

# Pure Storage FlashArray Implementation Guide: EMC VPLEX

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## Document History

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| Version   | Changes                                                                             |
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## Introduction

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Heterogeneous storage virtualization products abstract the underlying storage platform from the host layer, offering a set of additional features not available on the storage platform itself. Pure Storage FlashArrays (hereinafter referred to simply as FlashArrays) are currently supported, tested, or qualified with several virtualization products, including IBM's SVC, Falconstor, DataCore, HDS (via Generic Profile Support) and EMC VPLEX. This guide describes the steps for implementing Pure Storage FlashArrays in EMC Local and Metro VPLEX configurations. In addition, it highlights best practices, illustrates configurations, and describes current limitations of the combined solution.

The guide assumes that VPLEX has been installed and configured by authorized EMC representatives.

### Audience

The audience for the guide is Pure Storage System Engineers, Certified Partners and customers who deploy Pure Storage FlashArrays in VPLEX environments. Readers are assumed to be familiar with:

- SAN technology concepts
- EMC VPLEX concepts and components
- The VPLEX CLI
- FlashArray concepts and components
- The FlashArray CLI
- *Implementation and Planning Best Practices for EMC VPLEX Technical Notes* (EMC document h7139)



## Pure Storage FlashArrays

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Pure Storage FlashArrays improve organizations' server and workload productivity, while lowering their overall storage cost. The newest FlashArray//m generation arrays dramatically reduce organizations' storage complexity, making IT more agile and efficient, and accelerating the "journey to the cloud."



FlashArray performance makes businesses smarter with real-time analytics that drive customer loyalty by enabling innovative experiences that simply aren't possible with disk-based storage.

FlashArrays can transform data centers, clouds, and indeed, entire businesses, by affordably consolidating and accelerating key applications in four ways:

### Size

Power and space requirements as much as 90% lower than for comparable disk-based arrays

- 3U base chassis with 15-120 usable terabytes
- ~1kW of power

### Performance

Performance to meet any need

- Up to 300,000 32KB IOPS
- Up to 9 GB/s bandwidth
- < 1 millisecond average latency

### Scale

Capacity and performance that scale across technology generations

- Currently expandable to ~½ petabyte of usable capacity (with expansion shelves)
- Controller and flash module upgrades increase performance and capacity independently as needed

### Simplicity

Appliance-like deployment with worry-free operation

- 6 cables
- Plug-and-go deployment in minutes, not days
- Non-disruptive upgrades and hot-swap everything
- Fewer components for increased reliability

An evolution of the Pure Storage FlashArray modular stateless architecture, the FlashArray//m series is designed for expandability and multi-generation upgradability. FlashArray//m customizable modules enable non-disruptive capacity and performance upgrades to meet growing business needs and to take advantage of improvements in the underlying computing and flash technologies.

## Pure Storage FlashArray Properties

Pure Storage FlashArrays set the standard for all-flash enterprise storage arrays by delivering:

### Consistent Performance

- Consistent sub-millisecond average latency optimized for real world application workloads dominated by 32KB and larger I/Os, rather than the 4-8KB common in synthetic benchmarks
- Full performance even in failure scenarios and during updates.

### Lower Cost than Disk

- Inline deduplication and compression that reduce physical storage requirements by 5-10x for most I/O workloads, including databases, virtual machines and virtual desktop infrastructures.

### Mission-Critical Resiliency

- 99.999% or higher availability, measured across the entire FlashArray installed base
- Non-disruptive upgrades and component replacements.

### Built-In Disaster Recovery

- Data reduction-optimized backup and disaster recovery as part of the base product
- Policy-based automated snapshots and replication that configure in minutes
- Instant recovery using space-efficient local snapshots or remote replicas.

### Built-In Simplicity

- Game-changing simplicity that makes installation, configuration, storage provisioning and technology upgrades easy
- No managing of array performance, RAID, storage tiers or cache
- Optimized application performance without tuning
- Array management via web-based GUI, CLI, VMware vCenter PlugIn, Rest API, or OpenStack .

## Pure Storage FlashArray Applications

Pure Storage FlashArrays are ideal for:

### Accelerating Databases and Applications

- Transaction performance improvements of up to 10x with consistent low latency
- Online data analytics across huge datasets
- Mixed production, analytics, dev/test, and backup.

### Virtualizing and Consolidating Workloads

- Handling the most I/O-hungry tier 1 workloads
- Increased consolidation (reducing the number of servers)
- Simplified virtual infrastructure administration
- Eliminated or simplified common administrative tasks.

### Delivering the Ultimate Virtual Desktop Experience

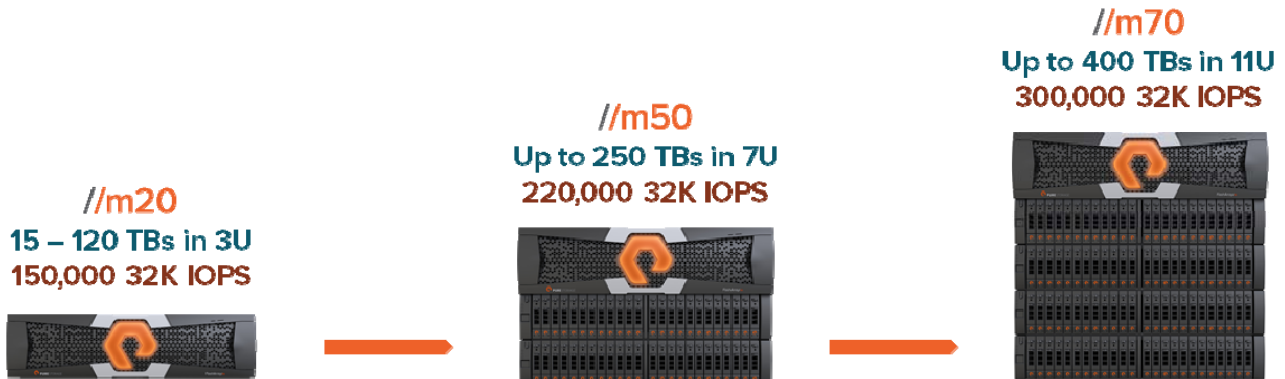
- Support for demanding users with better performance than physical desktops
- Scaling from pilot to thousands of users without disruption
- All-flash performance for less than \$100/desktop.

### Protecting and Recovering Vital Data Assets

- Always-on protection for business-critical data
- High performance even during failure and upgrade scenarios
- Instant recovery with FlashRecover.

## Pure Storage FlashArray//m Models

Table 1 lists the properties of the Pure Storage FlashArray//m20, FlashArray//m50, and FlashArray//m70.

|                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                   |                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                 |                                                                                                                                                                                                   |                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                      |
| <div> <div> <b>//m20</b><br/> <b>15 – 120 TBs in 3U</b><br/> <b>150,000 32K IOPS</b> </div> <div> <b>//m50</b><br/> <b>Up to 250 TBs in 7U</b><br/> <b>220,000 32K IOPS</b> </div> <div> <b>//m70</b><br/> <b>Up to 400 TBs in 11U</b><br/> <b>300,000 32K IOPS</b> </div> </div> |                                                                                                                                                                                                   |                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                      |
|                                                                                                                                                                                                                                                                                   | <b>//m20</b>                                                                                                                                                                                      | <b>//m50</b>                                                                                                                                                                                                                                         | <b>//m70</b>                                                                                                                                                                                                                                         |
| <b>Capacity</b>                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>Up to 120+ TB effective capacity*</li> <li>5 – 40TB raw capacity (base chassis)</li> </ul>                                                                 | <ul style="list-style-type: none"> <li>Up to 250+ TB effective capacity*</li> <li>30 – 88TB raw capacity (w/shelves)</li> </ul>                                                                                                                      | <ul style="list-style-type: none"> <li>Up to 400 TB effective capacity*</li> <li>44 – 136TB raw capacity w/shelves)</li> </ul>                                                                                                                       |
| <b>Performance</b>                                                                                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>Up to 150,000 32K IOPS**</li> <li>&lt; 1 ms average latency</li> <li>Up to 5 GB/s bandwidth</li> </ul>                                                     | <ul style="list-style-type: none"> <li>Up to 220,000 32K IOPS**</li> <li>&lt; 1 ms average latency</li> <li>Up to 7 GB/s bandwidth</li> </ul>                                                                                                        | <ul style="list-style-type: none"> <li>Up to 300,000 32K IOPS**</li> <li>&lt; 1ms average latency</li> <li>Up to 9 GB/s bandwidth</li> </ul>                                                                                                         |
| <b>Connectivity</b>                                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>8 Gb/s Fibre Channel</li> <li>10 Gb/s Ethernet iSCSI</li> <li>Management and replication ports</li> </ul>                                                  | <ul style="list-style-type: none"> <li>16 Gb/s Fibre Channel</li> <li>10 Gb/s Ethernet iSCSI</li> <li>Management and replication ports</li> </ul>                                                                                                    | <ul style="list-style-type: none"> <li>16 Gb/s Fibre Channel</li> <li>10 Gb/s Ethernet iSCSI</li> <li>Management and replication ports</li> </ul>                                                                                                    |
| <b>Physical</b>                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>3U</li> <li>742 Watts (nominal draw)</li> <li>110 lbs. (49.9 kg) fully loaded</li> <li>• 5.12" x 18.94" x 29.72"</li> <li>FlashArray//m chassis</li> </ul> | <ul style="list-style-type: none"> <li>3U – 7U</li> <li>1007 - 1447 Watts (nominal draw)</li> <li>110 lbs. (49.9 kg) fully loaded</li> <li>+ 44lbs. per expansion shelf</li> <li>• 5.12" x 18.94" x 29.72"</li> <li>FlashArray//m chassis</li> </ul> | <ul style="list-style-type: none"> <li>5U – 11U</li> <li>1439 – 2099 Watts (nominal draw)</li> <li>110 lbs. (49.9 kg) fully loaded</li> <li>+44lbs. per expansion shelf</li> <li>• 5.12" x 18.94" x 29.72"</li> <li>FlashArray//m chassis</li> </ul> |

\* Effective capacity, expressed in GiB (2<sup>30</sup> bytes), represents storage available for user data. It does not include storage reserved for RAID-3D checksums or the overprovisioning reserve. It is calculated using a 5:1 reduction ratio, which is lower than the average across the Pure Storage FlashArray installed base.

\*\* The storage industry commonly quotes array performance in terms of 4KiB IOPS. In practice, however, I/O sizes of 32KiB and larger are encountered more frequently, so Pure Storage quotes these as more representative. FlashArrays adapt automatically to I/O sizes between 512B and 32KiB I/O for superior performance, scalability, and data reduction.

Table 1: Pure Storage FlashArray//m Series Specifications

### The Pure Storage Purity Operating Environment

The Purity Operating Environment (Purity) software that runs in all Pure Storage FlashArrays includes advanced data reduction, storage management, and flash management. All Purity features are part of every array:

#### Storage Software Built for Flash

FlashCare technology manages an array's flash as a single pool, optimizing globally to extend life and maximize performance, ultimately delivering enterprise robustness using consumer-grade flash.

### Granular and Adaptive

Purity metadata is based on a variable block size with 512-byte granularity. This fine-grain metadata enables all of Purity's data and flash management services to operate at the highest efficiency.

### Best Data Reduction Available

FlashReduce implements five forms of inline and post-process data reduction to offer the most complete data reduction in the industry. Data reduction operates at a 512-byte aligned variable block size, to enable effective reduction across a wide range of mixed workloads without tuning.

### Highly Available and Resilient

FlashProtect includes high availability, dual-parity RAID-3D, and non-disruptive upgrades, all designed to deliver nearly full performance during failure and maintenance events.

### Backup and Disaster Recovery Built In

FlashRecover combines space-saving snapshots, replication, and protection policies for end-to-end data protection and recovery, protecting data against loss locally and globally. All FlashRecover services are fully integrated and leverage the FlashArray native data reduction capabilities.



### Pure1 Manage

By combining local web-based management with cloud-based monitoring, Pure1 Manage makes it possible to manage FlashArrays from anywhere using just a web browser.

### Pure1 Connect

A rich set of APIs, plugin-is, application connectors, and automation toolkits enable FlashArrays to connect to all major data center and cloud monitoring, management, and orchestration tools.

### Pure1 Support

FlashArrays are connected to the cloud full-time, enabling Pure Storage to deliver the most proactive support experience available. Highly trained staff combine with big data analytics to help avoid problems before they occur.

### Pure1 Collaborate

Extending development and support with online access to resources and experience, the Pure1 Collaborate community enables peer-based support and sharing of tips, tricks, and scripts.

## Evergreen™ Storage

The Pure Storage FlashArray *Evergreen storage* model, summarized in Figure 1 means that customers deploy arrays with an expectation of decade-long lifecycles. Capacity, performance, and capability are all incrementally expandable using the latest technology at the time of expansion. Most importantly, FlashArray *non-disruptive upgrades* eliminate planned downtime due to upgrades and data migrations for the life of an array.

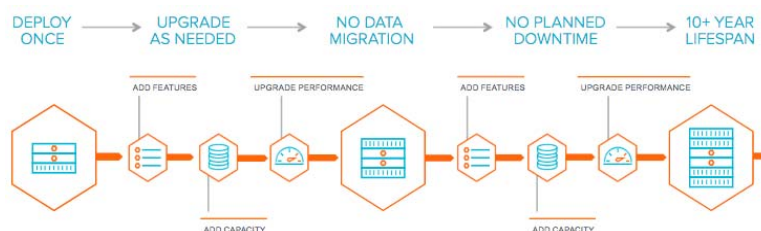


Figure 1: Pure Storage Evergreen™ Storage Model Highlights

## The VPLEX Architecture

VPLEX storage virtualization platforms are *clusters* of one or more *engines* connected to storage area networks. As described in EMC publication h8232,<sup>1</sup> the company offers three types of VPLEX Clusters:

### Local

A single VPLEX cluster located within a single data center (configuration examples in Figure 2)

### Metro

Two VPLEX clusters separated by up to 5 milliseconds of round trip latency

### GEO

Two VPLEX clusters separated by up to 50 milliseconds of round trip latency

|                     |               |             |             |
|---------------------|---------------|-------------|-------------|
| Directors           | 2             | 4           | 8           |
| Cores               | 12            | 24          | 48          |
| Fibre Channel Ports | 24            | 48          | 96          |
| Cache               | 72GB          | 144GB       | 288GB       |
|                     | Single Engine | Dual Engine | Quad Engine |

Figure 2: VPLEX Local Cluster Configuration Options

A VPLEX cluster can be added to a production SAN environment non-disruptively by attaching host and storage array Fibre Channel ports to its front and back-end ports. Hosts and volumes can be virtualized online or offline, using procedures described later in this guide.

## The VPLEX Engine

Each model VS2 VPLEX *engine* consists of two *I/O directors* and one *I/O annex* with a total of 24 Fibre Channel ports (8 front-end, 8 back-end, 4 inter-cluster COM, and 4 intra-cluster COM), and is protected by two redundant stand-by power supplies.

## Directors

Each director is an x86 multi-core multi-processor containing 4 hot-swappable I/O modules. The directors run *GeoSynchrony* clustered storage virtualization software. Each cluster has a *service management station* for alerting and software management.

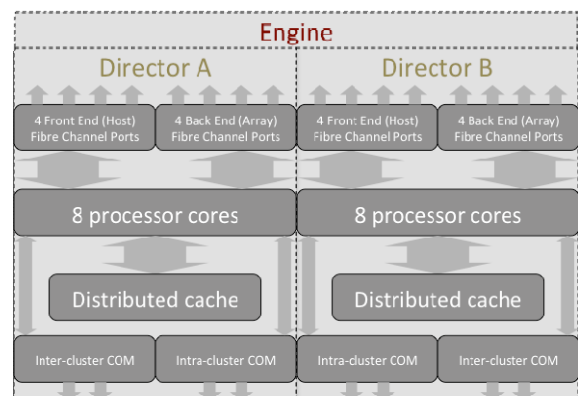


Figure 3: VPLEX Engine Block Diagram

<sup>1</sup> <https://www.emc.com/collateral/hardware/white-papers/h8232-vplex-architecture-wp.pdf>, pp6-7.

## Pure Storage FlashArray Components

Figures 4 and 5 depict a single FA-450 controller and FlashArray//m dual-controller chassis respectively.

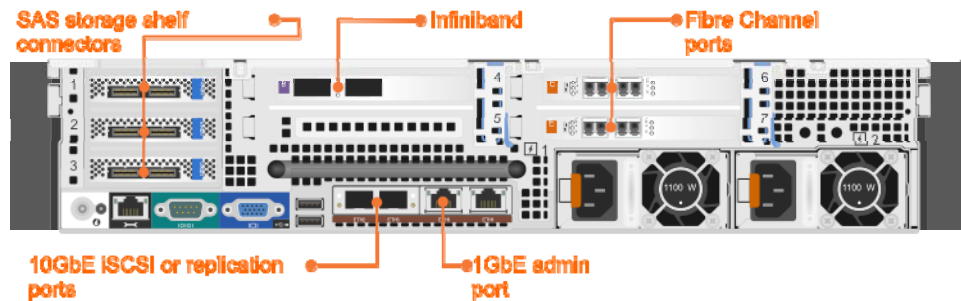


Figure 4: FA-400 Series Controller Chassis Rear View (2 Controllers per Array)



Figure 5: FlashArray//m Dual-Controller Chassis (1 Dual-Controller Chassis per Array)

## Implementing Pure Storage FlashArrays in VPLEX Environments

### Step 1: Identify VPLEX and FlashArray Worldwide Names (PWWNs)

VPLEX WWNs can be identified in any of four ways:

- Using the EMC VPLEX Port WWN Calculator
- Identifying VPLEX Port WWNs on the switch
- Using the VPLEX GUI
- VPLEX CLI: `ll /engines/**/ports -p`

FlashArray WWNs can be identified in any of three ways:

- FlashArray CLI: `pureport list --initiators`
- Using the Pure Storage FlashArray GUI
- Identifying Pure Storage FlashArray ports on the switch

Table 2: Identifying VPLEX and FlashArray Worldwide Names

## Step 2: Create Zones Containing VPLEX and FlashArray Ports

Pure Storage recommends that installers become familiar with EMC document h7139, *Implementation and Planning Best Practices for EMC VPLEX Technical Notes*, and follow the instructions in it. Figures 6 through 9 illustrate Pure Storage's zoning recommendations for FA-405, FlashArray//m10, FA-450, and FlashArray//m50.

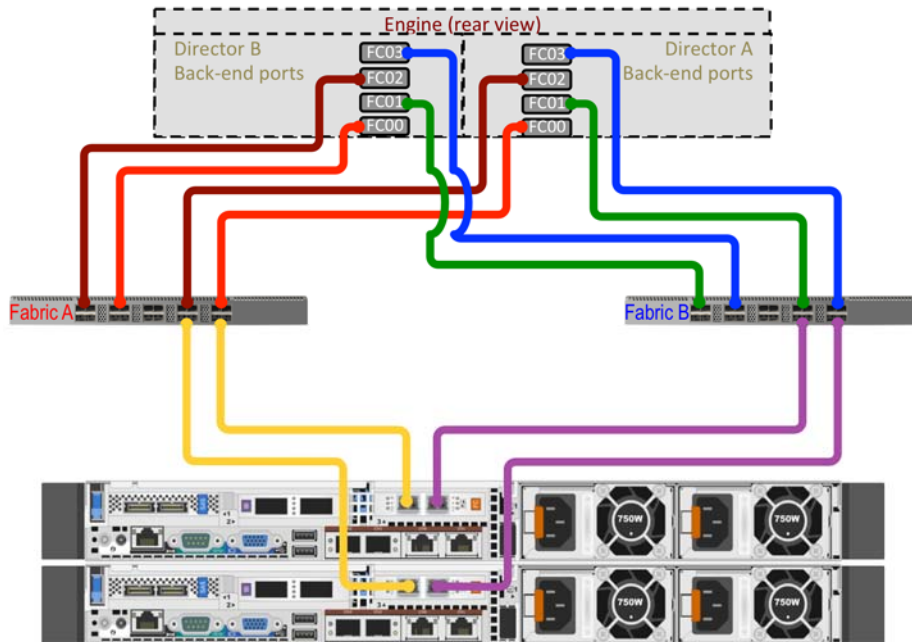


Figure 6: Recommended Zoning for FA-405 in a Single-Engine VPLEX Cluster

| Zone                                                | VPLEX Ports                   | FlashArray Ports                   |
|-----------------------------------------------------|-------------------------------|------------------------------------|
| Zone_VPLEX_Engine1_DirectorA1_FC00_PureStorageFA4xx | VPLEX_Engine1_DirectorA1_FC00 | FA4xx_CTR0_FC00<br>FA4xx_CTR1_FC00 |
| Zone_VPLEX_Engine1_DirectorA1_FC01_PureStorageFA4xx | VPLEX_Engine1_DirectorA1_FC01 | FA4xx_CTR0_FC01<br>FA4xx_CTR1_FC01 |
| Zone_VPLEX_Engine1_DirectorA1_FC02_PureStorageFA4xx | VPLEX_Engine1_DirectorA1_FC02 | FA4xx_CTR0_FC02<br>FA4xx_CTR1_FC02 |
| Zone_VPLEX_Engine1_DirectorA1_FC03_PureStorageFA4xx | VPLEX_Engine1_DirectorA1_FC03 | FA4xx_CTR0_FC03<br>FA4xx_CTR1_FC03 |
| Zone_VPLEX_Engine1_DirectorB1_FC00_PureStorageFA4xx | VPLEX_Engine1_DirectorB1_FC00 | FA4xx_CTR0_FC00<br>FA4xx_CTR1_FC00 |
| Zone_VPLEX_Engine1_DirectorB1_FC01_PureStorageFA4xx | VPLEX_Engine1_DirectorB1_FC01 | FA4xx_CTR0_FC01<br>FA4xx_CTR1_FC01 |
| Zone_VPLEX_Engine1_DirectorB1_FC02_PureStorageFA4xx | VPLEX_Engine1_DirectorB1_FC02 | FA4xx_CTR0_FC02<br>FA4xx_CTR1_FC02 |
| Zone_VPLEX_Engine1_DirectorB1_FC03_PureStorageFA4xx | VPLEX_Engine1_DirectorB1_FC03 | FA4xx_CTR0_FC03<br>FA4xx_CTR1_FC03 |

Table 3: Recommended Zoning for FA-405 in a Single-Engine VPLEX Cluster

Figure 6 illustrates zoning with a single-engine VPLEX cluster. Each zone contains a single VPLEX back-end port and two FlashArray ports. For multi-engine VPLEX clusters, create similar zones for each engine's ports.

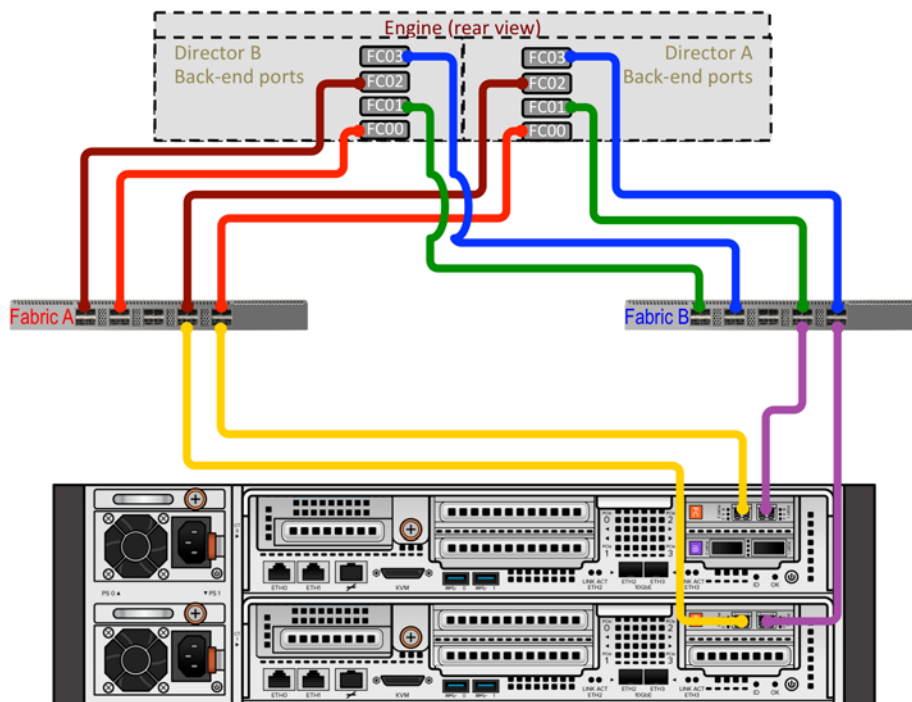


Figure 7: Recommended Zoning for a FlashArray//m10 in a Single-Engine VPLEX Cluster

| Zone                                                | VPLEX Ports                   | FlashArray Ports                   |
|-----------------------------------------------------|-------------------------------|------------------------------------|
| Zone_VPLEX_Engine1_DirectorA1_FC00_PureStorageFA4xx | VPLEX_Engine1_DirectorA1_FC00 | FAM10_CTR0_FC00<br>FAM10_CTR1_FC00 |
| Zone_VPLEX_Engine1_DirectorA1_FC01_PureStorageFA4xx | VPLEX_Engine1_DirectorA1_FC01 | FAM10_CTR0_FC01<br>FAM10_CTR1_FC01 |
| Zone_VPLEX_Engine1_DirectorA1_FC02_PureStorageFA4xx | VPLEX_Engine1_DirectorA1_FC02 | FAM10_CTR0_FC00<br>FAM10_CTR1_FC00 |
| Zone_VPLEX_Engine1_DirectorA1_FC03_PureStorageFA4xx | VPLEX_Engine1_DirectorA1_FC03 | FAM10_CTR0_FC01<br>FAM10_CTR1_FC01 |
| Zone_VPLEX_Engine1_DirectorB1_FC00_PureStorageFA4xx | VPLEX_Engine1_DirectorB1_FC00 | FAM10_CTR0_FC00<br>FAM10_CTR1_FC00 |
| Zone_VPLEX_Engine1_DirectorB1_FC01_PureStorageFA4xx | VPLEX_Engine1_DirectorB1_FC01 | FAM10_CTR0_FC01<br>FAM10_CTR1_FC01 |
| Zone_VPLEX_Engine1_DirectorB1_FC02_PureStorageFA4xx | VPLEX_Engine1_DirectorB1_FC02 | FAM10_CTR0_FC00<br>FAM10_CTR1_FC00 |
| Zone_VPLEX_Engine1_DirectorB1_FC03_PureStorageFA4xx | VPLEX_Engine1_DirectorB1_FC03 | FAM10_CTR0_FC01<br>FAM10_CTR1_FC01 |

Table 4: Recommended Zoning for a FlashArray//m10 in a Single-Engine VPLEX Cluster

Figure 7 illustrates zoning with a single-engine VPLEX cluster. Each zone contains a single VPLEX back-end port and two FlashArray ports. For multi-engine VPLEX clusters, create similar zones for each engine's ports.

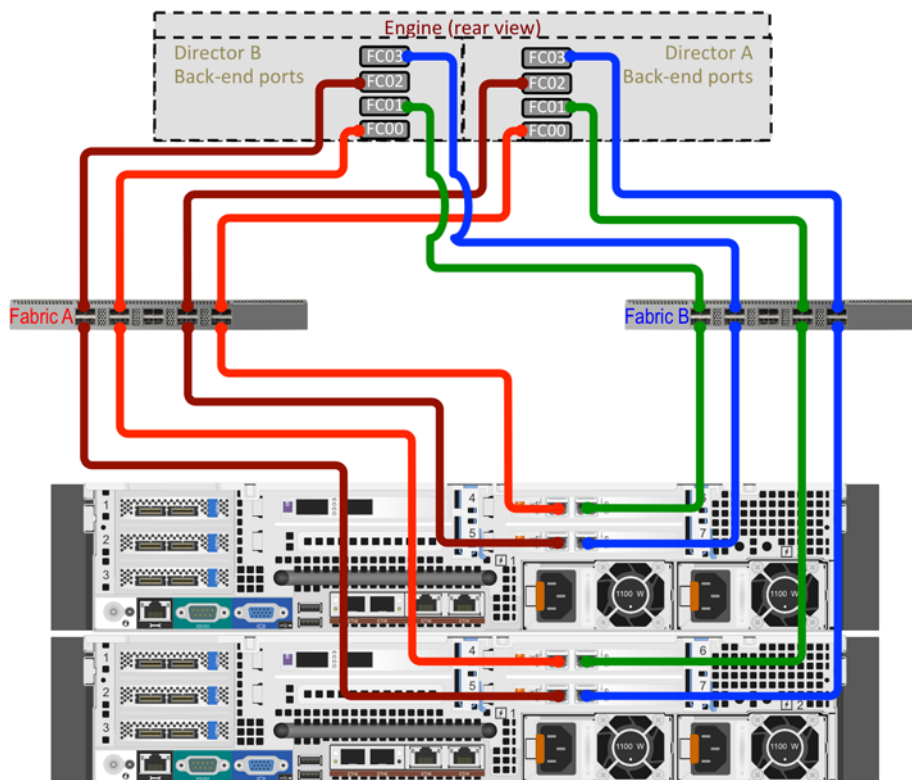


Figure 8: Recommended Zoning for a FA-450 in a Single-Engine VPLEX Cluster (FA-420 is Similar)

| Zone                                                | VPLEX Ports                   | FlashArray Ports                   |
|-----------------------------------------------------|-------------------------------|------------------------------------|
| Zone_VPLEX_Engine1_DirectorA1_FC00_PureStorageFA4xx | VPLEX_Engine1_DirectorA1_FC00 | FA4xx_CTR0_FC00<br>FA4xx_CTR1_FC00 |
| Zone_VPLEX_Engine1_DirectorA1_FC01_PureStorageFA4xx | VPLEX_Engine1_DirectorA1_FC01 | FA4xx_CTR0_FC01<br>FA4xx_CTR1_FC01 |
| Zone_VPLEX_Engine1_DirectorA1_FC02_PureStorageFA4xx | VPLEX_Engine1_DirectorA1_FC02 | FA4xx_CTR0_FC02<br>FA4xx_CTR1_FC02 |
| Zone_VPLEX_Engine1_DirectorA1_FC03_PureStorageFA4xx | VPLEX_Engine1_DirectorA1_FC03 | FA4xx_CTR0_FC03<br>FA4xx_CTR1_FC03 |
| Zone_VPLEX_Engine1_DirectorB1_FC00_PureStorageFA4xx | VPLEX_Engine1_DirectorB1_FC00 | FA4xx_CTR0_FC00<br>FA4xx_CTR1_FC00 |
| Zone_VPLEX_Engine1_DirectorB1_FC01_PureStorageFA4xx | VPLEX_Engine1_DirectorB1_FC01 | FA4xx_CTR0_FC01<br>FA4xx_CTR1_FC01 |
| Zone_VPLEX_Engine1_DirectorB1_FC02_PureStorageFA4xx | VPLEX_Engine1_DirectorB1_FC02 | FA4xx_CTR0_FC02<br>FA4xx_CTR1_FC02 |
| Zone_VPLEX_Engine1_DirectorB1_FC03_PureStorageFA4xx | VPLEX_Engine1_DirectorB1_FC03 | FA4xx_CTR0_FC03<br>FA4xx_CTR1_FC03 |

Table 5: Recommended Zoning for a FA-450 in a Single-Engine VPLEX Cluster

Figure 8 illustrates zoning with a single-engine VPLEX cluster. Each zone contains a single VPLEX back-end port and two FlashArray ports. For multi-engine VPLEX clusters, create similar zones for each engine's ports.

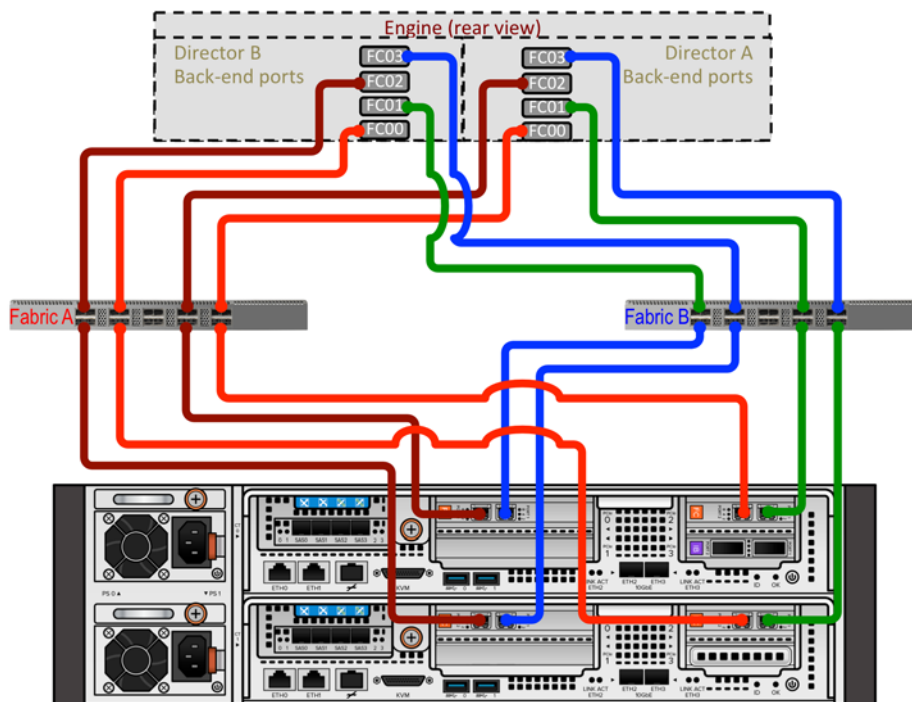


Figure 9: Recommended Zoning for a FlashArray//m50 in a Single-Engine VPLEX Cluster (FlashArray//m70 is similar)

| Zone                                                | VPLEX Ports                   | FlashArray Ports                   |
|-----------------------------------------------------|-------------------------------|------------------------------------|
| Zone_VPLEX_Engine1_DirectorA1_FC00_PureStorageFAM50 | VPLEX_Engine1_DirectorA1_FC00 | FAM50_CTR0_FC00<br>FAM50_CTR1_FC00 |
| Zone_VPLEX_Engine1_DirectorA1_FC01_PureStorageFAM50 | VPLEX_Engine1_DirectorA1_FC01 | FAM50_CTR0_FC01<br>FAM50_CTR1_FC01 |
| Zone_VPLEX_Engine1_DirectorA1_FC02_PureStorageFAM50 | VPLEX_Engine1_DirectorA1_FC02 | FAM50_CTR0_FC02<br>FAM50_CTR1_FC02 |
| Zone_VPLEX_Engine1_DirectorA1_FC03_PureStorageFAM50 | VPLEX_Engine1_DirectorA1_FC03 | FAM50_CTR0_FC03<br>FAM50_CTR1_FC03 |
| Zone_VPLEX_Engine1_DirectorB1_FC00_PureStorageFAM50 | VPLEX_Engine1_DirectorB1_FC00 | FAM50_CTR0_FC00<br>FAM50_CTR1_FC00 |
| Zone_VPLEX_Engine1_DirectorB1_FC01_PureStorageFAM50 | VPLEX_Engine1_DirectorB1_FC01 | FAM50_CTR0_FC01<br>FAM50_CTR1_FC01 |
| Zone_VPLEX_Engine1_DirectorB1_FC02_PureStorageFAM50 | VPLEX_Engine1_DirectorB1_FC02 | FAM50_CTR0_FC02<br>FAM50_CTR1_FC02 |
| Zone_VPLEX_Engine1_DirectorB1_FC03_PureStorageFAM50 | VPLEX_Engine1_DirectorB1_FC03 | FAM50_CTR0_FC03<br>FAM50_CTR1_FC03 |

Table 6: Recommended Zoning for a FlashArray//m50 in a Single-Engine VPLEX Cluster

Figure 9 illustrates zoning with a single-engine VPLEX cluster. Each zone contains a single VPLEX back-end port and two FlashArray ports. For multi-engine VPLEX clusters, create similar zones for each engine's ports.

## Step 3: Configure VPLEX Host Objects on Pure Storage FlashArrays

A FlashArray volume must be connected to two host objects to utilize all 8 of a VPLEX cluster engine's back-end ports (see Figure 3). Pure Storage recommends a FlashArray host object-to-VPLEX port association scheme similar to that shown in Table 7. The scheme limits the ITL (initiator, target, LUN) nexus count to 4 per director, while providing redundancy in case of a FlashArray HBA failure.

| Name of FlashArray Host Object<br>(installer-assigned) | VPLEX Ports whose Worldwide Names Should Be<br>Associated with Host Object (per Figures 8 and<br>9)                                                          |
|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>VPLEX_Host_1</b>                                    | <b>VPLEX_Engine1_DirectorA1_FC00</b><br><b>VPLEX_Engine1_DirectorB1_FC00</b><br><b>VPLEX_Engine1_DirectorA1_FC01</b><br><b>VPLEX_Engine1_DirectorB1_FC01</b> |
| <b>VPLEX_Host_2</b>                                    | <b>VPLEX_Engine1_DirectorA1_FC02</b><br><b>VPLEX_Engine1_DirectorB1_FC02</b><br><b>VPLEX_Engine1_DirectorA1_FC03</b><br><b>VPLEX_Engine1_DirectorB1_FC03</b> |

Table 7: Recommended VPLEX Back-End Port-FlashArray Host Object Associations

Use either the CLI or the GUI to create FlashArray host objects that represent a VPLEX cluster. For example, the CLI commands to create the host objects listed in Table 7 and connect them to volume **vol01** would be:

```
purehost create --wwnlist wwn<VPLEX_Engine1_DirectorA1_FC00>,  
wwn<VPLEX_Engine1_DirectorB1_FC00>,wwn<VPLEX_Engine1_DirectorA1_FC01>,  
wwn<VPLEX_Engine1_DirectorB1_FC01> VPLEX_Host_1  
  
purehost create --wwnlist wwn<VPLEX_Engine1_DirectorA1_FC02>,  
wwn<VPLEX_Engine1_DirectorB1_FC02>,wwn<VPLEX_Engine1_DirectorA1_FC03>,  
wwn<VPLEX_Engine1_DirectorB1_FC03> VPLEX_Host_2
```

Colors correspond to colors in Table 7.

The **wwn<VPLEX\_Engine1\_DirectorA1\_FC00>** and similar syntax indicate that the named port's WWN should be substituted.

## Step 4: Connect Pure Storage FlashArray Volumes to VPLEX Hosts

Pure Storage FlashArray volumes only respond to commands from the hosts to whose objects they are connected. Use either the CLI or the GUI to connect volumes to the FlashArray's VPLEX host objects. For example, the CLI commands to connect volumes to the host objects listed in Table 7 would be:

```
purehost connect - -vol volume1, volume2... VPLEX_Host_1
purehost connect - -vol volume10, volume11.... VPLEX_Host_2
```

Colors are keyed to Table 7.

Host-volume connections should be evenly distributed between the 2 VPLEX hosts for optimal performance.

### Limitation

With Purity v4.6 and prior releases, arrays support a maximum of 255 volumes connected to a single initiator, or VPLEX host. Configuring 2 VPLEX hosts doubles this number to 510 volumes. Newer Purity releases increase the maximum number of volumes per initiator to 500, making it possible to virtualize 1000 FlashArray volumes behind one VPLEX cluster.

## Step 5: Discover FlashArray Volumes in the VPLEX

Once FlashArray-VPLEX connections have been established, issue the following VPLEXCLI command to force back-end rediscovery of the FlashArray volumes:

```
cd /clusters/cluster-Cluster_ID/storage-elements/storage-arrays array re-discover
<array_name>
```

## Step 6: Create a Mapping File

Once zoning, masking and back-end rediscovery are complete, new volumes should be visible to the VPLEX cluster. To create a mapping file, log into VPLEXCLI on the VPLEX management server and issue the following command:

```
ll /clusters/cluster-1/storage-elements/storage-volumes
```

Output from the command should resemble the following:

| VPlexcli:/clusters/cluster-1/storage-elements/storage-volumes> ll |                                          |          |           |        |           |             |              |            |  |
|-------------------------------------------------------------------|------------------------------------------|----------|-----------|--------|-----------|-------------|--------------|------------|--|
| Name                                                              | VPD83 ID                                 | Capacity | Use       | Vendor | IO Status | Type        | Thin Rebuild | VIAS Based |  |
| VPD83T3:624a93707bbe9dc5bb91417c000118d2                          | VPD83T3:624a93707bbe9dc5bb91417c000118d2 | 90G      | unclaimed | PURE   | alive     | traditional | false        | false      |  |
| VPD83T3:624a93707bbe9dc5bb91417c000118d3                          | VPD83T3:624a93707bbe9dc5bb91417c000118d3 | 90G      | unclaimed | PURE   | alive     | traditional | false        | false      |  |
| VPD83T3:624a93707bbe9dc5bb91417c000118f8                          | VPD83T3:624a93707bbe9dc5bb91417c000118f8 | 3G       | unclaimed | PURE   | alive     | traditional | false        | false      |  |
| VPD83T3:624a93707bbe9dc5bb91417c0001194f                          | VPD83T3:624a93707bbe9dc5bb91417c0001194f | 5G       | unclaimed | PURE   | alive     | traditional | false        | false      |  |

1. Copy the output and paste it into a file (called **purestorage\_mapping** in this example) in the VPLEX management server's **/tmp** directory.
2. Type the following command to filter out irrelevant information and save what remains to a file (**<ArrayName>.txt** in this example):

```
cat /tmp/purestorage_mapping |awk '{print $2, "array_name_"NR " "}' >
/var/log/VPlex/cli/<ArrayName>.txt
```

3. Display the `<ArrayName>.txt` file as in the example below:

```
cat /VPlex/cli/<ArrayName>.txt
VPD83T3:624a93707bbe9dc5bb91417c000118d2 volume_1
VPD83T3:624a93707bbe9dc5bb91417c000118d3 volume_2
VPD83T3:624a93707bbe9dc5bb91417c000118f8 volume_3
VPD83T3:624a93707bbe9dc5bb91417c0001194f volume_4
```

Add a line containing the text **Generic storage-volumes** to the beginning of the `<ArrayName>.txt` file as in the example below:

```
cat /VPlex/cli/<ArrayName>.txt
Generic storage-volumes
VPD83T3:624a93707bbe9dc5bb91417c000118d2 volume_1
VPD83T3:624a93707bbe9dc5bb91417c000118d3 volume_2
VPD83T3:624a93707bbe9dc5bb91417c000118f8 volume_3
VPD83T3:624a93707bbe9dc5bb91417c0001194f volume_4
```

## Step 7: Import Volumes into the VPLEX Cluster

---

Each FlashArray volume to be used with a VPLEX cluster must be discovered (Step 5) and have a mapping file (Step 6) before it is imported. Supply the mapping file to either the VPLEX GUI or VPLEXCLI to import FlashArray volumes. For example, to import the volumes mapped in Step 6 issue the VPLEXCLI command:

```
cd /clusters/cluster-ID/storage-elements/storage-volumes
claimingwizard -f /tmp/<ArrayName>.txt -c cluster-ID
```

## Step 8: Create and Provision VPLEX Volumes

---

Once FlashArray volumes have been imported into the VPLEX cluster, they can be used as any other arrays' volumes in the creation of extends, devices, and virtual volumes. Refer to the VPLEX Administration Guide, downloadable via the VPLEX GUI, for instructions for creating local and distributed VPLEX volumes, provisioning volumes to hosts, etc.

## Importing a Pure Storage FlashArray into a VPLEX Cluster

---

A production FlashArray can be migrated into a VPLEX cluster in either of two ways:

### Offline Import with Encapsulation

1. On the SAN switches, zone the host to VPLEX front-end ports
2. On the SAN switches, zone the FlashArray to VPLEX back-end ports
3. On the FlashArray, create host objects to represent the VPLEX
4. On the FlashArray, connect the production volumes to the VPLEX host objects
5. On the FlashArray, disconnect production volumes from the original FlashArray host objects
6. On the VPLEX management server, perform an array-rediscover
7. On the VPLEX management server, create a FlashArray mapping file
8. On the VPLEX management server, claim production volumes and perform a 1:1 encapsulated volume
9. On the host(s), shutdown the application to be migrated
10. On the host(s), unmount all volumes to be migrated
11. On the host(s), export of the volume group configuration (required on some Unix platforms)
12. On the VPLEX management server, add volumes to StorageView
13. On the host(s), perform a rescan to discover the new volumes  
(Some operating systems may require additional discovery steps (e.g., `vgimport`, `importvg`...))
14. On the host(s), restart the application using the virtualized volumes.

### Online Import with Host Migration Tools

1. On the SAN switches, zone the FlashArray to VPLEX back-end ports
2. On the SAN switches, zone the host to VPLEX front-end ports
3. On the FlashArray, create host objects to represent the VPLEX
4. On the FlashArray, create new volumes of equal or greater size
5. On the FlashArray, connect the volumes to the VPLEX host objects
6. On the VPLEX management server, perform an array-rediscover
7. On the VPLEX management server, create a FlashArray mapping file
8. On the VPLEX management server, perform 1:1 encapsulation
9. On the VPLEX management server, create a new Storage View for the production host
10. On the VPLEX management server, add the production host's WWNs to the Storage View
11. On the VPLEX management server, add new volumes to the production host Storage View
12. On the host(s), perform a rescan to discover the new volumes
13. On the host(s), use Storage VMotion, LVM Mirror or other host-side mirroring tools to migrate data from the old production volumes to the new FlashArray volumes virtualized by VPLEX.

## Dual Array Names

---

A VPLEX cluster recognizes a storage array by its unique 16-hexadecimal digit node WWN (NWWN). Currently, VPLEX only utilizes 6 of the 16 digits to identify the array. For example: a VPLEX cluster identifies a Pure Storage FlashArray whose NWWN is **52:4A:93:74:BB:F5:08:00** as **PURE-FlashArray-9374BB**.

This causes a VPLEX cluster to recognize two FlashArrays whose NWWN digits 5-10 are the same as one, potentially confusing storage provisioning. When this occurs, however, proper VPLEX device discovery makes it possible for such configurations to work with no restrictions.

### To Discover Dual Array Name Identification

1. Observe the NWWNs of all FlashArrays to be connected to the VPLEX.
2. If NWWN digits 5-10 of two FlashArrays connected to the same side of a VPLEX Metro or Local cluster are the same, VPLEX will recognize the two as one array, identified, for example, as **PURE-FlashArray-9374BB**

### To Eliminate Dual Array-Names

1. Create volumes on one FlashArray (**PureStorage1** in the example below) and connect them to VPLEX host objects
2. Run VPLEX back-end rediscovery to discover the new volumes
3. Create a mapping file and add the new volumes to it; name each one based on its array name and volume ID as in the example below:

#### Generic storage-volumes

**VPD83T3:624a93707bbe9dc5bb91417c000118d2** **PureStorage1\_volume\_1**

**VPD83T3:624a93707bbe9dc5bb91417c000118d3** **PureStorage1\_volume\_2**

4. Create volumes on the other FlashArray (**PureStorage2** in the example) and connect them to VPLEX host objects
5. Run VPLEX back-end rediscovery to discover the new volumes
6. Add those volumes to the mapping file, naming each one based on its array name and volume ID as in the example below:

#### Generic storage-volumes

**VPD83T3:624a93707bbe9dc5bb91417c000118d2** **PureStorage1\_volume\_1**

**VPD83T3:624a93707bbe9dc5bb91417c000118d3** **PureStorage1\_volume\_2**

**VPD83T3:624a93707bbe9dc5bb91417c000118f8** **PureStorage2\_volume\_1**

**VPD83T3:624a93707bbe9dc5bb91417c0001194f** **PureStorage2\_volume\_2**

The VPLEX cluster recognizes the two arrays' volumes as distinct from each other.

## To Restore Volumes from Pure Storage FlashArray Snapshots

---

### VPLEX Local Restore

1. On the host(s), stop the application
2. On the host(s), unmount the file system
3. On the VPLEX management server, remove the volumes from StorageView  
Alternatively the following command can be used to invalidate cache:  
**virtual-volume cache-invalidate [-v |-volume] virtual-volume -force consistency-group cache-invalidate [-g |-consistency-group ] consistency-group -force**
4. On the FlashArray, identify the snapshot to be restored and use a command similar to the following to copy the snapshot to the production volume  
**purevol copy --overwrite <snapshot-suffix>.<volume-name> <volume-name>**
5. On the VPLEX management server, reinsert the volume into StorageView (not required if the **cache-invalidate** command is used)
6. On the host(s), mount the file system and restart the application

### VPLEX Metro Restore

1. On the host(s), stop the application
2. On the host(s), unmount the file system
3. On the VPLEX management server, remove the mirror from the distributed volume
4. On the VPLEX management server, remove the volume from StorageView, for example:  
**virtual-volume cache-invalidate [-v |-volume] virtual-volume -force consistency-group cache-invalidate [-g |-consistency-group ] consistency-group -force**
5. On the FlashArray, identify the snapshot to be restored and use a command similar to the following to copy the snapshot to the production volume  
**purevol copy --overwrite <snapshot-suffix>.<volume-name> <volume-name>**
6. On the VPLEX management server, reinsert the volume into StorageView (not required if the **cache-invalidate** command is used)
7. On the VPLEX management server, recreate the distributed volume (the volume will be fully re-synced)
8. On the host(s), mount the file system and restart the application

## Mobility Considerations

---

There are no Pure Storage FlashArray-specific limitations with VPLEX Mobility. General mobility considerations:

- Target extend should be equal or bigger than source
- A maximum of 25 concurrent mobility jobs is supported
- Distributed volume extend mobility must be performed at each site
- For local volume, device mobility should be performed.

## Controller and Capacity Upgrades

---

FlashArray upgrade operations are transparent to VPLEX clusters.

- Upgrading FlashArray controllers does not change controller WWNs
- During upgrade half of the VPLEX back-end paths go down; they recover after upgrading completes
- A VPLEX cluster only uses volumes connected to it, so FlashArray capacity upgrades are transparent.

## Appendix: FlashArray-VPLEX Implementation Checklist

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| Acknowledged/Done        | Description                                                                |
|--------------------------|----------------------------------------------------------------------------|
| <input type="checkbox"/> | Step 1: Identify VPLEX and FlashArray Worldwide Names (PWWNs) [page 12]    |
| <input type="checkbox"/> | Step 2: Create Zones Containing VPLEX and FlashArray Ports [page 13]       |
| <input type="checkbox"/> | Step 3: Configure VPLEX Host Objects on Pure Storage FlashArrays [page 17] |
| <input type="checkbox"/> | Step 4: Connect Pure Storage FlashArray Volumes to VPLEX Hosts [page 18]   |
| <input type="checkbox"/> | Step 5: Discover FlashArray Volumes in the VPLEX [page 18]                 |
| <input type="checkbox"/> | Step 6: Create a Mapping File [page 18]                                    |
| <input type="checkbox"/> | Step 7: Import Volumes into the VPLEX [page 19]                            |
| <input type="checkbox"/> | Step 8: Create and Provision VPLEX Volumes [page 19]                       |



## About the Author

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Prior to joining Pure Storage in 2014, he was a Global Solution Architect and Virtualization Specialist, designing and implementing complex virtualization solutions based on EMC VPLEX clusters.

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