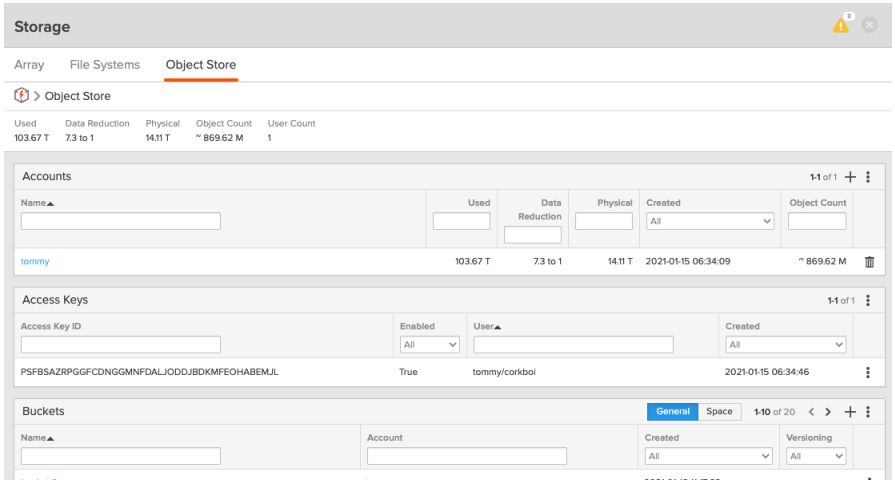
c Click **Add**.

The original replication setup has been restored.

Object Store

The **Object Store** tab is used to manage the array's object store accounts, users, and buckets.

Figure 5.8 Object Store Tab



The **Object Store** tab is divided into the following panels:

- **Accounts**: Displays all object store accounts.
- **Access Keys**: Displays all user access keys.
- **Buckets**: Displays all buckets.

In the **Accounts** panel, the following information is listed for each account:

- **Name**: The account name.
- **Used**: The amount of space used.
- **Data Reduction**: Ratio of mapped sectors within an account versus the amount of physical space the data occupies after data compression and deduplication.
- **Physical**: The amount of physical space.
- **Created**: The account creation date.
- **Object Count**: The approximate number of objects in the bucket. The units used for the approximate object count are **K** (thousands), **M** (millions), **B** (billions), and **T** (trillions). Note that there can be a temporary inconsistency in the number of objects shown in the GUI versus the client if an HA event (for example an NDU upgrade, software restart, failover event, etc.) occurred within a 12-hour period.

You can search the accounts list by entering search criteria in the search box under the column names.

The **Access Keys** panel displays the following information about user access keys:

- **Access Key ID**: The access key ID.
- **Enabled**: Whether the access key is enabled (True) or disabled (False).
- **User**: The user name in the format <account name>/<user name>.
- **Created**: The access key creation time.

You can search the access keys list by entering search criteria in the search box under the column names

The **Buckets** panel displays the following information about buckets:

- **Name**: The bucket name.

- **Account**: The account to which the bucket belongs.
- **Created**: The bucket creation time.
- **Versioning**: Whether bucket versioning is enabled or disabled.

You can search the buckets list by entering search criteria in the search box under the column names.

Creating an Account

To create a new account:

1. In the **Accounts** section of the **Storage > Object Store** page, click the add (+) button. The **Create Account** pop-up window appears.
2. Enter the new account's name in the **Name** field.
3. Click **Create**.

Deleting an Account

To delete an account:

1. In the **Accounts** section of the **Storage > Object Store** page, click the **Delete** button on the same row as the account you wish to delete. The **Delete Account** pop-up window appears.
2. Click the **Delete** button to confirm the account deletion.

Users

To view information about an existing user, from the **Storage > Object Store** page, click the account to which the user you wish to view belongs. The user information page appears which provides a **Users** panel, **Access Keys** panel, and **Buckets** panel.

The **Users** panel lists all account users. The following information is displayed about each account user:

- **Name**: The user name in the format <account name>/<user name>.
- **Access Key Age**: The age of the oldest access key for this user.
- **# Policies**: The number of access policies assigned to the user.
- **Created**: The user creation time.

The **Access Keys** panel lists all access keys for the account users:

- **Access Key ID**: The access key ID.
- **Enabled**: Whether the access key is enabled (True) or disabled (False).
- **User**: The user name in the format <account name>/<user name>.
- **Created**: The access key creation time.

The **Buckets** panel lists all buckets associated with the selected account and displays the following information:

- **Name**: The bucket name.
- **Created**: The bucket creation time.
- **Versioning**: Whether bucket versioning is enabled or disabled.

Access Keys

An access key allows the user to administer the object store. Users can have a maximum of two sets of keys at any single time. A set of keys consists of an access key ID and Secret Access Key.

Access keys can be created or imported for users. This can occur at the time of user creation, or any time after a user has been created.

When creating an access key you must copy or download your key information before closing the pop-up. The secret key can only be accessed during key creation confirmation and cannot be viewed or accessed after the confirmation pop-up is closed.

Credentials generated on one FlashBlade can be imported on another FlashBlade for a single account, with data on both arrays being accessible using the same credentials. This can be useful in FlashBlade replication setups, or in environments where multiple FlashBlades are used in multi-site deployments of Splunk SmartStore.

Note: FlashBlade does not validate if the access key being imported from another FlashBlade was a previously deleted access key during or after import.

When importing access keys, the following should be noted:

- Only new access keys created after Purity//FB 3.0.0 can be imported on another FlashBlade.

- The access key you are importing cannot already exist on the FlashBlade to which it is being imported.
- If there are two access keys present for a user, you cannot import a third access key.
- Credentials are not synchronized or validated against the FlashBlade from which they were imported; deleting or disabling a set of credentials on the source cluster will not delete or disable the credentials on any other clusters where they were imported.

As a best practice, Pure Storage recommends that customers assign a unique access key for each individual user and each application, and avoid sharing an access key across two FlashBlade arrays except when specifically required by your application configuration (for example, Splunk SmartStore configurations on FlashBlade that use a second FlashBlade for disaster recovery).

Creating an Access Key

Creating an access key also creates the user's associated secret key.

Be sure to save off or download the access key and secret key information when you create a key.

To create an access key:

1. From the **Storage** > **Object Store** page, click the account to which you recently added a new user.
2. From the **Users** panel, click the user name for whom you wish to create a new access key. The user details page appears.
3. In the **Access Keys** panel, click the **More Options** button and select **Create**. The **Access Key** pop-up window appears displaying the new access key ID and secret access key.
4. Make note of, or copy, the access key and secret key information displayed in the confirmation pop-up. Optionally use the **CSV** or **JSON** button to download the key information.

   ⚠ **Important note!** You must copy or download your key information before closing the pop-up. The secret key can only be accessed during key creation confirmation and cannot be viewed or accessed after the confirmation pop-up is closed.
5. Use the access key and secret key in your `.s3cfg` or `.s3curl` files, for example.

Importing an Access Key

To import an access key:

1. From the **Storage** > **Object Store** page of the FlashBlade to which you are importing the key, click the account containing the user to which you wish to import the access key.

2. From the **Users** panel, click the user name for whom you wish to import a new access key. The user details page appears.
3. In the **Access Keys** panel, click the **More Options** button and select **Import**. The **Import Access Key** pop-up window appears.
4. Enter the access key ID and secret access key.
5. Click **Import**.

Deleting an Access Key

Deleting an access key also deletes the user's associated secret key. Once an access key has been deleted, it cannot be recovered.

To delete an access key:

1. From the **Storage > Object Store** page, click the account containing the user who's access key you wish to delete.
2. From the **Access Keys** panel, click the **More Options** button on the same row as the user for which you wish to delete the access key and select **Delete**.
3. When prompted to confirm the access key deletion, click the **Delete** button.

Disabling an Access Key

Access keys are enabled when they are created. To disable an access key:

1. From the **Storage > Object Store** page, click the account containing the user who's access key you wish to disable.
2. From the **Access Keys** panel, click the **More Options** button on the same row as the user for which you wish to disable the access key and select **Disable**.
3. When prompted to confirm disabling the access key, click the **Disable** button.

Enabling an Access Key

To enable a previously disabled an access key:

1. From the **Storage > Object Store** page, click the account containing the user who's access key you wish to enable.
2. From the **Access Keys** panel, click the **More Options** button on the same row as the user for which you wish to enable the access key and select **Enable**.

3 When prompted to confirm enabling the access key, click the **Enable** button.

Access Policies

FlashBlade Object Store allows you to manage what actions can be carried out by what users when accessing objects and buckets via the S3 API.

By default, new users created in Purity//FB 3.2.0 have no permissions assigned to them. You can assign a user permissions by choosing from a set of predefined, Pure-managed simple user policies, or *access policies*. Adding an access policy to a user in Object Store grants that user permissions to make specific types of S3 API calls on any object or bucket within the Object Store account where the user was created.

FlashBlade's access policies are pre-defined, static, and can only be added to or removed from users. Policies can be added during user creation, or any time thereafter. Similarly, policies can be removed from a user at any time.

Note: The administrative users cannot create or delete the static policies.

The following table provides a list of the available access policies:

Table 5.4 Access Policies for Object Store

Access Policy	Policy Definition
pure:policy/bucket-list	Permissions to list all bucket names for the account.
pure:policy/bucket-info	Permissions to read bucket configurations.
pure:policy/bucket-configure	Permissions to configure versioning and lifecycle rules on buckets.
pure:policy/bucket-create	Permissions to create buckets.
pure:policy/bucket-delete	Permissions to delete empty buckets.
pure:policy/object-list	Permissions to list objects and versions and verify their sizes, entity tags (ETags), and timestamps (but not to read their data or custom metadata).

Table 5.4 Access Policies for Object Store (continued)

Access Policy	Policy Definition
pure:policy/object-read	Permissions to read object and version data and custom metadata.
pure:policy/object-write	Permissions to create and overwrite objects when versioning is not enabled and to create new versions when versioning is enabled.
pure:policy/object-delete	Permission to eradicate objects when versioning is not enabled on the bucket and to create object delete markers when versioning is enabled.
pure:policy/version-delete	Permissions to eradicate objects and versions.
pure:policy/full-access	Full Access is a special role. Permissions for all current and future S3 APIs and any non-standard FlashBlade S3 API extensions. (Triggers a warning in the GUI if selected)
pure:policy/safemode-configure	Permissions to configure safemode.

Adding Access Policies

Access policies can be added to a user at any time. See *Access Policies* for a list of policies and their definitions.

To add access policies to a user:

1. From the **Storage** > **Object Store** page, click the account with the user for which you wish to add policies.
2. From the **Users** panel, click the user name for whom you wish to add polices. The user details page appears.
3. In the **Access Policies** panel, click the **More Options** button and select **Add**. The **Add Access Policies** pop-up window appears displaying all available policies that can be added.
4. Select the policies you wish to add to the user from the **Available Policies** column.

5 Click **Add**.

The **Access Policies** panel is updated with the added policies.

Removing Access Policies

Access policies can be removed from a user at any time.

To remove access policies from a user:

1 From the **Storage** > **Object Store** page, click the account with the user for which you wish to remove policies.

2 From the **Users** panel, click the user name for whom you wish to remove polices. The user details page appears.

3 In the **Access Policies** panel, click the **More Options** button and select **Remove**. The **Remove Access Policies** pop-up window appears displaying all existing policies that can be removed from the user.

4 Select the policies you wish to remove to the user from the **Existing Policies** column.

5 Click **Remove**.

The removed policies no longer appear in the **Access Policies** panel.

Creating a User

To create a new user:

1 From the **Storage** > **Object Store** page, click the account to which you wish to add a new user.

2 In the **Users** panel, click the add (+) button. The **Step 1: Create User** pop-up window appears.

3 Enter the new user's name in the **User Name** field.

4 Click **Create**. The **Step 2: Add Policies to user...** pop-up window appears.

5 (Optional) Select the simple user policy or policies you wish to assign the new user from the **Available Policies** column (see *Access Policies* for a list of policies and their definitions). You can skip this step and add policies at a later date. Note that the user will not have any access until policies have been added.

6 Click **Add**. The **Step 3: Add Access Key to user...** pop-up window appears.

7 (Optional) Select to **Create a new key** or **Import an existing key**. You can skip this step and an access key can be created for the user at a later date.

a If you select **Create a new key**, click **Create**. The **Access Key** pop-up window appears allowing you to copy the **Access Key ID** and **Secret Access Key** or download them in JSON or CSV format.

b If you select **Import an existing key**, enter the **Access Key ID** and **Secret Access Key**, and click **Import**.

⚠ **Important note!** You must copy or download your key information before closing the pop-up. The secret key can only be accessed during key creation confirmation and cannot be viewed or accessed after the confirmation pop-up is closed.

The access key is automatically enabled.

Deleting a User

Deleting a user also deletes all access keys associated with that user. To delete a user:

1. From the **Storage** > **Object Store** page, click the account from which you wish to delete a user.
2. From the **Users** panel, click the **More Options** > **Delete** button on the same row as the user you wish to delete.
3. When prompted to confirm the deletion, click **Delete**.

Buckets

Buckets and their contents can be created and managed with the FlashBlade GUI, CLI, and management REST API. Buckets and their contents can also be managed with the object store REST API, with open source tools such as s3curl and s3cmd, and with Java, Python, or other languages.

To view buckets per account, from the **Storage** > **Object Store** page, click an account name. The buckets for that account are displayed in the **Buckets** panel. For each bucket, the amount of used space, data reduction, physical space, object count, and status of versioning (enabled or none) are displayed.

To view a bucket's replica link information, click the bucket name. For each replica link, the source bucket name, replication direction, remote bucket name, remote credentials, replication status, lags, and recovery point are displayed. See *Object Replica Links* for information.

To view a bucket's lifecycle rules, click the bucket name. For each lifecycle rule, the rule ID, rule status, object prefix filter, and number of days to keep non-current objects are displayed. See *Object Lifecycle Configuration Policy* for information.

Bucket Versioning

A bucket 's versioning status is displayed in the **Buckets** panel after clicking an account name from the **Storage** > **Object Store** page. Versioning status can also be displayed in the CLI using the **`purebucket list`** command.

Bucket versioning allows multiple variants of an object in the same bucket. Buckets can be in three different versioning states: None, Enabled, and Suspended. All buckets are initially created in a non-versioned (None) state. Once you enable versioning on a bucket, every object in the bucket automatically retains the entire history on every update, and that bucket can never return to the non-versioned state. However, you can suspend versioning on that bucket.

In a non-version bucket, each object name has only one version. This is always the current version. Deleting an existing object name permanently destroys the object.

In a versioning-enabled bucket, an object can have multiple versions for the same object name. Each object name has one current version and either zero or multiple non-current versions.

The versioning-suspended state can prevent the number of versions from growing.

Lifecycle rules can also prevent the number of versions from growing. Configuring a lifecycle rule, either for all objects or for objects matching a key name prefix, will cause noncurrent object versions older than the specified number of days to be permanently deleted from the bucket.

Creating a Bucket

To create a bucket:

1. From the **Storage** > **Object Store** page, click the account to which you wish to add a bucket.
2. From the **Buckets** pane, click the add (+) button. The **Create Bucket** pop-up window appears.
3. Enter a name for the bucket.
4. Click **Create**.

Enabling Bucket Versioning

To enable bucket versioning, perform the following:

1. From the **Storage** > **Object Store** page, click the account to which the bucket you wish to version belongs.

2 From the **Buckets** panel, click **More Options** > **Enable versioning** on the same row as the bucket you wish to version. The **Enable Versioning** pop-up window appears.

3 Click **Enable**.

Suspending Bucket Versioning

To suspend bucket versioning, perform the following:

1 From the **Storage > Object Store** page, click the account to which the bucket whose versioning you wish to suspend belongs.

2 From the **Buckets** panel, click **More Options** > **Suspend versioning** on the same row as the bucket whose versioning you wish to suspend.. The **Suspend Versioning** pop-up window appears.

3 Click **Suspend**.

Object Lifecycle Configuration Rules

When bucket versioning is enabled, multiple versions of an object in the same bucket are created that retain the object's entire history on every update. In order to help manage space usage, you can create object lifecycle configuration rules to automatically delete old, unneeded versions of the object. Without an object lifecycle rule, an object's versions are retained indefinitely until manually deleted.

Note: If bucket versioning was previously enabled, but currently suspended, the versions created while versioning was enabled are still subject to any lifecycle rules created after versioning was suspended.

When an object lifecycle rule is created, that rule manages the amount of time that the 'non-current' version of the object is retained. For example, you can specify that a non-current version be retained for 10 days. When the 10 day retention period is reached, that version will be deleted from the system within 24 hours.

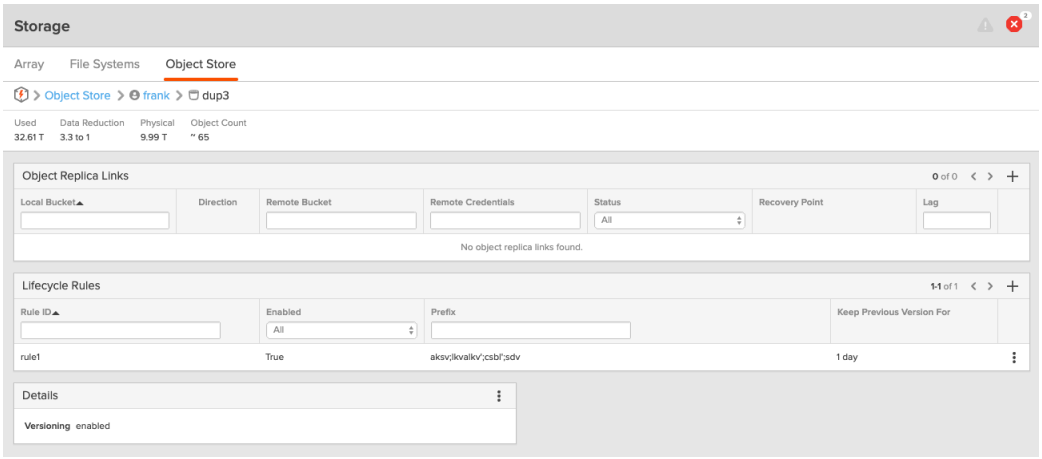
When a lifecycle policy is applied, then for all objects in the bucket or, if specified, for those objects matching the key prefix, all versions that have been noncurrent for more than the specified retention period are subject to immediate deletion.

Up to 1,000 object lifecycle rules can be created per bucket.

Object lifecycle rules can be viewed, created, edited, enabled, disabled, and deleted using the Purity//FB GUI, CLI, and Management REST API, as well as the Object Store REST API.

Object lifecycle rules are listed in the **Lifecycle Rules** list on a bucket's detail screen. To navigate to a bucket's detail screen, click **Storage** > **Object Store** > **Bucket** > **bucket name**.

Figure 5.9 Lifecycle Rules List



The **Lifecycle Rules** list displays the following information:

- **Rule ID** - The object lifecycle rule ID. This ID is either created by the system or specified by the user. If system-assigned, the ID is in the format `fbRuleIdX`, where X increases by one with each rule. The rule ID must be unique for the given bucket.
- **Enabled** - Indicates if the object lifecycle rule is enabled (**True**) or disabled (**False**).
- **Prefix** - An optional field that causes the rule to only be applied to objects beginning with this prefix.
- **Keep Previous Version For** - The duration that the non-current object version is retained expressed in a whole number day, for example: 10 days, 4 weeks, etc.

Creating an Object Lifecycle Rule

To create an object lifecycle rule, perform the following:

1. From the **Storage > Object Store** page, click the account that contains the bucket to which you wish to create a lifecycle configuration.
2. From the **Buckets** panel, select the bucket for which you wish to create an object lifecycle rule.
3. Click the **Add** (+) button in the heading of the **Lifecycle Rules** list. The **Create Lifecycle Rule** pop-up window appears.

4 (Optional) Enter a unique ID for the rule in the **Rule ID** field. The ID cannot exceed 255 characters. If no ID is entered, the system will assign a unique ID in the format `fbRuleIdX`, where X is the next available rule ID number in the `fbRuleIdX` format.

5 (Optional) Enter an object prefix in the **Prefix** field. The prefix cannot exceed 1,024 characters.

An object prefix filter objects within the bucket to which the rule is applied. For example, if `/tmp/` is entered, the created rule will apply to only objects with the prefix `/tmp/`.

6 In the **Keep Previous Version For** field, enter the period for the non-current object version will be retained. The value must be entered in the format `N[m/h/d/w]`, where `N` is an integer followed by `m` (minutes), `h` (hours), `d` (days), or `w` (weeks). The minimum valid retention period is one day. Note that the value entered must be in a multiple of 1 day increments. For example: 24h, 1440m, etc.

For example, entering 15d results in the retention of the non-current object version for 15 days; when the 15 day retention period is reached, that version will be deleted from the system within 24 hours.

7 Review the summary and click **Create**.

The object lifecycle rule is automatically enabled upon creation.

Editing an Object Lifecycle Rule

To edit an object lifecycle rule, perform the following:

1 From the **Storage** > **Object Store** page, click the account that contains the bucket to which you wish to edit a lifecycle configuration.

2 From the **Buckets** panel, select the bucket with the object lifecycle rule you wish to edit.

3 From the **Lifecycle Rules** list, click the **More Options** button in the row of the object lifecycle rule you wish to edit and select **Edit**. The **Edit Lifecycle Rule** pop-up window appears.

4 (Optional) Enable or disable the rule using the **Enable** toggle.

5 (Optional) Enter or change the object prefix in the **Prefix** field. The prefix cannot exceed 1,024 characters.

An object prefix filter objects within the bucket to which the rule is applied. For example, if `/tmp/` is entered, the created rule will apply to only objects with the prefix `/tmp/`.

6 (Optional) In the **Keep Previous Version For** field, enter the period for the non-current object version will be retained. The value must be entered in the format `N[m/h/d/w]`, where `N` is an integer followed by `m` (minutes), `h` (hours), `d` (days), or `w` (weeks). Note that the value entered must be in a multiple of 1 day increments. For example: 24h, 1440m, etc.

For example, entering 15d results in the retention of the non-current object version for 15 days; when the 15 day retention period is reached, that version will be deleted from the system within 24 hours.

7 Review the summary and click **Save**.

The object lifecycle rule is updated with your changes.

Deleting an Object Lifecycle Rule

To delete an object lifecycle rule, perform the following:

1. From the **Storage** > **Object Store** page, click the account to which the bucket whose object lifecycle rule you wish to delete belongs.
2. From the **Buckets** panel, select the bucket with the object lifecycle rule you wish to delete.
3. From the **Lifecycle Rules** list, click the **More Options** button in the row of the object lifecycle rule you wish to delete and select **Delete**. The **Delete Lifecycle Rule** pop-up window appears.
4. When prompted for confirmation, click **Delete**.

   The object lifecycle rule is deleted from the bucket.

Destroying a Bucket

When a bucket is destroyed, it enters a 24-hour eradication pending period. During this time, the bucket and its contents can be recovered. Note that also during this time, data in the bucket is inaccessible. When the 24-hour eradication pending period has lapsed, Purity//FB starts reclaiming storage space. During this time, the bucket can no longer be recovered.

To destroy a bucket:

1. From the **Storage** > **Object Store** page, click the account from which you wish to destroy a bucket.
2. From the **Buckets** panel, click the trash can icon on the same row as the bucket you wish to destroy. The **Destroy Bucket** pop-up window appears.

   If you wish to destroy multiple buckets, click **More Options** > **Destroy**. The **Destroy Buckets** pop-up window appears. From the **Existing Buckets** list, select the buckets you wish to destroy. You can optionally enter a partial name in the search box to filter the list. You can also optionally select all buckets by clicking the checkbox next to the search box. All selected file systems appear in the **Selected Buckets** list.
3. Click **Destroy**.

Recovering a Bucket

Destroyed buckets have 24 hours to be recovered. Once 24 hours has expired, the system begins eradicating the bucket, at which point the bucket is no longer recoverable.

To recover a destroyed bucket:

1. From the **Storage** > **Object Store** page, click the account from which you wish to recover a destroyed bucket.
2. From the **Destroyed Buckets** panel, click the clock icon on the same row as the bucket you wish to recover. The **Recover Bucket** pop-up window appears.

   If you wish to recover multiple buckets, click **More Options** > **Recover**. The **Recover Buckets** pop-up window appears. From the **Destroyed Buckets** list, select the buckets you wish to recover. You can optionally enter a partial name in the search box to filter the list. You can also optionally select all buckets by clicking the checkbox next to the search box. All selected file systems appear in the **Selected Buckets** list.
3. Click **Recover**.

Eradicating a Bucket

During the eradication pending period, you can manually eradicate the destroyed buckets to reclaim physical storage space. Once reclamation starts, the destroyed buckets can no longer be recovered.

To eradicate a destroyed bucket:

1. From the **Storage** > **Object Store** page, click the account from which you wish to eradicate a destroyed bucket.
2. From the **Destroyed Buckets** panel, click the clock icon on the same row as the bucket you wish to eradicate. The **Eradicate Bucket** pop-up window appears.

   If you wish to eradicate multiple buckets, click **More Options** > **Eradicate**. The **Eradicate Buckets** pop-up window appears. From the **Destroyed Buckets** list, select the buckets you wish to eradicate. You can optionally enter a partial name in the search box to filter the list. You can also optionally select all buckets by clicking the checkbox next to the search box. All selected file systems appear in the **Selected Buckets** list.
3. Click **Eradicate**.

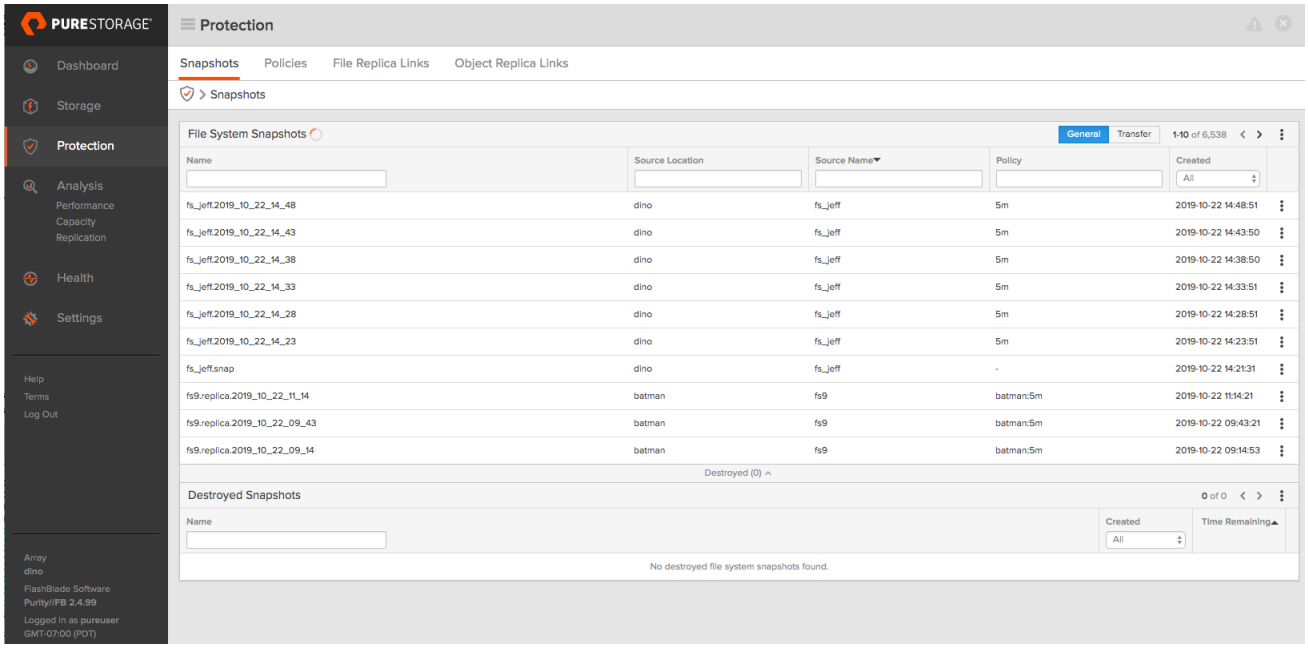
Chapter 6
The Purity//FB GUI Protection Page

The **Protection** page displays and manages the array's file system snapshots, replica links, and replication policies.

The **Protection** page provides the following four tabs:

- **Snapshots**: Displays and allows you to manage snapshots from all file systems.
- **Policies**: Displays and allows you to manage file system snapshot replication policies.
- **File Replica Links**: Displays and allows you to manage all file replica links used to schedule file system snapshot replication.
- **Object Replica Links**: Displays and allows you to manage all object replica links used to schedule object data replication.

Figure 6.1 Purity//FB Protection Page



Snapshots

By default, the **Protection** page displays the **Snapshots** tab. File system snapshots are created from the **Storage** > **File Systems** page (see *Creating a File System Snapshot*).

The top of the **Snapshots** tab contains the **File System Snapshots** panel, which displays general information about file system snapshots in a table with the following columns:

- **Name**: The name of the file system snapshot.
- **Source Location**: The name of the array from where the source file system was replicated.
- **Source Name**: The name of the source file system.
- **Policy**: The snapshot policy attached to the source file system.
- **Created**: The creation date and time of the snapshot.

Each column can be sorted by clicking the column title.

To view information about the replication transfer status of the file system snapshots, click **Transfer** from the title bar of the **File System Snapshots** panel. Note that replication transfer status information is shown only if replication has been configured.

Once selected, the table displayed in the **File System Snapshots** panel changes to display the following columns:

- **Name**: The name of the file system snapshot.
- **Started**: The date and time replication started.
- **Completed**: The date and time replication completed.
- **Transferred**: The amount of data replicated.
- **Progress**: The percentage of replication completed.

As with the **General** table, each column in the **Transfer** table can be sorted by clicking the column title.

The bottom of the **Snapshots** tab contains the **Destroyed Snapshots** panel, which displays all destroyed file system snapshots. Destroyed snapshots can be recovered within a 24-hour period. Once the 24-hour period has passed, the snapshot is permanently destroyed (eradicated). The **Time Remaining** column displays the time remaining for the snapshot to be restored.

Note that with scheduled snapshot replication, if there is a delay in snapshot completing the transfer of one snapshot, the next snapshot (per the policy schedule) is not created until the previous snapshot transfer is completed. For example, if snapshots are scheduled every 30 minutes and a snapshot completes transferring in 31 minutes, the next snapshot is created once that snapshot is completely transferred. The creation times as shown in the **File Systems Snapshots** panel will reflect this.

Destroying File System Snapshots

You can destroy a snapshot from either the **Storage** or **Protection** page.

The **Storage** page allows you to view snapshots per specific file system. The **Protection** page allows you to view all file system snapshots on the array.

To destroy one or more file system snapshots, perform the following:

1. If you are on the **Storage** page, select **Storage** > **File Systems** and then click the file system from the table in the **File Systems** panel to access that file system's snapshots. If you are on the **Protection** page, select **Protection** > **Snapshots**.
2. From the table in the **File System Snapshots** panel, locate the file system snapshot you either wish to destroy, or is the point from which earlier snapshots are to be destroyed.
3. If you wish to destroy the snapshot, perform the following:
   a. Click the **More Options** button located at the end of that snapshot's row and select **Destroy**. The **Destroy Snapshot** pop-up window appears.
   b. Click **Destroy**
4. If you wish to destroy multiple snapshots, perform the following:
   a. Click **More Options** > **Destroy** in the **File System Snapshots** panel title bar. The **Destroy File System Snapshots** pop-up window appears.
   b. From the **File System Snapshots** list, select the snapshots you wish to destroy. You can optionally enter a partial name in the search box to filter the snapshot list. You can also optionally select all snapshots by clicking the check box next to the search box. All selected snapshots appear in the **Selected File System Snapshots** list.
   c. Click **Destroy**.
5. If you wish to use the snapshot as the point from which earlier snapshots are destroyed, perform the following:

a Click the **More Options** button located at the end of that snapshot's row and select **Destroy older**. The **Destroy Snapshots older than...** pop-up window appears.

b Select the snapshots you wish to destroy from the **Older File System Snapshots** pane. You can optionally enter a partial name in the search box to filter the snapshot list. You can also optionally select all snapshots by clicking the check box next to the search box. All selected snapshots appear in the **Selected File System Snapshots** list.

c Click **Destroy**.

The destroyed file system snapshot appears under the **Destroyed Snapshots** panel on the **Snapshots** tab. Destroyed snapshots can be recovered within a 24-hour period. Once the 24-hour period has passed, the snapshot is permanently destroyed (eradicated).

Restoring a File System to a Snapshot

Purity//FB allows you to restore a file system to a given point in time from a snapshot (via file system rollback). Restoring a file system to a snapshot overwrites the contents of that file system with data from the snapshot.

File system rollback is available for snapshots created on a FlashBlade array running Purity//FB 3.0.0 or later.

CAUTION: If Pure File SafeMode is enabled, contact Pure Technical Services to perform this action.

CAUTION: When restoring to a snapshot, the file system's configured quota, as well as any configured user/group quotas, do not change to reflect the limit when the snapshot was taken. This can cause the live space usage to increase, resulting in subsequent write failures due to exceeding the quota. You may need to re-adjust your quota settings accordingly.

Note: It is highly recommended that there be no I/O on the file system when performing a restore.

You can restore a file system from a snapshot from either the **Storage** or **Protection** page.

Note: If there are snapshots that are newer than the snapshot you wish to use as the restore point, the newer snapshots must be first destroyed and eradicated before you can proceed with the file system restoration. See *Destroying and Eradicating Newer Snapshots*.

The **Storage** page allows you to view snapshots per specific file system. The **Protection** page allows you to view all file system snapshots on the array.

To restore a file system from a snapshot, perform the following:

1. If you are on the **Storage** page, select **Storage** > **File Systems** and then click the file system from the table in the **File Systems** panel to access that file system's snapshots. If you are on the **Protection** page, select **Protection** > **Snapshots**.
2. From the table in the **File System Snapshots** panel, locate the file system snapshot to be used to restore the file system.
3. Click the **More Options** button located at the end of row of the snapshot to be used for restore and select **Restore**. The **Restore File System from Snapshot** pop-up window appears.
4. Click **Restore**.

Destroying and Eradicating Newer Snapshots

Note: Destroyed snapshots can be recovered within a 24-hour period. Once the 24-hour period has passed, the snapshot is permanently destroyed (eradicated).

When restoring a file system from a snapshot, if there are snapshots that are newer than the snapshot you wish to use as the restore point, the newer snapshots must be first destroyed and eradicated before you can proceed with the file system restoration.

You can destroy and eradicate snapshots from either the **Storage** or **Protection** page.

The **Storage** page allows you to view snapshots per specific file system. The **Protection** page allows you to view all file system snapshots on the array.

1. If you are on the **Storage** page, select **Storage** > **File Systems** and then click the file system from the table in the **File Systems** panel to access that file system's snapshots. If you are on the **Protection** page, select **Protection** > **Snapshots**.
2. From the table in the **File System Snapshots** panel, locate the file system snapshot to be used to restore the file system.
3. Click the **More Options** button located at the end of that snapshot's row and select **Destroy newer**. The **Destroy Snapshots newer than...** pop-up window appears.
4. In the **Newer File System Snapshots** pane, select all snapshots by clicking the check box next to the search box. All selected snapshots appear in the **Selected File System Snapshots** list.
5. Click **Destroy**. The snapshot(s) appear in the **Destroyed Snapshots** panel (directly below the **File System Snapshots** panel).
6. Click **More Options** > **Eradicate** in of the **Destroyed Snapshots** panel. The **Eradicate File System Snapshots** pop-up window appears.
7. From the **Destroyed File System Snapshots** list, select the snapshots you wish to eradicate. You can optionally enter a partial name in the search box to filter the snapshot list. You can also optionally

select all snapshots by clicking the checkbox next to the search box. All selected snapshots appear in the **Selected File System Snapshots** list.

8 Click **Eradicate**.

Recovering File System Snapshots

When a file system snapshot is destroyed, you have 24 hours to recover the data. This is known as the eradication pending state. When the eradication pending state expires, the snapshot will be eradicated and you will no longer be able to retrieve the snapshot data.

You can recover a snapshot from either the **Storage** or **Protection** page.

The **Storage** page allows you to view snapshots per specific file system. The **Protection** page allows you to view all file system snapshots on the array.

To recover a previously destroyed file system snapshot, perform the following:

1 If you are on the **Storage** page, select **Storage** > **File Systems** and then click the file system from the table in the **File Systems** panel to access that file system's snapshots. If you are on the **Protection** page, select **Protection** > **Snapshots**.

2 If you wish to recover a single snapshot:

   a From the **Destroyed Snapshots** panel, locate the file system snapshot you wish to recover.

   b Click **More Options** > **Recover** at the end of the row of the file system snapshot you wish to recover.

   c Click **Recover**.

3 If you wish to recover multiple file system snapshots:

   a Click **More Options** > **Recover** in the **Destroyed Snapshots** panel title bar. The **Recover File System Snapshots** pop-up window appears.

   b From the **Destroyed File System Snapshots** list, select the snapshots you wish to recover. You can optionally enter a partial name in the search box to filter the snapshot list. You can also optionally select all snapshots by clicking the check box next to the search box. All selected snapshots appear in the **Selected File System Snapshots** list.

   c Click **Recover**.

Eradicating File System Snapshots

During the eradication pending period, you can manually eradicate the destroyed file system to reclaim physical storage space occupied by the destroyed snapshot. Once reclamation starts, the destroyed snapshots can no longer be recovered.

You can eradicate a snapshot from either the **Storage** or **Protection** page.

The **Storage** page allows you to view snapshots per specific file system. The **Protection** page allows you to view all file system snapshots on the array.

CAUTION: If Pure File SafeMode is enabled, contact Pure Technical Services to perform this action.

To eradicate a destroyed snapshot:

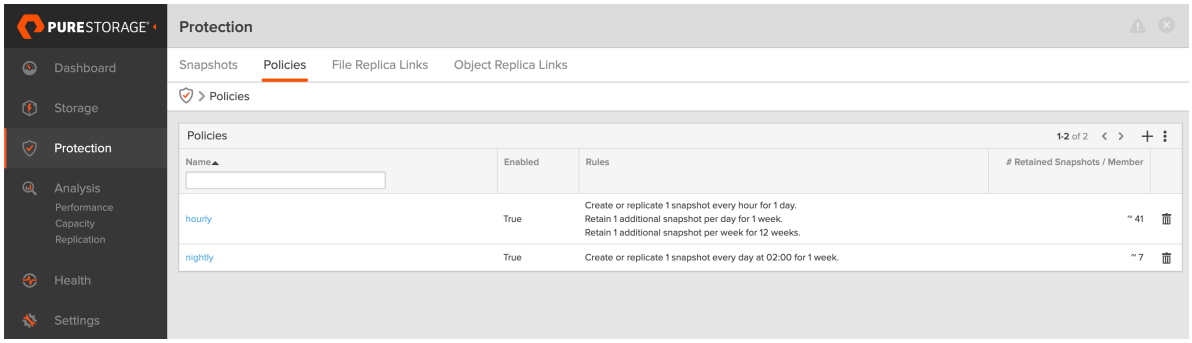
1. If you are on the **Storage** page, select **Storage** > **File Systems** and then click the file system from the table in the **File Systems** panel to access that file system's destroyed snapshots. If you are on the **Protection** page, select **Protection** > **Snapshots**.
2. If you wish to eradicate a single snapshot:
    a. In the **Destroyed Snapshots** panel under **File System Snapshots**, click **More Options** > **Recover** at the end of the row of the snapshot you want to eradicate. The **Eradicate Snapshot** pop-up window appears.
    b. Click **Eradicate**. The array will begin reclaiming the eradicated space of the snapshot.
3. If you wish to eradicate multiple snapshots:
    a. Click **More Options** > **Eradicate** in of the **Destroyed Snapshots** panel. The **Eradicate File System Snapshots** pop-up window appears.
    b. From the **Destroyed File System Snapshots** list, select the snapshots you wish to eradicate. You can optionally enter a partial name in the search box to filter the snapshot list. You can also optionally select all snapshots by clicking the checkbox next to the search box. All selected snapshots appear in the **Selected File System Snapshots** list.
    c. Click **Eradicate**. The array will begin reclaiming the eradicated space of the snapshots.

Policies

A policy consists of one or more rules that govern when snapshots are created or replicated, and how long they are retained. When a policy is attached to a file system, it will create local file system

snapshots. When a policy is attached to a file system replica link, it will replicate file system snapshots to a connected array. The **Policies** tab is used to manage the array's snapshot policies.

Figure 6.2 Policies



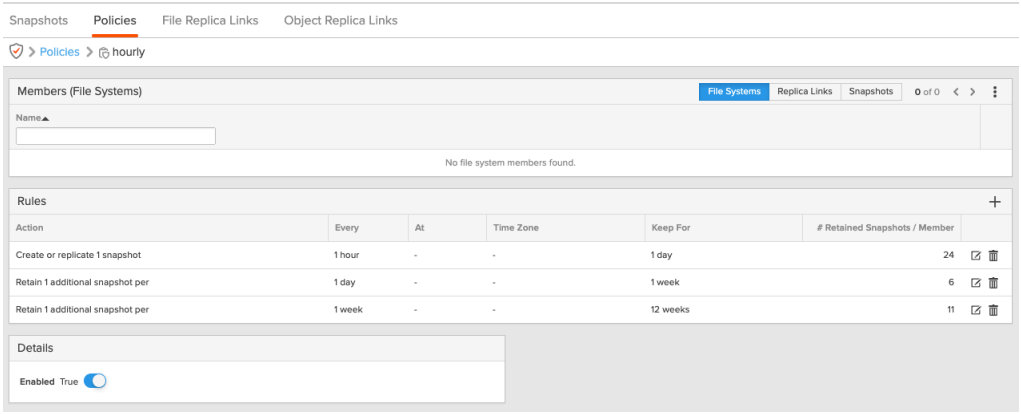
The **Policies** tab displays a list of all snapshot policies and the following rule information for each snapshot policy:

- **Name**: The policy name.
- **Enabled**: Whether the policy is enabled (**True**) or disabled (**False**).
- **Rules**: The snapshot creation and retention details of the policy rules.
- **# Retained Snapshots/Member**: The total number of snapshots retained per member per policy. If multiple rules exist for a policy, a summary is shown of the number of retained snapshots per member for each rule.

Viewing Policy Details

To view details about each policy in the array, from the **Protection** > **Policies** page, click a policy name to open a detail page about that policy.

Figure 6.3 Policy Details



The members, rules, and policy status are displayed in the **Members**, **Rules**, and **Details** panels, respectively.

Creating Policies

To create a policy, perform the following:

1. From the **Protection** > **Policies** page, click the **Add** (+) button in the heading of the **Snapshot Policies** list. The **Step 1: Create Policy** pop-up window appears.
2. In the **Name** field enter the name of the snapshot policy.
3. By default, the policy is set to enabled (blue). If you wish to disable the policy, set the **Enabled** toggle to disabled (gray).
4. Click **Create**. The **Step 2: Add Rule to Policy <name>** pop-up window appears.
5. In the **Create or replicate 1 snapshot every** field, enter the frequency at which snapshots are created or replicated. The value must be entered in the format n{m|h|d|w}. For example, 15m, 3h, 2d, 1w, etc. The minimum value is 5m.
6. In the **At** field, enter the time of day the snapshot is created. The value must be entered in the format n:[m][am|pm], where n is a value of 0-23. If entering a minute (m) value, m must be a two digit number between 00 and 59; for example 12:00am or 12:15pm. If entered without am or pm, n must be a value of 0-23. For example, 23, 5pm, 2:25am, 14:45, etc.

   This field is only editable if the value specified in the **Create or replicate 1 snapshot every** field is a multiple of a day. For example, 24h, 48h, 72h, 1d, 2d, 3d, 1w, etc
7. In the **And keep for** field, enter the retention period for the snapshot. The value must be entered in the format n{m|h|d|w}. For example, 30m, 1h, 2d, 1w, etc. The retention period cannot be less than the snapshot interval.
8. Click **Add**.

Adding Policy Rules

After creating a snapshot policy, add snapshot creation and retention rules.

To add a policy rule, perform the following:

1. From the **Protection** > **Policies** page, click the policy to which you wish to add a rule. The policy's detail page appears.
2. In the **Rules** panel, click the **Add** (+) button. The **Add Rule to Policy <name>** pop-up window appears.
3. In the **Create or replicate 1 snapshot every** field, enter the frequency at which snapshots are created or replicated. The value must be entered in the format n{m|h|d|w}. For example, 15m, 3h, 2d, 1w, etc.
4. In the **At** field, enter the time of day the snapshot is created. The value must be entered in the format n:[m][am|pm], where n is a value of 0-23. If entering a minute (m) value, m must be a two digit number between 00 and 59; for example 12:00am or 12:15pm. If entered without am or pm, n must be a value of 0-23. For example, 23, 5pm, 2:25am, 14:45, etc.

   This field is only editable if the value specified in the **Create or replicate 1 snapshot every** field is a multiple of a day. For example, 24h, 48h, 72h, 1d, 2d, 3d, 1w, etc
5. In the **And keep for** field, enter the retention period for the snapshot. The value must be entered in the format n{m|h|d|w}. For example, 30m, 1h, 2d, 1w, etc. The retention period cannot be less than the snapshot interval.
6. Click **Add**.

Adding Multiple Policy Rules

If you added a snapshot creation and retention rule when you created the policy, you can add up to four additional rules to the policy to save and retain snapshots from the original rule.

Consider the following example where a second rule is added to a policy with an existing rule:

- Rule 1 (existing) - One snapshot is created each hour and retained for a day.
- Rule 2 (new) - One snapshot per day will be retained for a week.

Rule 1 results in 24 snapshots being created in a 24-hour period. After 24 hours, the first snapshot that was created is destroyed and another snapshot is created; this cycle is repeated for each snapshot resulting in 24 snapshots each day. Per Rule 2, since one snapshot from Rule 1 is saved each day and retained for a week, six additional snapshots are retained for an additional six days. After one week, a total of 30 snapshots will be retained. This snapshot count is shown in the **#Retained Snapshots/ Member** column of the **Protection** > **Policies** page.

Note: If you are adding an additional retention rule to an existing rule, the values allowed for frequency of snapshot retention and the snapshot retention period are dependent on the snapshot creation rules that were initially created for the policy. For example, if a snapshot is created every 15 minutes and kept for one day, any additional retention frequency rule must be in multiples of 15 minutes and any additional retention periods must be greater than one day.

To add an additional rule, perform the following:

1. From the **Protection** > **Policies** page, click the policy to which you wish to add a rule. The policy's detail page appears.
2. In the **Rules** panel, click the **Add** (+) button. The **Add Rule to Policy <name>** pop-up window appears.
3. In the **Keep 1 snapshot for every** field, enter the frequency at which snapshots are retained. The value must be entered in the format n{m|h|d|w}, for example 15m.
4. In the **For** field, enter the retention period for the snapshot before it is eradicated. The value must be entered in the format n{m|h|d|w}, for example 30m.
5. Click **Add**.

Editing Policy Rules

Note: Existing snapshots managed by a modified policy will be destroyed if they do not comply with the policy's new snapshot schedule rules.

1. From the **Protection** > **Policies** page, click the policy whose rules you wish to edit. The policy's detail page appears.
2. In the **Rules** pane, click the **Edit** button on the row of the rule you wish to edit. The **Edit Rule for Policy <name>** pop-up window appears.
3. In the **Create or replicate 1 snapshot every** field, enter the frequency at which snapshots are created. The value must be entered in the format n{m|h|d|w}, for example 15m.
4. In the **At** field, enter the time of day the snapshot is created. The value must be entered in the format n:[m][am|pm], where n is a value of 0-23. If entering a minute (m) value, m must be a two digit number between 0 and 59; for example 12:00am or 12:15pm. If entered without am or pm, n must be a value of 0-23. For example, 23, 5pm, 2:25am, 14:45, etc.

   This field is only editable if the value specified in the **Create or replicate 1 snapshot every** field is a multiple of days. For example, 24h, 48h, 72h, 1d, 2d, 3d, 1w, etc.
5. In the **And keep for** field, enter the retention period for the snapshot. The value must be entered in the format n{m|h|d|w}, for example 30m.

6 Review the summary and consequence of modifying the rule.

7 Select **I understand these consequences of modifying this rule**.

8 Click **Save**.

Removing Policy Rules

Note: When a policy rule is removed, all snapshots managed by that rule are destroyed. Those destroyed snapshots will be eradicated after 24 hours.

1 From the **Protection** > **Policies** page, click the policy whose rules you wish to remove. The policy's detail page appears.

2 In the **Rules** pane, click the **Remove** button on the row of the rule you wish to remove. The **Remove Rule** pop-up window appears.

3 (Optional) Click to enable (blue) **Destroy Snapshots**. This verifies that snapshots created by the rule to be removed will be destroyed and that no new snapshots will be created with this rule. If no snapshots are managed by the policy, this step can be skipped.

4 Click **Remove**.

Adding File Systems to a Policy

1 From the **Protection** > **Policies** page, click the policy to which you wish to add file systems. The policy's detail page appears.

2 In the **Members** pane, click **More Options** > **Add File Systems**. The **Add File Systems** pop-up window appears.

3 From the **Available File Systems** pane, select one or more file systems from the list. The selected file system(s) appears in the **Selected File Systems** pane.

4 Click **Add**.

Removing File Systems from a Policy

⚠ **Important note!** After removing a file system from a policy, the policy will no longer create snapshots of that file system, but the policy will continue to destroy and eradicate the snapshots it created.

To remove a single file system:

1 From the **Protection** > **Policies** page, click the policy from which you wish to remove a file system. The policy's detail page appears.

2. In the **Members** pane, click the **Remove** (**X**) button in the row of the file system you wish to remove. The **Remove Member from Policy** dialog box appears.
3. Click **Remove**.

1. To remove multiple file systems:
4. From the **Protection** > **Policies** page, click the policy to which you wish to remove file systems. The policy's detail screen appears.
5. In the **Members** pane, click **More Options** > **Remove Members**. The **Remove Members** pop-up window appears.
6. From the **Current Members** pane, select one or more file systems from the list. The selected file system(s) appears in the **Selected File Systems** pane.
7. Click **Remove**.

Adding Replica Links to a Policy

1. From the **Protection** > **Policies** page, click the policy to which you wish to add file systems. The policy's detail page appears.
2. In the **Members** pane, click **More Options** > **Add Replica Links**. The **Add Replica Links** pop-up window appears.
3. From the **Available Replica Links** pane, select one or more replica links from the list. The selected replica link(s) appears in the **Selected Replica Links** pane.
4. Click **Add**.

Removing Replica Links from a Policy

To remove a single replica link from a policy:

1. From the **Protection** > **Policies** page, click the policy from which you wish to remove a replica link. The policy's detail page appears.
2. In the **Members** pane, click the **Remove** (**X**) button in the row of the replica link you wish to remove. The **Remove Member from Policy** dialog box appears.
3. Click **Remove**.

1. To remove multiple replica links:
4. From the **Protection** > **Policies** page, click the policy from which you wish to remove replica links. The policy's detail screen appears.

5 In the **Members** pane, click **More Options** > **Remove Members**. The **Remove Members** pop-up window appears.

6 From the **Current Members** pane, select one or more replica links from the list. The selected replica link(s) appears in the **Selected Members** pane.

7 Click **Remove**.

Enabling and Disabling Snapshot Policies

⚠ **Important note!** After a policy is disabled, that policy will no longer create snapshots or eradicate expired snapshots.

1 From the **Protection** > **Policies** page, click the policy you wish to enable or disable. The policy's detail screen appears.

2 In the **Details** pane, set **Enabled** to **True** (blue) to enable or **False** (gray) to disable the policy.

Removing a Policy from a Snapshot

Policies can be removed from snapshots at any time.

Note: If a policy is removed from a snapshot, that snapshot is no longer managed by that policy and must be destroyed manually.

You can remove a policy from a snapshot from either the **Storage** or **Protection** page.

The **Storage** page allows you to view snapshots per specific file system. The **Protection** page allows you to view all file system snapshots on the array.

To remove a policy from a snapshot, perform the following:

1 If you are on the **Storage** page, select **Storage** > **File Systems** and then click the file system from the table in the **File Systems** panel to access that file system's snapshots.

2 If you are on the **Protection** page, select **Protection** > **Snapshots**.

3 From the table in the **File System Snapshots** panel, locate the file system snapshot from which you wish to remove a policy.

4 Click the **More Options** button located at the end of that snapshot's row and select **Remove Policy**. The **Remove Policy from Snapshot** pop-up window appears.

5 Click **Remove**.

Deleting Policies

To delete a single policy:

1 From the **Protection** > **Policies** page, locate the policy you wish to delete from the policy list.

2 From the same row as the policy to be deleted, click the **Delete** button. The **Delete Policy** dialog box appears.

3 Click **Delete**.

1 To delete multiple policies:

4 From the **Protection** > **Policies** page, click **More Options** > **Delete**. The **Delete Policies** pop-up window appears.

5 From the **Existing Policies** pane, select the policies you wish to delete. Each selected policy appears in the **Selected Policies** pane.

For arrays with a large number of policies, you can search for a policy by entering a full or partial policy name in the search box to filter the policy list.

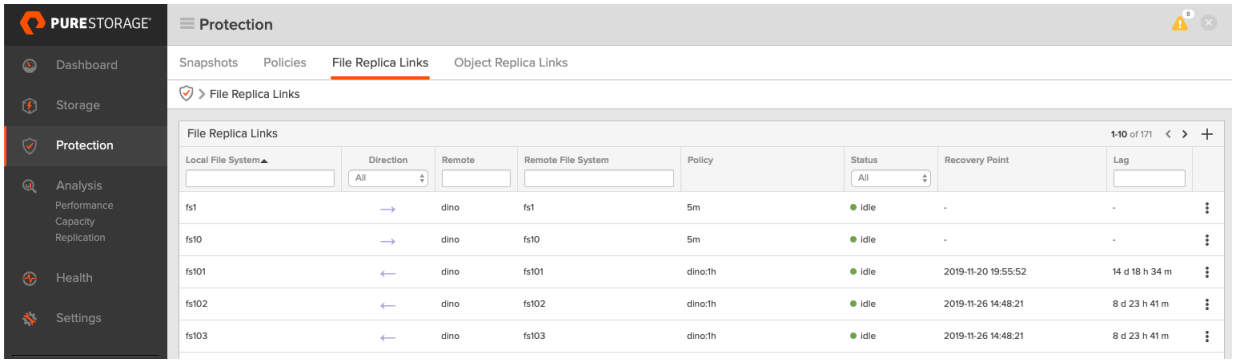
If you wish to delete all policies, from the **Existing Policies** pane, select the checkbox above the list of policies to select all policies.

6 Click **Delete**.

File Replica Links

File replica links are required for replicating file system snapshots between two connected FlashBlades. The **File Replica Links** tab is used to view and manage file replica links.

Figure 6.4 File Replica Links



The **File Replica Links** tab displays a list of all configured file replica links:

- **Local File System**: The name of the local (source) file system.
- **Direction**: The direction of replication, either inbound (←) or outbound (→).
- **Remote**: The name of the connected array.
- **Remote File System**: The name of the remote (target) file system.
- **Policy**: The name of the applied replication policy.
- **Status**: The current replication status.
  - **idle**: No errors, no current replication.
  - **replicating**: No errors, currently attempting replication.
  - **unhealthy**: No connectivity.
- **Recovery Point**: The creation time of the last snapshot that was completely replicated.
- **Lag**: The amount of time, if any, the replication target is behind the source, and is the time difference between the current time and the recovery point.

Clicking the file replica link on the local file system name directs you to the **Storage** > **File Systems** page, which provides detailed information about the file system to which the replica link is attached.

Creating a File Replica Link

File replica links are used to configure file system replication between two connected FlashBlade arrays.

To create a file replica link, perform the following:

1. From the **Protection** > **File Replica Links** page, click the add (+) button in the heading of the **File Replica Links** list. The **Create File Replica Link** pop-up window appears.
2. From the **Local File System** list, select the local (source) file system to be replicated.
3. From the **Remote Connection** list, select the remote (target) array.
4. (Optional) Enter a name for the remote file system to which data from the local file system will be replicated in the **Remote File System** field.
5. (Optional) From the **Policy** list, select a replication policy to attach to the replica link. If no policies are listed, click **Create Policy**. Follow the policy creation instructions as described in *Creating Policies*.

6 Click **Create**.

Adding a Policy to a File Replica Link

A snapshot policy can be added to any outbound (➜) replica link.

To add a snapshot policy to a replica link, perform the following:

1 From the **Protection** > **File Replica Links** page, locate the file replica link to which you wish to add a policy and click the **More Options** button located at the end of that replica link's row.

2 Select **Add Policies**. The **Add Policies** pop-up window appears.

3 Select the policy or policies you wish to add to the replica link from the **Available Policies** pane.

4 Click **Add**.

Removing a Policy from a File Replica Link

A snapshot policy can be removed from any outbound (➜) replica link.

To remove a snapshot policy from a replica link, perform the following:

1 From the **Protection** > **File Replica Links** page, locate the file replica link from which you wish to remove a policy and click the **More Options** button located at the end of that replica link's row.

2 Select **Remove Policies**. The **Remove Policies** pop-up window appears.

3 Select the policy or policies you wish to remove from the replica link from the **Available Policies** pane.

4 Click **Remove**.

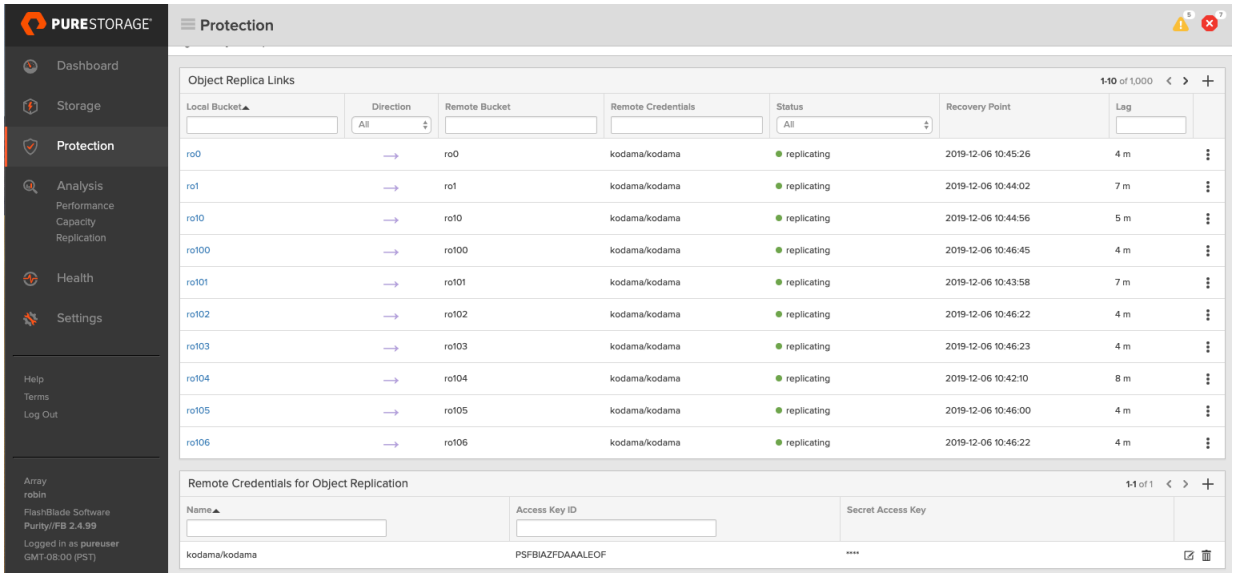
Object Replica Links

Object replica links and remote credentials are required for replicating object data between FlashBlade arrays and S3 targets.

Note: Objects that were created prior to the creation of the object replica link are not replicated. Objects created after the creation of the object replica link will be replicated from the source bucket to the target bucket.

The **Object Replica Links** tab is used to view and manage object replica links and remote credentials.

Figure 6.5 Object Replica Links



The **Object Replica Links** tab contains two panes, **Object Replica Links** and **Remote Credentials for Object Replication**.

The **Object Replica Links** pane displays a list of all configured object replica links:

- **Local Bucket**: The name of the local (source) bucket.
- **Direction**: The direction of replication, outbound (→).
- **Remote Bucket**: The name of the of the remote (target) bucket.
- **Remote Credentials**: The name of the remote credentials is the combined remote array name or S3 target with the remote credential name. For example `array2/cred1`.
- **Status**: The current replication status.
  - **replicating**: No errors, currently attempting replication.
  - **paused**: Data transfer is currently halted due to administrator action.
  - **unhealthy**: No connectivity.
- **Recovery Point**: A point in time where all object creations, updates, and deletions that occurred after the creation of the replica link and before this point in time are guaranteed to have been replicated. Object creations, updates, and deletions that occurred before the creation of a replica link are not replicated. Those that occurred after the recovery point may or may not have been replicated.

- **Lag**: The amount of time, if any, the replication target is behind the source, and is the time difference between the current time and the recovery point.

The **Remote Credentials for Object Replication** pane displays:

- **Name**: The name of the array and user is the combined remote array name or S3 target with the remote credential name. For example `array2/cred1`.
- **Access Key ID**: The access key ID created for the specific user.
- **Secret Access Key**: The secret key is encrypted and only revealed when first created.

Creating an Object Replica Link

Note: Objects created after the creation of the object replica link will be replicated from the source bucket to the target bucket. Any objects that were created prior to the creation of the object replica link are not replicated.

Object replica links allow object data to be replicated between FlashBlade arrays and S3 targets.

To create an object replica link, perform the following:

1. From the **Protection** > **Object Replica Links** page, click the **Add** (+) button in the heading of the **Object Replica Links** list. The **Create Object Replica Link** pop-up window appears.
2. From the **Local Bucket Name** list, select the local (source) bucket from which data will be replicated.
3. From the **Remote Array or Target** list, select the remote (target) array or S3 target.
4. From the **Remote Bucket** field, enter the name of the remote (target) bucket to which data will be replicated. Versioning must be enabled on the target bucket for replication to proceed.
5. From the **Remote Credential** list, select the proper remote credential to allow replication.
6. Click **Create**.

Editing an Object Replica Link

To edit (modify) an object replica link, perform the following:

1. From the **Protection** > **Object Replica Links** page, locate the object replica link you wish to modify and click the **More Options** button located at the end of that replica link's row.
2. Click **Edit**. The **Edit Object Replica Link** pop-up window appears.

3 From the **Remote Credential** list, select the proper remote credential to allow replication.

Pausing an Object Replica Link

Replication between a local bucket and target bucket can be paused at any time by pausing the replica link.

To pause an object replica link, perform the following:

1 From the **Protection** > **Object Replica Links** page, locate the object replica link you wish to pause and click the **More Options** button located at the end of that replica link's row.

2 Click **Pause**. The **Pause Replica Link** pop-up window appears.

3 Click **Pause** to confirm that you wish to pause the replica link.

Resuming an Object Replica Link

Paused replication between a local bucket and target bucket can be resumed at any time by resuming the replica link.

To resume a paused object replica link, perform the following:

1 From the **Protection** > **Object Replica Links** page, locate the paused object replica link you wish to resume and click the **More Options** button located at the end of that replica link's row.

2 Click **Resume**. The **Resume Replica Link** pop-up window appears.

3 Click **Resume** to confirm that you wish to resume the replica link.

Deleting an Object Replica Link

When an object replica link is deleted, replication between the local bucket and target bucket is suspended.

To delete an object replica link, perform the following:

1 From the **Protection** > **Object Replica Links** page, locate the object replica link you wish to delete and click the **More Options** button located at the end of that replica link's row.

2 Click **Delete**. The **Delete Replica Link** pop-up window appears.

3 Click **Delete** to confirm that you wish to delete the replica link.

Creating Remote Credentials

In addition to a replica link, a remote credential is required for replication between a local and target bucket. In order to create a remote credential, the following are required:

- The source and target array, or S3 target, must be connected.
- A previously created user access key and secret access key (see *Creating a User*).

To create remote credentials for a replica link, perform the following:

1. From the **Protection** > **Object Replica Links** page, click the **Add** (+) button in the heading of the **Remote Credentials for Object Replication** list. The **Create Remote Credentials** pop-up window appears.
2. From the **Remote Array or Target** list, select the connected remote (target) array or S3 target.
3. In the **Name** field, enter the credential name.
4. Enter the user access key from the target array or S3 target in the **Access Key ID** field.
5. Enter the user secret access key from the target array or S3 target in the **Secret Access Key** field.
6. Click **Create**.

Editing Remote Credentials

The access key ID and secret access key for remote credentials for object replication can be edited. In order to edit a remote credential, you must have created a new user access key and secret access key (see *Creating a User*).

To edit remote credentials, perform the following:

1. From the **Protection** > **Object Replica Links** page, click the edit button in the same row of the remote credential you wish to edit in the **Remote Credentials for Object Replication** list. The **Edit Remote Credentials** pop-up window appears.
2. Enter the user access key from the target array or S3 target in the **Access Key ID** field.
3. Enter the user secret access key from the target array or S3 target in the **Secret Access Key** field.
4. Click **Save**.

Deleting Remote Credentials

Deleting remote credentials in an object replication setup suspends replication between the array and its target.

To delete remote credentials, perform the following:

1. From the **Protection > Object Replica Links** page, click the delete button in the same row of the remote credential you wish to delete in the **Remote Credentials for Object Replication** list.
2. Click **Delete**.

Chapter 7
The Purity//FB GUI Analysis Page

The **Analysis** page displays historical array data, such as I/O performance trends and storage capacity and consumption data.

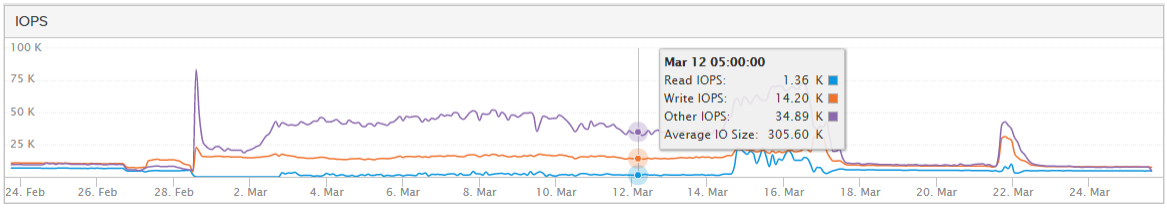
Performance

The **Analysis** > **Performance** panel displays a series of rolling charts consisting of real-time performance metrics for the array and its file systems and buckets. By default, performance metrics are displayed for the array.

The curves in each chart are comprised of a series of individual data points. Hover over any part of a chart to display values for a specific point in time. The values that appear in the point-in-time tooltips are rounded to two decimal places.

The Performance Chart

The following example displays the IOPS statistics on the array at precisely `5:00:00` on `March 12`.



The Performance panel includes the Latency, IOPS, and Bandwidth charts.

Latency

The Latency chart displays the average latency times for various operations.

- **Read Latency (R)** - Average arrival-to-completion time, measured in milliseconds, for a read operation.
- **Write Latency (W)** - Average arrival-to-completion time, measured in milliseconds, for a write operation.

- **Other Latency (O)** - Average arrival-to-completion time, measured in milliseconds, for all other metadata operations.

IOPS

The IOPS (Input/output Operations Per Second) chart displays I/O requests processed per second by the array. This metric counts requests per second, regardless of how much or how little data is transferred in each.

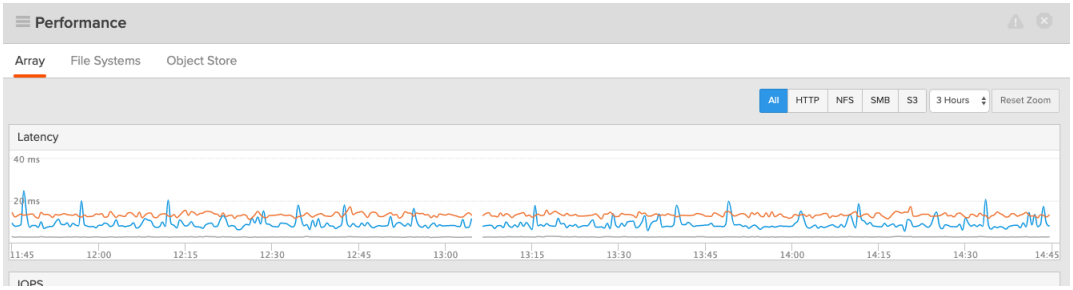
- **Read IOPS (R)** - Number of read requests processed per second.
- **Write IOPS (W)** - Number of write requests processed per second.
- **Other IOPS (O)** - Number of metadata operations processed per second.
- **Average IO Size** - Average I/O size per request processed. Requests include reads and writes.

Bandwidth

The Bandwidth chart displays the number of bytes transferred per second to and from all file systems. The data is counted in its expanded form rather than the reduced form stored in the array to truly reflect what is transferred over the storage network. Metadata bandwidth is not included in these numbers.

- **Read Bandwidth (R)** - Number of bytes read per second.
- **Write Bandwidth (W)** - Number of bytes written per second.

By default, the performance charts, as described above, are displayed for the array. Click the **File Systems** or **Object Store** tabs to view file system or object store-specific latency, IOPs, and bandwidth performance charts.



The **File Systems** and **Object Store** tabs allow you to view the performance charts for one or more selected NFS file systems or buckets, respectively.

Displaying Protocol-Specific Metrics

By default, the performance charts display data for all supported protocols, as indicated by the **All** button in the upper-right corner of the **Array** tab. Click a protocol button to display only the performance information for that protocol.

The performance charts display data in a user-friendly view that is common for all protocols.

For HTTP and S3 protocol data, there are two display options:

- **General**: The Latency and IOPS graphs display operations that the array is doing in chunks. Default.
- **Protocol Specific**: The Latency and IOPS graphs display a protocol-specific number of user operations.

For example, for HTTP data, in the **General** view, operations such as listing a directory and deleting are both grouped in the Other line. In the **Protocol Specific** view, read and write operations on a directory are split out into their own line.

The file transfer can be performed in many chunks for one large file. The **General** view shows one operation per chunk transfer, while the **Protocol Specific** view shows only one operation per file. When transferring small files, the number of operations is the same in both the **General** and **Protocol Specific** views.

Displaying a Different Time Range

By default, the performance charts display data for the past 3 hours, as indicated by the time range drop-down button. Click the drop-down button to view performance data over a different time range.

Note about the Performance Charts

The **Dashboard** and **Analysis** pages display the same latency, IOPS, and bandwidth performance charts, but the information is presented differently between the two pages.

In the **Dashboard** page:

- The performance charts are displayed for the array.
- The performance charts are updated once every second.
- The performance charts display up to 5 minutes of historical data.

In the **Analysis** page:

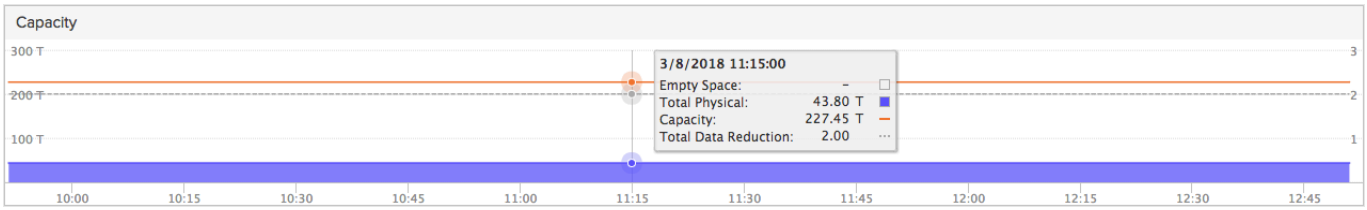
- The performance charts are provided for the array.
- At its shortest range (5m), the performance charts are updated once every second. As the range increases, the update frequency (and resolution) decreases.
- The performance charts display up to one year of historical data.
- The performance charts can be filtered to display metrics by protocol.

Capacity

By default, the **Capacity** graph displays information for all storage on the array. Click **File Systems** or **Object Store** to display information for only that storage type.

The **Capacity** graph displays the following array-wide capacity and consumption information:

- **Empty Space**: Total storage space available on the array.
- **Object Store**: Amount of space that the written data occupies on the array's buckets after reduction via data compression.
- **File Systems**: Amount of space that the written data occupies on the array's file systems after reduction via data compression.
- **Total Physical**: Total storage space used on the array.
- **Capacity**: Total storage capacity of the array.
- **Total Data Reduction**: Ratio of the size of the written data (i.e. Used) versus the amount of space the data occupies after data compression (i.e. Physical). Data reduction is given for all storage on the array, all file systems on the array, and all buckets on the array.
- **Unique**: Total space that the written data occupies on the array's file systems or buckets (Only shown if viewing the File systems or Object Store capacity graph).
- **Snapshots**: Amount of space that the written data occupies on the array's snapshots after reduction via data compression (Only shown if viewing the File systems capacity graph).



Hover over any part of a chart to display values for a specific point in time. The size values that appear in the point-in-time tooltips are rounded to two decimal places.

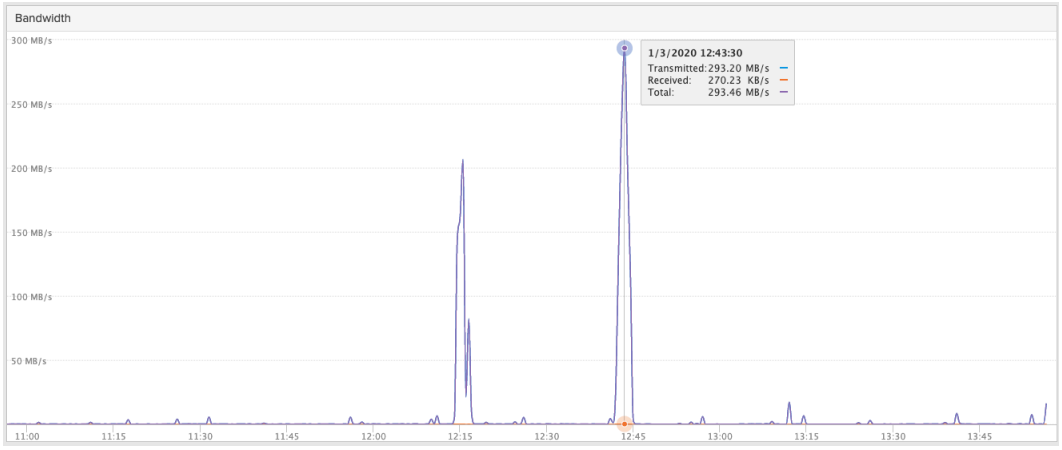
By default, the Capacity graph displays data for the past 3 hours, as indicated by the time range drop-down button. Click the drop-down button to view capacity data over a different time range.

Replication

The replication **Bandwidth** chart displays historical replication bandwidth on the array.

The replication **Bandwidth** chart displays the number of bytes of replication data transferred over the storage network per second between this array and its source arrays, target arrays, and external storage systems (such as S3 buckets), at certain points in time.

Hover over any part of a chart to display values for a specific point in time. The size values that appear in the point-in-time tooltips are rounded to two decimal places.



By default, the point-in-time pop-up in the replication **Bandwidth** chart displays the following metrics:

- **Transmitted**: The bandwidth of data transmitted to connected arrays and S3 targets.
- **Received**: The bandwidth of data received from connected arrays.

- **Total**: Total bandwidth of transmitted and received data.

Click **File Systems** or **Object Store** to display information for only that storage type.

By default, the **Bandwidth** chart is displayed for the array. Click the **Connected Arrays** or **Connected Targets** tabs to view array or target-specific bandwidth charts.

The **Connected Arrays** and **Connected Targets** tabs allow you to view the performance charts for one or more selected arrays or targets, respectively.

Chapter 8
The Purity//FB GUI Health Page

The **Health** page displays information to help gauge the health of the array.

Hardware

The **Health > Hardware** page contains information about the array hardware components.

Note: The array displayed will vary depending upon if your FlashBlade array consists of a single or a multi-chassis configuration. For multi-chassis configurations, in addition to front and rear views of the chassis, the display also includes the array's external fabric modules (XFMs).

The hardware panel graphically displays the status of each hardware component, which is useful for diagnosing hardware-related problems.

Figure 8.1 Health - Hardware Page (single chassis)

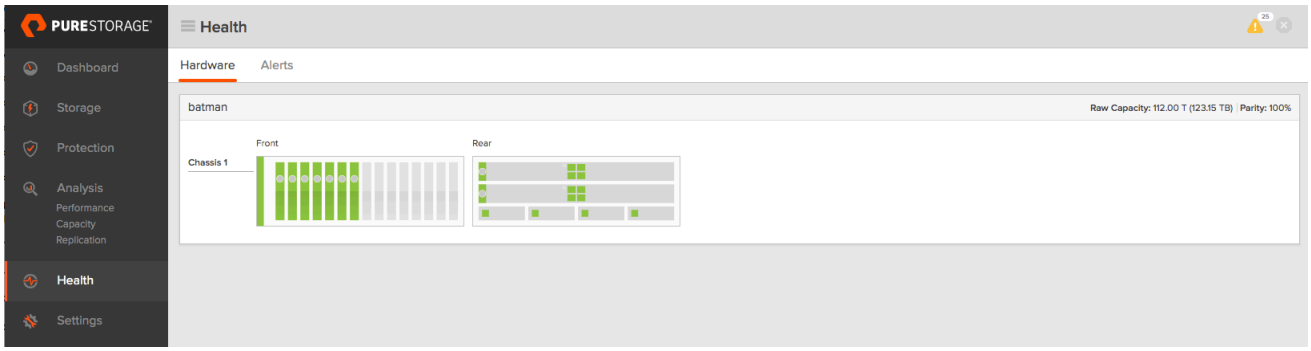
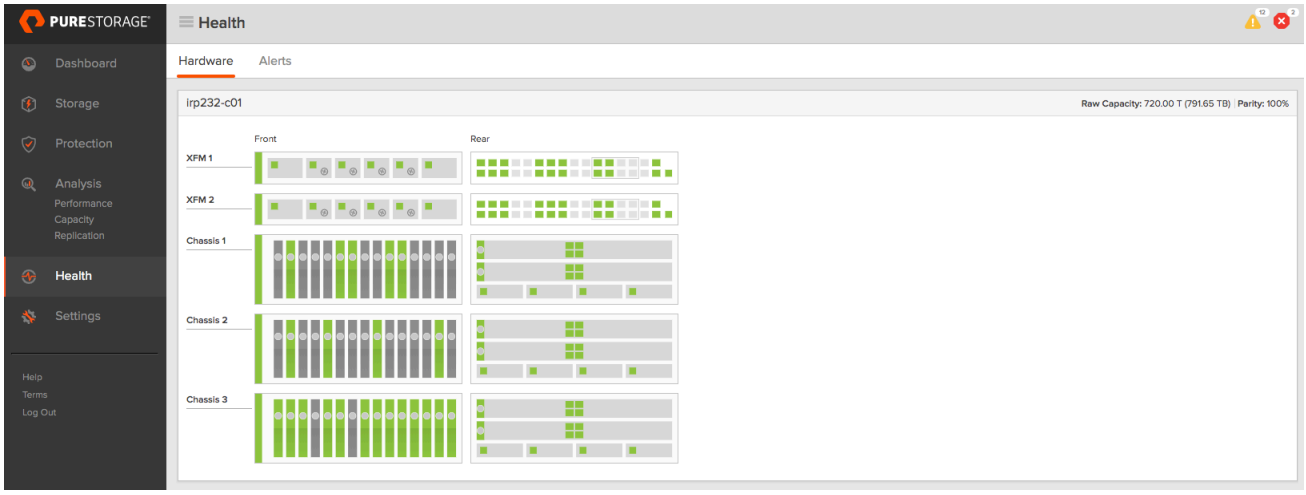


Figure 8.2 Health - Hardware Page (multi-chassis)



External Fabric Modules equipped with optional management ports will be displayed as follows:

Figure 8.3 Health - Management Ports

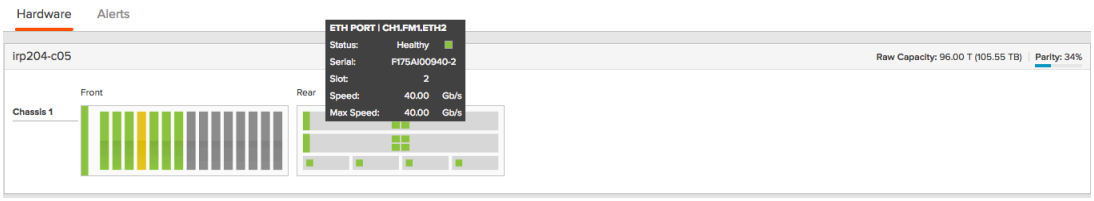
The view is a schematic representation of the array with colored indicators of each component's status.

The colors within each hardware component represent the component status:

- **Green**: Healthy and functioning properly.
- **Yellow**: Unhealthy, identifying, or unrecognized.
- **Red**: Critical or unknown.
- **Gray**: Disconnected, unused, or unclaimed.

Hover the mouse over a hardware component to display its status and details.

Figure 8.4 Health - Hardware Panel (Front and Rear Views)



The title bar of the hardware panel includes the array name, the raw capacity value, and parity information.

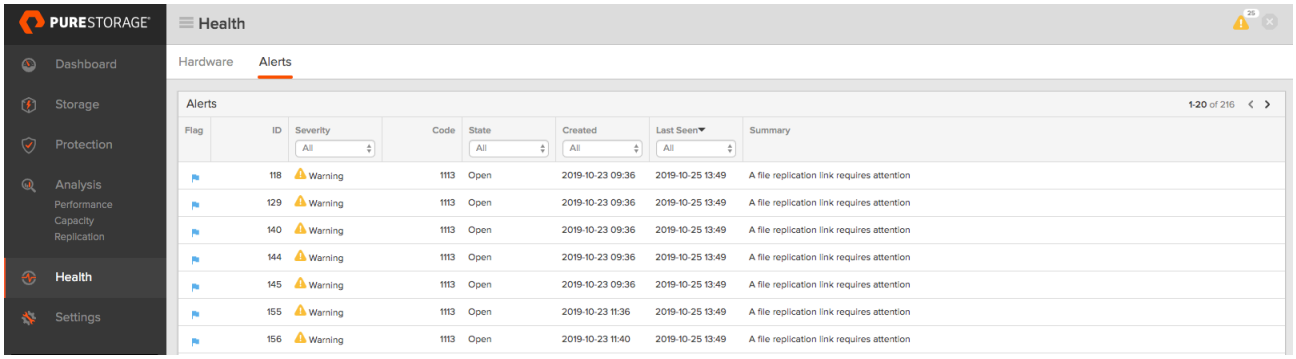
The raw capacity value represents the total usable capacity of the array, displayed in both tebibyte (T) and terabyte (TB) units.

The parity value represents the percentage of data that is fully protected. The value will drop below 100% if the data isn't fully protected, such as when a blade is pulled and the array is rebuilding the data to bring it back to full parity.

Alerts

Purity//FB generates an alert when there is a change to the array or to one of the Purity//FB hardware or software components. The **Health > Alerts** page displays a list of alerts that have been generated on the array.

Figure 8.5 Health - Alerts Page



To conserve space, Purity//FB stores a reasonable number of alert records on the array. Older entries are deleted from the log as new entries are added. To access the complete list of messages, contact Pure Storage Support.

Purity//FB assigns a unique numeric ID to each alert as it is created. By default, alerts are sorted in chronological descending order by "Last Seen" date.

The flag icon represents an alert that has been flagged by Purity or the user. Purity automatically flags all alerts. An alert remains flagged until you have manually cleared the flag to indicate that the alert has been addressed. If there are further changes to the condition that caused the alert (for example, the health of a blade has changed), Purity will set the flag again.

The icons that appear along the left side of each alert in the list output represent the alert severity level:

- **Blue (INFO)** icons represent informational messages generated due to a change in state. INFO messages can be used for reporting and analysis purposes. No action is required.
- **Yellow (WARNING)** icons represent important messages warning of an impending error if action is not taken.
- **Red (CRITICAL)** icons represent urgent messages that require immediate attention.

Click any of the column headings to change the sort order.

Each alert in the list output includes the following information:

- **ID**: Unique number assigned by the array to the alert. ID numbers are assigned to alerts in chronological ascending order.
- **Severity**: Alert severity, categorized as `critical`, `warning`, or `info`.

  Critical alerts are typically triggered by service interruptions, major performance issues, or risk of data loss, and require immediate attention. For example, Purity//FB triggers a critical alert if a blade has been removed from the chassis.

  Warning alerts are of low to medium severity and require attention, though not as urgently as critical alerts. For example, Purity//FB triggers a warning alert if it detects an unhealthy blade that is still processing data.

  Informational (Info) alerts inform users of a general behavior change and require no action. For example, Purity//FB triggers an informational alert if the NFS service is unhealthy.
- **Code**: Pure Storage alert code number that identifies the type of alert event.

- **State**: Current state of the alert. Possible states include: `open`, `closed`, `closing`, and `waiting to downgrade`.

  An alert goes from `open` state to `close` state when the issue is completely resolved, such as when a blade has been removed from the chassis. If the blade is then reinserted and pulled again, a new alert will be generated.

  Certain alerts are generated due to intermittent issues. Examples include temperature sensors reporting values outside of normal operating range and space usage exceeding certain capacity thresholds. These types of alerts can change from `open` state to `closing` or `waiting to downgrade` states.

  And alert changes from `open` state to `closing` state when it is no longer an issue. After the alert remains in `closing` state for 24 hours without change, it changes into `closed` state.

  An alert changes from `open` state to `waiting to downgrade` state when the issue becomes less severe. After the alert remains in `waiting to downgrade` state for 24 hours without change, the alert severity is downgraded. For example, when array capacity reaches 100%, a critical alert is issued with an `open` state. When array capacity drops below 100%, the alert changes to `waiting to downgrade` state. After the array has remained at less than 100%, but more than 90% capacity, for 24 hours, the alert severity is downgraded to `warning`.

- **Created**: Date and time the alert was first generated and initial alert email notifications were sent to alert watchers.
- **Last Seen**: Most recent date and time Purity//FB saw the issue that generated the alert.
- **Summary**: Alert summary.

Click anywhere in an alert row to display the alert details. Some alert detail descriptions include a **more info** link providing additional information about the alert through the Pure Storage Knowledge Base.

The identify light for blades and fabric modules can be illuminated from the GUI by clicking that individual component from the image of the array from the **Health** page. The identify light in the image will turn blue and the physical identify light will illuminate to assist with locating the physical component in the data center. Click the component again to turn off the indicator light.

Flagging Alert Messages

To flag alert messages:

1. Select **Health** > **Alerts**.
2. Locate the alert you want to flag.
3. Click the flag icon. When the icon becomes blue, the alert is flagged.

Unflagging Alert Messages

To unflag alert messages:

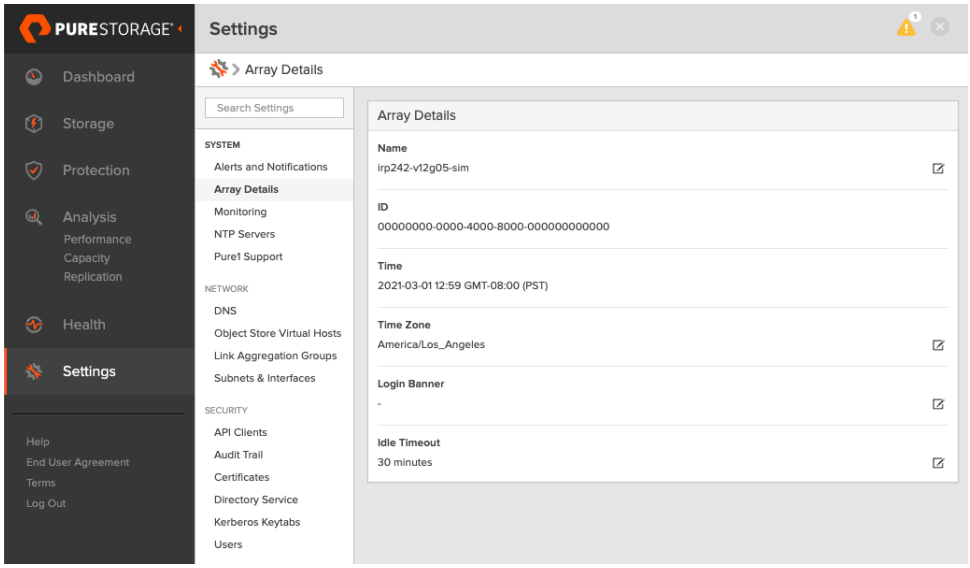
1. Select **Health** > **Alerts**.
2. Locate the alert you want to unflag.
3. Click the flag icon. When the icon becomes gray, the alert is unflagged.

Alerts can also be unflagged and dismissed from the **Recent Alerts** panel from the **Dashboard** page by clicking the X to the right of the alert.

Chapter 9
The Purity//FB GUI Settings Page

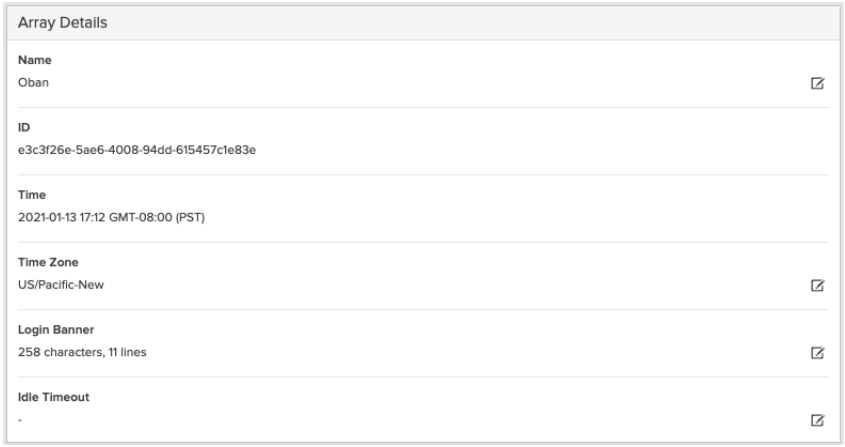
The **Settings** page is used to display and configure system, network, and security settings of an array.

Figure 9.1 Purity//FB Settings Page



By default, the **Settings** page displays the **Array Details** panel (see *Array Details Panel*). This panel displays basic information about your FlashBlade array.

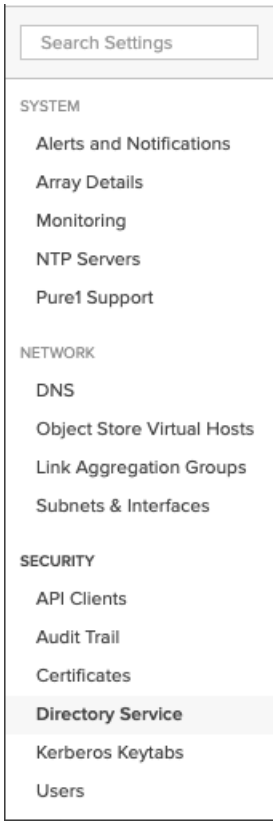
Figure 9.2 Array Details Panel



Side Navigation Bar

The **Settings** page provides a navigation sidebar, which allows you to view and manage various array settings.

Figure 9.3 Settings Page Navigation Sidebar



The navigation side bar is divided into three categories: **System**, **Network**, and **Security** settings.

The navigation sidebar also provides a search field, allowing you to search for specific system, network, and security items. For example, if you enter "CA Certificate", the navigation sidebar filters the list to just two items: **Certificates** and **Directory Service**.

Working with System Settings

The following **System** settings are available:

- **Alerts and Notifications**
  - **Alert Watchers** - Displays and manages recipients of alert notifications.
  - **Alert Routing** - Displays and allows configuration of how alerts and logs are managed.
  - **Quota Notifications** - Displays and manages recipients of quota notifications.
- **Array Details** - Displays and manages basic information about your FlashBlade array.
- **Monitoring**
  - **SNMP** - Displays and manages Simple Network Management Protocol (SNMP) manager information.
  - **Syslog Server Connections** - Displays and manages remote syslog servers.
- **NTP Servers** - Displays and manages the Network Time Protocol (NTP) servers that are currently being used by the array to maintain reference time.
- **Pure1 Support** - Displays and manages the features used to communicate with Pure Storage Support.

Alert Watchers

Purity//FB generates an alert whenever the health of a component degrades or a capacity threshold is reached. Alerts can also be sent as email notifications to designated alert watchers.

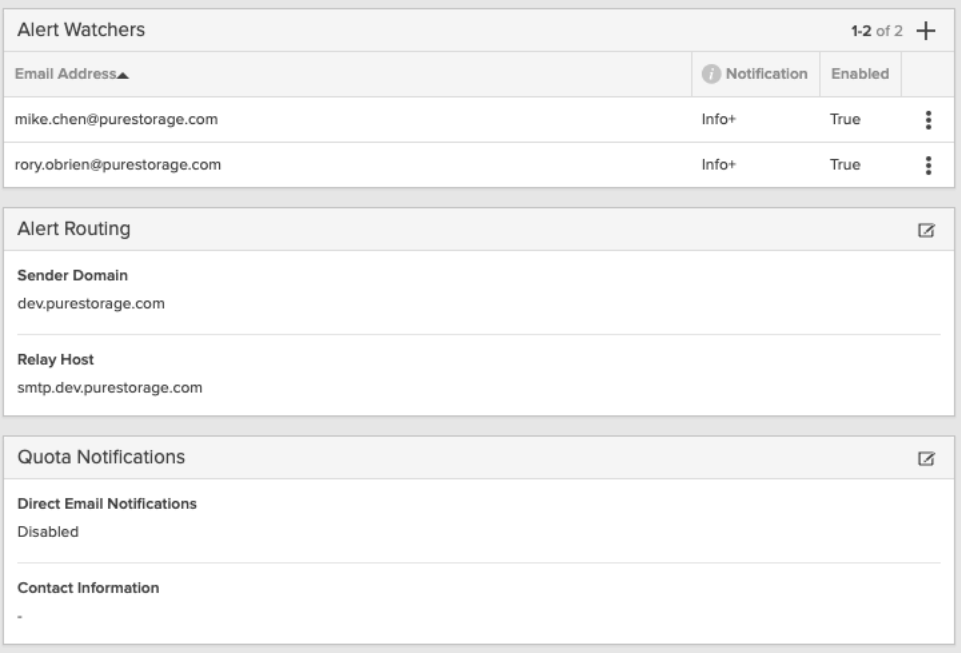
The **Alert Watchers** panel displays the email addresses of designated alert watchers, the severity level of alert notifications that alert watchers will receive, and the status of each watcher. The sending account name for Purity//FB alert email notifications is the array name at the configured sender domain.

Once added, an alert watcher will start receiving alert email notifications.

By default, alert watchers receive all alert email notifications regardless of alert severity. You can optionally configure alert watchers to receive only critical and warning-level alert notifications, or only critical-level alert notifications.

To access the **Alert Watchers** panel, from the **Settings** page navigation sidebar click **Alerts and Notifications** under **System**.

Figure 9.4 Viewing the Alert Watchers Panel



Alert watchers can be in enabled (**True**) or disabled (**False**) state. Alert watchers that are enabled will receive alert email notifications. New alert watchers are enabled by default. Disabled alert watchers do not receive email notifications. Disabling an alert watcher does not delete the recipient's email address, it only stops the watcher from receiving email notifications.

Deleting an alert watcher completely removes the watcher from the list. Once an email address has been deleted, the corresponding alert watcher will no longer receive alert notifications.

Adding an Alert Watcher

Add an alert watcher to receive email alert notifications.

To add an alert watcher, perform the following:

1. From the **Settings** page navigation sidebar, click **Alerts and Notifications** under **System**.
2. In the **Alert Watchers** panel, click the Add (+) button. The **Add Alert Watchers** pop-up window appears.
3. Enter the email address of the alert watcher in the **Email** field.
4. (Optional) Select a severity level (**Info+**, **Warning+**, or **Critical**) from the **Notification Severity** menu.

- **Info+**: If selected, the alert watcher will receive all alert notifications for all severity levels.
- **Warning+**: If selected, the alert watcher will receive any alert with a severity of Warning or more severe. Info-level alert notifications will not be received.
- **Critical**: If selected, the alert watcher will only receive the most severe Critical-level alert notifications.

5 (Optional) Click **Test** to send a test email to the new alert watcher.

6 Click **Add**.

Enabling and Disabling an Alert Watcher

In order for an alert watcher to receive email alert notifications, the alert watcher must be enabled. By default, alert watchers are enabled at creation.

1 From the **Settings** page navigation sidebar, click **Alerts and Notifications** under **System**.

2 In the **Alert Watchers** panel, click the **More Options** button in the row of the alert watcher for whom you wish to enable or disable and select **Edit**. The **Edit Alert Watchers** pop-up window appears.

3 Click the **Enabled** toggle switch to set the alert watcher to enabled (blue) or disabled (gray).

4 Click **Save**.

Setting the Severity Level for Alert Watcher Notifications

By default, an alert watcher receives all alert email notifications, regardless of severity. You can configure the severity level of alert that your alert watchers will receive.

To set the severity level for alert watcher notifications, perform the following:

1 From the **Settings** page navigation sidebar, click **Alerts and Notifications** under **System**.

2 In the **Alert Watchers** panel, click the **More Options** button in the row of the alert watcher for whom you wish to set a notification severity level and select **Edit**. The **Edit Alert Watchers** pop-up window appears.

3 Select a severity level (**Info+**, **Warning+**, or **Critical**) from the **Notification Severity** menu.

- **Info+**: If selected, the alert watcher will receive all alert notifications for all severity levels.
- **Warning+**: If selected, the alert watcher will receive any alert with a severity of Warning or more severe. Info-level alert notifications will not be received.
- **Critical**: If selected, the alert watcher will only receive the most severe Critical-level alert notifications.

4 Click **Save**.

Sending a Test Email

You can test an array 's ability to send email notifications to alert watchers, designated or not. Two types of test messages can be issued:

- Before creating an alert watcher, send a test message to the alert watcher's email address to ensure alert notifications can reach the intended destination.
- At any time, send a test message to all of the enabled alert watchers to ensure alert notifications reach their intended destinations.

To send an test email, perform the following:

1 From the **Settings** page navigation sidebar, click **Alerts and Notifications** under **System**.

2 In the **Alert Watchers** panel, click the **More Options** button in the row of the alert watcher for whom you wish to send a test email and select **Send Test Email**.

If the email is not valid, an error message appears.

Deleting an Alert Watcher

Once an email address has been deleted, the corresponding alert watcher will no longer receive alert notifications.

1 From the **Settings** page navigation sidebar, click **Alerts and Notifications** under **System**.

2 In the **Alert Watchers** panel, click the **More Options** button in the row of the alert watcher you wish to delete and select **Delete**. The **Delete Alert Watcher** pop-up window appears.

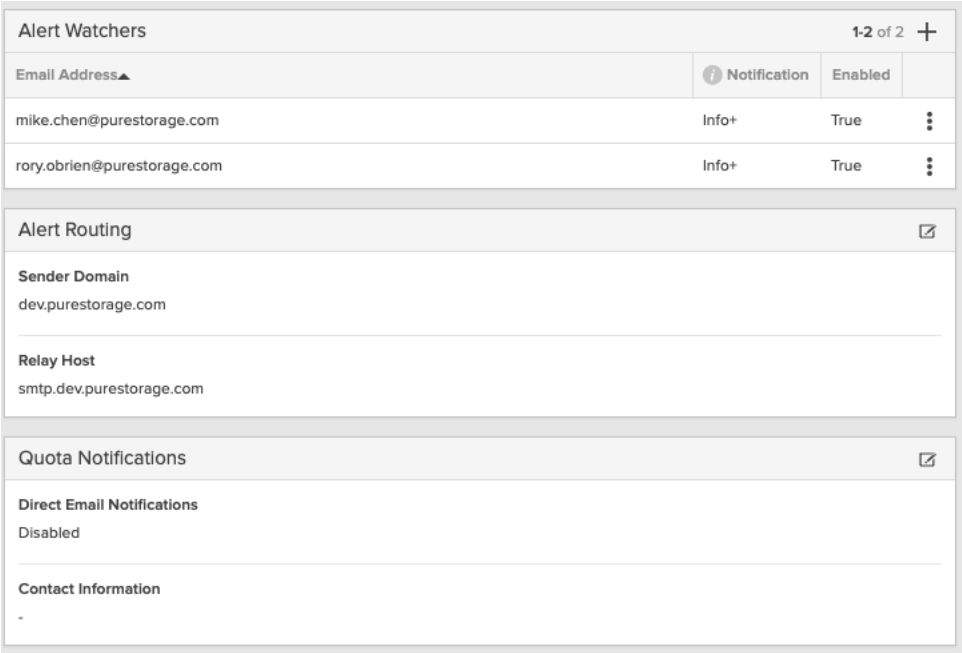
3 Click **Delete**.

Alert Routing

The **Alert Routing** panel displays the ways in which alerts and logs are managed.

To access the **Alert Routing** panel, from the **Settings** page navigation sidebar, click **Alerts and Notifications** under **System**.

Figure 9.5 Viewing the Alert Routing Panel



The sender domain determines how logs are parsed and treated by Pure Storage Support and Escalations. The domain name is also used in the "from" address of outgoing alert email notifications. The domain name must be set to your company's domain name. For example, `mydomain.com`.

The relay host represents the hostname or IP address of the email relay server currently being used as a forwarding point for alert email notifications generated by the array. If a relay host is not configured, Purity//FB sends all alert email notifications directly to the recipient addresses rather than route them via the relay (mail forwarding) server.

Configuring Alert Routing

Note: If a relay host is not configured, Purity//FB sends all alert email notifications directly to the recipient addresses rather than route them via the relay (mail forwarding) server.

To configure the sender domain and relay host for alert routing, perform the following.

1. From the **Settings** page navigation sidebar, click **Alerts and Notifications** under **System**.
2. In the **Sender Domain** section of the **Alert Routing** panel, click the edit icon. The **Edit Alert Routing** pop-up window appears.
3. Type the sender domain name. The domain name must be set to your company's domain name. For example, `mydomain.com`.
4. (Optional) Type the host name or IP address of the email relay server that is to be used as the forwarding point for alert email notifications generated by the array. If specifying an IP address, enter the IPv4 or IPv6 address.

   For IPv4, specify the IP address in the form `ddd.ddd.ddd.ddd`, where `ddd` is a number ranging from `0` to 255 representing a group of 8 bits. If a port number is also specified, append it to the end of the address in the form `ddd.ddd.ddd.ddd:PORT`, where `PORT` represents the port number.

   For IPv6, specify the IP address in the form `xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx`, where `xxxx` is a hexadecimal number representing a group of 16 bits. Consecutive fields of zeros can be shortened by replacing the zeros with a double colon (`::`) . If a port number is also specified, enclose the entire address in square brackets (`[]`) and append the port number to the end of the address. For example, `[xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx]:PORT`, where `PORT` represents the port number.
5. Click **Save**.

Quota Notifications

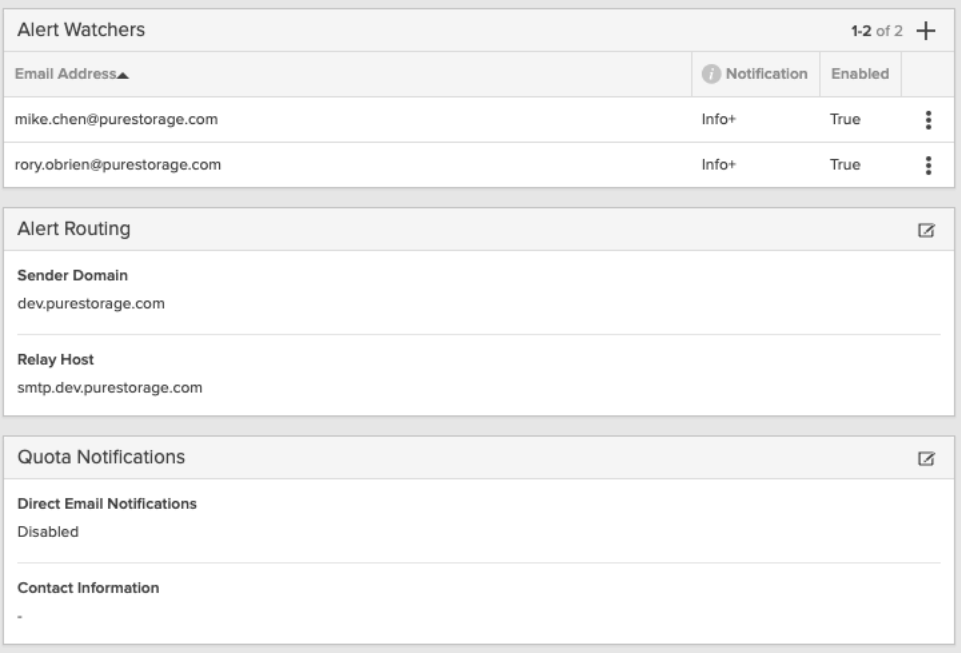
The **Quota Notifications** panel displays whether email notifications regarding quota usage are enabled as well as contact information for notification recipients, if any.

Direct email notifications can optionally be enabled to send emails to users and groups when they approach or exceed their file system quota. An email with a warning message is sent when a quota reaches 80% capacity and again at 90% capacity. When a quota is at 100% capacity, a critical email is sent. Emails are sent every 24-hours until the quota falls below the 80% capacity threshold.

A direct email notification can optionally be configured to include the administrator's contact information which the user and group can use to inquire about their quota and manageability options, such as requesting an increase of the file system quota. The FlashBlade administrator can include a free-form string. The contact information can include a name, phone number, or email. For example **`John Doe, Storage Admin Team. jdoe@example.com (555-867-5309)`**.

To access the **Quota Notifications** panel, from the **Settings** page navigation sidebar, click **Alerts and Notifications** under **System**.

Figure 9.6 Viewing the Quota Notifications Panel



Enabling Quota Notifications

If you wish for users and/or groups to receive notification when they approach or exceed their file system quota, configure (enable) quota notifications.

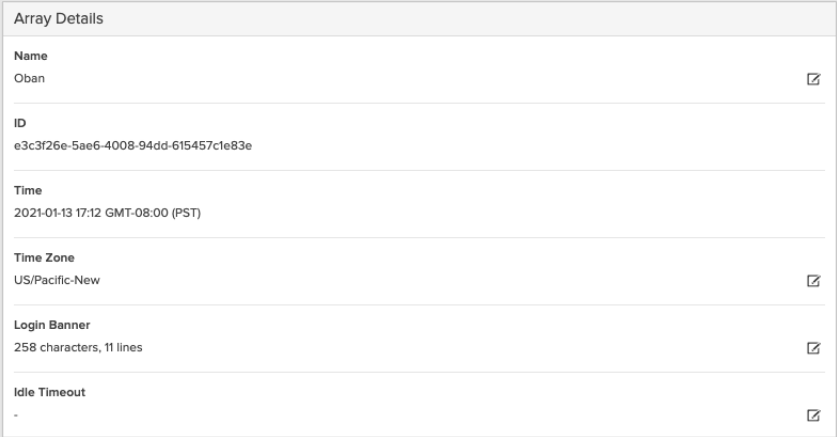
To enable quota notifications, perform the following:

1. From the **Settings** page navigation sidebar, click **Alerts and Notifications** under **System**.
2. In the **Quota Notifications** panel, click the edit icon. The **Edit Quota Notifications** pop-up window appears.
3. Set the **Direct Email Notifications Enabled** toggle button to enable (blue) quota notifications.
4. In the **Contact Information** field, optionally enter the contact information of FlashBlade administrator that users and groups should reach out to if they have questions about their quota. This may be an email, a phone number, a name, or some combination thereof. The contact field cannot exceed 256 characters in length.
5. Click **Save**.

Array Details Panel

The **Array Details** panel is displayed by default when navigating to the Purity//FB GUI's **Settings** page. It can also be accessed from the **Settings** page navigation sidebar by clicking **Array Details** under **System**

Figure 9.7 Viewing the Array Details Panel



This panel displays basic information about your FlashBlade array, including:

- **Name** - The array name set during FlashBlade installation.
- **ID** - The array's unique ID.
- **Time** - The array time is based on the time zone of the array, which is set during FlashBlade installation.
- **Time Zone** - The array time zone. The array time zone is not related to the user's local time zone that appears in the bottom-left corner of the Navigation pane. The user's local time zone is determined by the browser's local time.

  Note that Purity//FB CLI dates and times are displayed in the time zone of the array, while Purity//FB GUI dates and times are displayed in the local user's time zone.
- **Login Banner** - The number of characters and lines currently used for the login banner.
- **Idle Timeout** - The idle timeout period currently set on the FlashBlade.

Items displayed with an edit icon are configurable.

Renaming the Array

To rename the array, perform the following:

1. Navigate to the **Array Details** panel on the **Settings** page.
2. Click the edit icon next to the current array name. The **Rename Array** pop-up window appears.
3. Type the new array name.
4. Click **Rename**.

Array Time

The array time is based on the time zone of the array, which is set during FlashBlade installation.

The array time zone is not related to the user's local time zone that appears in the bottom-left corner of the Navigation pane. The user's local time zone is determined by the browser's local time.

Purity//FB CLI dates and times are displayed in the time zone of the array, while Purity//FB GUI dates and times are displayed in the local user's time zone.

Changing the Time Zone

To change the time zone of the array:

1. Navigate to the **Array Details** panel on the **Settings** page.
2. Click the edit icon next to **Time Zone**. The **Edit Array Time Zone** pop-up window appears.
3. Select the new time zone.
4. Click **Save**.

Creating and Editing a Login Banner

To help identify the FlashBlade system being logged into, you can set a login banner. If a login banner already exists, the **Array Details** panel displays the the number of characters and lines currently used for the login banner.

To create a login banner, perform the following:

1. Navigate to the **Array Details** panel on the **Settings** page.
2. Click the edit icon next to **Login Banner**. The **Edit Login Banner** pop-up window appears.

3 Enter the login banner text. The limit is 8,000 characters.

4 Click **Save**.

If you wish to edit an existing login banner, follow the instructions above.

Setting the Idle Timeout Period

To automatically log out the user after a period of inactivity, you can set the array's idle timeout period.

Set the idle timeout period in the **Array Details** panel. If a timeout period has already been set, the timeout value is displayed next to **Idle Timeout**.

To set the array idle timeout period, perform the following:

1 Navigate to the **Array Details** panel on the **Settings** page.

2 Click the edit icon next to **Idle Timeout**. The **Edit Idle Timeout** pop-up window appears.

3 Enter the timeout value. The timeout value can be set from five minutes to three hours and must be specified in seconds, minutes, or hours. For example, 300s, 15m, 2h, etc.

4 Click **Save**.

If you wish to disable the idle timeout period, follow the instructions above and set the timeout value to 0.

SNMP

The Simple Network Management Protocol (SNMP) is used by SNMP agents and SNMP managers to send and retrieve information. FlashBlade supports SNMP versions v2c and v3.

FlashBlade's built-in SNMP agent has local knowledge of the array. The agent collects and organizes this array information and translates it via SNMP to or from the SNMP managers. The agent cannot be deleted. The managers are defined by creating SNMP manager objects on the array. The managers communicate with the agent via the standard TCP port 161, and they receive notifications on port 162.

The SNMP agent has two functions, namely, responding to GET-type SNMP requests and transmitting alert messages.

The agent responds to GET-type SNMP requests made by the SNMP managers, and return values for an information block, such as purePerformance, or individual variables within the block, depending on the type of request issued. The following variables are supported:

Table 9.1 Supported Variables

Variable	Description
pureArrayReadBandwidth	Array read bandwidth (bytes/s)
pureArayWriteBandwidth	Array write bandwidth (bytes/s)
pureArrayReadIOPS	Array read IOPS (op/s)
pureArrayWriteIOPS	Array write IOPS (op/s)
pureArrayReadLatency	Array read latency (us/op)
pureArrayWriteLatency	Array write latency (us/op)
pureArrayAverageOperationSize	Array average operation size (bytes)
pureArrayAverageReadSize	Array average read size per read operation (bytes)
pureArrayAverageWriteSize	Array average write size per write operation (bytes)
pureArrayOtherIOPS	Array other operations process per second (op/s)
pureArrayOtherLatency	Array other latency (us/op)

The FlashBlade Management Information Base (MIB) describes the purePerformance variables and can be downloaded from the array to your local machine using the GUI or displayed using the CLI or REST API.

Note: MIB-2 object identifiers (OIDs) are not supported.

SNMP managers are added to the array through the creation of SNMP manager objects. When creating an SNMP manager object, enter the Host, which represents the DNS hostname or IP address of the computer that hosts the SNMP manager. Also specify the SNMP version from the Version drop-down list. Valid versions are v2c and v3.

The SNMP agent generates and transmits messages to the SNMP manager as traps or inform requests (informs), depending on the notification type that is configured on the manager. An SNMP trap is an unacknowledged SNMP message, meaning the SNMP manager does not acknowledge receipt of the message. An SNMP inform is an acknowledged trap.

If the SNMP manager notification type is set to `trap`, the agent sends the SNMP message (trap) without expecting a response. If the SNMP manager is set to `inform`, the agent sends the SNMP message (inform) and waits for a reply from the manager confirming message retrieval. If the agent does not receive a response within a certain timeframe, it will retry until the inform has passed through successfully. If the notification type is not set, the manager defaults to `trap`.

SNMPv2 uses a type of password called a community string to authenticate the messages that are passed between the agent and manager. The community string is sent in clear text, which is considered an unsecured form of communication. SNMPv3 supports secure communication between the agent and manager through the use of authentication and privacy encryption methods. As such, SNMPv2c and SNMPv3 have different security attributes.

To configure the SNMPv2c agent and managers, set the **Community** field to the community string under which the agent is to communicate with the managers. The agent and manager must belong to the same community; otherwise, the agent will not accept requests from the manager. When setting the community, Purity prompts twice for the community string. To remove the agent or manager from the community, leave the field blank.

To configure the SNMPv3 agent and managers, in the **User** field, specify the user ID that Purity uses to communicate with the SNMP manager. Also set the authentication and privacy encryption security levels for the agent and managers. SNMPv3 supports the following security levels:

- **noAuthNoPriv**: Authentication and privacy encryption is not set. Similar to SNMPv2c, communication between the SNMP agent and managers is not authenticated and not encrypted. noAuthNoPriv security requires no configuration.
- **authNoPriv**: Authentication is set, but privacy encryption is not set. Communication between the SNMP agent and managers is authenticated but not encrypted. Password authentication is based on MD5 or SHA hash authentication.

  To configure authNoPriv security, in the **Auth Protocol** field, set the authentication protocol to MD5 or SHA, and in the **Auth Passphrase** field, enter an authentication passphrase.

- **authPriv**. Communication between the SNMP agent and managers is authenticated and encrypted. Password authentication is based on MD5 or SHA hash authentication. Traffic between the FlashBlade and SNMP manager is encrypted using encryption protocol AES or DES.

  To configure authPriv security, in the **Auth Protocol** field, set the authentication protocol to MD5 or SHA, and in the **Auth Passphrase** field, enter an authentication passphrase. Also, in the **Privacy Protocol** field, set the privacy protocol to AES5 or DES, and in the **Privacy Passphrase** field, enter a privacy passphrase.

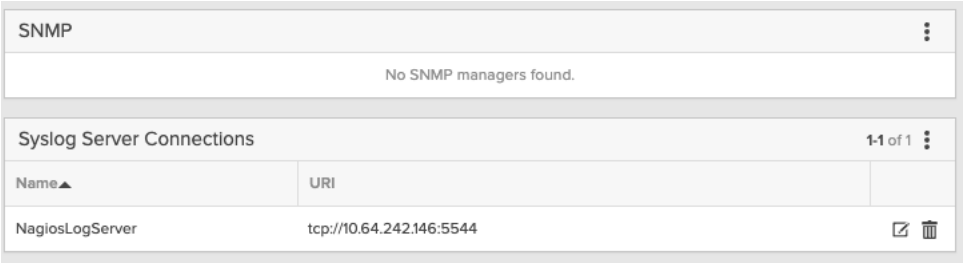
  Note that privacy cannot be configured without authentication

Once an SNMP manager object is created on the array, the FlashBlade immediately starts transmitting SNMP messages and alerts to the manager.

The **SNMP** panel displays configured SNMP managers. The **SNMP** panel also allows you to configure and manage SNMP managers and agents. From the panel you can also download the SNMP MIB.

To access the **SNMP** panel, from the **Settings** page navigation sidebar, click **Monitoring** under **System**.

Figure 9.8 Viewing the SNMP Panel



The **SNMP** panel displays a list of configured SNMP managers with the following information:

- **Name**: The name of the SNMP manager.
- **Host**: The host address configured with the SNMP manager.
- **Version**: The SNMP version.

Downloading the Management Information Base (MIB) File

To download the MIB file, perform the following:

1. From the **Settings** page navigation sidebar, click **Monitoring** under **System**.
2. From the header of the **SNMP** panel, click **More Options** and select **Download MIB**.

The `PURESTORAGE-MIB.txt` immediately downloads to the default download location on your local machine.

Creating an SNMP Manager Object

SNMP managers are added to the array through the creation of SNMP manager objects.

To add an SNMP manager object perform the following:

1. From the **Settings** page navigation sidebar, click **Monitoring** under **System**.
2. From the header of the **SNMP** panel, click **More Options** and select **Add SNMP Manager**. The **Add SNMP Manager** pop-up window appears.
3. Complete the following fields:

- **Name**: The SNMP manager's name.
- **Host**: DNS hostname or IP address of a computer that hosts an SNMP manager to which Purity is to send messages when it generates alerts. If specifying an IP address, enter the IPv4 or IPv6 address.

  For IPv4, specify the IP address in the form ddd.ddd.ddd.ddd, where ddd is a number ranging from 0 to 255 representing a group of 8 bits. If a port number is also specified, append it to the end of the address in the format ddd.ddd.ddd.ddd:PORT, where PORT represents the port number.

  For IPv6, specify the IP address in the form xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx, where xxxx is a hexadecimal number representing a group of 16 bits. Consecutive fields of zeros can be shortened by replacing the zeros with a double colon (::). If a port number is also specified, enclose the entire address in square brackets ([]) and append the port number to the end of the address. For example, [xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx]:PORT, where PORT represents the port number.
- **SNMP Version**: Version of the SNMP protocol to be used by Purity in communications with the specified managers. Valid values are v2c and v3 (default).
- **Community**: SNMPv2c only. SNMP manager community ID under which Purity is to communicate with the specified managers.
- **User**: SNMPv3 only. User ID recognized by the specified SNMP managers that Purity is to use in communications with them.
- **SNMP Notification**: Notification type that determines whether the recipient (remote host) acknowledges receipt of SNMP messages. Valid options are **trap** and **inform**. An SNMP trap is an unacknowledged (asynchronous) SNMP message, meaning the recipient does not acknowledge receipt of the message. An SNMP inform request is an acknowledged trap. If not specified, the notification type defaults to trap.
- **Auth Protocol**: SNMPv3 only. Hash algorithm used to validate the authentication passphrase. Valid values are **MD5**, **SHA**, or **None**.
- **Auth Passphrase**: SNMPv3 only. Passphrase used by Purity to authenticate the array with the specified managers. Required if the **Auth Protocol** option is set to **MD5** or **SHA**.
- **Privacy Protocol**: SNMPv3 only. Encryption protocol for SNMP messages. Valid values are **AES**, **DES**, or **None**.
- **Privacy Passphrase**: SNMPv3 only if privacy protocol is set to **AES** or **DES**. Passphrase used to encrypt SNMP messages. The passphrase must be between 8 and 63 non-spaced ASCII characters.

4 Click **Save**.

Editing an SNMP Manager Object

To edit an SNMP manager object, perform the following:

1. Select **Settings** > **System**.
2. In **SNMP** panel, locate the SNMP manager you wish to edit and click **More Options** and select **Edit**. The **Edit SNMP Manager** pop-up window appears.
3. Modify the following fields:

- **Host**: DNS hostname or IP address of a computer that hosts an SNMP manager to which Purity is to send messages when it generates alerts. If specifying an IP address, enter the IPv4 or IPv6 address.

  For IPv4, specify the IP address in the form ddd.ddd.ddd.ddd, where ddd is a number ranging from 0 to 255 representing a group of 8 bits. If a port number is also specified, append it to the end of the address in the format ddd.ddd.ddd.ddd:PORT, where PORT represents the port number.

  For IPv6, specify the IP address in the form xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx, where xxxx is a hexadecimal number representing a group of 16 bits. Consecutive fields of zeros can be shortened by replacing the zeros with a double colon (::). If a port number is also specified, enclose the entire address in square brackets ([]) and append the port number to the end of the address. For example, [xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx]:PORT, where PORT represents the port number.

- **SNMP Version**: Version of the SNMP protocol to be used by Purity in communications with the specified managers. Valid values are v2c and v3 (default).

- **Community**: SNMPv2c only. SNMP manager community ID under which Purity is to communicate with the specified managers.

- **User**: SNMPv3 only. User ID recognized by the specified SNMP managers that Purity is to use in communications with them.

- **SNMP Notification**: Notification type that determines whether the recipient (remote host) acknowledges receipt of SNMP messages. Valid options are **trap** and **inform**. An SNMP trap is an unacknowledged (asynchronous) SNMP message, meaning the recipient does not acknowledge receipt of the message. An SNMP inform request is an acknowledged trap. If not specified, the notification type defaults to trap.

- **Auth Protocol**: SNMPv3 only. Hash algorithm used to validate the authentication passphrase. Valid values are **MD5**, **SHA**, or **None**.

- **Auth Passphrase**: SNMPv3 only. Passphrase used by Purity to authenticate the array with the specified managers. Required if the **Auth Protocol** option is set to **MD5** or **SHA**.

- **Privacy Protocol**: SNMPv3 only. Encryption protocol for SNMP messages. Valid values are **AES**, **DES**, or **None**.

- **Privacy Passphrase**: SNMPv3 only if privacy protocol is set to **AES** or **DES**. Passphrase used to encrypt SNMP messages. The passphrase must be between 8 and 63 non-spaced ASCII characters.

4 Click **Save**.

Renaming an SNMP Manager Object

To rename an SNMP manager object, perform the following:

1. From the **Settings** page navigation sidebar, click **Monitoring** under **System**.
2. In **SNMP** panel, locate the SNMP manager you wish to rename and click **More Options** and select **Rename**. The **Rename SNMP Manager** pop-up window appears.
3. Enter a new name in the **Name** field.
4. Click **Rename**.

Deleting an SNMP Manager Object

To delete an SNMP manager object, perform the following:

1. From the **Settings** page navigation sidebar, click **Monitoring** under **System**.
2. In **SNMP** panel, locate the SNMP manager you wish to delete and click **More Options** and select **Delete**. The **Delete SNMP Manager** pop-up window appears.
3. Click **Delete**.

Sending a Test Trap

To send a test trap to an SNMP manager, perform the following:

1. From the **Settings** page navigation sidebar, click **Monitoring** under **System**.
2. In **SNMP** panel, locate the SNMP manager to which you wish to send a test trap and click **More Options** and select **Send Test Trap**. The **Send Test Trap** pop-up window appears notifying you that a test trap has been sent to the SNMP manager.
3. Click **Close**.

Editing an SNMP Agent

To edit an SNMP agent, perform the following:

1. From the **Settings** page navigation sidebar, click **Monitoring** under **System**.
2. From the header of the **SNMP** panel, click **More Options** and select **Edit SNMP Agent**. The **Edit SNMP Agent** pop-up window appears.
3. Modify the following fields:

- **SNMP Version**: Version of the SNMP protocol to be used by Purity in communications with the specified managers. Valid values are v2c (default) and v3.
- **Community**: SNMPv2c only. SNMP manager community ID under which Purity is to communicate with the specified managers.
- **User**: User ID recognized by the specified SNMP managers that Purity is to use in communications with them.
- **Auth Protocol**: SNMPv3 only. Hash algorithm used to validate the authentication passphrase. Valid values are **MD5**, **SHA**, or **None**.
- **Auth Passphrase**: SNMPv3 only. Passphrase used by Purity to authenticate the array with the specified managers. Required if the **Auth Protocol** option is set to **MD5** or **SHA**.
- **Privacy Protocol**: SNMPv3 only. Encryption protocol for SNMP messages. Valid values are **AES**, **DES**, or **None**.
- **Privacy Passphrase**: SNMPv3 only if privacy protocol is set to **AES** or **DES**. Passphrase used to encrypt SNMP messages. The passphrase must be between 8 and 63 non-spaced ASCII characters.

4 Click **Save**.

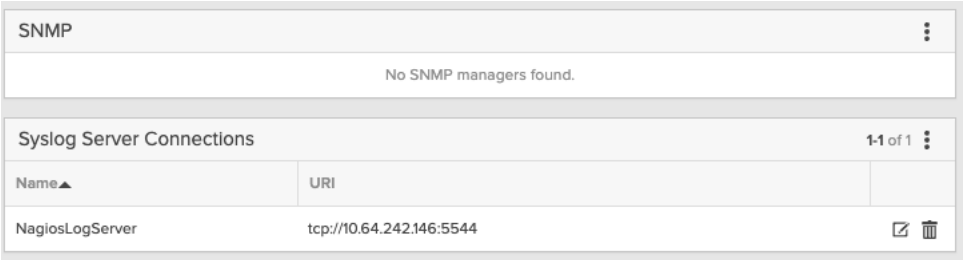
Syslog Server

The Syslog Server feature enables you to forward syslog messages to remote syslog servers.

Up to three remote syslog servers can be connected. All connected syslog servers can be viewed from the **Syslog Server Connections** panel.

To access the **Syslog Server Connections** panel, from the **Settings** page navigation sidebar, click **Monitoring** under **System**.

Figure 9.9 Viewing the Syslog Server Connections Panel



The Purity//FB syslog logging facility generates messages of major events within the FlashBlade and forwards the messages to remote servers. Purity//FB generates syslog messages for three types of events:

- Alerts (`purity.alert`)
- Audit (`purity.audit`)
- Tests (`purity.test`)

Alerts

Purity//FB generates alerts when there is a change to the array or to one of the Purity//FB hardware or software components. There are three alert severity levels:

- **INFO**: Informational messages that are generated due to a change in state. INFO messages can be used for reporting and analysis purposes. No action is required.
- **WARNING**: Important messages that warn of an impending error if action is not taken.
- **CRITICAL**: Urgent messages that require immediate attention.

Syslog alerts are broken down into the following format:

```
<Event Timestamp> <FM Host Name> purity.alert: <Alert Severity> <Alert State>
 <Alert Details>
```

In the following example, Purity//FB generated a Warning alert due to an unhealthy blade:

```
May 15 13:38:08 irp125a-v08g08-sim-ch1-fm1 purity.alert: WARNING Open - irp125a-
v08g08-sim: Blade CH1.FB1 is unhealthy [1000] #012A blade is unhealthy. No
 data has been lost, but performance may be impacted and additional wear may
 be occurring. There will be daily notifications for 7 days.#012#012Severity:
 Warning#012State: Open#012First Seen UTC Time: 2020 May 15 13:29:34 UTC#012First
 Seen Array Time: 2020 May 15 06:29:34 PDT#012Array Name: irp125a-v08g08-
sim#012Array ID: 00000000-0000-4000-8000-000000000000#012Purity//FB Version:
 3.1.99#012#012Suggested Action: This alert should automatically generate a
 support case. Please review your support case status by logging into Pure1
 at https://pure1.purestorage.com/. #012Knowledge Base Article: https://
support.purestorage.com/?cid=Alert_1000#012
```

Alerts are also sent via the phone home facility to the Pure Storage Support team. If configured, alerts can also be sent to designated email recipients and SNMP trap managers. Alerts can also be viewed from the GUI **Health > Alerts** page and from the **`purealert list`** CLI command.

Audit

An audit trail represents a chronological history of the GUI, CLI, or REST API operations that a user has performed to modify the configuration of the array. Each message within an audit trail includes the name of the Purity//FB user who performed the operation and the Purity//FB operation that was performed.

Syslog audit trail messages are broken down into the following format:

```
<Event Timestamp> <FM Host Name> purity.audit: <GUID> <ID> <Timestamp> <User>
 <Location> <User Interface> <Command Details>
```

In the following example, **pureuser** performed the **`purelog`** CLI command:

```
May 15 13:43:24 irp125a-v08g08-sim-ch1-fm1 purity.audit: - Adding audit entry.
 GUID=b1936eff-c4da-4582-89ad-9f5ab2d57777, ID=2, Time=2020-05-15 13:43:24.584225,
 User=pureuser, Location=10.255.8.1, UI=CLI, Command=purelog, Subcommand=delete,
 Arguments=test_syslog_alerts_remote
```

The audit trail can also be viewed from the GUI **Settings** > **User** page and from the the **`pureaudit list`** CLI command.

Tests

Test messages are generated by users to verify that the array can send messages to remote syslog servers. The message does not indicate whether or not the test message successfully reached the recipients; you must manually check the remote syslog server to confirm that the message arrived at the destination.

Syslog test messages are broken down into the following format:

```
<Event Timestamp> <FM Host Name> purity.test: <Test Message Details>
```

In the following example, a test was perfomed to determine if the array could send messages to a remote syslog server.

```
May 15 13:39:03 irp552-c01-ch1-fm2 purity.test: - This is a test message generated
 by Pure Storage FlashBlade. UTC Time: 2020 May 15 13:39:03 from FM Name: fm2
```

Creating a Syslog Server Connection

To create a remote syslog server connection, perform the following:

1 From the **Settings** page navigation sidebar, click **Monitoring** under **System**.

2 From the header of the **Syslog Server Connections** panel click **More Options** and select **Create Connection**. The **Create Syslog Server Connection** pop-up window appears.

3 In the **Name** field, enter the name for the remote syslog server connection.

4 In the **URI** field, enter the URI of the remote syslog server.

Specify the URI in the format **PROTOCOL://HOSTNAME:PORT**, where

- **PROTOCOL** is TCP, TLS, or UDP.

  Note that when establishing TLS communication, the syslog server must be configured with either a CA certificate or CA certificate group (for multiple remote syslog servers). See *Selecting CA Certificates for Syslog Server Connections*. Additionally, your firewall must be set to allow in-bound and out-bound traffic.

- **HOSTNAME** is the syslog server's hostname or IP address. If specifying an IP address, for IPv4, specify the IP address in the form ddd.ddd.ddd.ddd, where ddd is a number ranging from 0 to 255 representing a group of 8 bits.

  For IPv6, specify the IP address in the form [xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx], where xxxx is a hexadecimal number representing a group of 16 bits. Enclose the entire address in square brackets ([]). Consecutive fields of zeros can be shortened by replacing the zeros with a double colon (::).

- **PORT** is the port at which the server is listening. Append the port number after the end of the entire address. This is optional if the standard port number 514 for UDP or TCP, or the standard port number 6514 for TLS, is used.

5 Click **Create**.

The **Syslog Server Connections** panel is updated with the new syslog server

When establishing TLS communication, each remote syslog servers' certificate must have been signed by the configured CA certifcate, or by one of the CA certificates in the configured CA certificate group. See *Selecting CA Certificates for Syslog Server Connections*. Additionally, your firewall must be set to allow in-bound and out-bound traffic.

Selecting CA Certificates for Syslog Server Connections

For TLS connections, you must select a CA certificate for the remote syslog server.

If you are setting up TLS connections for mutliple remote syslog servers, select a CA certificate group.

1 From the **Settings** page navigation sidebar, click **Monitoring** under **System**.

2 From the header of the **Syslog Server Connections** panel click **More Options** and select **Select Certificate**. The **Select CA Certificate** pop-up window appears.

3 Select either a CA certificate or CA certificate group.

As a best practice, it is recommended that you create a separate CA certificate group for syslog certificates.

4 Click **Save**.

Testing Syslog Server Connections

To test connected remote syslog servers, perform the following:

1 From the **Settings** page navigation sidebar, click **Monitoring** under **System**.

2 From the header of the **Syslog Server Connections** panel click **More Options** and select **Test**. The **Test Syslog Server Connection** pop-up window appears displaying the results of the syslog server connection test.

A test message is sent to the remote syslog server. You must manually check the remote syslog server to confirm that the message at the destination.

If the test message is not received, possible issues can include:

- URI typos
- Issues with the remote syslog server's configuration
- Issues with firewall settings
- Issues IPv6 connectivity (if the FlashBlade is configured with IPv6 support)
- Invalid certificate configurations

3 Click **Close** after you have reviewed the test results.

Editing a Syslog Server Connection

To edit a connected remote syslog server, perform the following:

1 From the **Settings** page navigation sidebar, click **Monitoring** under **System**.

2 In the **Syslog Server Connections** panel click the **Edit** button to the right of the remote syslog server you wish to edit. The **Edit Syslog Server Connection** pop-up window appears.

3 In the **URI** field, enter the new URI of the remote syslog server.

Specify the URI in the format **PROTOCOL://HOSTNAME:PORT**, where

- **PROTOCOL** is TCP, TLS, or UDP.

  Note that when establishing TLS communication, the syslog server must be configured with either a CA certificate or CA certificate group (for multiple remote syslog servers). See *Selecting CA Certificates for Syslog Server Connections*. Additionally, your firewall must be set to allow in-bound and out-bound traffic.

- **HOSTNAME** is the syslog server's hostname or IP address. If specifying an IP address, for IPv4, specify the IP address in the form ddd.ddd.ddd.ddd, where ddd is a number ranging from 0 to 255 representing a group of 8 bits.

  For IPv6, specify the IP address in the form [xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx], where xxxx is a hexadecimal number representing a group of 16 bits. Enclose the entire address in square brackets ([]). Consecutive fields of zeros can be shortened by replacing the zeros with a double colon (::).

- **PORT** is the port at which the server is listening. Append the port number after the end of the entire address. This is optional if the standard port number 514 for UDP or TCP, or the standard port number 6514 for TLS, is used.

4 Click **Save**.

  The **Syslog Server Connections** pane is updated with your changes.

Deleting a Syslog Server Connection

To delete a remote syslog server connection, perform the following:

1 From the **Settings** page navigation sidebar, click **Monitoring** under **System**.

2 In the **Syslog Server Connections** panel click the **Delete** button to the right of the remote syslog server whose connection you wish to delete. The **Delete Syslog Server Connection** pop-up window appears.

3 Click **Delete**.

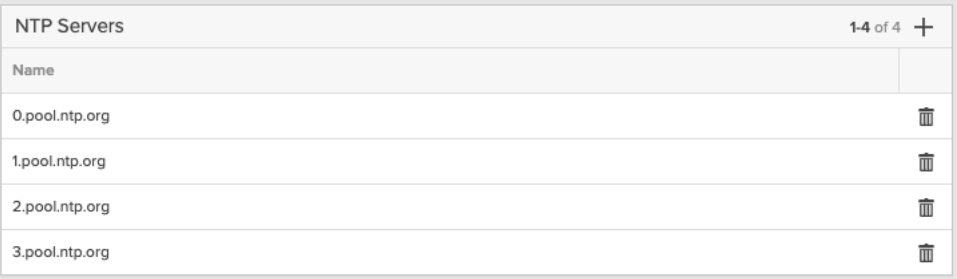
  The **Syslog Server Connections** panel is updated with your changes.

NTP Servers

The **NTP Servers** panel displays the hostnames or IP addresses of the Network Time Protocol (NTP) servers that are currently being used by the array to maintain reference time. The installation technician sets the proper time zone for an array when it is installed. During operation, arrays maintain time synchronization by interacting with the NTP server.

To access the **NTP Servers** panel, from the **Settings** page navigation sidebar, click **NTP Servers** under **System**.

Figure 9.10 Viewing the NTP Servers Panel



Configuring the NTP Server

The array maintains time synchronization by interacting with the NTP server.

1. From the **Settings** page navigation sidebar, click **NTP Servers** under **System**.
2. In the **NTP Servers** panel:
   - To add an NTP server, in the header of the **NTP Servers** panel, click the **Add** (+) button. The **Add NTP Server** pop-up window appears. Type the hostname or IP address of the NTP server, and then Enter multiple servers as comma-separated values.

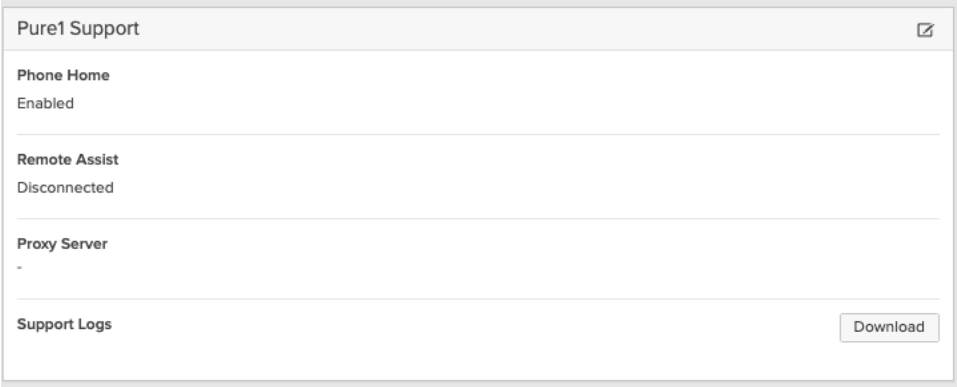
     If specifying an IP address, for IPv4, specify the IP address in the form `ddd.ddd.ddd.ddd`, where `ddd` is a number ranging from `0` to `255` representing a group of 8 bits. For IPv6, specify the IP address in the form `xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx`, where `xxxx` is a hexadecimal number representing a group of 16 bits. When specifying an IPv6 address, consecutive fields of zeros can be shortened by replacing the zeros with a double colon (`::`) .
   - To remove an NTP server, click the **Delete** button in the same row as the NTP server you wish to remove.

Pure1 Support

The **Pure1 Support** panel displays and manages the features used to communicate with Pure Storage Support.

To access the **Pure1 Support** panel, from the **Settings** page navigation sidebar, click **Pure1 Support** under **System**.

Figure 9.11 Viewing the Pure1 Support Panel



Phone Home

The phone home facility allows the array to transmit log and diagnostic information to Pure Storage Support via a secure network connection.

The phone home facility can be enabled and disabled at any time. The current phone home status appears just below the **Phone Home** label.

Enabling and Disabling Phone Home

Enabling phone home functionality allows the array to transmit log and diagnostic information to Pure Storage Support. It is highly recommended that you enable phone home.

To enable (or disable) phone home, perform the following:

1. From the **Settings** page navigation sidebar, click **Pure1 Support** under **System**.
2. In the header of the **Pure 1 Support** panel click the **Edit** button. The **Edit Pure1 Support Settings** pop-up window appears.
3. Click the **Phone Home** toggle button to switch between enabled (blue) and disabled (gray) status.
4. Click **Save**.

Remote Assist

In some cases, the most efficient way for Pure Storage Support to service a FlashBlade array or diagnose problems is through direct access to the array. A remote assistance (RA) session grants Pure Storage Support direct and secure access to the array through a reverse tunnel which you, the administrator, open. This is a two-way communication.

Opening an RA session gives Pure Storage Support the ability to log into the array, effectively establishing an administrative session. Once the RA session is successfully established, the array returns connection details, including the date and time when the session was opened, the date and time when the session expires, and the proxy status (true, if configured).

After the Pure Storage Support team has performed all of the necessary diagnostic or maintenance functions, close the RA session to terminate the connection.

RA sessions can be opened and closed at any time. The current status of the remote assistance session appears just below the Remote Assist label.

An open RA session automatically terminates (closes) after two days have lapsed.

Opening and Closing a Remote Assistance (RA) Session

A remote assistance (RA) session grants Pure Storage Support direct and secure access to the array through a reverse tunnel which you, the administrator, open. This is a two-way communication.

To open or close an RA session, perform the following:

1. From the **Settings** page navigation sidebar, click **Pure1 Support** under **System**.
2. In the header of the **Pure 1 Support** panel click the **Edit** button. The **Edit Pure1 Support Settings** pop-up window appears.
3. Click the **Remote Assist** toggle button to connect (blue) and disconnect (gray) an RA session. Opening an RA session gives Pure Storage Support direct and secure access to the array.
4. Click **Save**.

Proxy Server

The proxy hostname, if set, represents the server to be used as the HTTP or HTTPS proxy. The format for the proxy host name is `http(s)://hostname:port`, where `hostname` is the name of the proxy host, and `port` is the TCP/IP port number used by the proxy host.

Configuring the Proxy Host Name

1. From the **Settings** page navigation sidebar, click **Pure1 Support** under **System**.
2. In the header of the **Pure 1 Support** panel click the **Edit** button. The **Edit Pure1 Support Settings** pop-up window appears.
3. In the **Proxy Server** field type the proxy host name.

The format for the host name is `http(s)://hostname:port`, where `hostname` is the name of the proxy host, and `port` is the TCP/IP port number used by the proxy host.

4 Click **Save**.

Deleting the Proxy Host Name

1 From the **Settings** page navigation sidebar, click **Pure1 Support** under **System**.

2 In the header of the **Pure 1 Support** panel click the **Edit** button. The **Edit Pure1 Support Settings** pop-up window appears.

3 In the **Proxy Server** field, delete the proxy host name.

4 Click **Save**.

Support Logs

Purity//FB continuously logs a variety of array activity, including performance metrics, hardware and software operations, and administrative actions. The logs contain the activity of both fabric modules and all blades. The time stamp of each log is based on the array time.

If Phone Home is enabled, the logs are periodically transmitted to Pure Storage. The logs are also saved to the array with up to 30 days' worth of activity available for manual download.

When downloading support logs, specify an event date and time. The array generates a file containing a chronological list of array activity that occurred leading up to, during, and a little after the specified event time. Log files are password encrypted and can only be opened by Pure Storage Support.

Downloading Support Logs

Purity//FB continuously logs a variety of array activity. These logs contain the activity of both fabric modules and all blades. These logs are used by Pure Storage Support when assessing the array's performance and for diagnosing and troubleshooting any events or issues.

To download logs, perform the following:

1 From the **Settings** page navigation sidebar, click **Pure1 Support** under **System**.

2 In the **Support Logs** section of the **Pure1 Support** panel, click **Download**. The **Download Support Logs** dialog box appears.

3 Specify the event date and time, representing the approximate array time the activity of interest occurred, and the duration of time for which you wish log information to be collected (1 to 6 hours). Note that the time is based on your local browser's time zone.

4 If you have a multi-chassis system, optionally select the component(s) for which you wish to prepare support logs.

Figure 9.12 Downloading Support Logs for Single-Chassis Systems

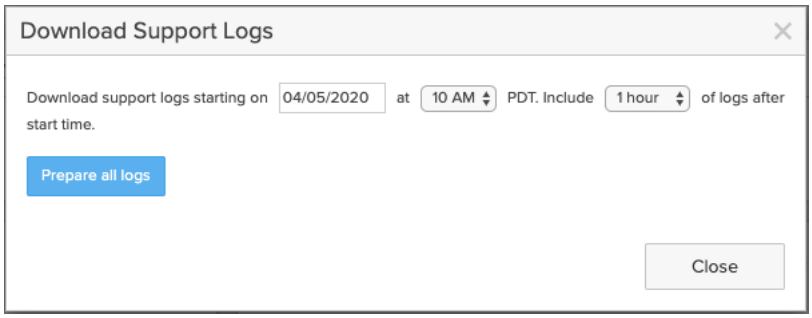
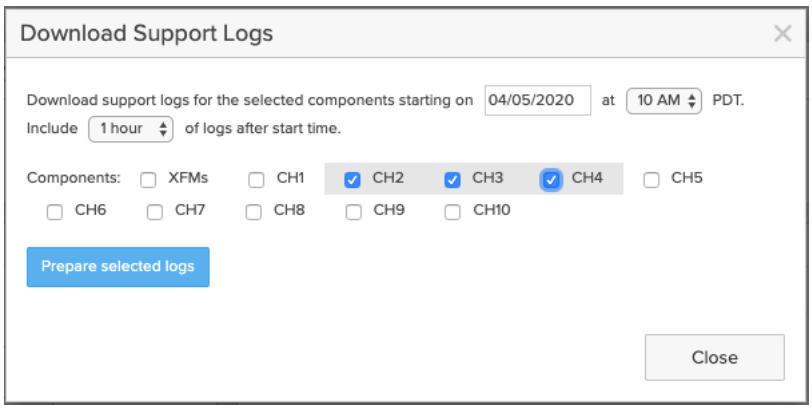


Figure 9.13 Downloading Support Logs for Multi-Chassis Systems



5 If you did not select a component, click **Prepare all logs**. If you selected one or more components, click **Prepare selected logs**.

6 Click **Download** to save the password encrypted file to your administrative workstation. The files can only be opened by Pure Storage Support.

Working with Network Settings

The following **Network** settings are available:

- **DNS** - Displays and manages DNS settings.

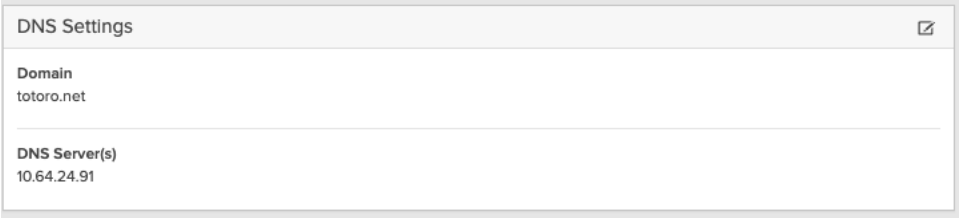
- **Object Store Virtual Hosts** - Displays and manages virtual hosts for object stores.
- **Link Aggregation Groups** - Displays and manages subnet link aggregation groups (LAGs).
- **Subnets** - Displays and manages all subnets used for file exports.

DNS Settings

The **DNS Settings** panel displays and manages the DNS attributes for an array's administrative network.

To access the **DNS Settings** panel, from the **Settings** page navigation sidebar, click **DNS** under **Network**.

Figure 9.14 Viewing the DNS Settings Panel



- **Domain** - The DNS domain represents the domain suffix to be appended by the array when performing DNS lookups. For example, `mydomain.com`.
- **DNS Server(s)** - The DNS servers manages the DNS domains that are configured for the array. Each DNS domain can include up to three static DNS server IP addresses. Purity//FB queries the DNS servers in the order in which the IP addresses are listed in this option.

Editing DNS Settings

To edit DNS settings, perform the following:

1. From the **Settings** page navigation sidebar, click **DNS** under **Network**.
2. Click the edit button in the header of the **DNS Settings** panel. The **Edit DNS Settings** pop-up window appears.
3. (Optional) In the **Domain** field, type the domain suffix to be appended by the array when doing DNS lookups. For example, `mydomain.com`.
4. (Optional) In the **DNS #** fields, specify up to three DNS server IP addresses for Purity//FB to use to resolve hostnames to IP addresses. Enter one IP address in each DNS # field. Purity//FB queries the DNS servers in the order that the IP addresses are listed.
5. Click **Save**.

Virtual Hosts

The **Object Store Virtual Hosts** panel displays and allows management of virtual host-style addressing for object buckets.

To access the **Obect Store Virtual Hosts** panel, from the **Settings** page navigation sidebar, click **Object Store Virtual Hosts** under **Network**.

Figure 9.15 Viewing the Object Store Virtual Hosts Panel

Note the following requirements and restrictions for virtual hosted-style access:

- FlashBlade supports a virtual hosted-style by using a proxy and the fixed host name `s3.amazonaws.com`. This cannot be deleted.
- In order to use virtual host-style addressing, your DNS must be configured so that requests to your host name are routed to the data vip of the FlashBlade.
- Up to 10 host names can be configured, including the default `s3.amazonaws.com`.
- The virtual host cannot be an IP address.
- If your client setup uses host names, set the host names as the virtual hosts.
- If your client setup uses FQDNs, set the FQDNs as the virtual hosts.
- If you wish to use host names and FQDNs interchangeably, set both the host names and FQDNs as the virtual hosts.
- Host names can be numeric, however this is not recommended. If using numeric hosts, ensure that `https://bucket_name.domain/` does not appear like an IP address as this could result in routing to the wrong destination.
- Supersets and subsets of existing host names with the same root are not allowed. For example, if `buckethost.example.com` is registered, then `prefix.buckethost.example.com` or `example.com` are not allowed.
- Supported characters are ASCII letters a through z (case-insensitive), 0-9, and the hyphen (-) character.

- The host name character limit is 255. It is recommended to limit the host name length to 191 or fewer characters. Since bucket names are limited to 63 characters, host name lengths of 191 characters guarantees that any bucket name plus a dot (".") will be less than the 255 character limit.

Virtual Hosted-style and Path-style S3 Requests

Applications that support S3 must support at least one of S3's two request types: path-style or virtual hosted-style. All versions of FlashBlade support path-style requests and, beginning with Purity//FB 3.2.0, FlashBlade also supports virtual hosted-style requests.

To enable applications to use virtual hosted-style S3 requests, an extra configuration step is typically required in both the FlashBlade and DNS, as compared to applications that use path-style S3 requests. Virtual hosted-style addressing allows applications to request objects using a bucket's virtual host name for example `mybucket.b1.s3.amazonaws.com`. Because bucket names may contain dots (".") and because FlashBlade does not know what parent domain name or DNS suffix has been set up in your on-prem DNS for S3 buckets, in order for FlashBlade to correctly map a virtual hosted-style request from your application to the correct bucket (for example, a request for `mybucket.b1.yourcompany.com` could map to bucket `mybucket` or `mybucket.b1`), the bucket virtual host name suffix used by an application and configured in your DNS must also be configured on FlashBlade settings under **Virtual Hosts**. In addition, you may need to configure DNS so that any bucket's virtual hostname and the parent domain of the buckets' hostnames resolve to the IP address of your FlashBlade's data interface

Applications, tools, and developer libraries sometimes allow customers and developers to configure whether the application should use virtual hosted-style requests or path-style requests. Instead of configuring a virtual host parent domain in FlashBlade and DNS, you may prefer to configure your application to use path-style addressing, which enables you to use the same hostname or IP address to access any bucket on FlashBlade

Virtual hosted-style access uses the format `https://somebucket.flashblade-data.somecompany.com/someobject` in S3 requests to read or write an object named "someobject" in bucket "somebucket" on FlashBlade. Applications that access objects in `somebucket` or access the bucket configuration of `somebucket` in this way expect your DNS server to resolve `somebucket.flashblade-data.somecompany.com` to the IP address of your FlashBlade's data VIP and (if using HTTPS) expect your FlashBlade's certificate to include `somebucket.flashblade-data.somecompany.com` in a Subject Alternative Name (SAN) field. Additionally, applications that list the names of all buckets in an S3 account on FlashBlade require your DNS server to resolve `flashblade-data.somecompany.com` (without the bucket name) to your FlashBlade's data VIP and your FlashBlade's certificate to include `flashblade-data.somecompany.com` in another SAN field.

Enabling FlashBlade to support applications that use virtual hosted-style S3 access requires configuring the host name or domain name for FlashBlade's data VIP that applications will use when making S3 requests. This can be configured in the **Object Store Virtual Hosts** panel. In the example above, the parent domain name for buckets on FlashBlade is `flashblade-data.somecompany.com`.

Path-style access uses the format, `https://flashblade-data.somecompany.com/somebucket/someobject` in S3 requests. Applications that access objects or bucket configuration in this way expect your DNS server to resolve `flashblade-data.somecompany.com` to the IP address of your FlashBlade's data VIP and expect your FlashBlade's certificate to include `flashblade-data.somecompany.com` in a SAN field.

Supporting a variety of applications that use both types of S3 access can be done by creating a wildcard entry in DNS for `*.flashblade-data.somecompany.com` and another entry in DNS for `flashblade-data.somecompany.com` that both resolve to a data VIP on your FlashBlade, and by including both of these as SAN fields in your FlashBlade certificate. Note that bucket names with dots (".") in their name may not match wildcard certificates and may not work with DNS wildcard entries, so using HTTPS to access buckets with dots in their name using virtual hosted-style requests requires a separate DNS entry and separate FlashBlade certificate SAN entry for each bucket name.

Use of path-style access is required when no hostname is configured in DNS to resolve to FlashBlade's data VIP and its IP address must be specified, e.g. `https://IP_OF_FLASHBLADE_DATA_VIP/somebucket/someobject` . In order to use HTTPS with S3 path-style requests, the certificate configured on FlashBlade must specify `flashblade-data.somecompany.com` in the certificate's SAN field. To handle situations where an application does not support path-style addressing or does not support specifying an IP address for an S3 endpoint, and where a hostname for FlashBlade's data VIP cannot be configured in DNS, refer to this *KB article*.

FlashBlade includes `s3.amazonaws.com` as a default entry on the **Object Store Virtual Hosts** panel. If you have an application that only supports Amazon S3 and does not support configuring a non-AWS hostname or IP address for an S3 server, then if it makes virtual-hosted style S3 requests to AWS region us-east-1 using `s3.amazonaws.com` as the parent domain name, and if the application uses HTTP rather than HTTPS, then configuring the local `/etc/hosts` file on your application's host to resolve `s3.amazonaws.com` to a data VIP on your FlashBlade will enable your application to work with FlashBlade Object Store.

Note: S3 use of path-style-access will be deprecated in the future by Amazon S3. IIf you use the same applications on both FlashBlade Object Store and Amazon S3, you may wish to switch from path-style access to virtual hosted-style access.

Creating a Virtual Host

Before creating virtual host-style addressing for object buckets, note the following requirements and restrictions:

- In order to use vitual host-style addressing, your DNS must be configured so that requests to your host name are routed to the data vip of the FlashBlade.
- Up to 10 host names can be configured, including the default `s3.amazonaws.com`.
- The virtual host cannot be an IP address.
- If your client setup uses host names, set the host names as the virtual hosts.
- If your client setup uses FQDNs, set the FQDNs as the virtual hosts.
- If you wish to use host names and FQDNs interchangeably, set both the host names and FQDNs as the virtual hosts.
- Host names can be numeric, however this is not recommended. If using numeric hosts, ensure that `https://bucket_name.domain/` does not appear like an IP address as this could result in routing to the wrong destination.
- Supersets and subsets of existing host names with the same root are not allowed. For example, if `buckethost.example.com` is registered, then `prefix.buckethost.example.com` or `example.com` are not allowed.
- Supported characters are ASCII letters a through z (case-insensitive), 0-9, and the hyhpen (-) character.
- The host name character limit is 255. It is recommended to limit the host name length to 191 or fewer characters. Since bucket names are limited to 63 characters, host name lengths of 191 characters guarantees that any bucket name plus a dot (".") will be less than the 255 character limit.

Your DNS must be configured so that requests to your virtual host are routed to the data vip of the FlashBlade.

For example, if `example.com` is set as the virtual host, then requests to `example.com` and `$(bucket).example.com` must be routed to the data vip. To achieve this, you can configure both `example.com` and `*example.com` in the DNS.

Note that your DNS settings are not visible to the FlashBlade. You can use **`dig`** (Linux) or **`nslookup`** (Windows) on the host where S3 clients run to ensure the DNS setting is correct and that sent requests are resolved to the data vip.

To create a virtual host, perform the following:

1. From the **Settings** page navigation sidebar, click **Object Store Virtual Hosts** under **Network**.
2. Click the Add (+) button in the header of the **Object Virtual Hosts** panel. The **Create Virtual Hosts** pop-up window appears.
3. Enter the new host name or domain.
4. Click **Create**.

Deleting a Virtual Host

⚠ **Important note!** When deleting a virtual host, subsequent requests made to the virtual host will be treated as path style requests. Applications that rely on the deleted virtual host may lose access or may access unintended resources.

To delete a virtual host, perform the following:

1. From the **Settings** page navigation sidebar, click **Object Store Virtual Hosts** under **Network**.
2. To delete a single virtual host:
   a. In the **Object Virtual Hosts** panel, locate the virtual host you wish to delete and click the **Delete** icon in the same row. The **Delete Virtual Host** pop-up window appears.
   b. Click **Delete**.
3. To delete multiple virtual hosts:
   a. Click the **More Options** button in the header of the **Object Virtual Hosts** panel and select **Delete**. The **Delete Virtual Hosts** pop-up window appears.
   b. From the **Existing Hosts** column, select the virtual hosts you wish to delete. The selected hosts will appear in the **Selected Hosts** column.
   c. Click **Delete**.

Link Aggregation Groups

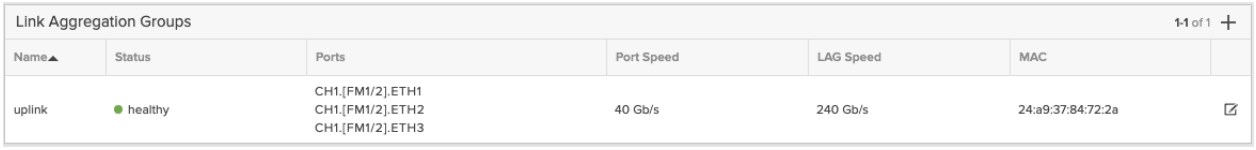
A link aggregation group (LAG) is a collection of Ethernet ports on the array. This concept is also known as a port channel, or a bond group. Multiple LAGs can be used to connect to separate physical networks.

By default, the array is preconfigured with all ports in a single LAG named **uplink**, which cannot be deleted. Ports can be removed from the uplink LAG and added to another LAG.

The **Link Aggregation Groups** panel displays and allows management of LAGs on the array.

To access the **Link Aggregation Groups** panel, from the **Settings** page navigation sidebar, click **Link Aggregation Groups** under **Network**.

Figure 9.16 Viewing the Link Aggregation Groups Panel



The **Link Aggregation Groups** panel displays the following information:

- **Name**: The assigned name of the LAG.
- **Status**: Condition of the LAG. If the status is **healthy**, then all ports in the LAG are functioning as expected.
- **Ports**: Port names associated with a LAG.
- **Port Speed**: Maximum speed of each port.
- **LAG Speed**: Combined speed of all ports in the LAG.
- **MAC**: Unique media access control (MAC) address assigned to the network interface. This field cannot be modified.

Creating a Link Aggregation Group

When creating a link aggregation group (LAG):

- All ports must be of the same speed.
- Ports must be created in pairs, mirroring FM1 and FM2. For example, ETH1.1 from FM1 and ETH1.1 from FM2 are a pair of mirrored ports from each FM.
- Ports can only be assigned to one LAG. Ports must be removed from one LAG before being added to another LAG.

To create a LAG, perform the following:

1. From the **Settings** page navigation sidebar, click **Link Aggregation Groups** under **Network**.
2. Click the Add (+) button in the header of the **Link Aggregation Groups** panel. The **Create Link Aggregation Group** pop-up window appears.
3. Select the ports to be assigned to the LAG.
4. Click **Create**.

   Once created, the new LAG will appear in the list of available LAGs when creating and editing subnets.

Adding and Removing Ports to and from a Link Aggregation Group

When adding ports to a link aggregation group (LAG):

- All ports must be of the same speed.
- Ports must be created in pairs, mirroring FM1 and FM2. For example, ETH1.1 from FM1 and ETH1.1 from FM2 are a pair of mirrored ports from each FM.
- Ports can only be assigned to one LAG. Ports must be removed from one LAG before being added to another LAG.

When removing ports from a LAG, ports must be removed in pairs, mirroring FM1 and FM2. For example, ETH1.1 from FM1 and ETH1.1 from FM2 are a pair of mirrored ports from each FM.

To add or remove ports, perform the following:

1. From the **Settings** page navigation sidebar, click **Link Aggregation Groups** under **Network**.
2. In the **Link Aggregation Groups** panel, click the **Edit** icon in the same row of the LAG to which you wish to add or remove ports. The **Edit Link Aggregation Group** pop-up window appears.
3. Select the ports you wish to add or remove.
4. Click **Save**.

Deleting a Link Aggregation Group

Deleting a link aggregation group (LAG) deletes the entire LAG configuration and unbinds the ports.

Note: The **uplink** LAG cannot be deleted

To delete a LAG, perform the following:

1 From the **Settings** page navigation sidebar, click **Link Aggregation Groups** under **Network**.

2 In the **Link Aggregation Groups** panel, click the **Delete** icon in the same row of the LAG you wish to delete. The **Delete Link Aggregation Group** pop-up window appears.

3 Click **Delete**.

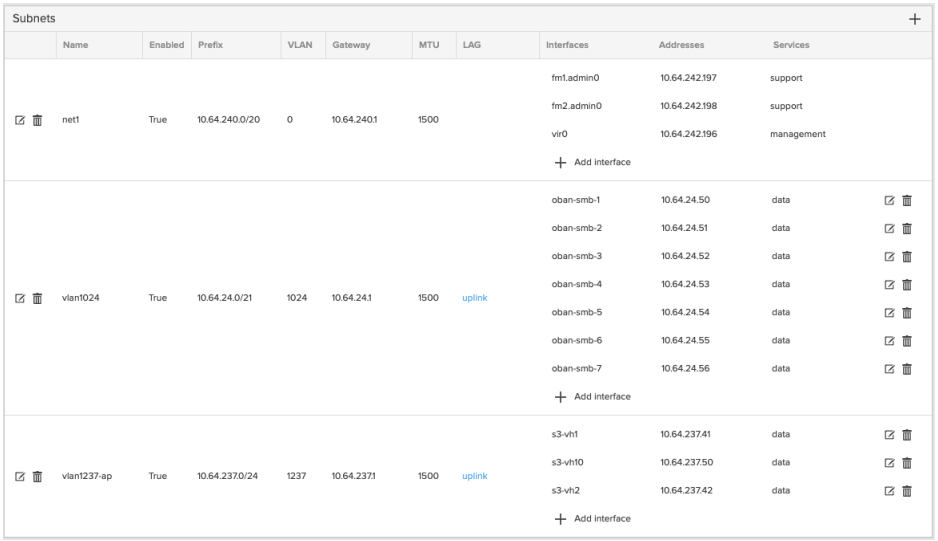
Subnets

In the FlashBlade array, data virtual IP addresses (data vips) are organized into subnetworks (subnets). Exporting a file system requires a data vip which, in turn, must be attached to a subnet. Data vips that share the same network prefix and gateway are grouped into the same subnet.

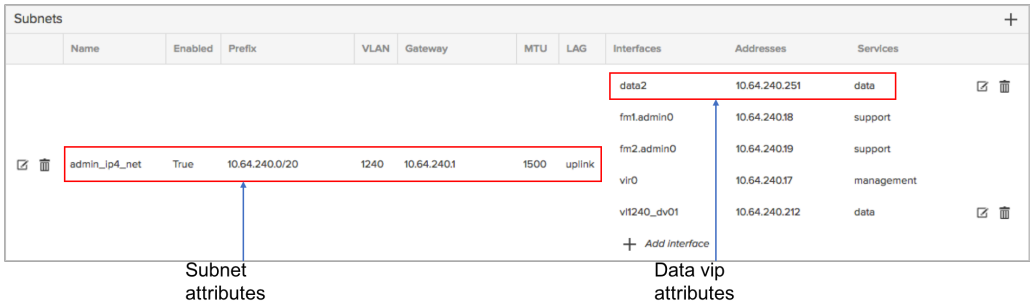
The **Subnets** panel displays the subnets on the array. Attached to each subnet are the data virtual IP addresses (data vips) that are used to export file systems.

To access the **Subnets** panel, from the **Settings** page navigation sidebar, click **Subnets** under **Network**.

Figure 9.17 Viewing the Subnets Panel



In the following example, data vip **10.64.240.251** is attached to subnet **admin_ip4_net**.



Each subnet in the list includes the following information:

- **Name**: Subnet name.
- **Enabled**: Subnet status. When a subnet is enabled, the data vips within the subnet that are enabled are automatically available and ready to connect. Newly created subnets are automatically enabled.
- **Prefix**: IP address of the network prefix and prefix length.
- **VLAN**: VLAN ID number.
- **Gateway**: IP address of the gateway through which the data vip communicates with the network.
- **MTU**: Maximum transmission unit (MTU) for the data vips, in bytes.
- **LAG**: Link aggregation group (LAG) for the data vips.
- **Interfaces**: Data virtual IP address (data vip).
- **Addresses**: IP address associated with the data vip.
- **Services**: Service types for which the data vip is configured. The supported service for data vips is `data`.

Subnets can be created, modified, and deleted at any time. Create a new subnet if the desired one does not appear in the **Subnets** panel.

Creating a subnet requires a prefix and VLAN interface. Specify the IP address of the network prefix and prefix length in the form `ddd.ddd.ddd.ddd/dd` for IPv4, or `xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx/xxx` for IPv6. Specify the VLAN ID to which the subnet is configured. Valid VLAN ID numbers are between 1 and 4094.

Optionally specify the gateway address in the form `ddd.ddd.ddd.ddd` for IPv4, or `xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx` for IPv6.

Optionally specify the maximum transmission unit (MTU), in bytes, of the data vip. If the MTU is not specified during subnet creation, the value defaults to `1500`.

When a data vip is attached to a subnet, it inherits the gateway, MTU and VLAN ID of the subnet. Likewise, the subnet inherits the `data` service type from the data vip.

Delete a subnet if it is no longer needed. Note that exporting a file system and file system replication require at least one valid data vip, which must be attached to a subnet. Therefore, there must always be at least one subnet (for service type `data` or `replication`) on the array.

Replication requires creating a replication vip. Replication vips can be in the same or different VLANs/subnets as data vips, and hence using different physical ports if required. The FlashBlade MTU setting applies to a subnet (VLAN). The MTU configured for replication VLAN must be the minimum MTU along the link between the source array and the target array.

Creating a Subnet

Data vips that share the same network prefix and gateway are grouped into the same subnet. Exporting a file system requires a data vip, which in turn, must be attached to a subnet. Create a subnet if none of the existing ones meet your requirements.

Replication vips can be in the same or different VLANs/subnets as data vips, and hence using different physical ports if required. The FlashBlade MTU setting applies to a subnet (VLAN). The MTU configured for the replication VLAN must be the minimum MTU along the link between the source array and the target array. If you notice the arrays are connected, but replication shows little throughput, ensure that the MTU configured for the replication VLAN is the correct size.

It is recommended to create separate VLANs for data and replication so that data and replication can use different MTU settings.

1. From the **Settings** page navigation sidebar, click **Subnets** under **Network**.
2. Click the Add (+) button in the header of the **Subnets** panel. The **Create Subnet** pop-up window appears.
3. In the **Name** field, type the name of the subnet.
4. In the **Prefix** field, type the IP address of the network prefix and prefix length in the form `ddd.ddd.ddd.ddd/dd` for IPv4, or `xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx/xxx` for IPv6.
5. In the **VLAN** field, specify the VLAN ID to which the subnet is configured. Valid VLAN ID numbers are between 1 and 4094.

6 In the **Gateway** field, type the IP address of the gateway through which the data vip communicates with the network in the form `ddd.ddd.ddd.ddd` for IPv4, or `xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx` for IPv6

7 In the **MTU** field, specify the maximum transmission unit (MTU) of the data vip. If the MTU is not specified during subnet creation, the value defaults to `1500`.

8 Select a Link Aggregation Group from the **LAG** list.

9 Click **Create**.

Editing a Subnet

To edit a subnet, perform the following:

1 From the **Settings** page navigation sidebar, click **Subnets** under **Network**.

2 In the **Subnets** panel, locate the subnet you wish to edit and click the **Edit** icon to the right of the subnet name. The **Edit Subnet** pop-up window appears.

3 In the **VLAN** field, specify the VLAN ID to which the subnet is configured. Valid VLAN ID numbers are between 1 and 4094.

4 In the **Gateway** field, type the IP address of the gateway through which the data vip communicates with the network in the form `ddd.ddd.ddd.ddd` for IPv4, or `xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx` for IPv6

5 In the **MTU** field, specify the maximum transmission unit (MTU) of the data vip. If the MTU is not specified during subnet creation, the value defaults to `1500`.

6 Select a Link Aggregation Group from the **LAG** list.

7 Click **Save**.

Deleting a Subnet

A subnet can only be deleted if it is empty.

To delete a subnet, perform the following:

1 From the **Settings** page navigation sidebar, click **Subnets** under **Network**.

2 In the **Subnets** panel, locate the subnet you wish to delete and click the **Delete** icon to the right of the subnet name. The **Delete Subnet** pop-up window appears.

3 Click **Delete**.

Creating a Network Interface

Once you have created a subnet you can create and add network interfaces.

To create a network interface, perform the following:

1. From the **Settings** page navigation sidebar, click **Subnets** under **Network**.
2. In the **Subnets** panel, locate the subnet to which you wish to add a network interface and click the Add interface (+). The **Create Network Interface** pop-up window appears.
3. In the **Name** field, enter the interface name.
4. The subnet defaults to the interface in which you are creating the interface. If you wish to change the subnet, select a subnet from the **Subnet** list.
5. In the address field, enter the network address.
6. From the **Services** list, select if the interface will be used for `data` or `replication`.
7. Click **Create**.

The **Interfaces** column of the **Subnets** list is updated with the new interface.

Editing a Network Interface

To edit a network interface, perform the following:

1. From the **Settings** page navigation sidebar, click **Subnets** under **Network**.
2. In the **Subnets** panel, locate the nettwork interface you wish to edit and click the **Edit** icon in the same row of the interface. The **Edit Network Interface** pop-up window appears.
3. If you wish to change the subnet, select a subnet from the **Subnet** list.
4. In the address field, enter the network address.
5. From the **Services** list, select if the interface will be used for `data` or `replication`.
6. Click **Save**.

Deleting a Network Interface

To delete a network interface, perform the following:

1. From the **Settings** page navigation sidebar, click **Subnets** under **Network**.

2. In the **Subnets** panel, locate the nettwork interface you wish to delete and click the **Delete** icon in the same row of the interface. The **Delete Network Interface** pop-up window appears.
3. Click **Delete**.

Working with Security Settings

The following **Security** settings are available:

- **API Clients** - Displays and manages configured API clients.
- **Audit Trail** - Displays a chronological history of modification operations (for example, commands that create, update, and delete) that were run on the array.
- **Certificates**
  - **Array Certificates** - Displays, imports, and exports array certificates.
  - **External Certificates** - Displays and manages CA certificates.
  - **Certificate Groups** - Displays and manages certificate groups.
- **Directory Service** - Displays and manages the integration of FlashBlades with Active Directory and directory services. Also displays the FlashBlade's SMB authentication mode.
- **Kerberos Keytabs** - Displays and manages Kerberos keytab files.
- **Users** - Displays and manages local and remote FlashBlade array users.

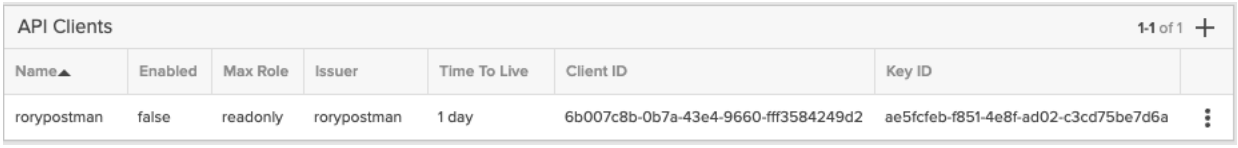
API Clients

The use of API clients is an alternate method of token authorization that is available on FlashBlade.

The **API Clients** panel displays and provides management of API clients used for authorization with the FlashBlade.

To access the **API Clients** panel, from the **Settings** page navigation sidebar, click **API Clients** under **Security**.

Figure 9.18 Viewing the API Clients Panel



The following information is displayed:

- **Name**: The API client name.
- **Enabled**: Whether the API client is enabled (**true**) or disabled (**false**) to exchange its ID tokens for access tokens.
- **Max Role**: The role associated with the API client.
- **Issuer**: The name of the API client's issuer.
- **Client ID**: The UUID that uniquely identifies the API client.
- **Key ID**: The UUID that uniquely identifies the issuer's public key.

Creating an API Client

Note: A public key is required when creating an API client. The public key should be in the OpenSSH format, which begins with ssh-rsa or ssh-ed25519.

To create an API client, perform the following:

1. From the **Settings** page navigation sidebar, click **API Clients** under **Security**.
2. Click the Add (+) button in the header of the **API Clients** panel. The **Create API Client** pop-up window appears.
3. Enter the API client's name.
4. The **Issuer** defaults to the name entered for the API client.
5. Select the role (permissions) of the API client from the **Max Role** list.
6. In the **Time To Live** field, enter the duration that the API token will be valid. The value must be entered in the format N[s|m|h|d]. For example **45s**, **50m**, **6h**, **3d**, etc. By default, the value is one day.
7. Enter the public key into the **Public Key** field.
8. Click **Create**.

Once the API client is created, it is displayed in the **API Clients** panel as disabled. You must manually enable it.

After creating and enabling an API client, you can use the Pure Unified 2.x SDK to make REST API calls to the FlashBlade. To create a session, you will need to specify the API client name, issuer, client ID, and key ID as shown in the GUI, along with the corresponding private key to the 2.x REST SDK.

Note: The FlashBlade 1.x REST SDK only supports API tokens. API clients for authentication are not supported. See the *FlashBlade Management REST API guide* for additional information.

Enabling an API Client

To enable an API client, perform the following:

1. From the **Settings** page navigation sidebar, click **API Clients** under **Security**.
2. In the **API Clients** panel, locate the API client you wish to enable. Click the **More Options** button in the same row and select **Enable API Client**. The **Enable API Client** pop-up window appears.
3. Click **Enable**.

Viewing an API Client's Public Key

To view an API client's public key perform the following:

1. From the **Settings** page navigation sidebar, click **API Clients** under **Security**.
2. In the **API Clients** panel, locate the API client whose public key you wish to view. Click the **More Options** button in the same row and select **View Public Key**. The **View Public Key** pop-up window appears displaying the key.
3. Click **Close** when finished.

Deleting an API Client

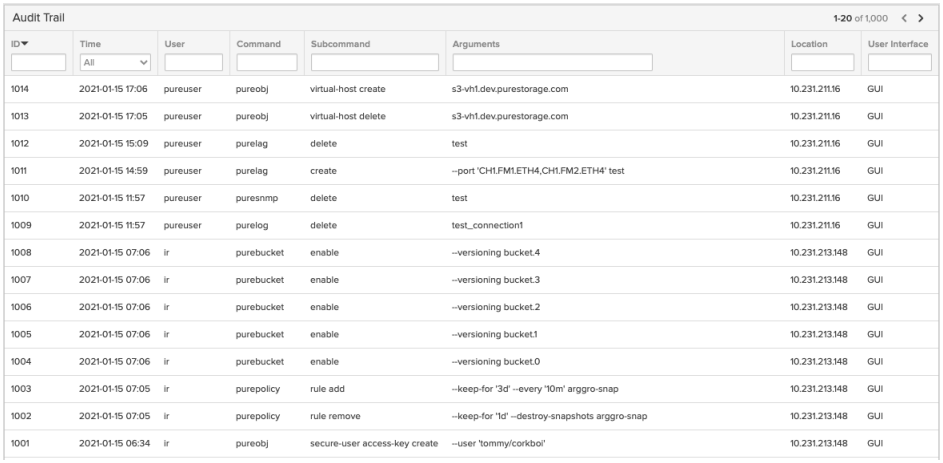
To delete an API client, perform the following:

1. From the **Settings** page navigation sidebar, click **API Clients** under **Security**.
2. In the **API Clients** panel, locate the API client you wish to delete. Click the **More Options** button in the same row and select **Delete API Client**. The **Delete API Client** pop-up window appears.
3. Click **Delete**.

Viewing the Audit Trail

The **Audit Trail** panel provides a chronological history of modification operations (for example, commands that create, update, and delete) that were run on the array.

Figure 9.19 Viewing the Audit Trail Panel



Audit Trail — 1-20 of 1,000

ID	Time	User	Command	Subcommand	Arguments	Location	User Interface
1014	2021-01-15 17:06	pureuser	pureobj	virtual-host create	s3-vh1.dev.purestorage.com	10.231.211.16	GUI
1013	2021-01-15 17:05	pureuser	pureobj	virtual-host delete	s3-vh1.dev.purestorage.com	10.231.211.16	GUI
1012	2021-01-15 15:09	pureuser	purelag	delete	test	10.231.211.16	GUI
1011	2021-01-15 14:59	pureuser	purelag	create	--port 'CH1.FM1.ETH4,CH1.FM2.ETH4' test	10.231.211.16	GUI
1010	2021-01-15 11:57	pureuser	puresnmp	delete	test	10.231.211.16	GUI
1009	2021-01-15 11:57	pureuser	purelog	delete	test_connection1	10.231.211.16	GUI
1008	2021-01-15 07:06	ir	purebucket	enable	--versioning bucket.4	10.231.213.148	GUI
1007	2021-01-15 07:06	ir	purebucket	enable	--versioning bucket.3	10.231.213.148	GUI
1006	2021-01-15 07:06	ir	purebucket	enable	--versioning bucket.2	10.231.213.148	GUI
1005	2021-01-15 07:06	ir	purebucket	enable	--versioning bucket.1	10.231.213.148	GUI
1004	2021-01-15 07:06	ir	purebucket	enable	--versioning bucket.0	10.231.213.148	GUI
1003	2021-01-15 07:05	ir	purepolicy	rule add	--keep-for '3d' --every '10m' arggro-snap	10.231.213.148	GUI
1002	2021-01-15 07:05	ir	purepolicy	rule remove	--keep-for '1d' --destroy-snapshots arggro-snap	10.231.213.148	GUI
1001	2021-01-15 06:34	ir	pureobj	secure-user access-key create	--user 'tommy/corkboi'	10.231.213.148	GUI

To view the history of modification operations issued on the array, from the **Settings** page navigation sidebar, click **Audit Trail** under **Security**.

The **Audit Trail** panel provides the following information:

- **ID**: The chronological number the command was used.
- **Time**: The date and time the command was run.
- **User**: The user who ran the command.
- **Command**: The name of the command.
- **Subcommand**: The subcommand used with the command.
- **Arguments**: Any arguments used with the command and their associated user-supplied input.
- **Location**: The IP address where the command was issued.
- **User Interface**: The interface from which the operation was run. For example, CLI, GUI, REST.

Array Certificates

Array certificates are used by clients to validate the array. Array certificates require private keys.

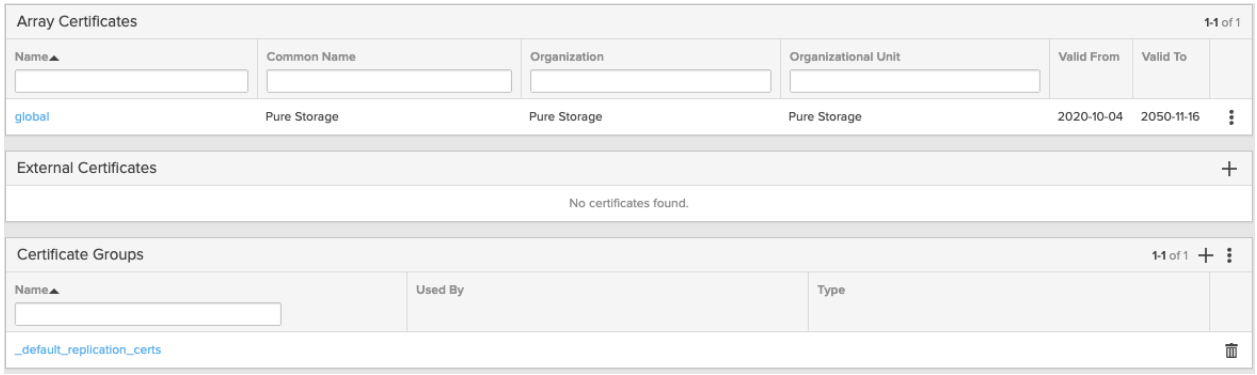
Purity creates a self-signed certificate and private key when you start the system for the first time. The SSL Certificate panel allows you to view the certificate and import or export certificates and private keys. Intermediate certificates can also be imported to the system.

Imported SSL certificates must be PEM formatted (Base64 encoded), include the "`-----BEGIN CERTIFICATE-----`" and "`-----END CERTIFICATE-----`" lines.

The **Array Certificates** panel displays imported array certificates on the FlashBlade.

To access the **Array Certificates** panel, from the **Settings** page navigation sidebar, click **Certificates** under **Security**.

Figure 9.20 Viewing the Array Certificates Panel



The following information is displayed:

- **Name**: The name of the array certificate. Clicking the array certificate name opens the **Certificate Detail**s panel.
- **Common Name**:
- **Organization**: IP
- **Organizational Unit**:
- **Valid From**: The date from which the certificate is valid.
- **Valid To**: The date the certificate expires.

Importing Array Certificates

To import array certificates, perform the following:

1 From the **Settings** page navigation sidebar, click **Certificates** under **Security**.

2 Click the **More Options** button in the **Array Certificates** panel. The **Import Array Certificate** pop-up window appears.

3 Complete or modify the following fields:

- **Certificate** - Click **Choose File** and select the signed certificate. Verify the certificate is PEM formatted (Base64 encoded), include the " `-----BEGIN CERTIFICATE-----` " and " `-----END CERTIFICATE-----` " lines.
- **Private Key** - Click **Choose File** and select the private key.
- **Intermediate Certificate** - (Optional) Click **Choose File** and select the intermediate certificate.
- **Key Passphrase** - (Optional) If the private key is encrypted with a passphrase, enter the passphrase.

4 Click **Import**.

Viewing Array Certificate Details

To view an array certificate's details, perform the following:

1 From the **Settings** page navigation sidebar, click **Certificates** under **Security**.

2 Click the certificate whose information you wish to view in the **Array Certificates** panel. The **Certificate Details** panel appears.

Exporting Array Certificates

To export array certificates, perform the following:

1 From the **Settings** page navigation sidebar, click **Certificates** under **Security**.

2 Locate the certificate you wish to export in the **Array Certificates** panel. Click the **More Options** button in the same row an select **Export Certificate**. The **Export Certificate** pop-up window appears.

3 Click **Download**.

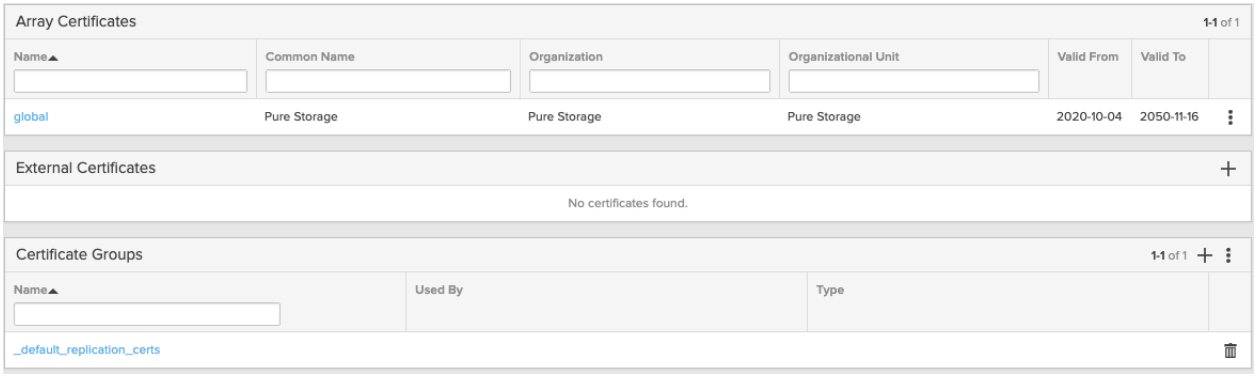
External Certificates

The **External Certificates** panel displays and allows you to import external (CA) certificates for the FlashBlade.

CA certificates are used to provide security authentication between two identities, allowing the FlashBlade to communicate securely with servers and clients.

To access the **External Certificates** panel, from the **Settings** page navigation sidebar, click **Certificates** under **Security**.

Figure 9.21 Viewing the External Certificates Panel



Importing an External Certificate

External (CA) certificates provide the security authentication between two identities. This allows the FlashBlade array to communicate securely with servers and clients.

1. From the **Settings** page navigation sidebar, click **Certificates** under **Security**.
2. Click the Add (+) button in the header of the **External Certificates** panel. The **Import CA Certificate** pop-up window appears.
3. In the **Name** field, type the name you wish to assign to the certificate.
4. In the **Type** field, **external** is displayed indicating the certificate used when the FlashBlade array acts as a client to validate a server.
5. In the **CA Certificate** field, click **Choose File** and select the certificate file.
6. Click **Import**.

Viewing Certificate Details

To view a certificate's details, perform the following:

1. From the **Settings** page navigation sidebar, click **Certificates** under **Security**.
2. In the **External Certificates** panel click the certificate whose details you wish to view.

   The **Certificate Details** panel appears displaying the certificate's information.

Exporting a Certificate

To export a certificate, perform the following:

1. From the **Settings** page navigation sidebar, click **Certificates** under **Security**.
2. In the **External Certificates** panel locate the certificate you wish to export. Click the **More Options** button in the same row and select **Export Certificate**. The **Export Certificate** pop-up window appears.
3. Click **Download**.

Deleting a Certificate

To delete a certificate, perform the following:

1. From the **Settings** page navigation sidebar, click **Certificates** under **Security**.
2. In the **External Certificates** panel locate the certificate you wish to delete. Click the **More Options** button in the same row and select **Export Certificate**. The **Delete Certificate** pop-up window appears.
3. Click **Delete**.

Certificate Groups

LDAP over TLS (Transport Layer Security) can be optionally configured to encrypt communication between the FlashBlade array, acting as an LDAP client, and LDAP servers. In order to establish LDAP over TLS, the LDAP server and FlashBlade must have mutually supported versions of TLS. FlashBlade supports TLS versions 1.0., 1.1, and 1.2. The LDAP server must support at least one of these versions. The highest matching TLS version on the LDAP server and FlashBlade is used.

⚠ **Important note!** The LDAP over TLS configuration does not support NFS with NIS (Network Information Service).

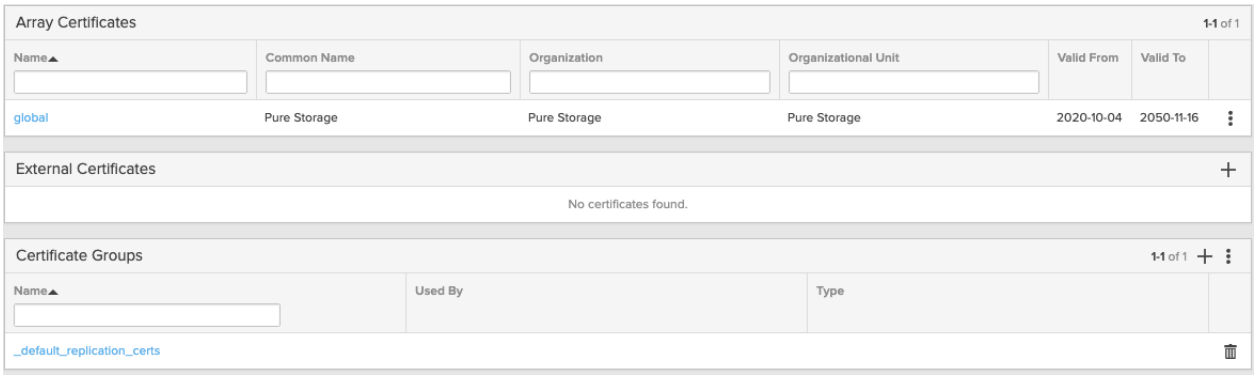
LDAP over TLS requires that each LDAP server's CA certificate be imported to the FlashBlade where they can be used individually by the FlashBlade or grouped into CA certificate groups to verify the LDAP server's identity and establish communication over TLS. CA certificate groups are used to manage multiple trusted certificates issued to different servers as a directory of certificates. A CA certificate group can contain one or more CA certificates. A CA certificate can be used in multiple CA certificate groups. CA certificates can be added, removed, or deleted without disruption to the services using them as long as the certificates for any configured servers remain in the group. While a CA certificate group is in use, it cannot be deleted, nor can you remove or delete all CA certificates in that group.

⚠ **Important note!** Adding multiple CA certificates in a certificate group which secure the same hostname can produce undefined behavior—there is no guarantee which certificate will be used.

The **Certificate Groups** panel displays all configured certificate groups for the FlashBlade.

To access the **Certificate Groups** panel, from the **Settings** page navigation sidebar, click **Certificates** under **Security**.

Figure 9.22 Viewing the Certificate Groups Panel



Creating a Certificate Group

A group can be created to house a collection of CA certificates. After you create a group, certificates can be added to that group.

To create a certificate group, perform the following:

1. From the **Settings** page navigation sidebar, click **Certificates** under **Security**.
2. Click the Add (+) button in the header of the **Certificate Groups** panel. The **Create Certificate Group** pop-up window appears.
3. In the **Name** field, type the name you want to assign to the certificate group.
4. Click **Create**.

Adding a Certificate to a Group

⚠ **Important note!** Adding multiple CA certificates in a certificate group which secure the same hostname can produce undefined behavior—there is no guarantee which certificate will be used.

Once a certificate group is created, you may add certificates to that group.

To add a CA certificate to a certificate group, perform the following:

1. From the **Settings** page navigation sidebar, click **Certificates** under **Security**.
2. In the **Certificate Groups** panel, click the certificate group to which you wish to add certificates. The selected group's certificate details page opens.
3. In the **Certificates** panel, click the Add (+) button. The **Add Certificates** pop-up window appears.
4. Select the certificate(s) you wish to add to the group from the **Available Certificates** column.
5. Click **Add**.

Removing a Certificate from a Group

Certificates can be removed from a certificate group if the certificate has expired or is no longer used.

To remove a CA certificate from a certificate group, perform the following:

1. From the **Settings** page navigation sidebar, click **Certificates** under **Security**.
2. In the **Certificate Groups** panel, click the certificate group from which you wish to remove certificates. The selected group's certificate details page opens.
3. In the **Certificates** panel, click the **More Options** button and select **Remove**. The **Remove Certificates** pop-up window appears.
4. Select the certificates you wish to remove from the group from the **Available Certificates** column.
5. Click **Remove**.

Deleting a Certificate Group

Note: While a certificate group is in use, it cannot be deleted, nor can you remove or delete all CA certificates in that group.

To delete a certificate group, perform the following:

1. From the **Settings** page navigation sidebar, click **Certificates** under **Security**.
2. In the **Certificate Groups** panel, locate the certificate group you wish to delete and click the **Delete** button in the same row. The **Delete Certificate Group** pop-up window appears.
3. Click **Delete**.

Viewing the SMB Mode

The **SMB Mode** panel displays the global SMB mode setting on the FlashBlade for Active Directory (AD) and directory services.

Note: SMB modes are global settings that can only be modified by Pure Technical Services.

The following SMB modes are supported:

- **AD RFC2307.** This is the default SMB mode setting for FlashBlade. It is recommended for customers where the same data needs to be accessed over SMB and NFS, and where access control is required. For more information, refer to the RFC 2307 specifications set by the Internet Engineering Task Force.
- **AD Auto.** Recommended for customers with SMB-only clients or when SMB and NFS clients never access the same file systems.
- **Native**. Required for native (non-Samba) SMB.

To access the **SMB Mode** panel, from the **Settings** page navigation sidebar, click **Directory Service** under **Security**.

The panel displays slightly different information depending on the SMB mode set on the FlashBlade as shown in the following figures:

Figure 9.23 Viewing the SMB Mode Panel (SMB Adapter Mode)

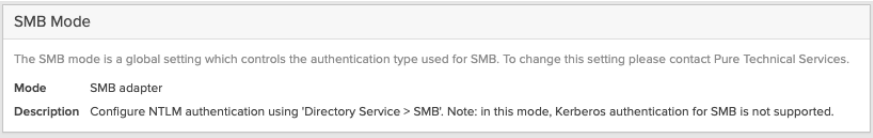
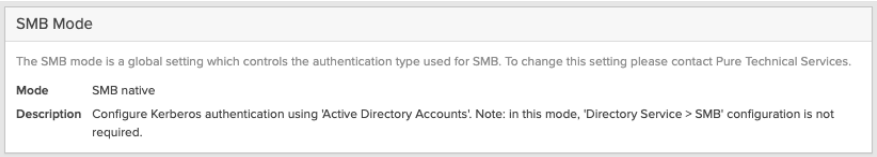


Figure 9.24 Viewing the SMB Mode Panel (SMB Native Mode)



- The **Mode** field displays the current global SMB mode setting.
  - **SMB adapter** is displayed if the SMB mode is set to AD RFC2307 or AD Auto. This also indicates that the FlashBlade will use Samba/gateway SMB.
  - **SMB native** is displayed if native SMB has been enabled by setting the FlashBlade's global SMB mode to native.
- The **Description** field provides your options for configuring an AD account or directory service.
  - If using SMB adapter mode, you are provided the GUI path to configure SMB directory service for NTLM authentication. Note that in this type of SMB directory service configuration, Kerberos authentication for SMB is not supported.
  - If using the SMB native mode, you are advised to create an AD account. You can alternatively configure SMB directory service.

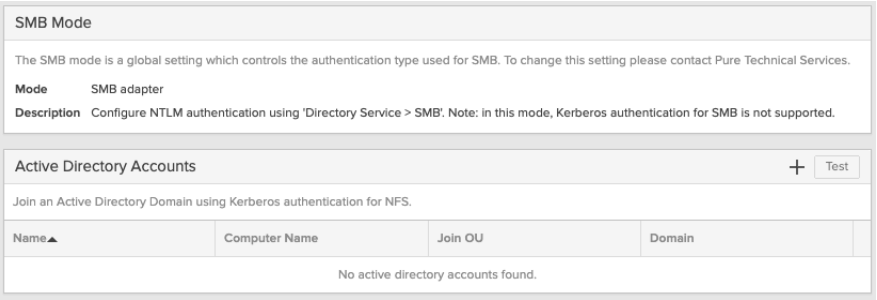
Active Directory Accounts

FlashBlade allows the management of a single Active Directory (AD) account, which is tied to a single AD domain. The **Active Directory Accounts** panel displays and manages AD accounts for the FlashBlade.

To access the **Active Directory Accounts** panel, from the **Settings** page navigation sidebar, click **Directory Service** under **Security**.

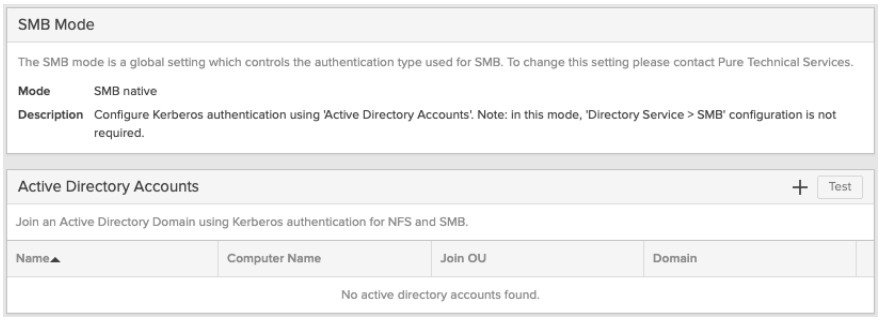
If the global SMB mode is set to SMB adapter, the **Active Directory** panel directs you to join an AD domain using Kerberos authentication for NFS as shown in the following figure.

Figure 9.25 Viewing the Active Directory Accounts Panel (SMB Adapter Mode)



If the global SMB mode is set to SMB native, the **Active Directory** panel directs you to join an AD domain using Kerberos authentication for NFS and SMB as shown in the following figure.

Figure 9.26 Viewing the Active Directory Accounts Panel (SMB Native Mode)



The following information is displayed:

- **Name**: The name of the AD computer account. Clicking the name directs you to the **Details** panel about the account (see *Viewing Active Directory Account Details*).
- **Computer Name**: The name of the computer account in the AD domain that represents the FlashBlade.
- **Join OU**: The organizational unit within the AD domain in which the AD computer account was created.
- **Domain**: The AD domain in which the AD computer account for FlashBlade was created.

For an overview about AD, see *Active Directory Overview*.

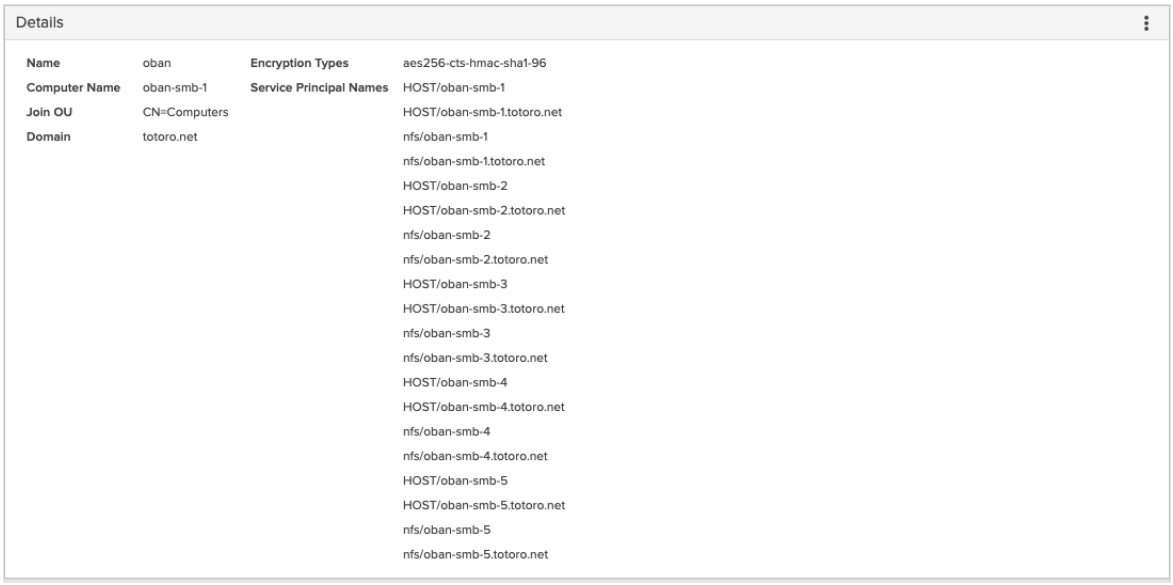
For instructions on creating an AD account, see *Creating an Active Directory Account*.

Viewing Active Directory Account Details

The Active Directory (AD) Accounts **Details** panel provides a summary of the configuration details about the AD account.

To access the **Details** panel, from the **Active Directory Accounts** panel, click the AD account name.

Figure 9.27 Viewing the Active Directory Accounts Details Panel



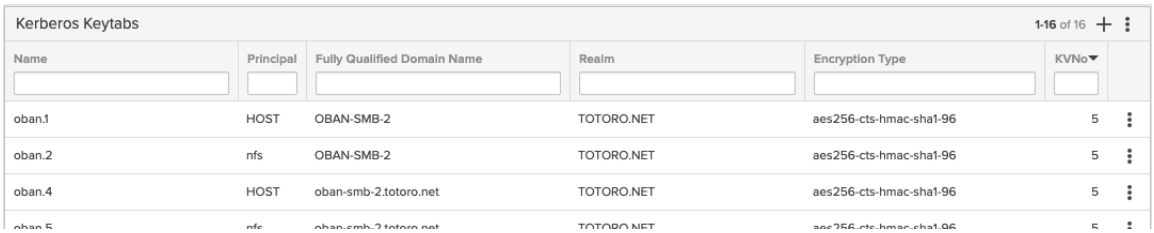
Managing AD accounts is described in detail under *Active Directory Overview*.

Viewing Active Directory Account Keytabs

The Active Directory (AD) Accounts **Kerberos Keytabs** panel displays all Kerberos keytabs in use with the AD account.

To access the **Kerberos Keytabs** panel, from the **Active Directory Accounts** panel, click the AD account name.

Figure 9.28 Viewing Active Directory Account Kerberos Keytabs



By default, keytabs are displayed newest to oldest. The following information is displayed:

- **Name**: The name of the keytab.
- **Principal**: The Service Principal Name (SPN).

- **Fully Qualified Domain Name**: The fully qualified domain name that the client will mount the file system over for NFS. This can be any of the FQDNs that have been registered for data VIPs on the FlashBlade.
- **Realm**: The Kerberos realm that issued the keytab.
- **Encryption Type**: The suite of encryption ciphers used for kerberized communication with clients whose Kerberos tickets are issued against this keytab.
- **KVNo**: The version number of the key used to issue the keytab.

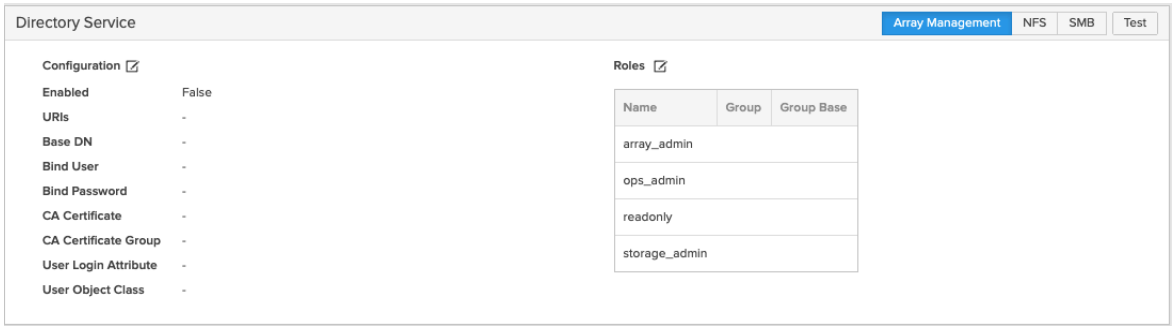
Managing Kerberos Keytabs for AD is described in detail under *Active Directory Overview*.

Directory Service

The **Directory Service** panel manages the integration of FlashBlades with an existing directory service.

To access the **Directory Service** panel, from the **Settings** page navigation sidebar, click **Directory Service** under **Security**.

Figure 9.29 Viewing the Directory Service Panel



When the **Directory Service** panel's user roles and directory service protocols are configured and enabled, the FlashBlade leverages a directory service to perform user account and permission level searches.

FlashBlade has three directory services:

- Array Management (see *Array Management Directory Service* for more details)
- NFS (see *NFS Directory Service* for more details)
- SMB (see *SMB Directory Service* for more details)

For an overview about directory services, see *Directory Services Overview*.

The FlashBlade supports a single local user, named `pureuser`, with array-wide (array_admin) permissions. Users can be added to the array through Lightweight Directory Access Protocol (LDAP) by integrating the array with a directory service such as Active Directory or OpenLDAP and assigning roles for one or more groups. Users can sign into the array only if they are in a group that has been assigned a role.

To integrate the FlashBlade array with a directory service:

1. Configure the FlashBlade directory service.
2. Test the directory service configuration.
3. Enable the directory service.

When configuring the directory service for array management, SMB, or NFS protocol integration with LDAP, specify the URIs (optional for SMB), base DN, and bind username and password of the directory service. Note that for file sharing over SMB, the base DN of the directory service is used to represent the domain that is joined, and the URIs can be configured for SMB to control what servers are communicated with when joining the domain. If selecting the NIS directory service for NFS, clear any existing LDAP configurations before specifying the NIS servers and NIS domain.

⚠ **Important note!** Anonymous binding is supported for NFS and Management. If configuring anonymous binding for NFS or Management, neither the bind user nor the bind password should be specified.

A "bind" account must be configured to allow the array to read the directory. The bind account should be tied to a service account (rather than an individual), and the account password should never expire or be required to change periodically. The bind account must have read privileges for users and groups and the privileges should be configured at the Organizational Unit.

For Active Directory, users with disabled accounts are not able to access the file systems.

After the directory service has been configured, test the configuration to verify that the URIs can be resolved and the FlashBlade array can bind and query the tree using the bind user credentials.

Enable the directory service after it has passed the directory service test. The directory service can be disabled at any time. Disabling the directory service stops any users in the directory from accessing the file system. In the case of management, disabling directory service prevents users from logging into the array.

For instructions on configuring each directory service, see:

- *Configuring the Array Management Directory Service*

- *Configuring the NFS Directory Service with LDAP*
- *Configuring the NFS Directory Service with NIS*
- *Configuring the SMB Directory Service*

Kerberos Keytabs

Purity//FB supports Kerberos authentication with directory services and Active Directory (AD) accounts.

Kerberos authentication is automatically enabled when configuring FlashBlade with an Active Directory account (see *Active Directory Overview*).

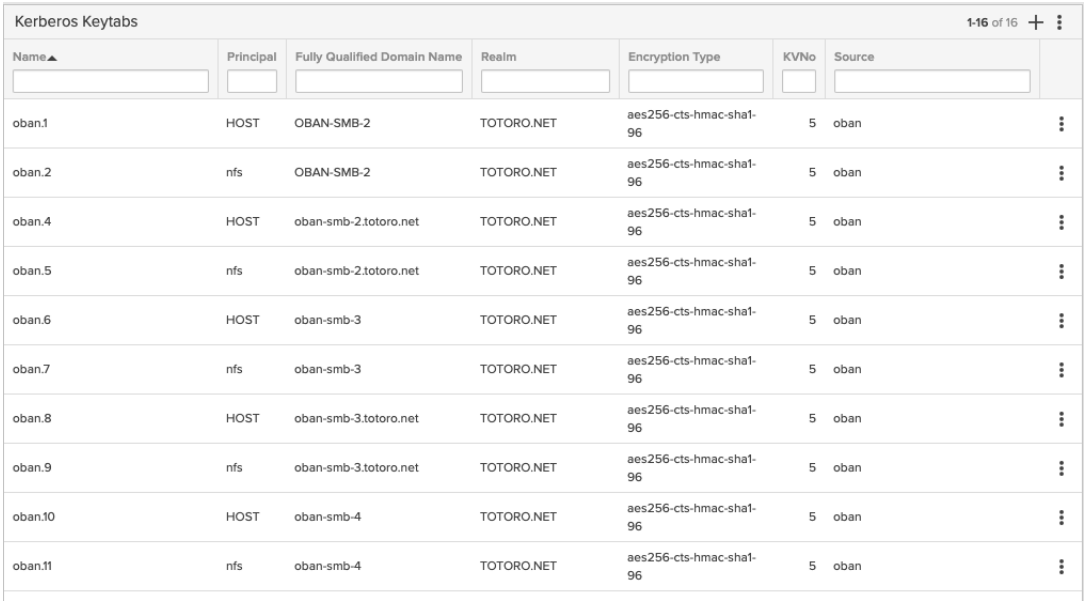
Kerberos network authentication protocol (krb5) for NFSv4.1 and SMB clients, in addition to auth_sys, are supported. With Kerberos, NFSv4.1 and SMB clients have to be authenticated by a Key Distribution Center (KDC) to get a session ticket. They have to present this session ticket to the FlashBlade array in order to get access to the file system.

Keytab files can be generated for a FlashBlade array by a KDC, and can then be imported and managed by the FlashBlade. Keytab files contain list of Kerberos principal names and encryption keys to automatically authenticate clients without requiring human interaction or access to password stored in a plain-text file. Keytab file must be manually uploaded with NFS or SMB directory services. With AD accounts, keytab files are automatically generated.

The **Kerberos Keytabs** panel displays and allows management of Kerberos keytabs on the FlashBlade for use with directory services and AD accounts.

To access the **Kerberos Keytabs** panel, from the **Settings** page navigation sidebar, click **Kerberos Keytabs** under **Security**.

Figure 9.30 Viewing the Kerberos Keytabs Panel



Kerberos Keytabs — 1-16 of 16

Name	Principal	Fully Qualified Domain Name	Realm	Encryption Type	KVNo	Source
oban.1	HOST	OBAN-SMB-2	TOTORO.NET	aes256-cts-hmac-sha1-96	5	oban
oban.2	nfs	OBAN-SMB-2	TOTORO.NET	aes256-cts-hmac-sha1-96	5	oban
oban.4	HOST	oban-smb-2.totoro.net	TOTORO.NET	aes256-cts-hmac-sha1-96	5	oban
oban.5	nfs	oban-smb-2.totoro.net	TOTORO.NET	aes256-cts-hmac-sha1-96	5	oban
oban.6	HOST	oban-smb-3	TOTORO.NET	aes256-cts-hmac-sha1-96	5	oban
oban.7	nfs	oban-smb-3	TOTORO.NET	aes256-cts-hmac-sha1-96	5	oban
oban.8	HOST	oban-smb-3.totoro.net	TOTORO.NET	aes256-cts-hmac-sha1-96	5	oban
oban.9	nfs	oban-smb-3.totoro.net	TOTORO.NET	aes256-cts-hmac-sha1-96	5	oban
oban.10	HOST	oban-smb-4	TOTORO.NET	aes256-cts-hmac-sha1-96	5	oban
oban.11	nfs	oban-smb-4	TOTORO.NET	aes256-cts-hmac-sha1-96	5	oban

Keytabs are displayed from newest to oldest. The following information is displayed:

- **Name**: The name of the keytab.
- **Principal**: The service principal name.
- **Fully Qualified Domain Name**: The fully qualified domain name that the client will mount the file system over for NFS or SMB. This can be any of the FQDNs that have been registered for data VIPs on the FlashBlade.
- **Realm**: The Kerberos realm that issued the keytab.
- **Encryption Type**: The suite of encryption ciphers used for kerberized communication with clients whose Kerberos tickets are issued against this keytab.
- **KVNo**: The version number of the key used to issue the keytab.
- **Source**: The keytab source. If generated by an AD account, the AD account would be displayed.

Importing a Keytab File

To import a keytab file, perform the following:

1 From the **Settings** page navigation sidebar, click **Kerberos Keytabs** under **Security**.

2 Click the **More Options** button in the header of the **Kerberos Keytabs** panel and select **Import**. The **Import Keytab File** pop-up window appears.

3 Enter a prefix in the **Name Prefix** field. Specifying a file entry prefix is required because a single keytab file can contain multiple keytab entries in multiple slots.

4 Click **Choose File** in the **Keytab File** field. Navigate to, and select the keytab file you wish to import.

5 Click **Import**.

Exporting a Keytab File

To export a keytab file that is currently present on your FlashBlade, perform the following:

1 From the **Settings** page navigation sidebar, click **Kerberos Keytabs** under **Security**.

2 To export one or more keytab files:

   a Click the **More Options** button in the header of the **Kerberos Keytabs** panel and select **Export**. The **Export Keytabs** pop-up window appears.

   b Select one or more keytab files from the **Existing Keytabs** column on the left. Each selected keytab file appears under the **Selected Keytabs** column on the right.

   c Click **Export**.

3 To export a single keytab:

   a From the **Kerberos Keytabs** panel, click the **More Options** button in the same row as the keytab file you wish to export. and select **Export**. The **Export Keytab File** pop-up window appears.

   b Click to export in **Binary** or **MIME** format.

Deleting a Keytab File

Note: Deleting keytab files can be a disruptive action if there were clients with active sessions that relied on the deleted keytab.

To delete a keytab file, perform the following:

1 From the **Settings** page navigation sidebar, click **Kerberos Keytabs** under **Security**.

2 To delete one or more keytab files:

a Click the **More Options** button in the header of the **Kerberos Keytabs** panel and select **Delete**. The **Delete Keytabs** pop-up window appears.

b Select one or more keytab files from the **Existing Keytabs** column on the left. Each selected keytab file appears under the **Selected Keytabs** column on the right.

c Click **Delete**.

3 To delete a single keytab:

a From the **Kerberos Keytabs** panel, click the **More Options** button in the same row as the keytab file you wish to delete and select **Delete**. The **Delete Keytab** pop-up window appears.

b Click **Delete**

Users

The **Users** panel manages local and remote FlashBlade array users.

To access the **Users** panel, from the **Settings** page navigation sidebar, click **Users** under **Security**.

Figure 9.31 Users - Users Panel

The panel displays the following:

- **Name**: The user name.
- **Type**: Displays `local` for users local to the array (pureuser), or `remote` for any other LDAP users.
- **Public Key**: The user's public key, if any, displayed as ****.
- **API Token**: Active tokens for API access displayed as ****.
- **Expires**: Expiration time , if any, of the API token.

In addition to displaying user attribute details, you can also create and manage user API tokens and user array authentication in the **Users** panel.

API Tokens

The REST API requires permission to run commands. To access the server to run REST API commands, an authentication API token must be generated for the user. Each API token is unique and has an optional expiration setting. When a token expires, it can no longer be used and a new token must be generated to continue running REST API commands. It is a best practice to set an expiration on a token for the duration of time it will be used.

Array Authentication

Note: Setting other users' public keys is available to administrators and users with admin permissions only. The public key should be in the OpenSSH format, which begins with `ssh-rsa` or `ssh-ed25519`. A maximum of 100 users may have a public key set.

Administrators and users with administrator privileges can set passwords for array users. Additionally, public key authentication can be configured allowing users to SSH to the array.

Creating an API Token

API tokens allow users to run REST API commands. To access the server to run REST API commands, you must generate an authentication API token for the user. As a best practice set an expiration on a token for the duration of time it will be used.

To create an API token for a user, perform the following:

1. From the **Settings** page navigation sidebar, click **Users** under **Security**.
2. Click the **More Options** button in the header of the **API Clients** panel and select **Create API Token**. The **Create API Token** pop-up window appears.
3. Enter user for whom the token will be created.
4. Enter the token's expiration duration in the format N[m/h/d/w]. For example, **15m**, **1h**, **2d**, **3w**. If not set, the API token will not expire.
5. Click **Create**.

The API Token pop-up window appears displaying the token and its creation and expiration dates.

Updating a User's Public Key

A public key can be added or updated for user authentication in order to allow users to SSH to the FlashBlade.

Note: Setting other users' public keys is available to administrators and users with admin permissions only. The public key should be in the OpenSSH format, which begins with `ssh-rsa` or `ssh-ed25519`. A maximum of 100 users may have a public key set.

To add or update a user's public key, perform the following:

1. From the **Settings** page navigation sidebar, click **Users** under **Security**.
2. Click the **More Options** button in the header of the **API Clients** panel and select **Update Public Key**. The **Update Public Key** pop-up window appears.
3. Enter the user for whom you are adding a public key.
4. Enter the public key into the **Public Key** field.
5. Click **Update**.

Editing Users

When editing a user, you can set and change the user's password and manage the user's public key configuration.

Note: Setting other users' public keys is available to administrators and users with admin permissions only. The public key should be in the OpenSSH format, which begins with `ssh-rsa` or `ssh-ed25519`. A maximum of 100 users may have a public key set.

To edit a user, perform the following:

1. From the **Settings** page navigation sidebar, click **Users** under **Security**.
2. In the **Users** panel, locate the user you wish edit. Click the **More Options** button in the same row, and select **Edit User**. The **Edit User** pop-up window appears.
3. (Optional) Enter and confirm a new password.
4. If a user's public key is set up you can optionally **Retain**, **Overwrite**, or **Remove** the public key. If you select **Overwrite**, enter the new public key in the displayed field.
5. Click **Save**.

Displaying an API Token

If you previously created an API token you can later display and copy the token for use with the REST API.

To display a user's API token for a user, perform the following:

1. From the **Settings** page navigation sidebar, click **Users** under **Security**.
2. In the **Users** panel, locate the user whose API token you wish to display. Click the **More Options** button in the same row, and select **Show API Token**. The **API Token** pop-up window appears.
3. Click **Copy** to copy the token if needed.
4. Click **Close**.

Recreating an API Token

API tokens can be recreated. Note that recreating an API token invalidates the old token and the recreated token must be authenticated.

To recreate an API token, perform the following:

1. From the **Settings** page navigation sidebar, click **Users** under **Security**.
2. In the **Users** panel, locate the user whose API token you wish to recreate. Click the **More Options** button in the same row, and select **Recreate API Token**. The **Recreate API Token** pop-up window appears.
3. Click **Recreate**.

Removing an API Token

To remove an API token from a user, perform the following:

1. From the **Settings** page navigation sidebar, click **Users** under **Security**.
2. In the **Users** panel, locate the user whose API token you wish to remove. Click the **More Options** button in the same row, and select **Remove API Token**. The **Remove API Token** pop-up window appears.
3. Click **Remove**.

Chapter 10
Choosing an Active Directory Account or Directory Services Configuration

FlashBlade supports both Active Directory (AD) account and directory services configuration. The following describes key differences between the two configuration types, as well as usage scenarios for each. Choose the configuration that provides the functionality you need and that best fits your environment.

Note: For additional information about Active Directory and directory services, see *Active Directory Overview* and *Directory Services Overview*.

Key Differences between Active Directory and Directory Services Configuration

Active Directory Accounts	Directory Services
Recommended for Native SMB. The computer account name or service principal name (SPN) should resolve to the data VIP. **Note:** A computer account should be associated with and resolved by DNS to a specific data VIP on the FlashBlade. **Note:** Refer to *Service Principal Names* for details on configuring AD accounts and DNS name registration. **Note:** Pure Technical Services is required to enable native SMB.	Required for SMB Adapter (Samba).
Only AD can be used as the directory services for SMB and NFS.	AD can be used as a directory service for SMB, and OpenLDAP or OUD or NIS can be used for NFS services

Active Directory Accounts	Directory Services
AD account creation configures Kerberos authentication with AD and creates the keytabs automatically. Service principal names (SPNs) and encryption types for Kerberos are managed on the FlashBlade.	Keytab files must be uploaded separately and Kerberos configurations are managed off the FlashBlade in the AD domain.
AD account creation can be used as a single workflow to configure AD Kerberos authentication for NFS and SMB.	NFS and SMB directory services is authenticated separately. You must upload keytab files separately to use Kerberos authentication for NFS.
FlashBlade communicates with the AD domain using the created AD account and authenticates via Kerberos. No machine account passwords are stored locally on the FlashBlade for security.	FlashBlade communicates with the AD/LDAP domain as the configured bind user and authenticates via simple authentication unless authentication is configured for NFS services. The specified bind password is stored locally on FlashBlade. Note that anonymous binding can be used if supported by your server.
FlashBlade uses only LDAPS for secure communication with the AD domain.	Plaintext LDAP can be configured or LDAPS can be used.

Configuration Choice Examples Based on Environment

Scenario	Configuration	Additional Information
Domain environment exclusively supports unsecure communication	Directory Services	• AD account only supports secure communication • Use directory service with plaintext LDAP • Upload keytabs if your NFS clients need Kerberos
You want to use Native SMB with AD Kerberos	AD Account	• AD account supports secure communications. • You can also use NFS with AD Kerberos
You do not need to use Kerberos	Directory Services	AD account creation automatically sets up Kerberos

Scenario	Configuration	Additional Information
You want to use two different AD domains for NFS and SMB	Directory Services and AD Account	At least one AD domain must be configured through directory service configuration because FlashBlade can join only one AD domain for any of the services
The realm that you use for Kerberos is disjointed from your AD domain	Directory Services	AD account configuration is not supported for environments using a disjointed Kerberos realm. You must upload keytab files manually on the FlashBlade for NFS Kerberos authentication.
You want to configure role-based access control (RBAC) for LDAP users	Directory Services	Configure the array management directory service and then configure user roles on the FlashBlade

Configuration Choices Based on Security Considerations

In addition to environmental requirements, there may be security considerations with your environment that require the configuration of directory services versus AD account as described below:

Scenario	Configuration
• Your corporate security policies mandate the Kerberos SPN and encryption types are managed on the domain side and not allow storage device to control it. • You configure service accounts that are used as the bind user/bind password on your storage devices. Such accounts would be read-only. • You configure your domains to allow anonymous binding for read-only operations from storage devices.	Configure directory services and upload keytab files if Kerberos is needed for NFS.

Scenario	Configuration
• You are not allowed to provide modify permisssions to your storage device at any time. • Your corporate security policies mandate that the Kerberos SPNs and encryption types are managed exclusively on the domain side and not allow storage devices to control it. • You may set up a computer account in your AD domain in advance to which FlashBlade can connect, allowing an AD account to be configured.	• Configure a computer account to allow minimal permissions to the FlashBlade upon joining the domain. • Configure AD account, joining the FlashBlade to your domain by connecting it to the pre-created computer account.
• FlashBlade is able to communicate only with a read-only domain controller in the domain, with change-capable domain controllers being unreachable. • You may have disjoint data and management networks.	Configure directory services and upload keytabs If the change-capable domain controllers are on your data network, but you sync a read-only controller on the management network for FlashBlade.

Combining Active Directory Account Configuration with NFS Directory Service Configuration

An Active Directory (AD) account can be configured in combination with the NFS directory service for the same supported data services.

When both are configured, the configured AD account performs lookup and mapping. If no results are returned or the lookup fails because the AD domain is unreachable, the configured NFS directory service then attempts the lookup.

Configuring both AD and NFS directory service can provide the following advantages:

- If you previously configured the NFS directory service and wish to migrate to an AD account, you can do so non-disruptively. By leaving the NFS directory service configured, you can ensure there is no outage while creating and testing your AD account.
- You can non-disruptively migrate your servers for NFS over time with FlashBlade switching between them as records are added to one and removed from another.

- Failback if the domain's Kerberos servers go down if simple bind was used and directory service was configured with a read-only bind credential.
- Failback if DNS goes down is provided if the directory service configuration and AD account point to the same domain.

Note: Combining AD accounts with the SMB directory service is not supported. If combined, the SMB directory service configuration will be ignored.

Active Directory Overview

An Active Directory is a hierarchical directory of large groups of computers, objects, and users within a network.

Configuring an Active Directory (AD) account to join the FlashBlade to an AD domain automatically enables support for Kerberos authentication for NFS and SMB services on FlashBlade.

FlashBlade allows the creation of one AD computer account, or joining of an existing AD computer account.

When an AD account is created on the FlashBlade, Kerberos keytabs are automatically generated for each encryption type and service principal name (SPN) that is set on the account, allowing clients to authenticate using Kerberos the same way that they would if keytab files were uploaded manually on the FlashBlade. This computer account is also used by FlashBlade to perform Lightweight Directory Access Protocol (LDAP) queries to the AD domain, such as user/group membership, netgroup information, name/ID, mappings for quotas, etc, which are authenticated by the computer account using Kerberos.

An AD account can support NFS, SMB, or both depending on the SPN. If the account has any SPNs beginning with `nfs/`, then it will be used to support Kerberos authentication for NFS services. If the account has any service principle names beginning with `HOST/` or `cifs/` (both case insensitive), then it will be used to support Kerberos authentication for SMB service.

When creating an AD account, SPNs or fully qualified domain names (FQDNs) can be specified for the account. If you specify FQDNs (or do not specify either FQDNs or SPNs), the account will be assigned SPNs automatically for all services supported by FlashBlade. If native SMB is enabled at the time of account creation, the account will support both SMB and NFS. If native SMB is not enabled, only NFS is supported. By default, AES256 encryption is used, though AES128 and RC4-HMAC are also supported as other choices.

Active Directory Networking Requirements

Network Ports

FlashBlade uses a variety of different protocols that require a variety of ports. Ports must be reachable on the Active Directory (AD) domain controller from the FlashBlade management network.

The following ports must not be blocked:

- Port 636 - default port used for secure communication (LDAPS) between the FlashBlade and AD domain for core AD functionality. Note that all LDAP communication is over TCP.
- Port 88 - default port used for Kerberos authentication within the domain allowing FlashBlade to perform "Kerberized" binds with the AD domain.

Network Speed

Slow environments can affect Kerberos performance. Kerberos KDCs, which handle key generation and authentication, will reject a request if two identical requests are received in a short time frame. This can occur if your network is slow or unstable, or with large MTU sizes.

Time Sync

FlashBlade and AD domain controllers (DCs) must be synchronized with Network Time Protocol (NTP) servers to maintain the network reference time. The time on the FlashBlade must be the same as the AD DCs. It is recommended that FlashBlade and AD DCs use the same NTP servers. If the time on the FlashBlade differs from the time in the AD domain, the FlashBlade's client Kerberos authentication requests with the domain might be rejected.

DNS Name Resolution

Domain Name System (DNS) is necessary for discovering domain controllers, KDCs, and LDAP servers within an AD domain. It is also necessary for Kerberized communications between the FlashBlade and the AD domain.

FlashBlade checks for the following DNS service entries:

- Service record: `_ldap._tcp.dc._msdcs.<DomainName>` - used to discover domain controllers against which LDAP queries can be made.

- Service record: `_kerberos._tcp.dc._msdcs.<DomainName>` - used to discover domain controllers that can issue Kerberos client tickets.

Resolving a hostname (or FQDN) to an IP address requires that DNS records be configured. You must configure reverse DNS if resolving an IP address to a hostname (or FQDN). A reverse DNS zone must be created to map IP addresses within the normal DNS zone in a range, and then PTR records can be automatically created when normal *hostname-to-IP* records are created. This process varies depending on the software used for your DNS nameserver.

Though Kerberos is designed to authenticate with FQDNs, some Kerberos clients support using IP addresses if reverse DNS is configured for the IP address. When reverse DNS is configured, and IP addresses are used, such a Kerberos client resolves the IP address to the proper FQDN and then obtains a client ticket for that FQDN. If you wish to specify IP addresses for the directory server and/or Kerberos server preferences on the FlashBlade, reverse DNS must be configured for all such IP addresses.

If the FlashBlade AD account was configured using only FQDNs and not short host names, i.e. `array1.mydomain.com` and `array1`, then clients attempting a Kerberos mount will not be able to obtain a ticket from the domain of the short host name. This will result in AD being unable to map the client ticket request against the FlashBlade account. Note that many DNS servers do not allow short host names to be configured. When using such a DNS server, a client-side configuration where the DNS search domain is configured to use short host names is required. How you configure the DNS search domain is dependent on the client type, I.e. Windows versus Linux; contact your network administrator for assistance.

Computer Account Naming and Credentials

By default, your Active Directory (AD) account configuration name will become the name of the computer account that is created by FlashBlade. The computer account name will be used to generate the fully qualified domain names (FQDNs), which can then be used for mapping the SMB shares in UNC pathnames. This is performed in a way that conforms with AD standards.

For example, the default FQDN for any `computer-name` in `example.domain.com` will be:

- Short host name: `computer-name`
- FQDN: `computer-name.example.domain.com`

The following restrictions apply for the computer name:

- A separate common name vs sAMAccountName is not supported.

- If you configure `computer-name` for the computer name attribute, FlashBlade sets the common name to `computer-name` and the sAMAccountName to `computer-name$`.
- The computer name cannot exceed 15 characters.
- The computer name must be a valid DNS name if no alternative FQDNs or service principal names (SPNs) are specified.
- The computer name cannot be changed after creation.
- The computer account name should resolve to a data VIP.

When creating an account in an AD domain, you must provide one-time credentials for FlashBlade. Credentials can take any of the following formats:

- Short username style (sAMAccountName): `username`
- Kerberos style: `username@domain.com`
- Windows logon style: `domain.com\username`
- LDAP distinguished name style: `CN=UserName,CN=...,DC=domain,DC=com`

Minimum Permissions for Joining an Active Directory Domain

FlashBlade joins an Active Directory (AD) domain using a one-time user name and password. The minimum set of user permissions needed in order to be used by FlashBlade for joining an AD domain depends on the mechanism used for joining.

The following are the minimum set of permissions needed if FlashBlade creates its own AD account:

- Create computer objects within the OU being joined.
- (Optional) Read and write computer account permissions allowing the created computer account to delete itself and update its own SPNs.

The following are the minimum set of permissions needed if FlashBlade connects to an existing AD account that was pre-created for FlashBlade:

- Basic READ permissions used to validate the attributes of the account:
  - Read servicePrincipalNames
  - Read msDS-SupportedEncryptionTypes
  - Read userAccountControl
- Reset password. This allows FlashBlade to reset the password on the computer account when generating Kerberos keys for the account.

Joining an Organizational Unit

When creating an Active Directory (AD) account, you must specify the organization unit (Join OU) within the AD domain where the computer account will reside. The location of the computer account can influence applied domain policies and permissions needed by credentials during creation.

By default, the computer accounts will use the CN=Computers OU. When specifying the Join OU, the OU should be specified as a relative distinguished name (RDN) in the LDAP style, for example: `OU=location,OU=storage-machines,CN=ny-datacenter`.

Note: The Join OU cannot be changed at the same time the encryption types, SPNs, or FQDNs are changed. This is due to permission changes that can occur when changing the Join OU.

Joining with an Existing Computer Account

In some instances, it may be preferable for FlashBlade to join using an existing Active Directory (AD) computer account in an AD domain (see *Choosing an Active Directory Account or Directory Services Configuration* for scenarios). This can include when environments have strong security restrictions or when different admin teams manage DNS naming for the FlashBlade as well as client encryption.

In order to use a pre-created computer account to join the FlashBlade to the domain, the following attributes must be pre-configured in AD:

- msDS-SupportedEncryptionTypes - defines what encryption types can use Kerberos authentication with FlashBlade.
- servicePrincipalNames - defines what protocols clients can use to mount and what FQDNs the protocols can mount over. Service components must be valid for the given FlashBlade; nfs/ for non-native SMB systems and nfs/, cifs/, or HOST/ for native SMB systems).

- userAccountControl - dictates controls on an account, including its password restrictions, enablement status, etc.

For the attributes above:

- The user whose credentials are used to perform the action of joining the domain must have READ access for these attributes on the pre-created computer account.
- You may wish to configure the msDS-SupportedEncryptionTypes and servicePrincipleNames attributes before having the FlashBlade join as the AD account configuration will pull the values of these attributes from the computer account.
- The userAccountControl attribute must include the WORKSTATION_TRUST_ACCOUNT and DONT_EXPIRE_PASSWD flags.

When joining an existing AD account, you need only specify the AD domain, credentials, and your computer account name. You can optionally specify directory and Kerberos servers. The Join OU, encryption type, and SPNs/FQDNs are "inherited" from the existing AD computer account. FlashBlade searches and validates the computer account and then resets the account's password/Kerberos key in order to generate Kerberos keys for FlashBlade use.

For security purposes, when joining an existing AD account, multiple FlashBlade arrays or other appliances cannot share the same computer account.

Service Principal Names

When creating an Active Directory (AD) account using the FlashBlade GUI or CLI, you can specify what service principal names (SPNs) will be used by clients to mount FlashBlade file systems. Up to 32 SPNs can be specified per computer account. Only a single computer name per AD account can be configured.

An SPN is a unique identifier of a service instance and is used by Kerberos authentication to associate a service instance with a service account.

If an SPN is not specified during the creation of an AD account on FlahBlade, the computer name will be used as the SPN name. If an AD account is added with the computer name without specifying an SPN then you will have to manually register the data VIP against the computer account name in the DNS server.

SPNs follow two formats:

- Short name - `<SERVICE>/<NAME>`

- Long name - <SERVICE>/<NAME>.<DOMAIN_NAME>

<SERVICE> can have the following values:

- nfs: For NFSv4.1 Kerberized access. NFS must be specified in lowercase, i.e. nfs.
- cifs: Available if native SMB is enabled.
- HOST: Available if native SMB is enabled. This is the default SMB service with AD.

<NAME> should be the DNS name associated with the data VIP on the FlashBlade. When accessing the file system, this name should be used instead of the IP address for Kerberized authentication.

If SPNs were not specified during AD account creation, they can be added to the account at a later time by editing the AD account on the FlashBlade.

If you configured multiple data VIPs for different services, you can register them as extra SPNs with the <NAME> registered on a DNS server corresponding to the FlashBlade data VIP. For example, if you configured data VIP 10.1.1.2 with the DNS name data-vip2 for NFS and data VIP 10.2.2.3 with the DNS name data-vip3 for NFS and SMB, you would specify the following SPNs:

- nfs/data-vip2
- nfs/data-vip2.mydomain.com
- nfs/data-vip3
- nfs/data-vip3.mydomain.com
- HOST/data-vip3
- HOST/data-vip3.mydomain.com

Directory and Kerberos Servers

Up to five directory servers and/or five Kerberos servers can be specified for Active Directory (AD) account configuration.

During configuration, FlashBlade automatically discovers the five fastest/closest directory and Kerberos servers in the DNS. You may wish to manually configure the servers if:

- FlashBlade needs to connect to specific servers in the domain with very specific policies. For example, you may have policies to derive RFS2307 UID/GID mappings on only a subset of domain controllers; your FlashBlade configured for both NFS and SMB would need to be configured accordingly in order to communicate with the server.
- all updates to the domain will happen in a specific change-capable server and you would like the FlashBlade to pick up the updates without waiting for them to propogate across the domain.

When configuring servers, the following formats are accepted:

- DNS names
- IP addresses for Kerberos servers.
- IP addresses for directory servers if reverse DNS is configured for those IP addresses.

Creating an Active Directory Account

To create an Active Directory account, perform the following:

1. From the **Settings** sidebar, click **Directory Service** under **Security**. The **Active Directory Accounts** panel appears.
2. Click the Add (+) button. The **Create Active Directory Account** pop-up window appears.
3. Select **Create a new account**.
4. Enter the name of the new account in the **Name** field.
5. In the **Computer Name** field, enter the name for the AD computer account that will be created in the AD domain. If a computer name is not entered, the computer name will default to the value entered in the **Name** field. The computer account name should resolve to the data VIP.
6. In the **Domain** field, enter the AD domain to which this computer account will be created.
7. In the **User Name** field, enter the name of the user who is capable of creating the computer account within the domain.
8. Enter the user's password in the **Password** field.

   If you wish to enter additional configuration information, click **Additional Settings**.
9. In the **Join OU** filed, enter the organization unit (location) where the computer account will be created. For example, **OU=Arrays**, **OU=Storage**, etc. If an OU is not entered, the value defaults to **CN=Computers**.
10. Select the **Encryption Type**. The default encryption type is **aes256-sha1**.

11 Click the Add (+) button to the right of the **Service Principal Names** field and enter a comma-separated list of service principal names (SPNs) or fully qualified domain names (FQDNs) for registering services with the AD domain. If nothing is entered, the value defaults to **Computer Name.Domain** as an FQDN.

12 Click the Add (+) button to the right of the **Kerberos Servers** field, and enter a comma-separated list of key distribution servers for Kerberos. Servers can be listed as IP addresses or DNS names. If nothing is entered, servers are resolved for the domain in DNS.

13 Click the Add (+) button to the right of the **Directory Servers** field, and enter a comma-separated list of directory servers used for authorization. Servers can be listed as IP addresses or DNS names. If nothing is entered, servers are resolved for the domain in DNS.

14 Click **Create**.

Creating an Active Directory Account using the CLI

Active Directory (AD) accounts can also be created using the **`puread account create`** CLI command. For full details about the **`puread`** command, see the *FlashBlade CLI Reference*.

To create an active directory account using the CLI, perform the following:

1 Run the **`puread account create account --domain DOMAIN ACCOUNT`** command, where `ACCOUNT` is the name of the new AD account. Note that the `--domain` argument, which specifies the AD domain to which the computer account will be created, is required. You can also specify the following:

- `--computer-name`: (Optional) The name for the AD computer account that will be created in the AD domain. If a computer name is not entered, the computer name will default to the name used for the `ACCOUNT-NAME`. The computer account name should resolve to the data VIP.
- `--join-ou`: (Optional) The organization unit (location) where the computer account will be created. For example, `OU=Arrays`, `OU=Storage, etc`. If an OU is not entered, the value defaults to `CN=Computers`.
- `--encryption-type`: (Optional) A comma-separated list of encryption types that will be supported for use by clients for Kerberos authentication. Defaults to `AES256-cts-hmac-sha1-96`.
- `--fqdn`: (Optional) A comma-separated list of fully qualified domain names (FQDNs) used for the creation of keys for Kerberos authentication. If FQDNs are specified, all supported service principals will be registered for them. If neither FQDNs nor SPNs are specified, all supported service princples with the `COMPUTER_NAME.DOMAIN` as the FQDN are registered.
- `--spn`: (Optional) A comma-separated list of service principal names (SPNs) or fully qualified domain names (FQDNs) for registering services with the AD domain. Up to 32 SPNs can be specified. If nothing is entered, all supported SPNs with the `COMPUTER_NAME.DOMAIN` as the FQDN are registered.
- `--kerberos-server`: (Optional) A comma-separated list of key distribution servers for Kerberos. Servers can be listed as IP addresses or DNS names. If nothing is entered, servers are resolved for the domain in DNS.
- `--directory-server`: (Optional) A comma-separated list of directory servers used for authorization. Servers can be listed as IP addresses or DNS names. If nothing is entered, servers are resolved for the domain in DNS.

For example:

```
puread account create mynewadaccnt --domain mycorp.com --computer-name
 flashblade01
```

2 When prompted enter your user name and password.

```
puread account create mynewadaccnt --domain mycorp.com --computer-name
 flashblade01
Enter the user name used to join:
```

```
Enter password for user:
```

In this example:

- the created account is `mynewadaccnt`
- the account is created in the domain `mycorp.com`
- the account is created in the organization unit (OU) `CN=Computers` because no Join OU value was specified
- the AD computer name that is created in the AD domain is `flashblade01`
- the encryption type defaults to `AES-256-SHA1` because no encyrption type was specified
- all supported service principles with `COMPUTER_NAME.DOMAIN` as the FQDN are registered because no FQDNs or SPNs were specified
- Kerberos and directory servers are resolved for the domain in DNS

Joining Active Directory with an Existing Computer Account

When joining AD with an existing computer account, you need only specify the AD domain, credentials, and your computer account name. The Join OU, encryption type, and SPNs/FQDNs are "inherited" from the existing AD account.

To create a computer account to join an existing AD account, perform the following:

1. From the **Settings** sidebar, click **Directory Service** under **Security**. The **Active Directory Accounts** panel appears.
2. Click the Add (+) button. The **Create Active Directory Account** pop-up window appears.
3. Select **Connect to existing account**.
4. Enter the name of the new account in the **Name** field.
5. In the **Computer Name** field, enter the name for the AD computer account that will be created in the AD domain. If a computer name is not entered, the computer name will default to the value entered in the **Name** field.
6. In the **Domain** field, enter the AD domain to which this computer account will be created.
7. In the **User Name** field, enter the name of the user who is capable of creating the computer account within the domain.

8 Enter the user's password in the **Password** field.

If you wish to enter additional configuration information, click **Additional Settings**.

9 In the **Kerberos Servers** field, enter a comma-separated list of key distribution servers for Kerberos. Servers can be listed as IP addresses or DNS names. If nothing is entered, servers are resolved for the domain in DNS.

10 In the **Directory Servers** field, enter a comma-separated list of directory servers used for authorization. Servers can be listed as IP addresses or DNS names. If nothing is entered, servers are resolved for the domain in DNS.

11 Click **Create**.

Joining Active Directory with an Computer Existing Account using the CLI

The CLI can also be used to join an existing Active Directory (AD) account.

Use the **`puread account create --join-existing-account`** command to create a computer account to join an existing AD account. For full details about the **`puread`** command, see the *FlashBlade CLI Reference*.

To create a computer account to join an existing AD account using the CLI, perform the following:

1 Run the **`puread account create account --domain --join-existing-account ACCOUNT-NAME`** command, where `ACCOUNT-NAME` is the name of the existing AD account. Note that the `--domain` argument, which specifies the AD domain to which the computer account will be created, is required. You can also specify the following arguments:

- `--computer-name`: (Optional) The name for the AD computer account that will be created in the AD domain. If a computer name is not entered, the computer name will default to the name used for the `ACCOUNT-NAME`.
- `--kerberos-server`: (Optional) A comma-separated list of key distribution servers for Kerberos. Servers can be listed as IP addresses or DNS names. If nothing is entered, servers are resolved for the domain in DNS.
- `--directory-server`: (Optional) A comma-separated list of directory servers used for authorization. Servers can be listed as IP addresses or DNS names. If nothing is entered, servers are resolved for the domain in DNS.

For example:

```
puread account create mynewaccnt --computer-name newcomputer --domain
 mycorp.com --join-existing-account
```

2 When prompted enter your user name and password.

```
puread account create mynewaccnt --computer-name newcomputer --domain
 mycorp.com --join-existing-account
Enter the user name used to join:
Enter password for user:
```

In this example:

- the computer account `newcomputer` is created in the existing AD account `mynewaccnt`.
- the account is in the domain `mycorp.com`

Testing an Active Directory Configuration

An Active Directory (AD) configuration can fail if:

- there is a change to your DNS configuration (or nameserver failure) resulting in FlashBlade's auto-resolution of LDAP and Kerberos servers to fail.
- the server that FlashBlade is communicating with for user and group lookups is misconfigured or goes down.
- the AD account is moved, modified, reset, or deleted by an administrator.

If any of these have occurred, test your AD account to ensure that your configuration is valid.

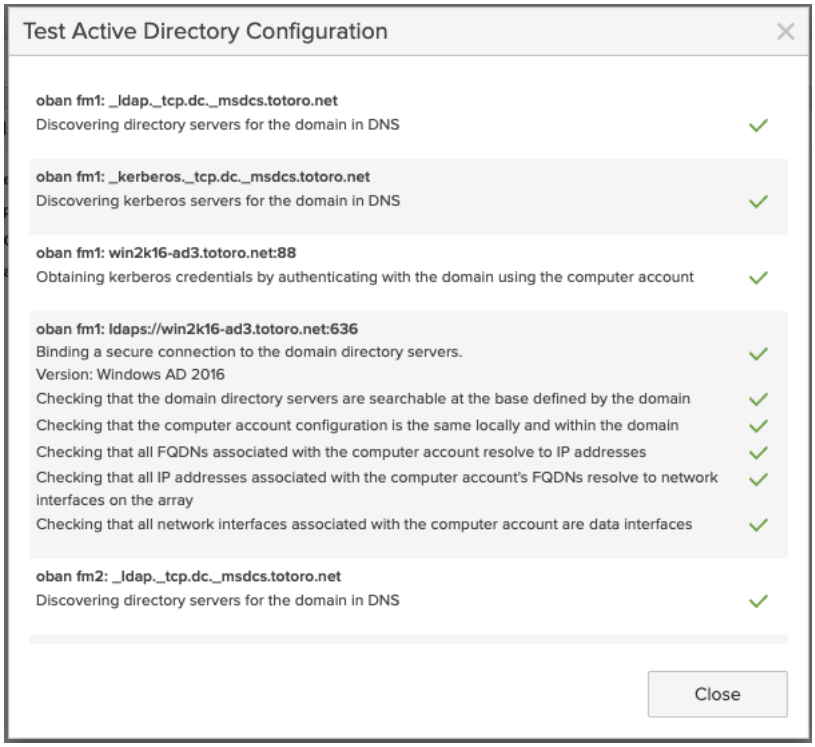
To test an AD configuration, perform the following:

1 From the **Settings** sidebar, click **Directory Service** under **Security**. The **Active Directory Accounts** panel appears.

2 Click the AD account. The **Details** panel appears.

3 Click the **More Options** button and select **Test**. The **Test Active Directory Configuration** pop-up window appears displaying test results.

Figure 10.1 Viewing Active Directory Configuration Test Results



If there are items that did not pass, you may need to edit your AD account configuration.

4 Click **Close**.

Testing an Active Directory Configuration using the CLI

You can also use the CLI to test your AD configuration to ensure that your configuration is valid.

Run the **`puread account test`** command to test an AD using the CLI. For full details about the **`puread`** command, see the *FlashBlade CLI Reference*.

For example:

```
puread account test
Name  Component Name  Component Address  Destination                          Test
                      Success  Details
oban  fm1             10.64.242.197      _ldap._tcp.dc._msdcs.totoro.net      dns-
directory-server-discovery  True     -
                                         _kerberos._tcp.dc._msdcs.totoro.net  dns-
kerberos-server-discovery   True     -
                                         win2k16-ad3.totoro.net:88
 kerberos-initialization         True     -
                                         ldaps://win2k16-ad3.totoro.net:636
 directory-server-binding        True     Version:...
```

```
 base-dn-searching               True     -

 account-consistency-check       True     -

 network-resolution-check        True     -

 network-interface-check         True     -

 network-service-check           True     -
      fm2             10.64.242.198      _ldap._tcp.dc._msdcs.totoro.net      dns-
directory-server-discovery  True     -
                                         _kerberos._tcp.dc._msdcs.totoro.net  dns-
kerberos-server-discovery   True     -
                                         win2k16-ad3.totoro.net:88
 kerberos-initialization         True     -
                                         ldaps://win2k16-ad3.totoro.net:636
 directory-server-binding        True     Version:...

 base-dn-searching               True     -

 account-consistency-check       True     -

 network-resolution-check        True     -

 network-interface-check         True     -

 network-service-check           True     -
```

Verify that all tests are successfully passed (`True`) in the `Success` column.

Additional options are availble to format the output of the command. Refer to **`puread`** in the *FlashBlade CLI Reference* for details.

Editing an Active Directory Account

To edit an Active Directory (AD) account, perform the following:

1. From the **Settings** sidebar, click **Directory Service** under **Security**. The **Active Directory Accounts** panel appears.
2. Click the AD account. The **Details** panel appears.
3. Click the **More Options** button and select **Edit Account**. The **Edit Active Directory Account** pop-up window appears.
4. In the **Join OU** field, enter the organization unit (location) where the computer account will be created. For example, **OU=Arrays**, **OU=Storage**, etc. If an OU is not entered, the value defaults to **CN=Computers**.
5. Select the **Encryption Type**. The default encryption type is **aes256-sha1**.

6 Click the Add (+) button to the right of the **Service Principal Names** field and enter a comma-separated list of service principal names (SPNs) for registering services with the AD domain. If you wish to remove previously entered SPNs, click the Remove (**x**) button next to the SPN you wish to remove.

7 Click the Add (+) button to the right of the **Kerberos Servers** field, and enter a comma-separated list of key distribution servers for Kerberos. Servers can be listed as IP addresses or DNS names. If you wish to remove previously entered servers, click the Remove (**x**) button next to the server you wish to remove.

8 Click the Add (+) button to the right of the **Directory Servers** field, and enter a comma-separated list of directory servers used for authorization. Servers can be listed as IP addresses or DNS names. If you wish to remove previously entered servers, click the Remove (**x**) button next to the server you wish to remove.

9 Click **Save**.

Editing an Active Directory Account using the CLI

The **`puread account setattr`** CLI command can also be used to edit the configuration of active directory accounts. For full details about the **`puread`** command, see the *FlashBlade CLI Reference*.

When running the command, the `ACCOUNT-NAME` must be specified. Similar to creating an AD account, the following can be set/changed:

- `--join-ou`: (Optional) The organization unit (location) where the computer account will be created. For example, `OU=Arrays`, `OU=Storage, etc`. If an OU is not entered, the value defaults to `CN=Computers`.
- `--encryption-type`: (Optional) A comma-separated list of encryption types that will be supported for use by clients for Kerberos authentication. Defaults to `AES256-sha1`.
- `--fqdn`: (Optional) A comma-separated list of fully qualified domain names (FQDNs) used for the creation of keys for Kerberos authentication. If FQDNs are specified, all supported service principals will be registered for them. If neither FQDNs nor SPNs are specified, all supported service principles with the `COMPUTER_NAME.DOMAIN` as the FQDN are registered.
- `--spn`: (Optional) A comma-separated list of service principal names (SPNs) or fully qualified domain names (FQDNs) for registering services with the AD domain. Up to 32 SPNs can be specified. If nothing is entered, all supported SPNs with the `COMPUTER_NAME.DOMAIN` as the FQDN are registered.

- `--kerberos-server`: (Optional) A comma-separated list of key distribution servers for Kerberos. Servers can be listed as IP addresses or DNS names. If nothing is entered, servers are resolved for the domain in DNS.
- `--directory-server`: (Optional) A comma-separated list of directory servers used for authorization. Servers can be listed as IP addresses or DNS names. If nothing is entered, servers are resolved for the domain in DNS.

For example, an account previously created with the default encryption type AES256-SHA1 is updated to also use RC4-HMAC:

```
puread account setattr mynewacct --encryption-type AES256-SHA1,RC4-HMAC
```

Rotating Keytabs

FlashBlade provides the ability to rotate keytabs. Rotating keytabs creates new keytabs for your Active Directory (AD) account.

You may need to rotate your AD acocunt's keytabs if:

- your keytabs have been compromised.
- there is a security policy requiring your security implementation to change after a specific duration.

When keytabs are rotated, new keytabs are created and added to your AD account. You can specify a new prefix for the new keytabs. Your existing keytabs will still exist and can be deleted as needed to ensure that users are not locked out.

To rotate keytabs for your Active Directory (AD) account, perform the following:

1. From the **Settings** sidebar, click **Directory Service** under **Security**. The **Active Directory Accounts** panel appears.
2. Click the AD account. The **Details** panel appears (the **Kerberos Keytabs** panel appears below the **Details** panel).
3. Click the **More Options** button in the header of the **Details** panel and select **Rotate Keytabs**. The **Rotate Keytabs** pop-up window appears.
4. (Optional) In the **Keytab Name Prefix**, enter a new prefix to be used for the generated keytabs.
5. Click **Rotate**.

The new keytabs appear at the top of the **Kerberos Keytabs** panel.

Rotating Keytabs using the CLI

Keytabs can be rotated for Active Directory (AD) accounts using the CLI.

Use the **`purekeytab create --ad`** CLI command to rotate keytabs. For full details about the **`purekeytab`** command, see the *FlashBlade CLI Reference*

When rotating keytabs, new keytabs are created and added to your AD configuration, as identified with the `--ad` argument. You can optionally specify the `--prefix` argument. This allows you to specify a prefix used for naming the new keytab entries.

For example:

```
purekeytab create --ad myadaccnt --prefix myaccnt
```

In this example, `--ad myadaccnt` specifies the new keytabs are created for the `myadaccnt` AD configuration and `--prefix myaccnt` specifies that all new keytabs begin with the prefix `myaccnt`.

Your existing keytabs will still exist and can be deleted as needed to ensure that users are not locked out.

Importing a Keytab File

To import a keytab file, perform the following:

1. From the **Settings** page navigation sidebar, click **Kerberos Keytabs** under **Security**.
2. Click the **More Options** button in the header of the **Kerberos Keytabs** panel and select **Import**. The **Import Keytab File** pop-up window appears.
3. Enter a prefix in the **Name Prefix** field. Specifying a file entry prefix is required because a single keytab file can contain multiple keytab entries in multiple slots.
4. Click **Choose File** in the **Keytab File** field. Navigate to, and select the keytab file you wish to import.
5. Click **Import**.

Importing a Keytab File using the CLI

Use the **`purekeytab create --keytab-file`** CLI command to import keytabs. For full details about the **`purekeytab`** command, see the *FlashBlade CLI Reference*

Specifying a file entry prefix with the `--prefix` argument is required because a single keytab file can contain multiple keytab entries in multiple slots. When prompted, enter the keytab file you wish to import. The keytab file must be in Base64 MIME-encoded format.

For example:

```
purekeytab create --prefix new --keytab-file
Please enter a keytab file in Base64 MIME-encoded format followed by ^D:
```

In this example, the entered keytab beginning with the prefix `new` is imported.

Exporting a Keytab File

To export a keytab file that is currently present on your FlashBlade, perform the following:

1. From the **Settings** page navigation sidebar, click **Kerberos Keytabs** under **Security**.
2. To export one or more keytab files:
   a. Click the **More Options** button in the header of the **Kerberos Keytabs** panel and select **Export**. The **Export Keytabs** pop-up window appears.
   b. Select one or more keytab files from the **Existing Keytabs** column on the left. Each selected keytab file appears under the **Selected Keytabs** column on the right.
   c. Click **Export**.
3. To export a single keytab:
   a. From the **Kerberos Keytabs** panel, click the **More Options** button in the same row as the keytab file you wish to export. and select **Export**. The **Export Keytab File** pop-up window appears.
   b. Click to export in **Binary** or **MIME** format.

Exporting a Keytab File using the CLI

You cannot directly export a keytab file present on the FlashBlade using the CLI. However, the CLI does allow you to view the BASE64 MIME-encoded format of keytabs currently in use with the AD account that you can copy and use elsewhere.

Use the **`purekeytab list --keytab-file`** CLI command to view the BASE64 MIME-encoded format of a keytab file. For full details about the **`purekeytab`** command, see the *FlashBlade CLI Reference*

For example:

```
purekeytab list --keytab-file
Keytab File
BQIAAABNAAIAClRPVE9STy5ORVQABEhPU1QACk9CQU4tU01CLTIAAAABX5KrmgUAEgAgmJn3q0GV
ZuieCjlU8MmZWoLyO16EuQaWLB+GQNWC85MAAABMAAIAClRPVE9STy5ORVQAA25mcwAKT0JBTi1T
TUItMgAAAAFfkquaBQASACCYmferQZVm6J4KOVTwyZlagvI7XoS5BpYsH4ZA1YLzkwAAAFgAAgAK
VE9UT1JPLk5FVAAESE9TVAAVb2Jhbi1zbWItMi50b3Rvcm8ubmV0AAAAAV+Sq5oFABIAIJiZ96tB
lWbongo5VPDJmVqC8jtehLkGliwfhkDVgvOTAAAAVwACAApUT1RPUk8uTkVUAANuZnMAFW9iYW4t
c21iLTIudG90b3JvLm5ldAAAAAFfkquaBQASACCYmferQZVm6J4KOVTwyZlagvI7XoS5BpYsH4ZA
1YLzkwAAAE0AAgAKVE9UT1JPLk5FVAAESE9TVAAKb2Jhbi1zbWItMwAAAAFfkquaBQASACCYmfer
QZVm6J4KOVTwyZlagvI7XoS5BpYsH4ZA1YLzkwAAAEwAAgAKVE9UT1JPLk5FVAADbmZzAApvYmFu
LXNtYi0zAAAAAV+Sq5oFABIAIJiZ96tBlWbongo5VPDJmVqC8jtehLkGliwfhkDVgvOTAAAAWAAC
AApUT1RPUk8uTkVUAARIT1NUABVvYmFuLXNtYi0zLnRvdG9yby5uZXQAAAABX5KrmgUAEgAgmJn3
...
```

Copy and save the output for use elsewhere.

Deleting a Keytab File

Note: Deleting keytab files can be a disruptive action if there were clients with active sessions that relied on the deleted keytab.

To delete a keytab file, perform the following:

1. From the **Settings** page navigation sidebar, click **Kerberos Keytabs** under **Security**.
2. To delete one or more keytab files:
   a. Click the **More Options** button in the header of the **Kerberos Keytabs** panel and select **Delete**. The **Delete Keytabs** pop-up window appears.
   b. Select one or more keytab files from the **Existing Keytabs** column on the left. Each selected keytab file appears under the **Selected Keytabs** column on the right.
   c. Click **Delete**.
3. To delete a single keytab:
   a. From the **Kerberos Keytabs** panel, click the **More Options** button in the same row as the keytab file you wish to delete and select **Delete**. The **Delete Keytab** pop-up window appears.
   b. Click **Delete**

Deleting Keytab Files using the CLI

Use the **`purekeytab delete KEYTAB`** CLI command to delete one or more keytabs from the FlashBlade. For full details about the **`purekeytab`** command, see the *FlashBlade CLI Reference*

KEYTAB is the name of the keytab file you wish to delete. Multiple keytab files can be specified in a comma-separated list.

For example:

```
purekeytab delete keytab1,keytab2,keytab3
```

In this example, keytab files `keytab1`, `keytab2`, and `keytab3` are deleted from the AD account.

Deleting an Active Directory Account

Deleting an Active Directory (AD) account deletes the computer account associated with the FlashBlade and all Kerberos keytabs associated with the account.

To delete an Active Directory (AD) account, perform the following:

1. From the **Settings** sidebar, click **Directory Service** under **Security**. The **Active Directory Accounts** panel appears.
2. Click the **Delete** icon in the row of the account. The **Delete Active Directory Account** pop-up window appears.
3. (Optional) If you wish to retain the computer account associated with the FlashBlade in your AD domain, enable (blue) **Local Only**. Note that if enabled, you will need to manually delete Kerberos keytabs.
4. Click **Delete**.

Deleting an Active Directory Account using the CLI

Deleting an Active Directory (AD) account can also be performed using the CLI.

Use the **`puread account delete`** command to delete an AD account using the CLI. For full details about the **`puread`** command, see the *FlashBlade CLI Reference*.

To delete an AD account using the CLI, issue the **`puread account delete ACCOUNT-NAME`** command, where `ACCOUNT-NAME` is the AD account name you wish to delete. For example:

```
puread account delete mynewacct
```

You can optionally specify the `--local-only` argument, which will only delete the AD account on the local array. The computer account will not be deleted in the AD domain.

Directory Services Overview

A directory service allows the configuration of a server that will be used to perform some form of lookup. For example, a management directory server is used to look up users and validate their passwords, as well as to search for groups to which the users belong.

By configuring a directory service, FlashBlade is able to look up relevant information to authenticate users along different data and management paths.

A directory service is defined by the following configuration:

- A list of one or more URIs that specify the directory servers that will be used for lookups by the directory service. These may be specified in the form of IP addresses.
- A Base Distinguished Name (Base DN) as the point from which a server will begin its searches.
- A bind user and bind password (user and password) of a single service account that is used by FlashBlade to search the directory server.

Generally, FlashBlade communicates with directory servers over the Lightweight Directory Access (LDAP) protocol.

FlashBlade has three directory services:

- Array Management (see *Array Management Directory Service* for more details)
- NFS (see *NFS Directory Service* for more details)
- SMB (see *SMB Directory Service* for more details)

If you want to enable Kerberos authentication for FlashBlade's clients when configuring NFS or SMB directory services, you must upload keytab files with keytabs for the appropriate encryption types and service principal names that clients will use. Doing so grants the same client functionality as joining an AD domain.

Array Management Directory Service

The array management directory service configuration is used to allow users within an LDAP server to log in to a Flashblade (via the CLI, GUI, or REST) and manage it.

In order for a user to log in to the FlashBlade, they must be within a group that is configured to have a role on the array. If a group does not have a role, then its members cannot log in.

When configuring the array management directory service, a bind user and bind password can be optionally specified. If not specified, FlashBlade attempts to bind anonymously (without authenticating) with the configured LDAP servers. Note that if the configured LDAP servers do not grant read permissions on the needed pathways to unauthenticated machines, the anonymous bind will fail.

Roles

Directory services for array management can configure role-based access control (RBAC) for LDAP users by configuring groups in the directory that corresponds to the following permission groups (roles) on the array.

Role	Description
readonly	Read Only users have read-only privileges to run commands that convey the state of the array. Read Only users cannot alter the state of the array
storage_admin	Storage Admin users have all the privileges of Read Only users, plus the ability to run commands related to storage operations, such as administering file systems and snapshots, as well as object store accounts, users, and access keys. Storage Admin users cannot perform operations that deal with global and system configurations.
array_admin	Array Admin users can perform all FlashBlade operations.
ops_admin	Ops Admin users have all the privileges of Read Only users, plus the ability to run commands related to support operations, such as managing remote assistance sessions, phonehome, and proxy settings. Ops Admin users cannot perform operations that deal with storage or non-support global and system configurations.

When an array management user connects to the FlashBlade, the array confirms the user's identity from the directory service. The response from the directory service includes the user's group, which Purity//FB maps to a role on the array, granting access accordingly.

If users are assigned to more than one role, an alert is issued. For security purposes, a user belonging to more than one FlashBlade role will inherit the permissions of the most restrictive role. For example, a user who has been assigned both the Storage Admin and Read Only roles will inherit the privileges of the more restrictive Read Only role. Note that the user will continue to have privileges from the original

role until the directory service role cache is cleared (cache is automatically cleared every 8 hours). To make new permissions take immediate effect, run the **`pureadmin refresh`** command.

One exception to this rule is users assigned the Ops Admin role—users assigned the Ops Admin role and any other role are denied the ability to log into the FlashBlade. If there is an error with the directory service configuration on the FlashBlade array, contact a user with Array Admin privileges to resolve the issue. If the LDAP server is configured incorrectly, contact your LDAP server administrator. The alert issued in the case where a user is denied access due to being assigned the Ops Admin and another role, provides additional information to help resolve the issue.

As a best practice, after changing a user's role or management directory service configuration settings, use the **`pureadmin refresh`** command to refresh the user's role or clear directory service role cache to ensure all user privileges are up to date.

For directory service-enabled accounts, user passwords to the FlashBlade are managed through the directory service while API tokens are configured through Purity//FB. The password can be a maximum of 100 characters in length and include any character that is entered from a US keyboard.

In the FlashBlade GUI, buttons and menu items for unauthorized actions are disabled per the user's configured role.

Configuring the Array Management Directory Service

The array management directory service enables FlashBlade management access for LDAP users.

To configure the array management directory service using the GUI, perform the following:

1. Verify that the directory server is accessible through a management interface.
2. Verify that the DNS settings can be used to resolve the directory server domain and server.
3. From the **Settings** sidebar, click **Directory Service** under **Security**. The **Directory Service** panel appears.
4. In the **Directory Service** panel, select **Array Management**.
5. Click the **Edit** icon to the right of **Configuration**. The **Edit Directory Service Configuration** pop-up window appears.
6. In the **URIs** field, type the comma-separated list of up to 30 URIs of the directory servers.

   Each URI must include the scheme `ldap://` or `ldaps://` (for LDAP over SSL), a hostname, and a domain name or IP address. For example, `ldap://ad.company.com` configures the directory

service with the hostname "ad" in the domain "company.com" while specifying the unencrypted LDAP protocol.

We highly recommend either configuring StartTLS by enabling a certificate or certificate group, or configuring URIs by using the `ldaps://` scheme to use LDAP over SSL, unless there is no need for secure communication in your environment.

If specifying a domain name, it should be resolvable by the configured DNS servers.

If specifying an IP address, for IPv4, specify the IP address in the form `ddd.ddd.ddd.ddd`, where `ddd` is a number ranging from `0` to `255` representing a group of 8 bits.

For IPv6, specify the IP address in the form `[xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx]`, where `xxxx` is a hexadecimal number representing a group of 16 bits. Enclose the entire address in square brackets (`[]`) . Consecutive fields of zeros can be shortened by replacing the zeros with a double colon (`::`).

If the base DN is not configured and a URI is provided, the base DN will automatically default to the domain components of the URIs.

Optionally specify a port. Append the port number after the end of the entire address. Default ports are 389 for LDAP, and 636 for LDAPS. Non-standard ports can be specified in the URI if they are in use.

7 In the **Base DN** field, type the base distinguished name (DN) of the directory service.
The Base DN is built from the domain and should consist of only domain components (DCs). For example, for `ldap://ad.storage.company.com`, the Base DN would be: `DC=storage,DC=company,DC=com`.

⚠ **Important note!** Anonymous binding is supported for the array management directory service. If configuring anonymous binding, neither the bind user nor the bind password should be specified.

8 In the **Bind User** field, type the username used to bind to and query the directory. For OpenLDAP and Active Directory servers, you can use the full DN of the user account that is used to perform lookups. For example, `CN=John,OU=Users,DC=example,DC=com`. For Active Directory servers, you may instead choose to enter the username - often referred to as the sAMAccountName or user login name - of the account that is used to perform directory lookups. The username cannot contain the characters `" [] : ; | = + * ? < > / \`, and cannot exceed 104 characters in length.

9 In the **Bind Password** field, type the password for the bind user account.

10 (Optional) Select a CA certificate or certificate group to verify the authenticity of configured LDAP servers to establish a TLS (Transport Layer Security) communication for directory services.

11 The **User Login Attribute** defaults to the sAMAccountName for Active Directory, or UID for other server types.

12 The **User Object Class** defaults to User for AD, posixAccount or shadowAccount for OpenLDAP depending on the server's schema, posixAccount for posix-compliant servers, or person for all other server types.

13 Click **Test** to verify the configuration information. The **Test <Directory Service> Configuration** pop-up window appears, displaying the output of the test. During the directory service test, Purity//FB tests the directory service configuration to verify that the URI can be resolved and that the directory service can successfully bind and query the tree using the bind user credentials.

If the test fails, update the configuration information and retest.

Alternatively, you may save the configuration and enable the directory service at a later time.

14 If the test passes, set the **Enabled** toggle to enable (blue) to enable the directory service.

15 Click **Save**.

16 Click the **Edit** icon next to **Roles** to configure the role(s) you wish to assign the service (see *Roles* for details about FlashBlade roles). The **Edit Directory Service Roles** pop-up window appears. Enter the following for each role you wish to assign:

a In the **Group** field, enter the common name (CN) of the directory group. The name should be the Common Name of the group without the "CN=" specifier. If the configured groups are not in the same OU, also specify the OU. For example, "pureusers,OU=PureStorage", where pureusers is the common name of the directory service group.

b In the **Group Base** field, enter the organizational unit (OU) to the configured groups in the directory tree. The Group Base consists of OUs that, when combined with the base DN attribute and the configured group CNs, complete the full distinguished name of each group. The group base should specify "OU=" for each OU and multiple OUs should be separated by commas. The order of OUs should get larger in scope from left to right. In the following example, SANManagers contains the sub-organizational unit PureGroups: "OU=PureGroups,OU=SANManagers"

c Click **Save**.

Configuring the Array Management Directory Service using the CLI

The array management directory service can also be configured using the **`pureds setattr management`** command. For full details about the **`pureds`** command, see the *FlashBlade CLI Reference*.

To configure the array management directory service using the CLI, perform the following:

1 Issue the **`pureds setattr management`** command with the following arguments:

- `--uri`: Up to 30 URIs can be specified in a comma-separated list.

  Each URI must include the scheme `ldap://` or `ldaps://` (for LDAP over SSL), a hostname, and a domain name or IP address. For example, `ldap://ad.company.com` configures the directory service with the hostname "ad" in the domain "company.com" while specifying the unencrypted LDAP protocol.

  We highly recommend either configuring StartTLS by enabling a certificate or certificate group, or configuring URIs by using the `ldaps://` scheme to use LDAP over SSL, unless there is no need for secure communication in your environment.

  If specifying a domain name, it should be resolvable by the configured DNS servers.

  If specifying an IP address, for IPv4, specify the IP address in the form `ddd.ddd.ddd.ddd`, where `ddd` is a number ranging from `0` to `255` representing a group of 8 bits.

  For IPv6, specify the IP address in the form `[xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx]`, where `xxxx` is a hexadecimal number representing a group of 16 bits. Enclose the entire address in square brackets (`[]`) . Consecutive fields of zeros can be shortened by replacing the zeros with a double colon (`::`).

  If the base DN is not configured and a URI is provided, the base DN will automatically default to the domain components of the URIs.

  Optionally specify a port. Append the port number after the end of the entire address. Default ports are 389 for LDAP, and 636 for LDAPS. Non-standard ports can be specified in the URI if they are in use.

- `--base-dn`: The base distinguished name (DN) of the directory service. The Base DN is built from the domain and should consist of only domain components (DCs). For example, for `ldap://ad.storage.company.com`, the Base DN would be: `DC=storage,DC=company,DC=com`.

  ⚠ **Important note!** Anonymous binding is supported for the array management directory service. If configuring anonymous binding, neither the bind user nor the bind password should be specified.

- `--bind-user`: The username used to bind to and query the directory. For OpenLDAP and Active Directory servers, you can use the full DN of the user account that is used to perform lookups. For example, `CN=John,OU=Users,DC=example,DC=com`. For Active Directory servers, you may instead choose to enter the username - often referred to as the sAMAccountName or user login name - of the account that is used to perform directory lookups. The username cannot contain the characters `" [] : ; | = + * ? < > / \`, and cannot exceed 104 characters in length.

- `--bind-password`: The password for the bind user account.

- `--ca-certificate` or `--ca-certificate-group`: (Optional) A CA certificate or certificate group to verify the authenticity of configured LDAP servers to establish a TLS (Transport Layer Security) communication for directory services.
- `--user-login-attribute`: Defaults to the sAMAccountName for Active Directory, or UID for other server types.
- `--user-object-class`: Defaults to User for AD, posixAccount or shadowAccount for OpenLDAP depending on the server's schema, posixAccount for posix-compliant servers, or person for all other server types.

For example:

```
pureds setattr --uri ldaps://[2000:0db1:54a1::ae25:7b1f:0505:1112] --base dn
 DC=mycompany,DC=com management
```

In this example:

- the URI is set to the IPv6 address `2000:0db1:54a1::ae25:7b1f:0505:1112`
- the scheme is set to `ldaps://` to enable SSL
- the base DN is set to be the correct domain components (DC)
- anonymous binding is used

2. Test the configuration using the **`pureds test management`** command. If the test fails, update the configuration information.
3. If the test passes, enable the directory service using the **`pureds enable management`** command.
4. Configure the role(s) you wish to assign the service by issuing the **`pureds role setattr --group --group-base ROLE`** command, where:

- `--group`: The common name (CN) of the directory group. The name should be the Common Name of the group without the "CN=" specifier. If the configured groups are not in the same OU, also specify the OU. For example, "pureusers,OU=PureStorage", where pureusers is the common name of the directory service group.
- `--group-base`: The organizational unit (OU) to the configured groups in the directory tree. The Group Base consists of OUs that, when combined with the base DN attribute and the configured group CNs, complete the full distinguished name of each group. The group base should specify "OU=" for each OU and multiple OUs should be separated by commas. The order of OUs should get larger in scope from left to right. In the following example, SANManagers contains the sub-organizational unit PureGroups: "OU=PureGroups,OU=SANManagers"
- `ROLE`: The role assigned to the service. See *Roles* for details about FlashBlade roles.

For example:

```
pureds role setattr --group admins --group-base OU=Marketing storage_admin
```

In this example the role `storage_admin` is set as belonging the group `admins` in the group base `Marketing`.

NFS Directory Service

The NFS directory service is used for resolving addresses for netgroups, looking up the extended group membership of NFS data path clients, and looking up name/ID mappings.

Active Directory, OpenLDAP, and Oracle Unified Directory servers (that are RFC-2307 or RFC-2307bis compliant) are supported.

When configuring NFS directory service, you can optionally specify a bind user and bind password. If not specified, FlashBlade attempts to bind anonymously (without authenticating) with the configured LDAP servers. Note that if the configured LDAP servers do not grant read permissions on the needed pathways to unauthenticated machines, the anonymous bind will fail.

If a user belongs to more than 16 groups then you must configure and enable the NFS directory service in order to obtain proper user permissions. If NFS directory service is enabled, FlashBlade attempts to look up user IDs and determine the groups to which they belong.

NIS Domains and NIS Servers

NIS Domains

NIS domains can be used with quotas and normal group lookup.

NIS servers can be configured instead of LDAP servers. When NIS servers are configured, FlashBlade communicates with them over the NIS protocol in order to convert between user IDs and user names, as well as to convert between group IDs and group names.

Mixing NIS and LDAP configurations is not supported.

NIS Servers

NIS servers can also be used with quotas and normal group lookup.

NIS servers can be configured instead of, or in addition to, LDAP servers. The servers can be specified as either host names or IP addresses.

NIS servers are required in order to configure the NFS directory service to use NIS.

NFS Nested User Groups

A nested group is a group which is a member of another group. When using groups to manage permissions, you can create nested groups to allow inheritance of membership permissions from one group to its sub-groups. Similarly, users can belong to multiple group hierarchies and inherit those groups' membership permissions.

Purity//FB supports NFS users belonging to a nested hierarchy of group membership (NFS nested groups). NFS allows access to users who are not the owners of particular files, but who instead belong to a group that owns the files. A user can belong to a group directly or indirectly (when groups are nested, i.e. when a group belongs to another group). Without NFS nested groups, Pure's NFS server allows only access to users that are direct members of the group that owns the file. With NFS nested groups, a user's membership in nested groups, as well as in direct groups, is taken into account for access checks.

The following limits apply to nested groups:

- Maximum number of groups, including direct and indirect groups, per user = 10,000
- Maximum number of nested groups to which a user can be a direct member = 500

- Maximum number of nested groups to which a group can be a direct member = 500
- Maximum number of nested levels = 5

Pure's implementation of NFS nested groups supports the following LDAP-based directory servers:

- OpenLDAP
- Oracle Unified Directory (OUD)
- Active Directory (AD)

In order to use NFS nested groups with directory services, nesting must be configured according to the RFC2307bis specification on your LDAP server.

Multi-domain and AD trusted domains are not supported.

Configuring the NFS Directory Service with LDAP

The NFS directory service enables file access for LDAP users (without Kerberos authentication).

Configuring the NFS directory service is a one-time process and is only required if you are integrating the FlashBlade array with a directory service for protocol support.

To export a file system over NFS where a user might belong to more than 16 groups, the FlashBlade array must be integrated with a directory service such as Active Directory, OpenLDAP, or Network Information Service (NIS).

To configure the NFS directory service with LDAP for protocol support, perform the following:

1. Verify that the directory server is accessible through a management interface.
2. Verify that the DNS settings can be used to resolve the directory server domain and server.
3. From the **Settings** sidebar, click **Directory Service** under **Security**. The **Directory Service** panel appears.
4. In the **Directory Service** panel, select **NFS**.
5. Click the **Edit** icon to the right of **Configuration**. The **Edit Directory Service Configuration** pop-up window appears.
6. Under the **Service Name** field, select **LDAP**.
7. In the **URIs** field, type the comma-separated list of up to 30 URIs of the directory servers.

Each URI must include the scheme `ldap://` or `ldaps://` (for LDAP over SSL), a hostname, and a domain name or IP address. For example, `ldap://ad.company.com` configures the directory service with the hostname "ad" in the domain "company.com" while specifying the unencrypted LDAP protocol.

We highly recommend either configuring StartTLS by enabling a certificate or certificate group, or configuring URIs by using the `ldaps://` scheme to use LDAP over SSL, unless there is no need for secure communication in your environment.

If specifying a domain name, it should be resolvable by the configured DNS servers.

If specifying an IP address, for IPv4, specify the IP address in the form `ddd.ddd.ddd.ddd`, where `ddd` is a number ranging from `0` to `255` representing a group of 8 bits.

For IPv6, specify the IP address in the form `[xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx]`, where `xxxx` is a hexadecimal number representing a group of 16 bits. Enclose the entire address in square brackets (`[]`) . Consecutive fields of zeros can be shortened by replacing the zeros with a double colon (`::`).

If the base DN is not configured and a URI is provided, the base DN will automatically default to the domain components of the URIs.

Optionally specify a port. Append the port number after the end of the entire address. Default ports are 389 for LDAP, and 636 for LDAPS. Non-standard ports can be specified in the URI if they are in use.

8 In the **Base DN** field, type the base distinguished name (DN) of the directory service. The Base DN is built from the domain and should consist of only domain components (DCs). For example, for `ldap://ad.storage.company.com`, the Base DN would be: `DC=storage,DC=company,DC=com`.

⚠ **Important note!** Anonymous binding is supported for the NFS directory service. If configuring anonymous binding, neither the bind user nor the bind password should be specified.

9 In the **Bind User** field, type the username used to bind to and query the directory. For OpenLDAP and Active Directory servers, you can use the full DN of the user account that is used to perform lookups. For example, `CN=John,OU=Users,DC=example,DC=com`. For Active Directory servers, you may instead choose to enter the username - often referred to as the sAMAccountName or user login name - of the account that is used to perform directory lookups. The username cannot contain the characters `" [] : ; | = + * ? < > / \`, and cannot exceed 104 characters in length.

10 In the **Bind Password** field, type the password for the bind user account.

11 (Optional) Select a CA certificate or certificate group to verify the authenticity of configured LDAP servers to establish a TLS (Transport Layer Security) communication for directory services.

12 Click **Test** to verify the configuration information. The **Test <Directory Service> Configuration** pop-up window appears, displaying the output of the test. During the directory service test, Purity//FB tests the directory service configuration to verify that the URI can be resolved and that the directory service can successfully bind and query the tree using the bind user credentials.

   If the test fails, update the configuration information and retest.

   Alternatively, you may save the configuration and enable the directory service at a later time.

13 If the test passes, set the **Enabled** toggle to enable (blue) to enable the directory service.

14 Click **Save**.

Configuring the NFS Directory Service with LDAP using the CLI

The NFS directory service with LDAP can also be configured using the **`pureds setattr nfs`** command. For full details about the **`pureds`** command, see the *FlashBlade CLI Reference*.

To configure the NFS directory service using the CLI, perform the following:

1 Run the **`puredns list`** command to verify that DNS settings can be used to resolve the directroy server domain and server.

2 Issue the **`pureds setattr nfs`** command with the following arguments:

- `--uri`: Up to 30 URIs can be specified in a comma-separated list.

  Each URI must include the scheme `ldap://` or `ldaps://` (for LDAP over SSL), a hostname, and a domain name or IP address. For example, `ldap://ad.company.com` configures the directory service with the hostname "ad" in the domain "company.com" while specifying the unencrypted LDAP protocol.

  We highly recommend either configuring StartTLS by enabling a certificate or certificate group, or configuring URIs by using the `ldaps://` scheme to use LDAP over SSL, unless there is no need for secure communication in your environment.

  If specifying a domain name, it should be resolvable by the configured DNS servers.

  If specifying an IP address, for IPv4, specify the IP address in the form `ddd.ddd.ddd.ddd`, where `ddd` is a number ranging from `0` to `255` representing a group of 8 bits.

  For IPv6, specify the IP address in the form `[xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx]`, where `xxxx` is a hexadecimal number representing a group of 16 bits. Enclose the entire address in square brackets (`[]`) . Consecutive fields of zeros can be shortened by replacing the zeros with a double colon (`::`).

  If the base DN is not configured and a URI is provided, the base DN will automatically default to the domain components of the URIs.

  Optionally specify a port. Append the port number after the end of the entire address. Default ports are 389 for LDAP, and 636 for LDAPS. Non-standard ports can be specified in the URI if they are in use.

- `--base-dn`: The base distinguished name (DN) of the directory service. The Base DN is built from the domain and should consist of only domain components (DCs). For example, for `ldap://ad.storage.company.com`, the Base DN would be: `DC=storage,DC=company,DC=com`.

  ⚠ **Important note!** Anonymous binding is supported. If configuring anonymous binding, neither the bind user nor the bind password should be specified.

- `--bind-user`: The username used to bind to and query the directory. For OpenLDAP and Active Directory servers, you can use the full DN of the user account that is used to perform lookups. For example, `CN=John,OU=Users,DC=example,DC=com`. For Active Directory servers, you may instead choose to enter the username - often referred to as the sAMAccountName or user login name - of the account that is used to perform directory lookups. The username cannot contain the characters `" [] : ; | = + * ? < > / \`, and cannot exceed 104 characters in length.

- `--bind-password`: The password for the bind user account.

- `--ca-certificate` or `--ca-certificate-group`: (Optional) A CA certificate or certificate group to verify the authenticity of configured LDAP servers to establish a TLS (Transport Layer Security) communication for directory services.

- `--user-login-attribute`: Defaults to the sAMAccountName for Active Directory, or UID for other server types.
- `--user-object-class`: Defaults to User for AD, posixAccount or shadowAccount for OpenLDAP depending on the server's schema, posixAccount for posix-compliant servers, or person for all other server types.

For example:

```
pureds setattr --uri ldap://ds.mycompany.com --base dn DC=mycompany,DC=com nfs
```

In this example:

- the URI is set to `ds.company.com`, where `ds` is the host name in the domain `mycompany.com`
- the scheme is set to unencrypted `ldap://`
- the base DN is set to be the correct domain components (DC)
- anonymous binding is used

3. Test the configuration using the **`pureds test nfs`** command. If the test fails, update the configuration information.
4. If the test passes, enable the directory service using the **`pureds enable nfs`** command.

Configuring the NFS Directory Service with NIS

The NFS directory service enables file access for LDAP users (without Kerberos authentication).

Configuring the NFS directory service is a one-time process and is only required if you are integrating the FlashBlade array with a directory service for protocol support.

To export a file system over NFS where a user might belong to more than 16 groups, the FlashBlade array must be integrated with a directory service such as Active Directory, OpenLDAP, or Network Information Service (NIS). For NFS with NIS, clear any existing LDAP configurations before specifying the NIS servers and NIS domain.

To configure the NFS directory service with NIS for protocol support, perform the following:

1. Verify that the directory server is accessible through a management interface.
2. Verify that the DNS settings can be used to resolve the directory server domain and server.

3 From the **Settings** sidebar, click **Directory Service** under **Security**. The **Directory Service** panel appears.

4 In the **Directory Service** panel, select **NFS**.

5 Click the **Edit** icon to the right of **Configuration**. The **Edit Directory Service Configuration** pop-up window appears.

6 Under the **Service Name** field, select **NIS**.

7 In the **NIS Servers** field, type the comma-separated list of server host names or IP addresses. For example, `myserver.example.com,188.121.4.56`.

8 In the **NIS Domain** field, type the domain name. For example, `yp-example-domain`.

9 Click **Test** to verify the configuration information. The **Test <Directory Service> Configuration** pop-up window appears, displaying the output of the test. During the directory service test, Purity//FB tests the directory service configuration to verify that the URI can be resolved and that the directory service can successfully bind and query the tree using the bind user credentials.

   If the test fails, update the configuration information and retest.

   Alternatively, you may save the configuration and enable the directory service at a later time.

10 If the test passes, set the **Enabled** toggle to enable (blue) to enable the directory service.

11 Click **Save**.

Configuring the NFS DIrectory Service with NIS using the CLI

NFS directory service with NIS can alternately be configured using the CLI.

The NFS directory service with NIS is configured using the **`pureds setattr nfs`** command. For full details about the **`pureds`** command, see the *FlashBlade CLI Reference*.

To configure the NFS directory service using the CLI, perform the following:

1 Issue the **`pureds setattr nfs`** command with the following arguments:

- `--nis-servers`: A comma-separated list of server host names or IP addresses. For example, `myserver.example.com,188.121.4.56`.
- `--nis-domain`: The NIS domain name. For example, `yp-example-domain`.

For example:

```
pureds setattr --nis-servers my-server.com,188.121.25.4 --nis-domain my-nis-domain nfs
```

In this example:

- the NIS domain is set to `my-nis-domain`
- the NIS servers are set to `my-server.com` and `188.121.25.4`

2. Test the configuration using the **`pureds test nfs`** command. If the test fails, update the configuration information.
3. If the test passes, enable the directory service using the **`pureds enable nfs`** command.

SMB Directory Service

The SMB directory service is compatible with only Active Directory (AD) servers.

For file sharing over SMB, the base DN of the directory service is used to represent the joined domain and the URIs can be configured for SMB to control what servers are communicated with when joining the domain.

When joining a domain, a machine account is created with the AD domain. FlashBlade then issues a keytab to that machine account, which is used for future communication with that domain. The default Organizational Unit (OU) where the machine account is created within the AD domain is "Computers".

Because SMB authentication is inherently a Kerberos authentication setup, Kerberos ports must be open for the SMB directory service configuration to function properly.

The following issues can result in loss of SMB functionality and file access:

- If domain controllers delete or otherwise invalidate FlashBlade's keytab or machine account, SMB will stop functioning.
- SMB clients do not have IDs; they have names. FlashBlade resolves the client's name to an ID using the array's SMB mode and the configured SMB directory service. If the SMB directory service is unhealthy or disabled, SMB clients will lose all file access because the name/ID cannot be resolved.

Configuring the SMB Directory Service

Note: If you are switching from SBM Adapter (Samba) to Native SMB, refer to the *Configuration Choice Examples Based on Environment* section in *Choosing an Active Directory Account or Directory Services Configuration* to determine if you need to keep SMB directory service configured. Otherwise, remove the SMB directory service configuration.

Configuring the SMB directory service is a one-time process and is only required if you are integrating the FlashBlade array with a directory service for protocol support.

To export a file system over SMB, the FlashBlade array must be integrated with an Active Directory service. The SMB account must have read privileges for users and groups, including write permissions to add computer objects in Active Directory.

To configure the SMB directory service for protocol support, perform the following:

1. Verify that the Active Directory server is accessible through a management interface.
2. Verify that the DNS settings can be used to resolve the directory server domain and server.
3. Verify that the FlashBlade array can access the directory service through a management interface. Interfaces are managed through the **Subnets** panel.
4. From the **Settings** sidebar, click **Directory Service** under **Security**. The **Directory Service** panel appears.
5. In the **Directory Service** panel, select **SMB**.
6. Click the **Edit** icon to the right of **Configuration**. The **Edit Directory Service Configuration** pop-up window appears.
7. Under the **Service Name** field, select **LDAP**.
8. In the **URIs** field, type the comma-separated list of up to 30 URIs of the directory servers.

   For file sharing over SMB, this field is optional. If not specified, the base DN of the SMB directory service is used to try to discover domain controllers within an Active Directory domain. If URIs are configured for SMB, they will be treated as the preferences for the servers with which FlashBlade will communicate when joining the domain.

   Each URI must include the scheme `ldap://` or `ldaps://` (for LDAP over SSL), a hostname, and a domain name or IP address. For example, `ldap://ad.company.com` configures the directory

service with the hostname "ad" in the domain "company.com" while specifying the unencrypted LDAP protocol.

We highly recommend either configuring StartTLS by enabling a certificate or certificate group, or configuring URIs by using the `ldaps://` scheme to use LDAP over SSL, unless there is no need for secure communication in your environment.

If specifying a domain name, it should be resolvable by the configured DNS servers.

If specifying an IP address, for IPv4, specify the IP address in the form `ddd.ddd.ddd.ddd`, where `ddd` is a number ranging from `0` to `255` representing a group of 8 bits.

For IPv6, specify the IP address in the form `[xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx]`, where `xxxx` is a hexadecimal number representing a group of 16 bits. Enclose the entire address in square brackets (`[]`) . Consecutive fields of zeros can be shortened by replacing the zeros with a double colon (`::`).

If the base DN is not configured and a URI is provided, the base DN will automatically default to the domain components of the URIs.

Optionally specify a port. Append the port number after the end of the entire address. Default ports are 389 for LDAP, and 636 for LDAPS. Non-standard ports can be specified in the URI if they are in use.

9 In the **Base DN** field, type the base distinguished name (DN) of the directory service. The Base DN is built from the domain and should consist of only domain components (DCs). For example, for `ldap://ad.storage.company.com`, the Base DN would be: `DC=storage,DC=company,DC=com`.

10 In the **Bind User** field, type the username used to bind to and query the directory. For OpenLDAP and Active Directory servers, you can use the full DN of the user account that is used to perform lookups. For example, `CN=John,OU=Users,DC=example,DC=com`. For Active Directory servers, you may instead choose to enter the username - often referred to as the sAMAccountName or user login name - of the account that is used to perform directory lookups. The username cannot contain the characters `" [] : ; | = + * ? < > / \`, and cannot exceed 104 characters in length.

11 In the **Bind Password** field, type the password for the bind user account.

12 In the **Join OU (SMB)** field, enter the relative DN of the organizational unit (OU) within your domain where the system machine account should be created when joining the domain for SMB. For example, `OU=Arrays,OU=Storage,OU=ServiceMachines`.

13 Click **Test** to verify the configuration information. The **Test <Directory Service> Configuration** pop-up window appears, displaying the output of the test. During the directory service test, Purity//FB tests the directory service configuration to verify that the URI can be resolved and that the directory service can successfully bind and query the tree using the bind user credentials.

If the test fails, update the configuration information and retest.

Alternatively, you may save the configuration and enable the directory service at a later time.

14 If the test passes, set the **Enabled** toggle to enable (blue) to enable the directory service.

15 Click **Save**.

Configuring the SMB Directory Service using the CLI

Note: If you are switching from SMB Adapter (Samba) to Native SMB, refer to the *Configuration Choice Examples Based on Environment* section in *Choosing an Active Directory Account or Directory Services Configuration* to determine if you need to keep SMB directory service configured; otherwise remove the SMB directory service configuration.

The SMB directory service can also be configured using the CLI.

The SMB directory service is configured using the **`pureds setattr smb`** command. For full details about the **`pureds`** command, see the *FlashBlade CLI Reference*.

To configure the SMB directory service using the CLI, perform the following:

1 Run the **`puredns list`** command to verify that DNS settings can be used to resolve the directroy server domain and server. Refer to the *FlashBlade CLI Reference* for complete details about the **`puredns`** command.

2 Run the **`purenetwork list`** command to verify that the FlashBlade can access the directory service through a management interface. Refer to the *FlashBlade CLI Reference* for complete details about the **`purenetwork`** command.

3 Issue the **`pureds setattr smb`** command with the following arguments:

- `--uri`: (Optional) Up to 30 URIs can be specified in a comma-separated list.

  For file sharing over SMB, this field is optional. If not specified, the base DN of the SMB directory service is used to try to discover domain controllers within an Active Directory domain. If URIs are configured for SMB, they will be treated as the preferences for the servers with which FlashBlade will communicate when joining the domain.

  Each URI must include the scheme `ldap://` or `ldaps://` (for LDAP over SSL), a hostname, and a domain name or IP address. For example, `ldap://ad.company.com` configures the directory service with the hostname "ad" in the domain "company.com" while specifying the unencrypted LDAP protocol.

  We highly recommend either configuring StartTLS by enabling a certificate or certificate group, or configuring URIs by using the `ldaps://` scheme to use LDAP over SSL, unless there is no need for secure communication in your environment.

  If specifying a domain name, it should be resolvable by the configured DNS servers.

  If specifying an IP address, for IPv4, specify the IP address in the form `ddd.ddd.ddd.ddd`, where `ddd` is a number ranging from `0` to 255 representing a group of 8 bits.

  For IPv6, specify the IP address in the form `[xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx]`, where `xxxx` is a hexadecimal number representing a group of 16 bits. Enclose the entire address in square brackets (`[]`) . Consecutive fields of zeros can be shortened by replacing the zeros with a double colon (`::`).

  If the base DN is not configured and a URI is provided, the base DN will automatically default to the domain components of the URIs.

  Optionally specify a port. Append the port number after the end of the entire address. Default ports are 389 for LDAP, and 636 for LDAPS. Non-standard ports can be specified in the URI if they are in use.

- `--base-dn`: The base distinguished name (DN) of the directory service. The Base DN is built from the domain and should consist of only domain components (DCs). For example, for `ldap://ad.storage.company.com`, the Base DN would be: `DC=storage,DC=company,DC=com`.

- `--bind-user`: The username used to bind to and query the directory. For OpenLDAP and Active Directory servers, you can use the full DN of the user account that is used to perform lookups. For example, `CN=John,OU=Users,DC=example,DC=com`. For Active Directory servers, you may instead choose to enter the username - often referred to as the sAMAccountName or user login name - of the account that is used to perform directory lookups. The username cannot contain the characters `" [] : ; | = + * ? < > / \`, and cannot exceed 104 characters in length.

- `--bind-password`: The password for the bind user account.

- `--join-ou`: The relative DN of the organizational unit (OU) within your domain where the system machine account should be created when joining the domain for SMB. For example, `OU=Arrays,OU=Storage,OU=ServiceMachines`.

For example:

```
pureds setattr --uri ldaps://ad1.mycompany.com,ldaps://ad2.mycompany.com --
base-dn DC=mycompany,DC=com --bind-user CN=John,OU=Users,DC=mycompany,DC=com
 smb
```

In this example:

- the URI is set to `ad1.mycompany.com` and `ad2.mycompany.com`
- the scheme is set to `ldaps://` to enable SSL
- the base DN is set to be the correct domain components (DC)
- the bind username is set as the usename used to bind to and query the directory

4 Test the configuration using the **`pureds test smb`** command. If the test fails, update the configuration information.

5 If the test passes, enable the directory service using the **`pureds enable smb`** command.

Appendix A
Replication and Recovery

Replication

File systems can be replicated from one FlashBlade array to another FlashBlade array. File system replication requires two connected arrays and a replica link between the source file system and a target file system. A replica link is the connection between a local file system and target file system.

Objects can be replicated from a bucket on a FlashBlade (source) to a remote target bucket residing on another FlashBlade or an S3 target using replica links. A replica link is the relationship between a source bucket and target bucket, and describes the properties of that connection. During replication, all objects in the source bucket are replicated to the target bucket.

File Replication Prerequisites

- Replication traffic requires a replication vip using port 8117; before arrays can replicate, they must first be connected over the management vip/port 443.
- Ports 8117 and 80 are used for non-encrypted file replication.

Object Replication Prerequisites

- Replication traffic requires a replication vip using port 8117; before arrays can replicate, they must first be connected over the management vip/port 443.
- Ports 8117 and 443 are used for encrypted object replication.
- Versioning must be enabled on the target bucket for object replication to proceed, and a lifecycle rule may need to be configured to limit space used by noncurrent versions.

Recovery

CAUTION: If Pure File SafeMode is enabled, contact Pure Technical Services to promote and demote file systems.

In file system replication setups you can stop writes to the local file system and redirect writes to the target file system (failover). Failover can be used if there is an issue with the local file system. During failover, replication stops until you reprotect.

Failover requires promotion of the target file system and redirection of all clients to the target array to return to operation. To reprotect, demote the (former) source file system. Once the file system is demoted, replication policies will start replicating in the new direction.

Note that when demoting the local file system, any writes performed since the last replication will be discarded. If a local snapshot was taken since last replication, demoting the file system requires that snapshot be destroyed and eradicated. You must remove any data since the last snapshot of the file system was taken. The file system must either have no snapshots, or the most recent snapshot must be the last replicated snapshot. Additionally, it is suggested that any policies attached to the local file system and replica link be removed or disabled in order to avoid taking new snapshots.

Once the local file system is demoted, re-enable or re-add the policies that were disabled before demoting the file system. Replication resumes as scheduled between the promoted remote file system and the demoted local file system. Data is written to the promoted remote file system, which is then replicated to the demoted local file system.

To resume the original replica link direction (failback), manually stop writes on the remote file system and send the remaining data to the local file system. Once data is sent to the local file system, promote the local file system and demote the remote file system. You can change the file system to not writeable or stop clients while failing back to avoid having any writes that need to be discarded when demoting the target.

Getting Started

Replication setup and recovery can be performed using either the Purity//FB GUI or CLI.

The following sections provide an overview of the tasks required for file and object replication setup and for performing recovery. Complete instructions using the GUI and CLI are provided for each in subsequent topics.

Replication Setup

To set up file replication, the following tasks must be completed:

1. Create replication network interfaces on the source and target arrays.
2. Create a connection key on the target array.
3. Connect the source and target arrays.
4. Create a policy to govern snapshot creation and retention.

5 Create a file replica link on the local array.

Complete instructions for completing each of these tasks are provided in:

- *Setting Up File Replication Using the GUI*
- *Setting Up File Replication Using the CLI*

To set up object replication from a bucket on a source FlashBlade array to a remote target bucket on another FlashBlade array, the following tasks must be completed:

1 Create replication network interfaces on the source and target arrays.

2 Create a connection key on the target array.

3 Connect the source and target arrays.

4 Create remote credentials for use with the replica link.

5 Create an object replica link on the local array.

6 Enable versioning on the target bucket.

7 Optionally configure a lifecycle rule on the target bucket to control space usage of non-concurrent versions.

Complete instructions for completing each of these tasks are provided in:

- *Setting Up Array to Array Object Replication Using the GUI*
- *Setting Up Array to Array Object Replication Using the CLI*

To set up object replication from a bucket on a source FlashBlade array to a remote target bucket on an Amazon S3 target, the following tasks must be completed:

1 Connect the source FlashBlade array to the S3 target.

2 Create remote credentials for use with the replica link.

3 Create an object replica link on the local array.

4 Enable versioning using the AWS Management Console or the Amazon S3 API.

5 Optionally enable a lifecycle rule using the AWS Management Console or the Amazon S3 API.

Complete instructions for completing each of these tasks are provided in:

- *Setting Up FlashBlade to Amazon S3 Object Replication Using the GUI*
- *Setting Up FlashBlade to Amazon S3 Object Replication Using the CLI*

File Replication Failover

To perform file replication failover, the following tasks must be completed:

1. Promote the remote file system.
2. Manually direct clients to the remote array.
3. Remove any policies from the local file system.
4. Demote the local file system.

Complete instructions for completing each of these are provided in:

- *Performing File Replication Failover and Reprotect Using the GUI*
- *Performing Failover Using the CLI*

File Replication Failback

To perform file replication failback, the following tasks must be completed:

1. Disable writes on the remote file system.
2. Promote the local file system.
3. Re-add any policies to the local file system.
4. Manually redirect clients back to the local array.
5. Demote the target file system.

Complete instructions for completing each of these tasks are provided in:

- *Performing Failback Using the GUI*
- *Performing Failback Using the CLI*

Setting Up File Replication Using the GUI

The following instructions describe how to set up file replication from one FlashBlade array to another FlashBlade array using the Purity//FB GUI. These instructions should be followed in the order that they are presented.

Creating Replication Network Interfaces

Perform the following on both your source and target FlashBlade arrays:

1. From the **Settings** sidebar, click **Subnets** under **Network**. The **Subnets** panel apears.
2. In the **Subnets** panel, locate the subnet to which you wish to add a network interface and click the **Add interface** (+) button. The **Create Network Interface** pop-up window appears.
3. In the **Name** field, enter the interface name.
4. In the address field, enter the network address.
5. From the **Services** list, select `replication`.
6. The subnet defaults to the subnet in which you are creating the interface. Click **Create**.

Creating a Connection Key

⚠ **Important note!** The connection key is active for two hours. If the source and target arrays have not been connected within that two hour period, a new connection key must be created.

Once you have created replication network interfaces, you must create a connection key on the target array.

1. On the target array, select **Storage** > **Array** page.
2. In the **FlashBlade Array Connections** pane, click **More Options** > **Create Connection Key**. The **Connection Key** pop-up window appears displaying the new connection key.
3. Copy the new connection key.

Connecting the Source and Target Arrays

With the creation of replication network interfaces on the source and target arrays, and the creation of a connection key on the target array, you can now connect the source and target arrays.

Note: Encryption is only valid for object replication.

⚠ **Important note!** When connecting the source array to the target array, a secure connection is required even if encryption is not enabled. Certificates with small key sizes, weak signature algorithms, or that only support weak TLS algorithms are not supported.

⚠ **Important note!** The management IP address required during configuration cannot be a loopback IP address.

⚠ **Important note!** It is highly recommended that you add the `pure:policy/full-access` access policy to the user (whose credentials are used for replication) on the target cluster, otherwise replication may fail due to denied access. See *Adding Access Policies* for instructions on how to add access policies to users.

1. On the source array, select **Storage** > **Array** page, click the add (+) button in the **FlashBlade Array Connections** panel. The **Connect FlashBlade Array** pop-up window appears.
2. Enter the target array's hostname or management address in the **Management Address** field. The address can be located from the **Subnets** table by navigating to the **Settings** > **Network** page.
3. Paste the copied connection key for the target array in the **Connection Key** field.
4. The replication address is auto-discovered, unless using NAT. If using NAT, enter the target array's replication network address in the **Replication Address** field.
5. (Optional) Enable encryption by setting the **Encrypted** toggle to on. If set, the `_default_replication_certs` CA certificate group is applied. Before toggling, make sure to import the CA certificate to the source array if the target array's array-certificate is signed by a CA and add it to the certificate group. Note that encryption is set on the source array only. If enabled, the encryption setting displays as enabled on the target array.

   Warning: Use of CA certificates to establish trust and secure communication for object replication is the recommended configuration. If the target array's array-certificate is self-signed, directly importing the target array certificate to the source and adding it to the certificate group will not provide as strict validation around aspects of the peer, such as certificate expiry.
6. Click **Connect**.
7. If using NAT, on the target array, enter the source array's replication address.
   a. On the target array, in the **FlashBlade Array Connections** panel on the **Storage > Array** page, click the edit button at the end of the row displaying the connected source array. The **Edit Connected Array** pop-up window appears.
   b. Enter the replication address for the source array in the **Replication Address** field and click **Save**.

Creating a Policy

Policies set the rules that govern the frequency of replication and the duration that snapshots are retained.

1. From the source array, select**Protection** > **Polices**, and click the add (+) button in the heading of the **Snapshot Policies** list. The **Step 1: Create Policy** pop-up window appears.
2. Enter a policy name.
3. Ciick **Create**. The **Step 2: Add Rule to Policy <name>** pop-up window appears.
4. In the **Create or replicate 1 snapshot every** field, enter the frequency at which snapshots are created or replicated. The value must be entered in the format n{m|h|d|w}. For example, 15m, 3h, 2d, 1w, etc.
5. In the **At** field, enter the time of day the snapshot is created. The value must be entered in the format n[am|pm], where n is a value of 1-12. If entered without am or pm, n must be a value of 0-23. This field is only editable if the value specified in the **Create or replicate 1 snapshot every** field is in days. For example, 24h, 48h, 72h, 1d, 2d, 3d, 1w, etc.
6. In the **And keep for** field, enter the retention period for the snapshot. The value must be entered in the format n{m|h|d|w}. For example, 30m, 1h, 2d, 1w, etc. The retention period cannot be less than the snapshot interval.
7. Click **Add**.

Creating a File Replica Link

Once the source and target arrays are connected, you must create a file replica link on the source array. The file replica link contains the details and specifies the rules of the replication relationship between the local and remote file systems.

1. From the **Protection** > **File Replica Links** page, click the add (+) button in the heading of the **File Replica Links** list. The **Create File Replica Link** pop-up window appears.
2. From the **Local File System** list, select the local (source) file system to be replicated.
3. From the **Remote Connection** list, select the remote (target) array.
4. (Optional) Enter a name for the remote file system to which data from the local file system will be replicated in the **Remote File System** field.
5. From the **Policy** list, select a replication policy to attach to the replica link.
6. Click **Create**.

Setting Up File Replication Using the CLI

The following instructions describe how to set up file replication from one FlashBlade array to another FlashBlade array using the Purity//FB CLI. These instructions should be followed in the order that they are presented.

Creating Replication Network Interfaces

On both the source and target arrays, issue the **`purenetwork vip create --address ADDRESS --servicelist replication`** command, where ADDRESS is the IP address associated with the replication vip.

```
# purenetwork vip create --address 123.123.123.123 --servicelist replication
```

Creating a Connection Key

⚠ **Important note!** The connection key is active for two hours. If the source and target arrays have not been connected within that two hour period, a new connection key must be created.

Once you have created replication network interfaces on the source and target arrays, you must create a connection key on the target array.

1 Issue the purearray **`create --connection-key`** command.

```
# purearray create --connection-key
Connection Key                          Created                  Expires
T-71a63c01-80aa-4173-842c-8ec9a1285d5b  2020-01-09 14:49:08 PST  2020-01-09
 16:49:08 PST
```

2 Copy the connection key.

Connecting the Source and Target Arrays

With the creation of replication network interfaces on the source and target arrays, and the creation of a connection key on the target array, you can now connect the source and target arrays.

⚠ **Important note!** It is highly recommended that you add the `pure:policy/full-access` access policy to the user (whose credentials are used for replication) on the target cluster, otherwise replication may fail due to denied access. See the `pureobj` command in the *FlashBlade CLI Reference* for information on how to add access policies to users.

⚠ **Important note!** When connecting the source array to the target array, a secure connection is required even if encryption is not enabled. Certificates with small key sizes, weak signature algorithms, or that only support weak TLS algorithms are not supported.

⚠ **Important note!** The management IP address required during configuration cannot be a loopback IP address.

1. On the target array, issue the **`purenetwork list`** command and make note of the array's management IP address.

```
# purenetwork list
Name          Enabled  Subnet Address       ...  Services
vir1          True     admin  10.11.123.12  ...  management
```

2. On the source array, issue the **`purearray connection --management-address MANAGEMENT_ADDRESS`** command, where `MANAGEMENT_ADDRESS` is the mangement IP address of the target array.
   - You can optionally specify the `--replication-address` argument, which will set the specified replication address on the source array and the remote array connection will have no replication address set.
   - If the `--replication-address` argument is not used, the available replication address on the target array is used and the replication address of the source array is automatically populated on the target array connection.

```
# purearray connect --management-address 10.11.123.12
Enter the connection key of the target array:
```

3. When prompted, enter (paste) the target array's connection key.
4. If using NAT, on the target array issue the **`purearray setattr --replication address REPLICATION_ADDRESS`** command, where `REPLICATION_ADDRESS` is the replication address of the source array.
5. The connection between two arrays in an object replication set up can be encrypted. To enable encryption between two arrays, on the source array run the **`purearray enable --connect --encrypted NAME`** command, where `NAME` is the name of the target array.

Creating a Policy

Policies set the rules that govern the frequency of replication and the duration that snapshots are retained.

1 From source array, issue the **`purepolicy create POLICY`** command, where `POLICY` is the name of the snapshot policy.

```
# purepolicy create snap_pol1
```

2 Add rules to the new policy by issuing the **`purepolicy rule add`** command. You must specify when the snapshots are created, the interval at which they are created, and the duration they are retained using the `--at`, `--every`, and `--keep-for` arguments. In the following example, snapshots are created at 12 AM each day and retained for one day for the policy `snap_pol1`.

```
# purepolicy rule add --at 12am --every 1d --keep-for 1d snap_pol1
```

Next, create the file replica link.

Creating a File Replica Link

Once the source and target arrays are connected, you must create a file replica link on the source array. The file replica link contains the details and specifies the rules of the replication relationship between the local and remote file systems.

From the source array, issue the **`purefs replica-link create --policy LOCAL_FILE-SYSTEM`** command, where `LOCAL_FILE-SYSTEM` is the name of the source file system. Additionally, specify the remote array as well as the remote file system to which the source will be replicating, using the `--remote` and `--remote-fs` arguments.

```
# purefs replica-link create --remote Array2 --remote-fs fs1-R --policy pol_pol1
fs1
```

In this example, the replica link is created between the file system `fs1` on the local array and the remote file system `fs1-R` (also created with this command) on the remote array `Array2`. Replication occurs per the schedule defined in the policy `pol_pol1`. Note that if the file system `fs1-R` already existed on the remote array, this command would fail.

Setting Up Array to Array Object Replication Using the GUI

The following instructions describe how to set up object replication from one FlashBlade array to another FlashBlade array using the Purity//FB GUI. These instructions should be followed in the order that they are presented.

Creating Replication Network Interfaces

Perform the following on both your source and target FlashBlade arrays:

1. From the **Settings** sidebar, click **Subnets** under **Network**. The **Subnets** panel apears.
2. In the **Subnets** panel, locate the subnet to which you wish to add a network interface and click the **Add interface** (+) button. The **Create Network Interface** pop-up window appears.
3. In the **Name** field, enter the interface name.
4. In the address field, enter the network address.
5. From the **Services** list, select `replication`.
6. The subnet defaults to the subnet in which you are creating the interface. Click **Create**.

Creating a Connection Key

⚠ **Important note!** The connection key is active for two hours. If the source and target arrays have not been connected within that two hour period, a new connection key must be created.

Once you have created replication network interfaces, you must create a connection key on the target array.

1. On the target array, select **Storage** > **Array** page.
2. In the **FlashBlade Array Connections** pane, click **More Options** > **Create Connection Key**. The **Connection Key** pop-up window appears displaying the new connection key.
3. Copy the new connection key.

Connecting the Source and Target Arrays

With the creation of replication network interfaces on the source and target arrays, and the creation of a connection key on the target array, you can now connect the source and target arrays.

Note: Encryption is only valid for object replication.

⚠ **Important note!** When connecting the source array to the target array, a secure connection is required even if encryption is not enabled. Certificates with small key sizes, weak signature algorithms, or that only support weak TLS algorithms are not supported.

⚠ **Important note!** The management IP address required during configuration cannot be a loopback IP address.

⚠ **Important note!** It is highly recommended that you add the `pure:policy/full-access` access policy to the user (whose credentials are used for replication) on the target cluster, otherwise replication may fail due to denied access. See *Adding Access Policies* for instructions on how to add access policies to users.

1. On the source array, select **Storage** > **Array** page, click the add (+) button in the **FlashBlade Array Connections** panel. The **Connect FlashBlade Array** pop-up window appears.
2. Enter the target array's hostname or management address in the **Management Address** field. The address can be located from the **Subnets** table by navigating to the **Settings** > **Network** page.
3. Paste the copied connection key for the target array in the **Connection Key** field.
4. The replication address is auto-discovered, unless using NAT. If using NAT, enter the target array's replication network address in the **Replication Address** field.
5. (Optional) Enable encryption by setting the **Encrypted** toggle to on. If set, the `_default_replication_certs` CA certificate group is applied. Before toggling, make sure to import the CA certificate to the source array if the target array's array-certificate is signed by a CA and add it to the certificate group. Note that encryption is set on the source array only. If enabled, the encryption setting displays as enabled on the target array.

   Warning: Use of CA certificates to establish trust and secure communication for object replication is the recommended configuration. If the target array's array-certificate is self-signed, directly importing the target array certificate to the source and adding it to the certificate group will not provide as strict validation around aspects of the peer, such as certificate expiry.
6. Click **Connect**.
7. If using NAT, on the target array, enter the source array's replication address.

a On the target array, in the **FlashBlade Array Connections** panel on the **Storage** > **Array** page, click the edit button at the end of the row displaying the connected source array. The **Edit Connected Array** pop-up window appears.

b Enter the replication address for the source array in the **Replication Address** field and click **Save**.

Creating Remote Credentials

Object replica links, which allow object data to be replicated between arrays and S3 targets, require remote credentials. In order to create a remote credential, you must have previously created an access key ID and secret access key (see *Creating a User* for instructions).

1. From the **Protection** > **Object Replica Links** page, click the add (+) button in the heading of the **Remote Credentials for Object Replication** list. The **Create Remote Credentials** pop-up window appears.
2. From the **Remote Array or Target** list, select the connected remote (target) array.
3. In the **Name** field, enter the credential name.
4. Enter the user access key from the target array in the **Access Key ID** field.
5. Enter the user secret access key from the target array in the **Secret Access Key** field.
6. Click **Create**.

Creating an Object Replica Link

Once the source and target are connected, you must create an object replica link on the source array. The object replica link contains the details about the source array and bucket from which objects are replicated, and the target bucket to which objects are replicated.

1. From the **Protection** > **Object Replica Links** page, click the add (+) button in the heading of the **Object Replica Links** list. The **Create Object Replica Link** pop-up window appears.
2. From the **Local Bucket Name** list, select the local (source) bucket from which data will be replicated.
3. From the **Remote Array or Target** list, select the remote (target) array.
4. From the **Remote Bucket** field, enter the name of the remote (target) bucket to which data will be replicated.
5. From the **Remote Credential** list, select the remote credential that was previously created to allow replication.

6 Click **Create**.

Enabling Bucket Versioning

Bucket versioning allows multiple variants of an object in the same bucket.

Object replication requires versioning to be enabled on the target bucket. Versioning is not required on the source bucket. On buckets with versioning enabled, you can use lifecycle rules to control the space used by non-current object versions.

In a versioning-enabled bucket, an object can have multiple versions for the same object name. Each object name has one current version and either zero or multiple non-current versions. Modifying an existing object results in that instance of the object name becoming the most current version and the previous version becoming a non-current version.

1 From the **Storage > Object Store** page, locate the bucket for which you wish to enable versioning in the **Buckets** panel.

2 Click the more options button at the end of the row in which the bucket appears and select **Enable versioning**.

3 Click **Enable** when prompted for confirmation.

Setting Up Array to Array Object Replication Using the CLI

The following instructions describe how to set up object replication from one FlashBlade array to another FlashBlade array using the Purity//FB CLI. These instructions should be followed in the order that they are presented.

Creating Replication Network Interfaces

On both the source and target arrays, issue the **`purenetwork vip create --address ADDRESS --servicelist replication`** command, where ADDRESS is the IP address associated with the replication vip.

```
# purenetwork vip create --address 123.123.123.123 --servicelist replication
```

Creating a Connection Key

⚠ **Important note!** The connection key is active for two hours. If the source and target arrays have not been connected within that two hour period, a new connection key must be created.

Once you have created replication network interfaces on the source and target arrays, you must create a connection key on the target array.

1 Issue the purearray **`create --connection-key`** command.

```
# purearray create --connection-key
Connection Key                          Created                   Expires
T-71a63c01-80aa-4173-842c-8ec9a1285d5b  2020-01-09 14:49:08 PST  2020-01-09
 16:49:08 PST
```

2 Copy the connection key.

Connecting the Source and Target Arrays

With the creation of replication network interfaces on the source and target arrays, and the creation of a connection key on the target array, you can now connect the source and target arrays.

⚠ **Important note!** It is highly recommended that you add the `pure:policy/full-access` access policy to the user (whose credentials are used for replication) on the target cluster, otherwise replication may fail due to denied access. See the `pureobj` command in the *FlashBlade CLI Reference* for information on how to add access policies to users.

⚠ **Important note!** When connecting the source array to the target array, a secure connection is required even if encryption is not enabled. Certificates with small key sizes, weak signature algorithms, or that only support weak TLS algorithms are not supported.

⚠ **Important note!** The management IP address required during configuration cannot be a loopback IP address.

1 On the target array, issue the **`purenetwork list`** command and make note of the array's management IP address.

```
# purenetwork list
Name          Enabled  Subnet Address       ...  Services
vir1          True     admin  10.11.123.12  ...  management
```

2 On the source array, issue the **`purearray connection --management-address MANAGEMENT_ADDRESS`** command, where `MANAGEMENT_ADDRESS` is the mangement IP address of the target array.

- You can optionally specify the `--replication-address` argument, which will set the specified replication address on the source array and the remote array connection will have no replication address set.
- If the `--replication-address` argument is not used, the available replication address on the target array is used and the replication address of the source array is automatically populated on the target array connection.

```
# purearray connect --management-address 10.11.123.12
Enter the connection key of the target array:
```

3. When prompted, enter (paste) the target array's connection key.
4. If using NAT, on the target array issue the **`purearray setattr --replication address REPLICATION_ADDRESS`** command, where `REPLICATION_ADDRESS` is the replication address of the source array.
5. The connection between two arrays in an object replication set up can be encrypted. To enable encryption between two arrays, on the source array run the **`purearray enable --connect --encrypted NAME`** command, where NAME is the name of the target array.

Creating Remote Credentials

Object replica links, which allow object data to be replicated between arrays, require remote credentials. In order to create a remote credential, you must have previously created an access key ID and secret access key using the **`pureobj user access-key create --user`** command.

To create remote credentials, issue the **`pureobj remote-credentials create`** command. You must specify the `--access-key-id` argument to set the access key ID and also specify the name of the remote credentials. The remote credentials name must be specified in the format of `<remote_array_name>/<remote_credential_name>`.

In the following example, the credentials `array1/credential1` are created.

```
# pureobj remote-credentials create --access-key-id ABCDE12345 array1/credential1
```

Creating an Object Replica Link

Once the source and target are connected, and you have created remote credentials, you must create an object replica link on the source array. The object replica link contains the details about the source array and bucket from which objects are replicated, and the target bucket to which objects are replicated.

From the source array, issue the **`purebucket replica-link create BUCKET`** command, where BUCKET is the name of the local bucket from which object data is replicated. You must also specify the name of the remote bucket and the remote credentials using the `--remote-bucket` and `--remote-credentials` arguments.

```
# purebucket replica-link create --remote-bucket r_bucket1 --remote-credentials
 array1/credential1 bucket1
```

In this example, the replica link is created between the local bucket `bucket1` on the local array and the remote bucket `r_bucket1`.

Enabling Bucket Versioning

Bucket versioning allows multiple variants of an object in the same bucket.

Object replication requires versioning to be enabled on the target bucket. Versioning is not required on the source bucket. On buckets with versioning enabled, you can use lifecycle rules to control the space used by non-current object versions.

In a versioning-enabled bucket, an object can have multiple versions for the same object name. Each object name has one current version and either zero or multiple non-current versions. Modifying an existing object results in that instance of the object name becoming the most current version and the previous version becoming a non-current version.

Issue the **`purebucket enable --versioning BUCKET`** command, where bucket is the name of the remote bucket.

```
# purebucket enable --versioning r_bucket1
```

In this example, versioning is enabled on the remote bucket `r_bucket1`.

Setting Up FlashBlade to Amazon S3 Object Replication Using the GUI

The following instructions describe how to set up object replication from one FlashBlade array to an Amazon S3 target using the Purity//FB GUI. These instructions should be followed in the order that they are presented.

Creating a Replication Network Interface

Perform the following on the source FlashBlade array:

1. Select **Settings** > **Network**.
2. In the **Subnets** list, locate the subnet to which you wish to add a network interface and click the **Add interface** (+) button. The **Create Network Interface** pop-up window appears.
3. In the **Name** field, enter the interface name.
4. In the address field, enter the network address.
5. From the **Services** list, select `replication`.
6. The subnet defaults to the subnet in which you are creating the interface. Click **Create**.

Connecting the FlashBlade Array to the S3 Target

With the creation of replication network interfaces on the source array, you can now connect the source array and S3 target.

1. On the source array, select **Storage** > **Array** page, click the add (+) button in the **S3 Target Connections** panel. The **Connect S3 Target** pop-up window appears.
2. Enter the S3 target name in the **Name** field.
3. Enter the S3 target's address in the **Address** field. For example, `s3.amazonaws.com`.
4. Click **Connect**.

Creating Remote Credentials

Object replica links, which allow object data to be replicated between arrays and S3 targets, require remote credentials. In order to create a remote credential, you must have previously created an access key ID and secret access key (see *Creating a User* for instructions).

1. From the **Protection** > **Object Replica Links** page, click the add (+) button in the heading of the **Remote Credentials for Object Replication** list. The **Create Remote Credentials** pop-up window appears.
2. From the **Remote Array or Target** list, select the connected remote (target) array.
3. In the **Name** field, enter the credential name.
4. Enter the user access key from the target array in the **Access Key ID** field.

5 Enter the user secret access key from the target array in the **Secret Access Key** field.

6 Click **Create**.

Creating an Object Replica Link

Once the source and target are connected, you must create an object replica link on the source array. The object replica link contains the details about the source array and bucket from which objects are replicated, and the target bucket to which objects are replicated.

1 From the **Protection** > **Object Replica Links** page, click the add (+) button in the heading of the **Object Replica Links** list. The **Create Object Replica Link** pop-up window appears.

2 From the **Local Bucket Name** list, select the local (source) bucket from which data will be replicated.

3 From the **Remote Array or Target** list, select the remote (target) array.

4 From the **Remote Bucket** field, enter the name of the remote (target) bucket to which data will be replicated.

5 From the **Remote Credential** list, select the remote credential that was previously created to allow replication.

6 Click **Create**.

Enabling Bucket Versioning

Bucket versioning allows multiple variants of an object in the same bucket.

Object replication requires versioning to be enabled on the target bucket. Versioning is not required on the source bucket. On buckets with versioning enabled, you can use lifecycle rules to control the space used by non-current object versions.

In a versioning-enabled bucket, an object can have multiple versions for the same object name. Each object name has one current version and either zero or multiple non-current versions. Modifying an existing object results in that instance of the object name becoming the most current version and the previous version becoming a non-current version.

Bucket versioning can be enabled on an Amazon S3 bucket via the AWS Management Console, the Amazon S3 API, or the AWS CLI.

Optionally configure a lifecycle rule on the target bucket to control space usage of non-concurrent versions.

Setting Up FlashBlade to Amazon S3 Object Replication Using the CLI

The following instructions describe how to set up object replication from one FlashBlade array to an Amazon S3 target using the Purity//FB CLI. These instructions should be followed in the order that they are presented.

Creating a Replication Network Interface

On the source array, issue the **`purenetwork vip create --address ADDRESS --servicelist replication`** command, where ADDRESS is the IP address associated with the replication vip.

```
# purenetwork vip create --address 123.123.123.123 --servicelist replication
```

Connecting the FlashBlade Array to the S3 Target

On the FlashBlade array, issue the **`puretarget s3 create TARGET`** command, where TARGET is the name of the S3 target. You must use the `--address` argument to specify the address of the S3 target.

```
# puretarget s3 create --address s3.amazonaws.com s3r1
```

In this example, the S3 target name is `s3r1` and its address is `s3.amazonaws.com`.

Creating Remote Credentials

Object replica links, which allow object data to be replicated between arrays, require remote credentials. In order to create a remote credential, you must have previously created an access key ID and secret access key using the **`pureobj user access-key create --user`** command.

To create remote credentials, issue the **`pureobj remote-credentials create`** command. You must specify the `--access-key-id` argument to set the access key ID and also specify the name of the remote credentials. The remote credentials name must be specified in the format of `<remote_array_name>/<remote_credential_name>`.

In the following example, the credentials `array1/credential1` are created.

```
# pureobj remote-credentials create --access-key-id ABCDE12345 array1/credential1
```

Creating an Object Replica Link

Once the source and target are connected, and you have created remote credentials, you must create an object replica link on the source array. The object replica link contains the details about the source array and bucket from which objects are replicated, and the target bucket to which objects are replicated.

From the source array, issue the **`purebucket replica-link create BUCKET`** command, where BUCKET is the name of the local bucket from which object data is replicated. You must also specify the name of the remote bucket and the remote credentials using the `--remote-bucket` and `--remote-credentials` arguments.

```
# purebucket replica-link create --remote-bucket r_bucket1 --remote-credentials
 array1/credential1 bucket1
```

In this example, the replica link is created between the local bucket `bucket1` on the local array and the remote bucket `r_bucket1`.

Enabling Bucket Versioning

Bucket versioning allows multiple variants of an object in the same bucket.

Object replication requires versioning to be enabled on the target bucket. Versioning is not required on the source bucket. On buckets with versioning enabled, you can use lifecycle rules to control the space used by non-current object versions.

In a versioning-enabled bucket, an object can have multiple versions for the same object name. Each object name has one current version and either zero or multiple non-current versions. Modifying an existing object results in that instance of the object name becoming the most current version and the previous version becoming a non-current version.

Bucket versioning can be enabled on an Amazon S3 bucket via the AWS Management Console, the Amazon S3 API, or the AWS CLI.

Optionally configure a lifecycle rule on the target bucket to control space usage of non-concurrent versions.

Performing File Replication Failover and Reprotect Using the GUI

CAUTION: If Pure File SafeMode is enabled, contact Pure Technical Services to promote and demote file systems.

To initiate failover in a file replication setup:

- The target file system must first be promoted.
- All clients must then be directed to the target array.
- The local file system is then demoted. Note that when a file system is demoted, any writes performed since the last replication will be discarded.

To initiate failover, perform the following:

1. On the target array, from the **Storage** > **File Systems** page, locate the remote file system that you wish to promote from the **File Systems** panel.
2. Click **More Options** > **Promote** at the end of the row in which the remote file system appears.
3. Click **Promote** when prompted for confirmation.
4. Manually redirect clients to the target array.

   To reprotect, you must remove snapshots since the last replicated snapshot. This can be difficult if the policy engine is creating new snapshots. You can stop the policy engine from creating new snapshots by removing the policies form the file system and replica link.
5. On the local array, remove policies attached to the to-be-demoted local file system and replica link.

   To remove the policy from the local file system:

   a. From the **Storage** > **File Systems** page, locate and click local file system that you wish to demote from the **File Systems** panel. The file system's details page appears.

   b. In the **Policies** panel, click the remove button (**X**) in the same row as the policy you wish to remove.

   c. Click **Remove** when prompted for confirmation.

   To remove the policy from the replica link:

a From the **Protection** > **File Replica Links** page, click **More Options** > **Remove Policies** at the end of the row of the replica link you wish to edit. The **Remove Policies** pop-up window appears.

b Select the policy or policies you wish to remove from the replica link from the **Available Policies** list.

c Click **Remove**.

6 Navigate back to the **Storage** > **File Systems** page and locate the local file system that you wish to demote from the **File Systems** panel.

7 Click **More Options** > **Demote** at the end of row in which the local file system appears.

8 Click **Demote** when prompted for confirmation.

Writes to the local file system are stopped and are redirected to the promoted remote file system.

9 If you removed policies in step 5, add the removed policy or policies back to the file system and replica link.

To add the policy to the file system:

a From the **Storage** > **File Systems** page, locate and click the file system from the **File Systems** panel. The file system's details page appears.

b In the **Policies** panel, click the add button (+). The **Add Policies** pop-up window appears.

c Select the policy or policies you wish to add to the file system from the **Available Policies** list.

d Click **Add**.

To add the policy to the replica link:

a From the **Protection** > **File Replica Links** page, click **More Options** > **Add Policies** at the end of the row of the replica link you wish to edit. The **Add Policies** pop-up window appears.

b Select the policy or policies you wish to add back to the replica link from the **Available Policies** list.

c Click **Add**.

Once the local file system comes back up, replication resumes as scheduled between the newly promoted target file system and demoted local file system because the policy was re-added to the replica link. Because clients have been redirected to the target, data is written to the promoted remote file system, which is then replicated to the demoted local file system.

Performing Failover Using the CLI

CAUTION: If Pure File SafeMode is enabled, contact Pure Technical Services to promote and demote file systems.

In a replication setup, failover requires promoting the file system on target (remote) array and then demoting the file system on the local (source) array.

Note that when demoting the local file system, any writes performed since the last replication will be discarded. If a local snapshot was taken since last replication, demoting the file system requires that snapshot be destroyed and eradicated. You must use the `--discard-non-snapshotted-data` option to remove any data since the last snapshot of the file system was taken. The file system must either have no snapshots, or the most recent snapshot must be a replication snapshot.

In the procedure below:

- The local array is `array1`
- The local file system is `fs1`
- The target array is `array2`
- The target file system is `fs1-R`
- The policy attached to the local file system `fs1` is `fs_snap_pol1`.
- The policy attached to the replica link is `rl_pol1`.

1. On the target array, `array2`, promote the target file system. In the following example, the target file system `fs1-R` is promoted:

```
# purefs promote fs1-R
```

2. Manually redirect clients to the the target array, `array2`.
3. On the local array, `array1`, remove the policy `fs_snap_pol1` that attached to the local file system `fs1`

```
# purepolicy remove fs_snap_pol1
```

4 Remove the policy from the replica link using the **`purepolicy remove --remote`** command, where `--remote` specifies the remote (target) array. In the following example the policy `rl_pol1` is removed from the replica link:

```
# purepolicy remove --remote array2 rl_pol1
```

5 On the local array, `array1`, demote the local file system :

```
# purefs demote --discard-non-snapshotted-data fs1
```

6 Add the policy back to the replica link using the **`purepolicy add --remote`** command, where `--remote` specifies the demoted array In the following example, the policy `rl_pol1` is added back to the replica link:

```
# purepolicy add --remote array1 rl_pol1
```

7 On the local array, verify that replication is disabled and that the target file system is promoted:

```
# purefs replica-link list
Name  Direction  Remote  Remote File System  Policy       Status     Recov...
fs1   <--        array2  fs1-R               rl_pol1      unhealthy  2019-...

purefs replica-link list --status-details
Name  Direction  Remote  Remote File System  Policy       Status     Details
fs1   <--        array2  fs1-R               rl_pol1      unhealthy  The
 target file system is promoted.
```

Once the local file system comes back up, replication resumes as scheduled between the newly promoted target file system and demoted local file system because the policy was re-added to the replica link. Because clients have been redirected to the target, data is written to the promoted remote file system, which is then replicated to the demoted local file system.

Performing Failback Using the GUI

CAUTION: If Pure File SafeMode is enabled, contact Pure Technical Services to promote and demote file systems.

Note: In this procedure, the remote file system was promoted and the local file system was demoted during the failover procedure.

As noted in the failover procedure, if the replication schedule policy was re-added to the replica link in the replication setup, once the local file system comes back up, replication resumes as scheduled between the promoted target file system and demoted local file system. Performing failback restores the

original local/target relationship between arrays and file systems in a replication setup. During failback, once the remote file system is demoted and the local file system is promoted and clients redirected to the local file system, the original replication setup resumes; data is written to the local file system and then replicated to the remote file system.

To initiate failback in a file replication setup:

- Stop writes on the promoted remote file system.
- Optionally manually create a snapshot of the file system and send it to the demoted local file system to ensure that data written since the last snapshot resides on the to-be-promoted file system.
- Promote the previously demoted local file system.
- Add back any removed policy to the local file system and replica link.
- Demote the remote file system.

To initiate failback, perform the following:

1. On the target array, from the **Storage** > **File Systems** page, locate the remote file system that is to be demoted from the **File Systems** panel.
2. Click **More Options** > **Disable Writes** at the end of row in which the remote file system appears.
3. Click **Disable** when prompted for confirmation.
4. Ensure all writes are sent to the source file system by creating a snapshot on the target and send it to the source.
5. On the local array, from the **Storage** > **File Systems** page, locate the local file system that you wish to promote from the **File Systems** panel.
6. Click **More Options** > **Promote** at the end of row in which the local file system appears.
7. Manually redirect clients back to the to the local array.
8. Remove policies attached to the to-be-demoted remote file system and replica link.

   To remove the policy from the file system:

   a. From the **Storage** > **File Systems** page, locate and click local file system that you wish to demote from the **File Systems** panel. The file system's details page appears.

   b. In the **Policies** panel, click the remove button (**X**) in the same row as the policy you wish to remove.

   c. Click **Remove** when prompted for confirmation.

To remove the policy from the replica link:

a From the **Protection** > **File Replica Links** page, click **More Options** > **Remove Policies** at the end of the row of the replica link you wish to edit. The **Remove Policies** pop-up window appears.

b Select the policy or policies you wish to remove from the replica link from the **Available Policies** list.

c Click **Remove**.

9 On the target array, from the **Storage** > **File Systems** page, locate the remote file system that you wish to demote from the **File Systems** panel.

10 Click **More Options** > **Demote** at the end of row in which the remote file system appears.

11 Click **Demote** when prompted for confirmation.

Writes to the remote file system are stopped and are redirected to the promoted local file system.

12 If you removed policies in step 8, add the removed policy or policies back to the file system and replica link.

To add the policy to the file system:

a From the **Storage** > **File Systems** page, locate and click the file system from the **File Systems** panel. The file system's details page appears.

b In the **Policies** panel, click the add button (+). The **Add Policies** pop-up window appears.

c Select the policy or policies you wish to add to the file system from the **Available Policies** list.

d Click **Add**.

To add the policy to the replica link:

a From the **Protection** > **File Replica Links** page, click **More Options** > **Add Policies** at the end of the row of the replica link you wish to edit. The **Add Policies** pop-up window appears.

b Select the policy or policies you wish to add back to the replica link from the **Available Policies** list.

c Click **Add**.

The original replication setup has been restored.

Performing Failback Using the CLI

CAUTION: If Pure File SafeMode is enabled, contact Pure Technical Services to promote and demote file systems.

As noted in the failover procedure, if the replication schedule policy was re-added to the replica link in the replication setup, once the local file system comes back up, replication resumes as scheduled between the promoted target file system and demoted local file system. Performing failback restores the original local/target relationship between arrays and file systems in a replication setup. During failback, once the remote file system is demoted and the local file system is promoted and clients redirected to the local file system, the original replication setup resumes; data is written to the local file system and then replicated to the remote file system.

In the procedure below:

- The local array is `array2`
- The local file system is `fs1-R`
- The target array is `array1`
- The target file system is `fs1`
- The policy re-attached to the local file system `fs1` is `fs_snap_pol1`.
- The policy attached to the replica link is `rl_pol1`.

1. On the local array, `array2`, stop all writes on the local file system `fs1-R` and then transfer all remaining data to the target file system `fs1`:

```
# purefs disable --writable fs1-R
# purefs snap --send --target array1 fs1
```

2. Create a snapshot of the file system and send it to the target file system `fs1` to ensure that data since the last snapshot resides on the to-be-promoted file system (`fs1`). Skip this step if you do not need data written since the last snapshot.

3. On the target array, `array1`, promote the target file system `fs1`:

```
# purefs promote fs1
```

4 Add back any previously removed file system policy. In the following example, the `policy fs_snap_pol1` is added back to file system `fs1`.

```
# purepolicy add fs_snap_pol1
```

5 Remove the policy from the replica link using the **`purepolicy remove --remote`** command, where `--remote` specifies the remote (target) array. In the following example the policy `rl_pol1` is removed from the replica link:

```
# purepolicy remove --remote array1 rl_pol1
```

6 Manually direct all clients back to the promoted file system `fs1`.

7 On the local array, `array2`, demote the local file system `fs1-R`:

```
# purefs demote --discard-non-snapshotted-data fs1-R
```

8 Add the policy back to the replica link using the **`purepolicy add --remote`** command, where `--remote` specifies the demoted array In the following example, the policy `rl_pol1` is added back to the replica link:

```
# purepolicy add --remote array2 rl_pol1
```

9 On the (now) local array `array1`, verify that the replica link has returned to its original direction (from file system `fs1` to the target file system `fs1-R`):

```
# purefs replica-link list
Name  Direction  Remote  Remote File System  Policy       Status   Lag
 Recovery P...
fs1   -->        array2  fs1-R               rl_pol1      healthy  10m
 2019-11-11 12...
```

The original replication setup has been restored.

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