

VMAX3 Configuration Management



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Welcome to VMAX3 Configuration Management.

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Revision Number: MR-1XP-VMAXCM.5977.1

Course Overview

Description	This Specialist level course provides participants with an in-depth understanding of configuration tasks on the VMAX3 Family of arrays. Key features and functions of the VMAX3 arrays are covered in detail. Topics include storage provisioning concepts, virtual provisioning, automated tiering (FAST), device creation and port management, service level objective based storage allocation to hosts, and eNAS. Participants will use Unisphere for VMAX and Solutions Enabler (SYMCLI) to manage configuration changes on the VMAX3 arrays.
Audience	IT professionals responsible for managing VMAX3 arrays in Open Systems environments.
Objectives	Upon completion of this course, you should be able to: • Provide an overview of VMAX3 configuration and storage provisioning • Describe virtual provisioning concepts and automated tiering in VMAX3 arrays • Create VMAX3 thin devices and manage ports and port characteristics • Perform service level objective based provisioning to hosts • Set/change Host I/O limits, SLO and Workload Type • Monitor Storage Resource Pools and SLO Compliance • Use Unisphere for VMAX for Workload Planning • Provide an overview of the eNAS solution for VMAX3 Arrays and manage eNAS • Provide an overview of VMAX3 storage management in a virtualized environment

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Course Overview and Agenda



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This course provides participants with an in-depth understanding of configuration tasks on the VMAX3 Family of arrays. Key features and functions of the VMAX3 arrays are covered in detail. Topics include storage provisioning concepts, virtual provisioning, automated tiering (FAST), device creation and port management, service level objective based storage allocation to hosts, and eNAS. Participants will use Unisphere for VMAX and Solutions Enabler (SYMCLI) to manage configuration changes on the VMAX3 arrays.

Agenda – Days 1 & 2

Module/Lessons	Labs
Day 1 • VMAX3 Configuration Management Overview • VMAX3 Overview • VMAX3 Storage Provisioning Overview • VMAX3 - Virtual Provisioning and FAST Concepts • Virtual Provisioning and FAST Overview • FAST Algorithms and Parameters • Device Creation and Port Management • Device Creation • Port Management	• Explore VMAX3 Environment with Unisphere for VMAX and SYMCLI • Port Management with Unisphere and SYMCLI
Day 2 • Storage Allocation using Autoprovisioning Groups • Autoprovisioning Groups Overview • Host Considerations – Storage Allocation • Service Level Objective based provisioning with Unisphere • Service Level Objective based provisioning with SYMCLI	• Service Level Objective based provisioning with Unisphere for VMAX • Service Level Objective based provisioning with SYMCLI • Cascaded Storage Groups – Moving devices non-disruptively and changing SLO • Managing Host I/O Limits

Here is the agenda for the first two days.

Agenda – Day 3

Module/Lessons	Labs
Day 3 • Monitoring and Workload Planning with Unisphere for VMAX • Monitor SRP • Monitor SLO Compliance • Workload Planning with Unisphere • eNAS Overview • eNAS Management • Unisphere for VMAX File Dashboard • Managing File Systems/Shares • Management in a Virtualized Environment • Virtual Server Management – Unisphere for VMAX • EMC VSI for VMware vSphere Web Client	• Monitoring SRP and SLO Compliance with Unisphere for VMAX • Workload Planning with Unisphere for VMAX • Allocate storage to eNAS with Unisphere for VMAX File Dashboard • Create FS/Share on VMAX3 Storage with Unisphere for VNX

Here is the agenda for day three.

Module: VMAX3 Configuration Management Overview

Upon completion of this module, you should be able to:

- Describe the VMAX3 with HYPERMAX OS 5977 Family of arrays
- Provide overview of key features
- Articulate VMAX3 Storage Provisioning concepts
- Identify the available tools for managing VMAX3 arrays

This module provides an overview of the VMAX³ Family of arrays with HYPERMAX OS 5977. Key features and storage provisioning concepts are covered. The CLI command structure for configuration, and how to perform configuration changes with Unisphere for VMAX are also described.

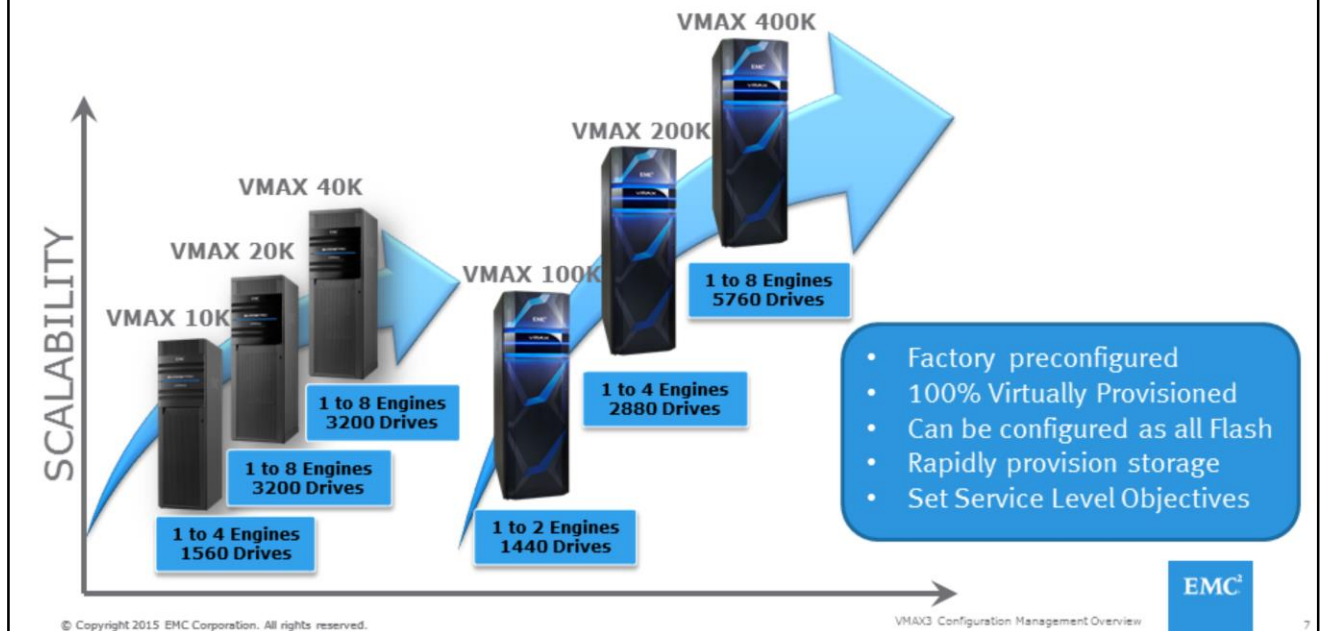
Lesson: VMAX3 Overview

This lesson covers the following topics:

- VMAX3 Model Comparison
- Key Features
- Management Tools

This lesson provides an overview of the VMAX3 Family of arrays with HYPERMAX OS 5977. We compare the three models and list the key features. Software tools use to manage VAMX3 arrays are also introduced.

VMAX3 Family with HYPERMAX OS 5977



The VMAX3 Family with HYPERMAX OS 5977 release delivers a number of revolutionary changes. The HYPERMAX Operating System provides the first Enterprise Data Platform with a data services hypervisor running natively. The density optimized hardware and Dynamic Virtual Matrix deliver dramatic improvements in throughput, performance, scale, and physical density per floor tile.

The VMAX3 Family with HYPERMAX OS 5977 encompasses three new array models: VMAX 100K, VMAX 200K and VMAX 400K. The VMAX 100K for Enterprise and commercial data centers, the VMAX 200K for most Enterprise data centers, and the VMAX 400K for large-environment Enterprise data centers. For high-demand storage environments, where extremely low latency and high IOPS are required, all the VMAX3 Family arrays can be configured with all flash. VMAX3 arrays are pre-configured with array-based software and hardware configurations based on pre-packaged Service Level Objectives (SLOs).

In previous versions of the VMAX Family, the operating system was called Enginuity. Starting with VMAX3, the array operating system is called HYPERMAX OS.

Just like the VMAX 10K arrays, the VMAX3 family arrays will be 100% virtually provisioned and pre-configured in the factory. The arrays are built for management simplicity, extreme performance and massive scalability in a small footprint. With the VMAX3 Family of arrays, storage can be rapidly provisioned with a desired Service Level Objective (SLO).

EMC Solutions Enabler (SE) version 8.0 and Unisphere for VMAX version 8.0 provide array management and control.

VMAX3 Arrays - Common Features

VMAX 100K, 200K, 400K	
Feature	Description
Maximum Drives per Engine	• (720) 2.5" • (360) 3.5"
Drive Options	• Hybrid (mixed drive types) • All-Flash
DAE Mixing	• 60-drive and 120-drive behind an engine • Single increments
Power Options	• Three-Phase Delta (50 amp), WYE (32 amp) • Single-Phase (32 amp)
Dispersion	• System Bays 2-8, up to 25 meters from System Bay 1
Vault	• Vault to Flash in engine
Racking Options	• Single engine • Dual engine • Third-party racking
Service Access	• Integrated service processor in System Bay 1 • Management Module Control Station (MMCS) • Service tray on additional system bays

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VMAX3 Configuration Management Overview

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Common features throughout the VMAX³ Family include maximum drives per engine; both hybrid and all-Flash, DAE mixing behind engines in single increments, power configuration options, system bay dispersion, multiple racking options and service access points. Also, Vault to Flash in engine is implemented on the with VMAX³ Family, which is a change from the previous vaulting process. Service access is provided by a Management Module Control Station (MMCS), which is the integrated service processor located in System Bay 1.

VMAX3 Arrays - Model Comparison

	VMAX 100K	VMAX 200K	VMAX 400K
# of Engines	1-2	1-4	1-8
Cache/Engine	512GB or 1TB	512GB, 1TB, or 2TB	512GB, 1TB, or 2TB
Engine Type	2.1 GHz 24-core	2.6 GHz 32-core	2.7 GHz 48-Core
Max 2.5" Drives	1440	2880	5760
Max 3.5" Drives	720	1440	2880
Max Usable Capacity	0.5 PBu	2.1 PBu	4.0 PBu
Max FE Ports	64	128	256
Infiniband Fabric	Dual 12-Port switches	Dual 12-Port switches	Dual 18-Port switches



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VMAX3 Configuration Management Overview

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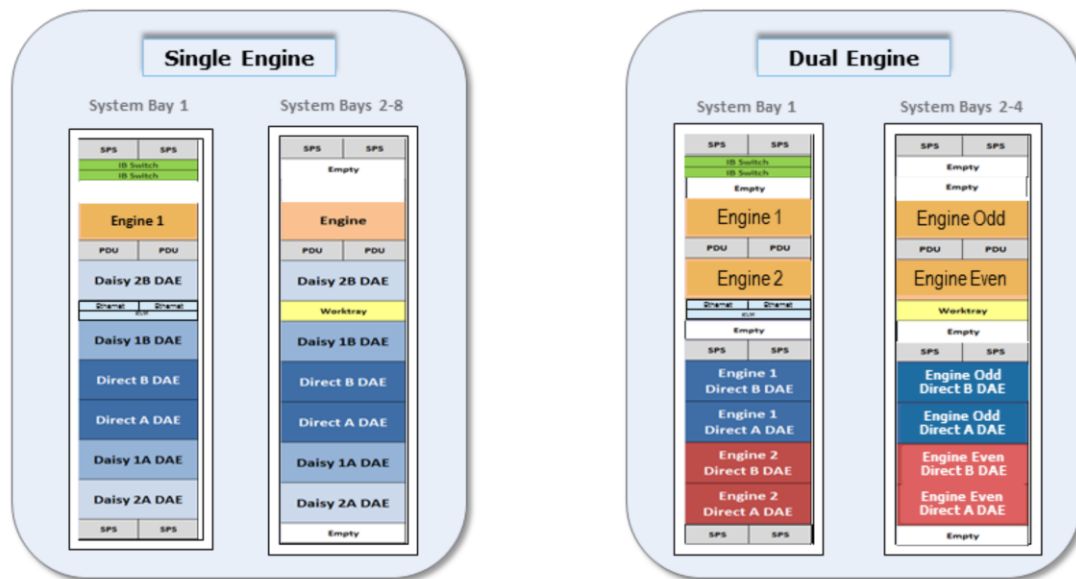
This table shows a comparison of all three VMAX³ Family arrays.

The VMAX 100K is configured with one to two engines. With the maximum two-engine configuration, the VMAX 100K supports up to (1440) 2.5" drives, or up to (720) 3.5" drives, providing up to 0.5 Petabytes of usable capacity. When fully configured, the 100K provides up to 64 front-end ports for host connectivity. The internal fabric interconnect uses dual Infiniband 12-port switches for redundancy and availability.

The VMAX 200K is configured with one-to-four engines. With the maximum four-engine configuration, the VMAX 200K supports up to (2880) 2.5" drives, or up to (1440) 3.5" drives, providing up to 2.1 Petabytes of usable capacity. When fully configured, the 200K provides up to 128 front-end ports for host connectivity. The internal fabric interconnect uses dual Infiniband 12-port switches for redundancy and availability.

The VMAX 400K is configured with one to eight engines. With the maximum eight-engine configuration, the VMAX 400K supports up to (5760) 2.5" drives, or up to (2880) 3.5" drives, providing up to 4 Petabytes of usable capacity. When fully configured, the 400K provides up to 256 front-end ports for host connectivity. The internal fabric interconnect uses dual Infiniband 18-port switches for redundancy and availability.

Single Engine/Dual Engine Bay Configurations



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VMAX3 Configuration Management Overview

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VMAX3 Family arrays can be either in Single Engine Bay configuration or Dual Engine Bay configuration.

In a single engine bay configuration, as the name suggests, there is one engine per bay supported by the power subsystem, and up to six (6) DAEs. Two of the DAEs are direct-attach to the engine, and each of them can have up to two additional daisy-chained DAEs.

The dual engine bay configuration contains up to two engines per bay, a supporting power subsystem, and up to four (4) DAEs. All four DAEs in the bay are direct-attach, two to each engine; there is no daisy-chaining in the dual engine bay.

In both single and dual engine systems, there are unique components only present in System Bay 1 which include the KVM (Keyboard, Video, Mouse), a pair of Ethernet switches for internal communications, and dual Infiniband switches (a.k.a., Fabric or MIBE) used for the fabric interconnect between engines. The dual Infiniband switches are present in multi-engine systems only. In system bays 2 through 8 a work tray is located in place of the KVM and Ethernet switches, and provides remote access to scripts, diagrams, and other service processor functionality

Single Engine/Dual Engine Bay Configurations



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VMAX3 Configuration Management Overview

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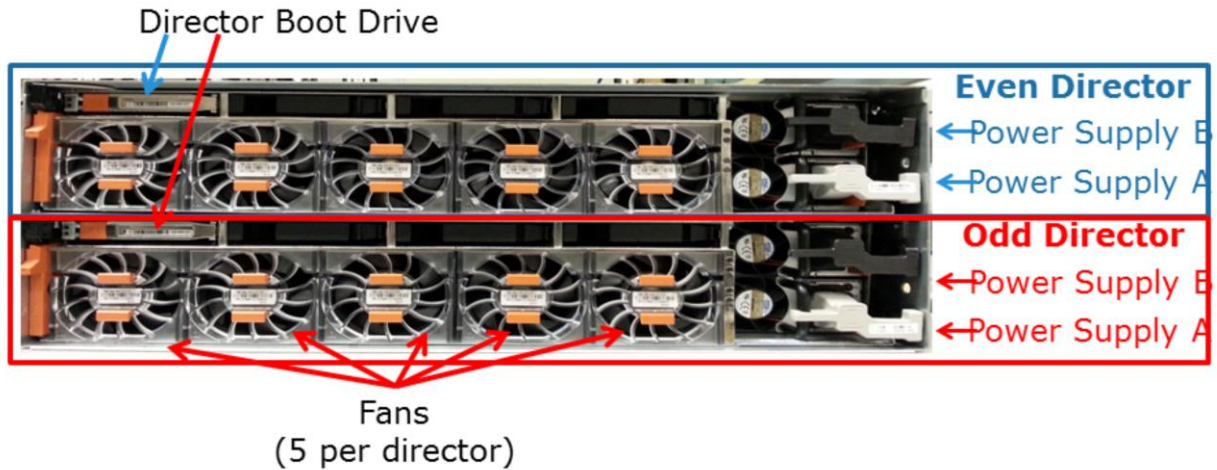
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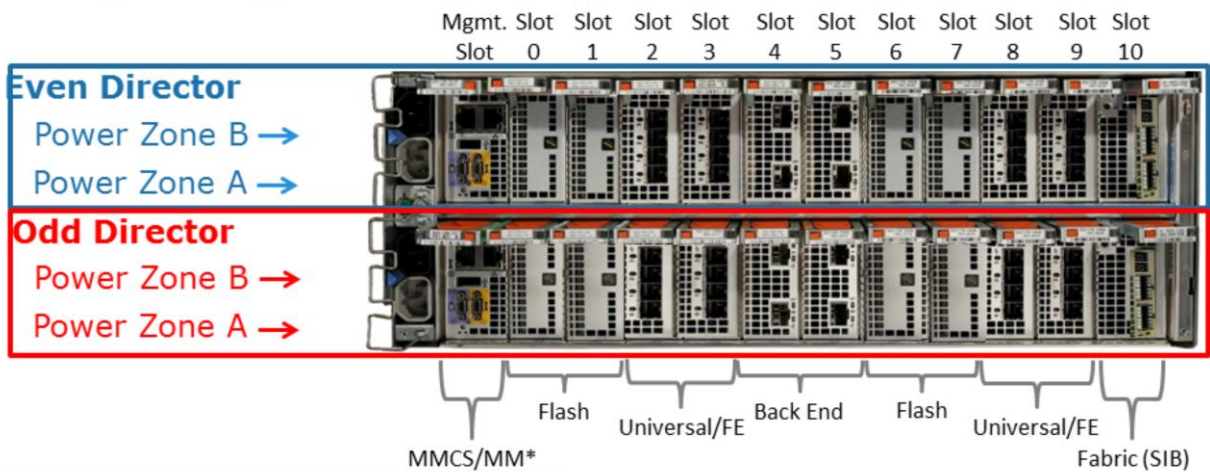
Engine Front



There are two directors per engine: an Even Director (for example, Director 2, 4, 6 or 8) and an Odd Director (such as Director 1, 3, 5 or 7). A boot drive* is included in each director, along with five cooling fans and redundant power supplies. Power Supply A is on the bottom of each director and uses a gray connector. Power Supply B is on the top, using a black connector.

*The boot drive is used to boot HYPERMAX OS 5977 onto the director. It holds emulation binaries and contains firmware binaries for the devices in the system. It also contains the director's error logs and some IMPL related configuration data. This is what the EEPROM was in legacy systems. In legacy systems, the boot device was installed on the director board and not removable, unless the director was removed from the chassis. In this system, the 16GB boot drive is accessible and can be replaced while the director is online.

Bay Components - Engine Rear



*MM displayed in this image (Engine 2-8)

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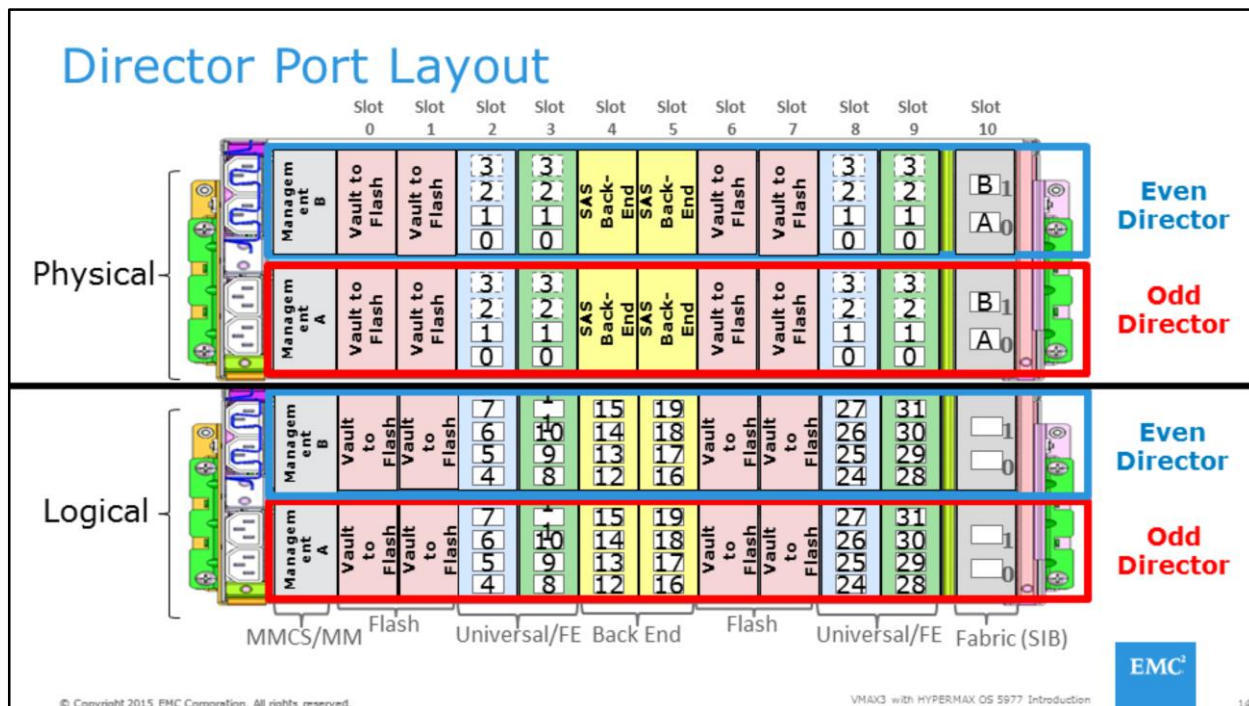
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VMAX3 with HYPERMAX OS 5977 Introduction

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The rear of the engine contains the Management Module Control Stations (Engine 1 only) or the Management Modules (all other Engines), Flash modules, Back-end modules, Front-end I/O modules, and Fabric-connect modules (SIBs). Slots are numbered 0 through 10 across the top, and module types are slot-specific, as shown here.

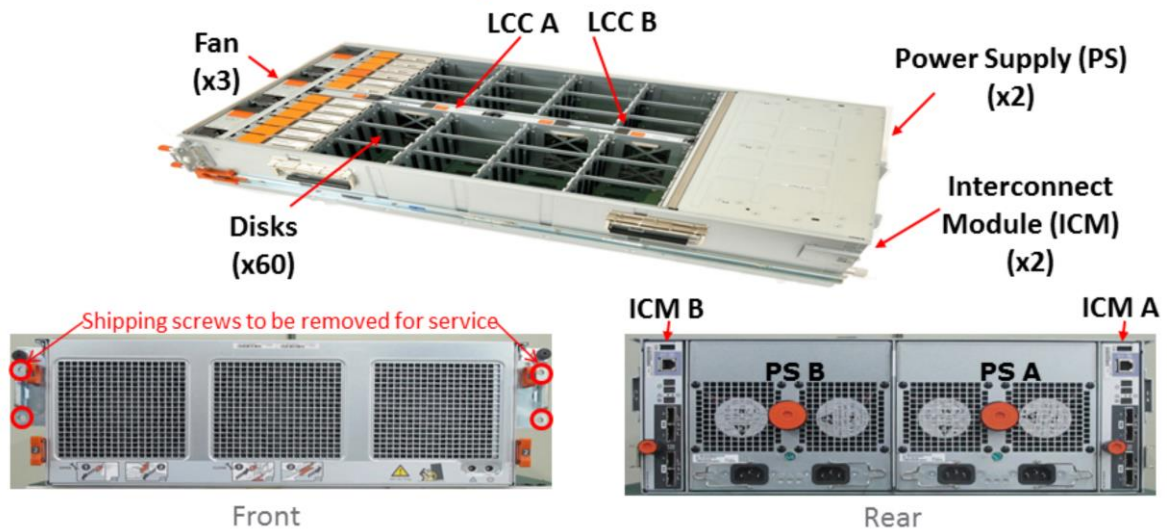
In the event of a vault, the VMAX 100K, 200K and 400K systems use the flash SLICs, not disk.



Physical port numbering has not changed. When connecting to an I/O module, ports are numbered 0 through 3 from top to bottom on the module. I/O modules with two ports (not shown) are labeled Port 0 and 1 from bottom to top. Fabric ports are numbered 0 to 1 from bottom to top as well. Fabric Port 0 connects to Fabric A. Fabric Port 1 connects to Fabric B.

VMAX3 is designed to support 32 ports per director, ports 0 through 31. These logical ports are numbered left to right, bottom to top, across the eight slots available for front-end and back-end connectivity. Ports 0, 1, 2, 3, 20, 21, 22, and 23 are reserved and not currently used. Slots 4 through 11 and 24 through 31 can be used for front-end connectivity. Ports 12 through 19 are used for back-end connectivity. On the SIB, ports 0 and 1 are used for connectivity to the fabric in each director. Port numbers do not become available unless an I/O module is inserted in the slot.

60-Drive DAE Components



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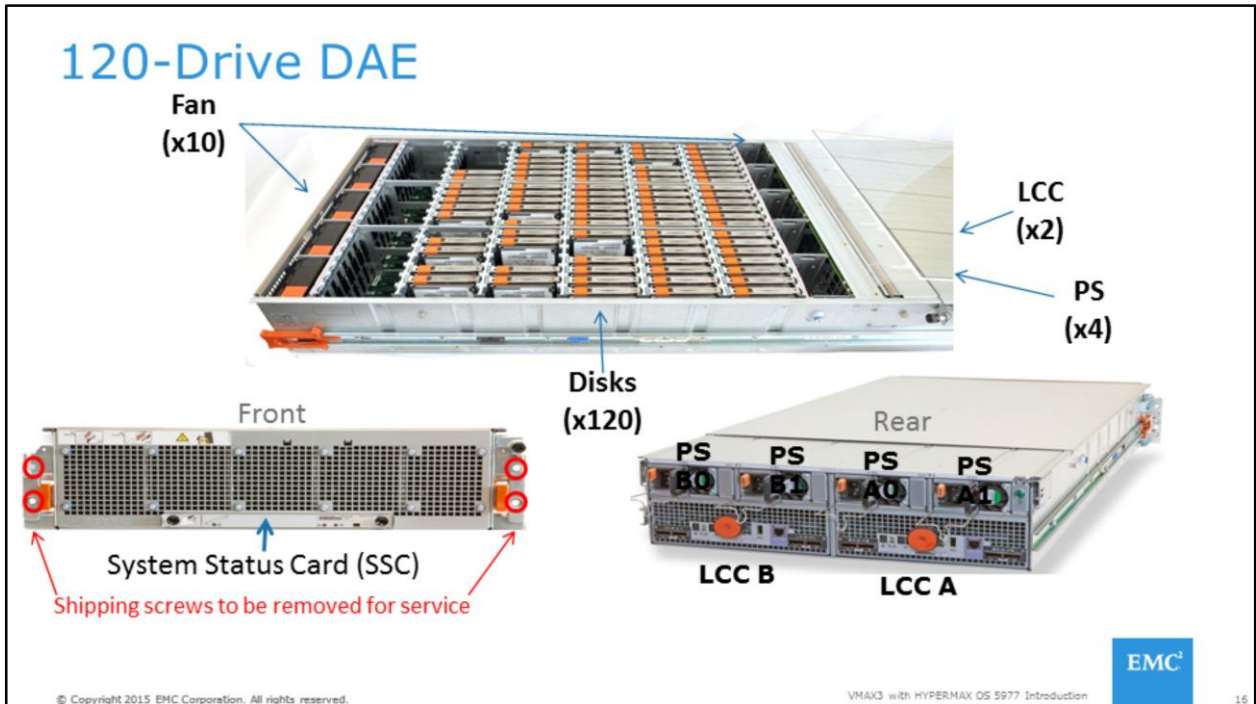
VMAX3 with HYPERMAX OS 5977 Introduction

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60-Drive DAE components include:

- Fans = N+1 (three total) with adaptive cooling (if one fails, others will speed up to ensure proper cooling)
- LCC = Link Control Card - connectivity to disks
- Disks = 60 Disks - 3.5", multiple sizes and speeds
- PS = Power Supply - PSA and PSB for redundant power (each with dual power connections from PDU)
- ICM = Inter Connect Module (back-end modules connect to LCCs through the cable connections to the ICM)
- As marked in red above, all DAEs will be screwed into the rack per shipping requirements. These 4 screws will need to be removed in order to service the given DAE and/of its internal components.



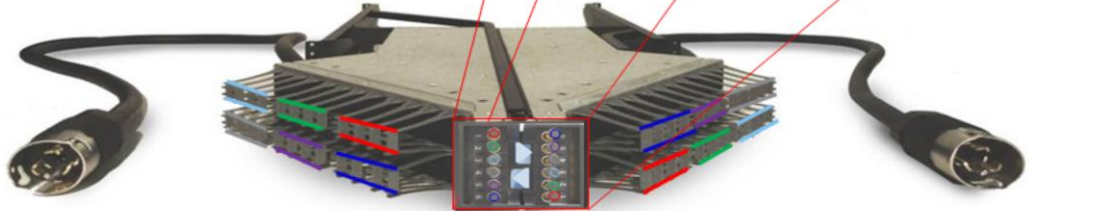
120-Drive DAE components include:

- SSC = System Status Card - Responsible for environmental monitoring of the DAE components
- Fans = N+2 (10 total) with adaptive cooling (if one fails, others will speed up to ensure proper cooling)
- LCC = Link Control Card - connectivity to disks
- Disks = 120 Disks - 2.5", multiple sizes and speeds
- PS = Power Supply - PSA0/PSA1 and PSB0/PSB1 for redundant power
- As marked in red above, all DAEs will be screwed into the rack per shipping requirements. These 4 screws will need to be removed in order to service the given DAE and/of its internal components.

2U Power Distribution Unit (PDU)

2U PDU Features

- Combines PDP and PDU functionality
- 24 outlets per PDU
- Breaker protected in groups of four
- Available in 3 power options
- Weighs 15lbs (7kg)



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System Installation

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VMAX³ Family systems introduce the new 2U PDU. This PDU combines PDP and PDU functionality. There are 24 outlets per PDU broken up into six groups of four. Each group is connected to a breaker. Breakers are accessed through the rear door. The “power tees” are used to turn on (push in) or turn off (pull out) the power for that particular bank of ports on the given PDU. The two blue triangles in the center are used to lock/unlock the PDU from the rack. These are used in the event of rack-mounting and/or replacing a PDU. This PDU is available in 3 power options: Three-Phase Delta, Three-Phase Wye and Single-Phase power. Each outlet on a given breaker is responsible for a specific component. For example; PDU Zone B, outlet 10 (breaker 3) is responsible for supplying power to the KVM. Wiring diagrams are available through Simplified SymmWin verification scripts.

Note: Color-coding is for knowledge transfer only and does not reflect any documented troubleshooting method.

Accessing the System



KVM

- Same as previous VMAX arrays
- Located in System Bay 1
- No CE laptop required

Point-Of-Service Work Tray

- Located in System Bays 2-8
- Internal connection to system
- Local access to System Bay requiring FRU



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Obtaining Credentials

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When accessing a VMAX3 system it is important to determine where you're work would best be completed from. For example, if you have a service call to replace a drive in a dispersed system located in a DAE in system bay 4, it may be easier and more efficient to complete this task from the point of service work tray located in the same bay as the given FRU. The next few slides will discuss how we make this connection.

Management Modules and Switches

1

Management Module Control Station (MMCS)

2

Management Module (MM)

3

GS900/16 Ethernet Switch



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System Installation

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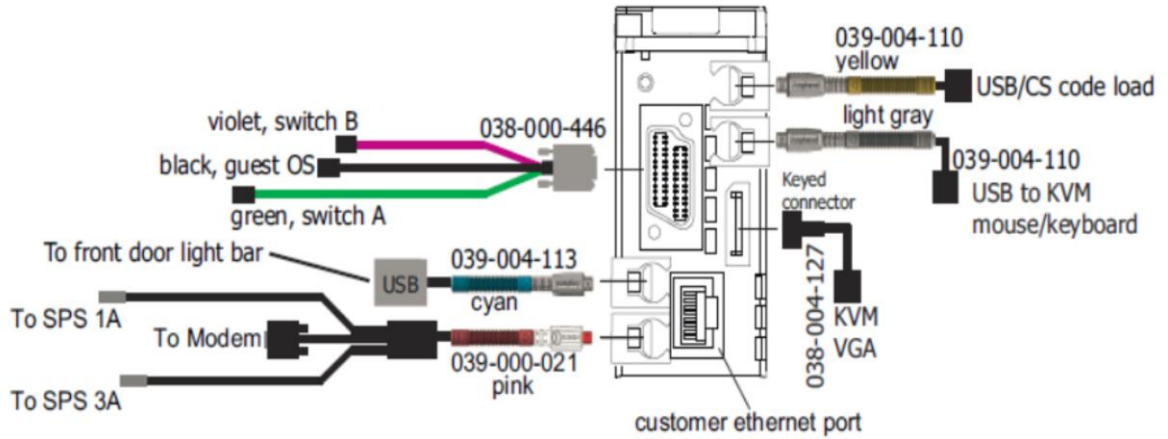
The VMAX³ systems include:

Two Management Module Control Stations (MMCSs), which are preinstalled in Engine 1. The MMCS combines the management modules and control station hardware into a single module and is used as the Service Processor.

Two Management Modules (MM) per engine (2 through 8), which provide management ports that connect to the Ethernet switch in System Bay 1.

Two GS900/16 Ethernet switches, which connect to every engine and the matrix (through the a management port), and resides in System Bay 1 only.

MMCS Cable Diagram



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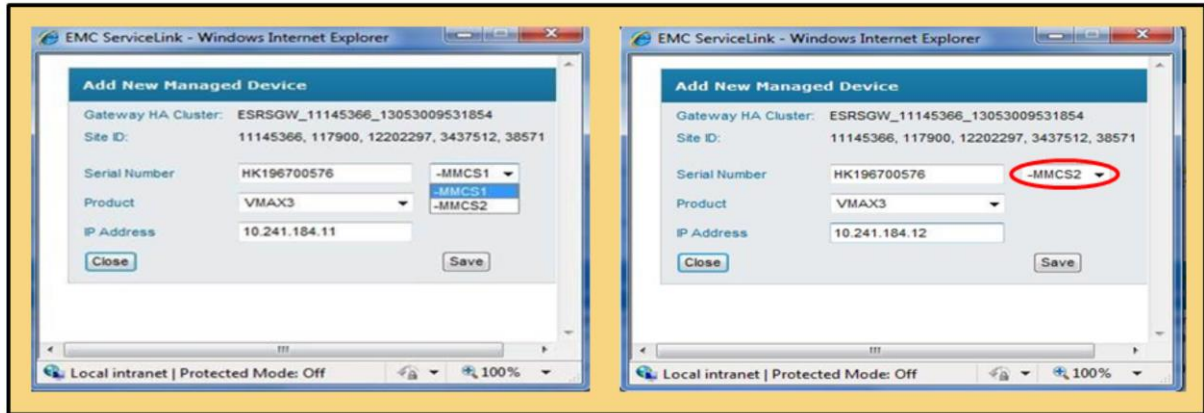
Field Replaceable Units (FRUs)

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Shown here is the MMCS cable diagram.

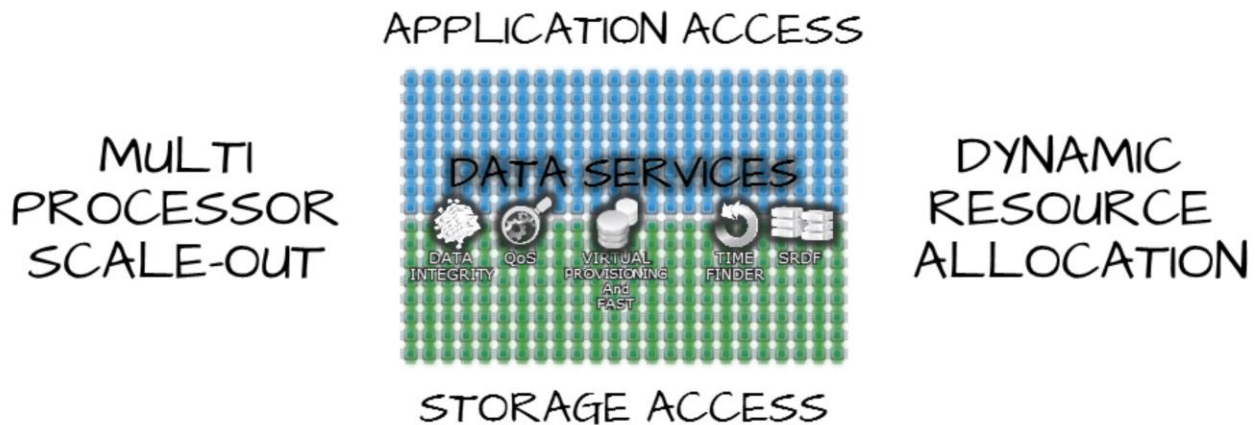
Configure Remote Support

Devices must be deployed as MMSC-1 and MMSC-2



- When deploying the devices, they must be deployed as MMCS-1 and MMCS-2 respectively, as shown here.

VMAX3 – Dynamic Virtual Matrix



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VMAX3 features the world's first and only Dynamic Virtual Matrix – It enables hundreds of CPU cores to be pooled and allocated on-demand to meet the performance requirements for dynamic mixed workloads and is architected for agility and efficiency at scale.

Resources are dynamically apportioned to host applications, data services, and storage pools to meet application service levels. This enables the system to automatically respond to changing workloads and optimize itself to deliver the best performance available from the current hardware.

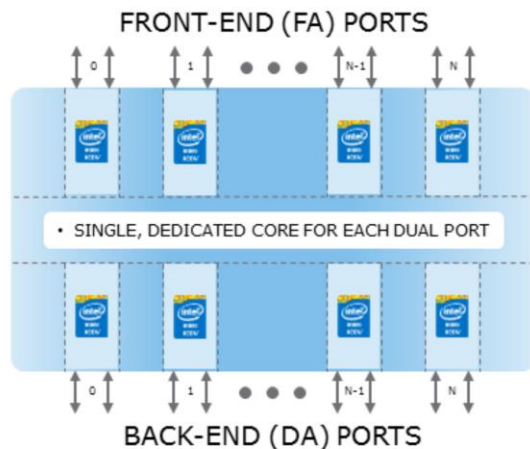
The Dynamic Virtual Matrix provides:

Fully redundant architecture along with fully shared resources within a dual controller node and across multiple controllers.

A Dynamic load distribution architecture. The Dynamic Virtual Matrix is essentially the bios of the VMAX operating software, and provides a truly scalable multi-controller architecture that scales and manages from two fully redundant storage controllers up to sixteen fully redundant storage controllers all sharing common I/O, processing and cache resources.

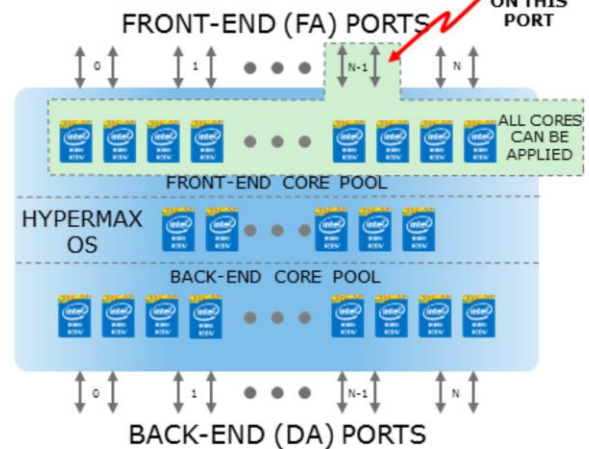
VMAX3 – Multi-Core Technology

VMAX



VMAX³

DEFAULT (BALANCED) SETTING



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VMAX3 Configuration Management Overview

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The VMAX3 System can focus hardware resources (namely cores) as needed by storage data services. The VMAX architecture (VMAX 10K, 20K and 40K) supports a single, hard-wired dedicated core for each dual port for FE or BE access - regardless of data service performance changes.

The VMAX3 architecture provides a CPU pooling concept – and to go further, it provides a set of threads on a pool of cores, and the pools provide a service for FE access, BE access or a data service such as replication. The default configuration as shown - the services are balanced across FE ports, BE ports and data services.

A unique feature of VMAX3 though now allows the system to provide the best performance possible even when the workload is not well distributed across the various ports/drives and central data services – as the example shows when there may be 100% load on a port pair. In this specific use case for the heavily utilized FE port pair, all the FE cores can be used for a period of time to the active dual port.

There are 3 core allocation policies - balanced, front-end, back-end. The default is balanced as shown on the slide. EMC Services can shift the 'bias' of the pools between balanced, front-end (e.g. lots of small host I/Os and high cache hits), and back-end (e.g. write-heavy workloads) – and that this will become dynamic and automated over time. Currently this change cannot be managed via software.

VMAX3 Arrays – Key Features

100% Virtually Provisioned

Arrays are shipped pre-configured

- Data Devices, Data Pools, Storage Resource Pool and Service Level Objectives

FAST

- Enables Service Level Objective based provisioning
- All host related data managed by FAST

Replication

- TimeFinder SnapVX
- SRDF
- ProtectPoint – Integration with EMC Data Domain

eNAS

- Embedded NAS Data Services on Virtual Data Movers and Control Stations



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VMAX3 Configuration Management Overview

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This slide provides a brief overview of some of the features of the VMAX3 arrays. HYPERMAX OS 5977 is installed at the factory and the array is pre-configuration. The VMAX3 arrays are all virtually provisioned. The pre-configuration creates all of the required Data Pools and RAID protection levels. With HYPERMAX OS 5977, Fully Automated Storage Tiering (FAST) eliminates all of the administrative overhead previously required to create a FAST environment.

The new TimeFinder SnapVX, point in time replication technology will not require a target volume. The ProtectPoint solution will integrate VMAX3 arrays with Data Domain to provide backup and restore capability leveraging TimeFinder SnapVX and Federated Tiered Storage. A number of enhancements to SRDF have also been made.

VMAX3 also offers an embedded NAS (eNAS) solution. eNAS leverages the HYPERMAX OS storage hypervisor. The storage hypervisor manages and protects embedded services by extending VMAX high availability to these services that traditionally would have run outside the array. It also provides direct access to hardware resources to maximize performance. Virtual instances of Data Movers and Control Stations provide the NAS services.

EMC Solutions Enabler (SE) 8.0.x and Unisphere for VMAX 8.0.x will provide array management and control of the new arrays.

VMAX3 Configuration Tools

- Initial configuration
 - Configuration is done at the factory
 - SymmWin and Simplified SymmWin
 - Runs on Management Module Control Station (MMCS)
 - Access restricted to authorized EMC personnel only
- End user tools for configuration and management
 - Solutions Enabler 8.0.x
 - Unisphere for VMAX 8.0.x

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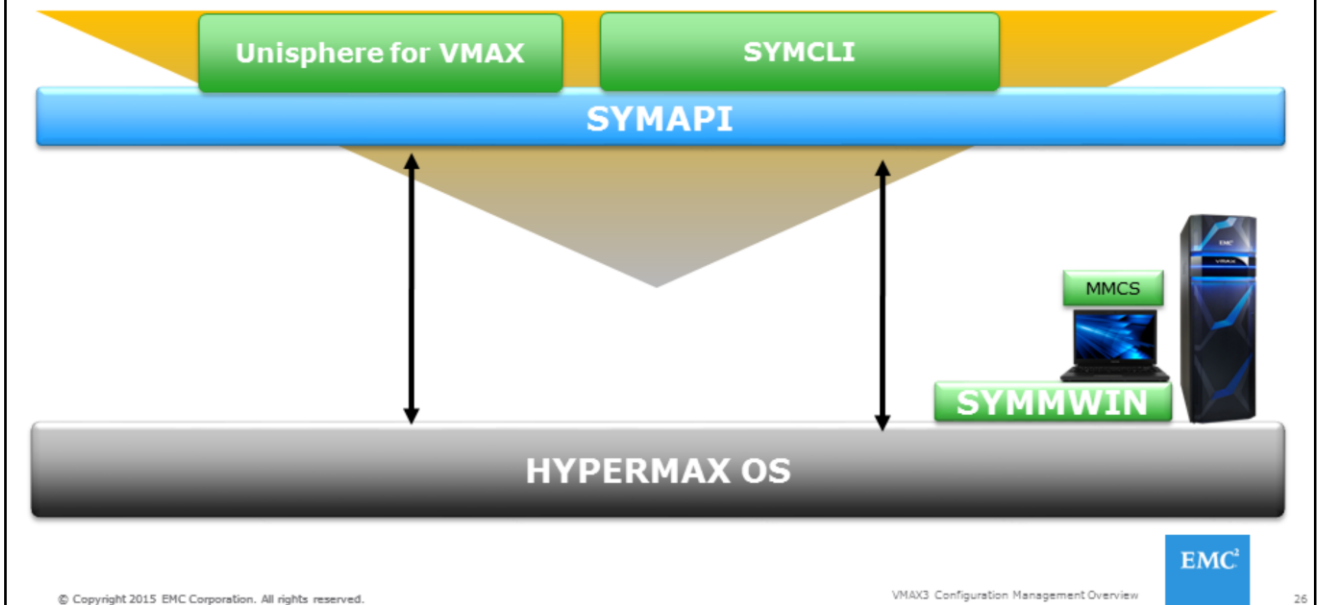
VMAX3 Configuration Management Overview

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The initial configuration of the VMAX3 array is done at the EMC factory with SymmWin and Simplified SymmWin. These software application run on the Management Module Control Station (MMCS) of the VMAX3 arrays. Once the arrays has been installed one can use Solutions Enabler CLI (SYMCLI) or Unisphere for VMAX to manage the VMAX3 arrays.

Solutions Enabler Integration with HYPERMAX OS



This illustrates the software layers and where each component resides.

EMC's Solution Enabler APIs are the storage management programming interfaces that provide an access mechanism for managing the VMAX3 arrays. They can be used to develop storage management applications. SYMCLI resides on a host system to monitor and perform control operations on VMAX3 arrays. SYMCLI commands are invoked from the host operating system command line (shell). The SYMCLI commands are built on top of SYMAPI library functions, which use system calls that generate low-level I/O SCSI commands to the storage arrays.

Unisphere for VMAX is the graphical user interface that makes API calls to SYMAPI to access the VMAX3 array.

Symmwin running on the VMAX3 MMCS accesses HYPERMAX OS directly.

EMC Solutions Enabler – Introduction

- Symmetrix Command Line Interface (SYMCLI)
- Comprehensive command set for managing VMAX3 arrays
 - Invoked from the host OS command line
 - Scripts that may provide further integration with OS and application
- Security and access controls
 - Monitor only
 - Host-based and user-based controls

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VMAX3 Configuration Management Overview

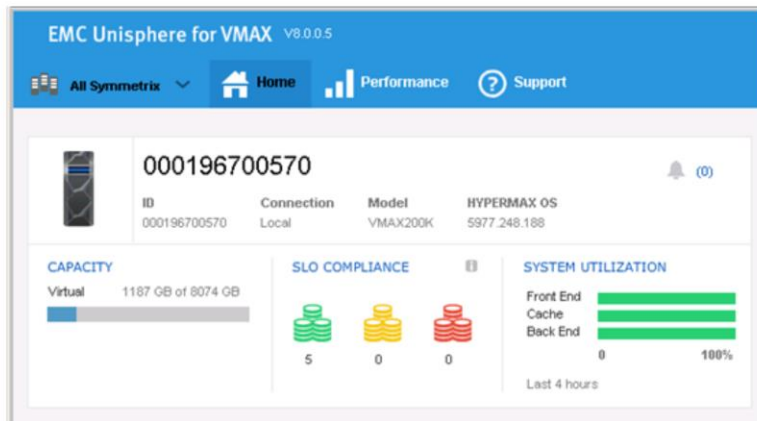


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Solutions Enabler command line interface (SYMCLI) is used to perform control operations on VMAX arrays, and the array devices, tiers, groups, directors, and ports. Some of the VMAX3 array controls include setting array-wide metrics, creating devices, and masking devices.

You can invoke SYMCLI from the local host to make configuration changes to a locally-connected VMAX3 array or to an RDF-linked VMAX3 array.

Unisphere for VMAX - Introduction

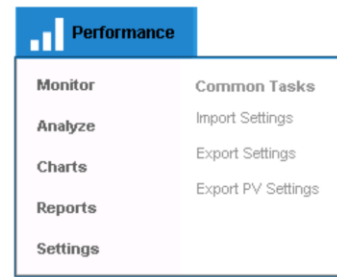
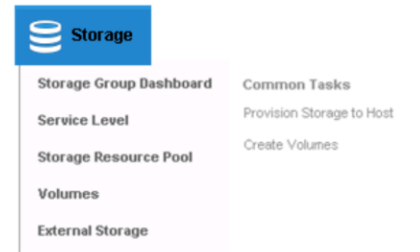


- VMAX³ Arrays
 - Service Level Based Management
- Performance Analyzer
 - Installed by default
 - PostgreSQL
- APIs for Automation and Provisioning

EMC Unisphere for VMAX is the management console for the EMC VMAX family of arrays. Unisphere for VMAX 8.0.x supports service level based management for the VMAX³ Family of arrays. Starting with Unisphere 8.0.x the installation of performance analyzer is done by default during the installation of Unisphere. In previous versions of Unisphere, Performance Analyzer was an optional component. Starting with Unisphere 8.0.x, PostgreSQL replaces MySQL as the database for performance analyzer. Unisphere for VMAX also provides a comprehensive set of APIs which can be used by orchestration services like ViPR, Open Stack and VMware.

Unisphere for VMAX - Functionality

- Manage eLicenses, User and Roles
- Storage Configuration Management
 - SLO based provisioning
 - FAST
- Configure and Monitor Alerts
- Performance Monitoring
 - Real time, Root cause and Historical
 - Dashboards



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VMAX3 Configuration Management Overview

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You can use Unisphere for VMAX for a variety of tasks, including, managing eLicenses, user accounts and roles, and performing array configuration and volume management operations, such as SLO based provisioning on VMAX³ arrays and managing Fully Automated Storage Tiering (FAST).

With Unisphere for VMAX, you can also configure alerts and alert thresholds and monitor alerts.

In addition, Unisphere for VMAX provides tools for performing analysis and historical trending of VMAX performance data. With the performance option you can view high frequency metrics in real time, view VMAX3 system heat maps and view graphs detailing system performance. You can also drill-down through data to investigate issues, monitor performance over time, execute scheduled and ongoing reports (queries), and export that data to a file. Users can utilize a number of predefined dashboards for many of the system components, or customize their own dashboard view.

Lesson Summary

During this lesson the following topics were covered:

- VMAX3 Model Comparison
- Key Features
- Management Tools

This lesson provided an overview of the VMAX3 Family of arrays with HYPERMAX OS 5977. We compared the three models and listed the key features. Software tools used to manage VAMX3 arrays were also introduced.

Lesson: VMAX3 Storage Provisioning Overview

This lesson covers the following topics:

- Factory Pre-Configuration
- Service Level Objective Based Provisioning
- Introduction to configuration changes with Unisphere for VMAX and SYMCLI

This lesson covers factory pre-configuration of VMAX3 arrays and VMAX3 storage provisioning concepts. An introduction to configuration changes with Unisphere for VMAX and SYMCLI is also provided.

Factory Pre-Configuration

Disk Groups

- A collection of physical drives

Data Pools

- Collection of Data Devices
- Preconfigured in each Disk Group
- All Data devices in a disk group added to a Data Pool
- 1-to-1 relationship between Data Pool and disk group
- Performance capability of each Data Pool is known
- Based on the drive type, speed, capacity, quantity of drives, and RAID protection

Storage Resource Pool

- Collection of Data Pools

Service Level Objectives



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VMAX3 Configuration Management Overview

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Disk Groups in the VMAX3 Family are similar to previous generation VMAX arrays. A Disk Group is a collection of physical drives. Each drive in a Disk Group shares the same performance characteristics, determined by the rotational speed and technology of the drives (15K, 10K, 7.2K or Flash) and the capacity.

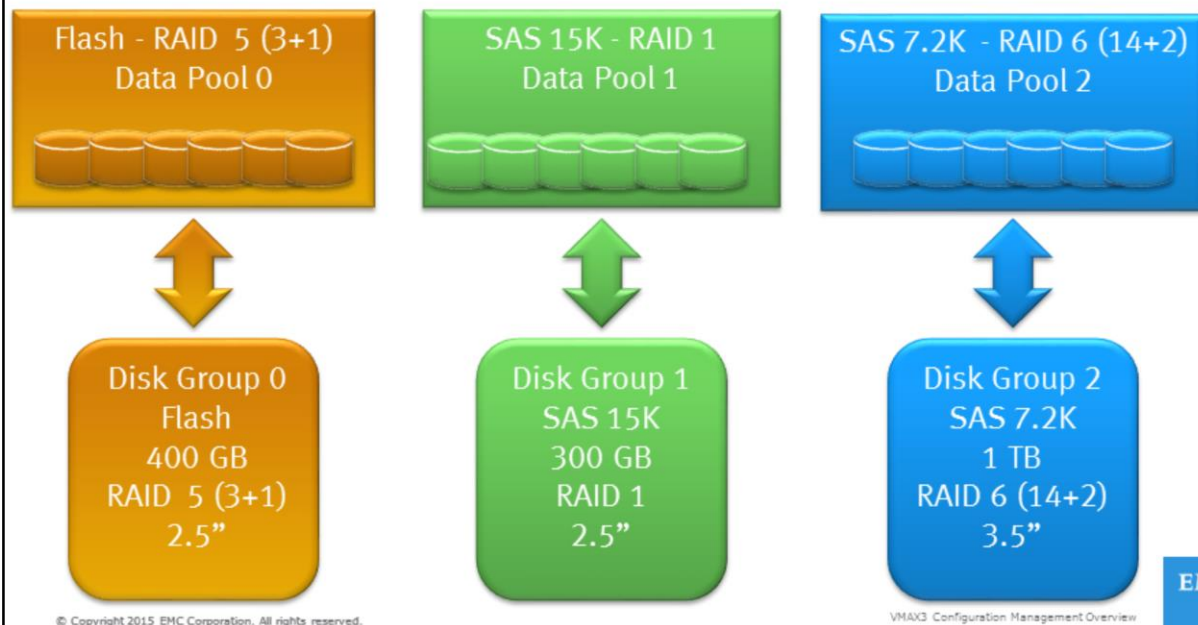
Data Pools are a collection of data devices. Each individual Disk Group is pre-configured with data devices (TDATs). All the data devices in the Disk Group have the same RAID protection. Thus, a given Disk Group only has data devices with one single RAID protection. All the data devices in the Disk Group will have the same fixed size devices. All available capacity on the disk will be consumed by the TDATs. All the data devices (TDATs) in a Disk Group are added to a Data Pool. There is a one-to-one relationship between a Data Pool and Disk Group.

The performance capability of each Data Pool is known and is based on the drive type, speed, capacity, quantity of drives and RAID protection.

One Storage Resource Pool (SRP) is preconfigured. SRP is discussed in a later slide. The available Service Level Objectives are also pre-configured.

Disk Groups, Data Pool, Storage Resource Pools and Service Level Objectives cannot be configured or modified by Solutions Enabler or Unisphere for VMAX. They are created during the configuration process in the factory.

Data Pool and Disk Group Relationship



The Data Devices of each Data Pool are preconfigured. The Data Pools are built according to what is selected by the customer during the ordering process. All Data Devices that belong to a particular Data Pool must belong to the same Disk Group. There is a one-to-one relationship between Data Pools and Disk Groups.

Disk Groups must contain drives of the same: disk technology, rotational speed, capacity and RAID type.

The performance capability of each Data Pool is known, and is based on the drive type, speed, capacity, quantity of drives and RAID protection.

In our example: Disk Group 0 contains 400 Gigabyte Flash drives configured as RAID 5 (3+1). Only Flash devices of this size and RAID type can belong to Disk Group 0. If additional drives are added to Disk Group 0, they must be 400 Gb Flash configured as RAID 5 (3+1).

Disk Group 1 contains 300 Gigabyte (GB) SAS drives with rotational speeds of 15 thousand (15K) revolutions per minute (rpm) configured as RAID 1.

Disk Group 2 contains 1 Terabyte (TB) SAS drives with rotational speeds of seven thousand two hundred (7.2K) revolutions per minute (rpm) configured as RAID 6 (14 + 2).

Please note that this is just an example.

Protection Options – Data Pools

Option	Characteristics	Protection	Performance	Cost
RAID 1	- Write to two separate physical drives - Read from single drive	Higher	Fastest	Low
RAID 5	- Parity based protection - Striped data and parity 3+1 and 7+1	High	Fast Read Good Write	Lower
RAID 6	- Two parity drives 6 + 2 and 14 + 2 - Data Availability is primary consideration - Performance is a secondary consideration	Highest	Fast Read Fair Write	Lower

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VMAX3 Configuration Management Overview

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VMAX3 arrays are preconfigured with Data Pools and Disk Groups as we had discussed earlier. There is a 1:1 correspondence between Data Pools and Disk Groups. The Data Devices in the Data Pools are configured with one of the data protection options listed on the slide. The choice of the data protection option is made during the ordering process and the array will be configured with the chosen options.

RAID 5 is based on the industry standard algorithm and can be configured with three data and one parity, or seven data and one parity. While the latter will provide more capacity per \$, there is a greater performance impact in degraded mode where a drive has failed and all surviving drives must be read in order to rebuild the missing data.

RAID 6 focuses on availability. With the new larger capacity disk drives, rebuilding may take multiple days, therefore increasing the exposure to a second disk failure.

Random read performance is similar across all protection types, assuming you are comparing the same number of drives. The major difference is write performance. With mirrored devices for every host write, there are two writes on the back-end. With RAID 5, each host write results in two reads and two writes. For RAID 6, each host write results in three reads and three writes.

Storage Resource Pool

- Collection of Data Pools
- Factory Pre-configuration includes one SRP
- Not configurable via Solutions Enabler or Unisphere for VMAX
- Multiple SRPs may be configured



A Storage Resource Pool (SRP) is a collection of Data Pools, which are configured from Disk Groups. A Data Pool can only be included in one SRP. SRPs are not configurable via Solutions Enabler or Unisphere for VMAX. The factory preconfigured array includes one SRP that contains all Data Pools in the array. Multiple SRPs may be configured by qualified EMC personnel, if required. If there are multiple SRPs, one of them must be marked as the default.

Service Level Objective Based Provisioning

Service Level Objective

- Defines ideal performance operating range of an application
- Can be combined with a Workload Type
 - Further refines the performance objective
- Preconfigured

Storage Groups

- Can be explicitly associated with an SRP
- Can be explicitly associated with an SLO and Workload Type
 - Defines the SG as FAST managed
- SGs are implicitly associated with the Default SRP and the Optimized SLO



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VMAX3 Configuration Management Overview

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A Service Level Objective (SLO) defines the ideal performance operating range of an application. Each SLO contains an expected maximum response time range. The response time is measured from the perspective of the frontend adapter. The SLO can be combined with a workload type to further refine the performance objective.

SLOs are predefined and come prepackaged with the array and are not customizable by Solutions Enabler or Unisphere for VMAX.

A storage group in HYPERMAX OS 5977 is similar to the storage groups used in the previous generation VMAX arrays. It is a logical grouping of devices used for FAST, device masking, control and monitoring.

In HYPERMAX OS 5977, a storage group can be associated with an SRP. This allows devices in the SGs to allocate storage from any pool in the SRP. When an SG is associated with an SLO, it defines the SG as FAST managed.

SLO based provisioning will be covered in more detail in subsequent modules in the course.

Available Service Level Objectives

SLO	Performance Behavior	Expected Average Response Time
Diamond	Flash	0.8 ms
Platinum	Between Flash & 15K RPM	3.0 ms
Gold	15K RPM	5.0 ms
Silver	10K RPM	8.0 ms
Bronze	7.2K RPM	14.0 ms
Optimized (default)	System optimized	N/A



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VMAX3 Configuration Management Overview

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In addition to the default Optimized SLO there are five available service level objectives, varying in expected average response times targets,. The Optimized SLO has no explicit response time target. The optimized SLO achieves optimal performance by placing the most active data on higher performing storage and least active data on the most cost-effective storage.

Diamond emulates Flash drive performance, Platinum emulates performance between Flash and 15K RPM drives, Gold emulates the performance of 15K RPM drives, Silver emulates the performance of 10K RPM drives and Bronze emulates performance of 7.2K RPM drives. The actual response time of an application associated with an SLO vary based on the actual workload. It will depend on the average I/O size, read/write ratio, and the use of local and remote replication.

Note that these SLOs are fixed and cannot be modified. The end user can associate the desired SLO with a storage group. Also note that certain SLOs may not be available on an array if certain drive types are not configured. Diamond SLO will not be available if there are no Flash drives present. Bronze SLO will be unavailable if 7.2K RPM drives are not present.

Available Workload Types

Workload Type	Description
OLTP	Small block I/O workload
OLTP with Replication	Small block I/O workload with local or remote replication
DSS	Large block I/O workload
DSS with Replication	Large block I/O workload with local or remote replication

There are four workload types as shown on the slide. The workload type can be specified with the Diamond, Platinum, Gold, Silver and Bronze SLOs to further refine response time expectations. One cannot associate a workload type with the Optimized SLO.

Host View of VMAX3 Storage

- Auto-provisioning Groups are used to allocate VMAX3 storage to hosts
- VMAX3 arrays present Thin Devices to hosts
 - Open Systems host sees VMAX3 Thin Devices as FBA SCSI disk drives
- VMAX3 Thin Device – Size Metrics
 - Sector – 16 Blocks (512 byte block) – 8 KB
 - Track Size – 16 Sectors – $16 \times 8 = 128$ KB
 - Cylinder Size – 15 Tracks – $15 \times 128 = 1920$ KB
 - Maximum Device Size – 8947848 Cylinders = 16384 GB = 16 TB
 - Device sizes are typically specified in Cylinders



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VMAX3 Configuration Management Overview

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Auto-provisioning groups are used to allocate VMAX3 storage to hosts. VMAX3 arrays are 100% virtually provisioned and thus Thin Devices are presented to the hosts. From a host's perspective, the VMAX3 thin device is simply seen as one or more FBA SCSI device. Standard SCSI commands such as SCSI INQUIRY and SCSI READ CAPACITY return low-level physical device data, such as vendor, configuration, and basic configuration, but have very limited knowledge of the configuration details of the storage system.

Knowledge of VMAX3 specific information, such as director configuration, cache size, number of devices, mapping of physical-to-logical, port status, flags, etc. require a different set of tools, and that is what Solutions Enabler and Unisphere for VMAX are all about.

Host I/O operations are managed by the HYPERMAX OS operating environment, which runs on the VMAX3 arrays. VMAX3 thin devices are presented to the host with the following configuration or emulation attributes:

Each device has N cylinders. The number is configurable .

Each cylinder has 15 tracks (heads).

Each device track in a fixed block architecture (FBA) is 128 KB (256 blocks of 512 bytes each).

Maximum Thin Device size that can be configured on a VMAX3 is 8947848 cylinders or about 16 TB.

Storage Allocation – VMAX3 Arrays

Auto-provisioning groups are used to allocate storage from VMAX3 arrays to hosts:

Initiator Group	• Fibre Channel Initiator • Port Flags set on Initiator Group ▶ FCID Lockdown per initiator
Port Group	• Front End Ports • A port can belong to multiple port groups • Ports must have the ACLX flag enabled
Storage Group	• VMAX3 Thin Devices • A device can belong to more than one Storage group • Can be associated with SRP, SLO and Workload Type
Masking View	• One of each type of group is associated together to form a Masking View

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VMAX3 Configuration Management Overview

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Auto-provisioning Groups are used for device masking on VMAX3 family of arrays.

An Initiator Group contains the world wide name of a host initiator, also referred to as an HBA or host bus adapter. An initiator group may contain a maximum of 64 initiator addresses or 64 child initiator group names. Initiator groups cannot contain a mixture of host initiators and child IG names.

Port flags are set on an initiator group basis, with one set of port flags applying to all initiators in the group. However, the FCID lockdown is set on a per initiator basis. An individual initiator can only belong to one Initiator Group.

However, once the initiator is in a group, the group can be a member in another initiator group. It can be grouped within a group. This feature is called cascaded initiator groups, and is only allowed to a cascaded level of one.

A Port Group may contain a maximum of 32 front-end ports. Front-end ports may belong to more than one port group. Before a port can be added to a port group, the ACLX flag must be enabled on the port.

Storage groups can only contain devices or other storage groups. No mixing is permitted. A Storage Group with devices may contain up to 4K VMAX3 logical volumes. A logical volume may belong to more than one storage group. There is a limit of 16K storage groups per VMAX3 array. A parent SG can have up to 32 child storage groups.

One of each type of group is associated together to form a Masking View.

Managing Configuration and Provisioning

- Execute using Unisphere for VMAX or SYMCLI
 - Unisphere for VMAX – various wizards and tasks
 - SYMCLI
 - `symconfigure`
 - `symaccess`
 - `symmsg`
- Perform configuration and storage provisioning
 - Thin device management – creation, deletion, attribute modification
 - Front-end port management – attributes, association
 - Array metrics
 - Manage Auto-provisioning groups – storage provisioning



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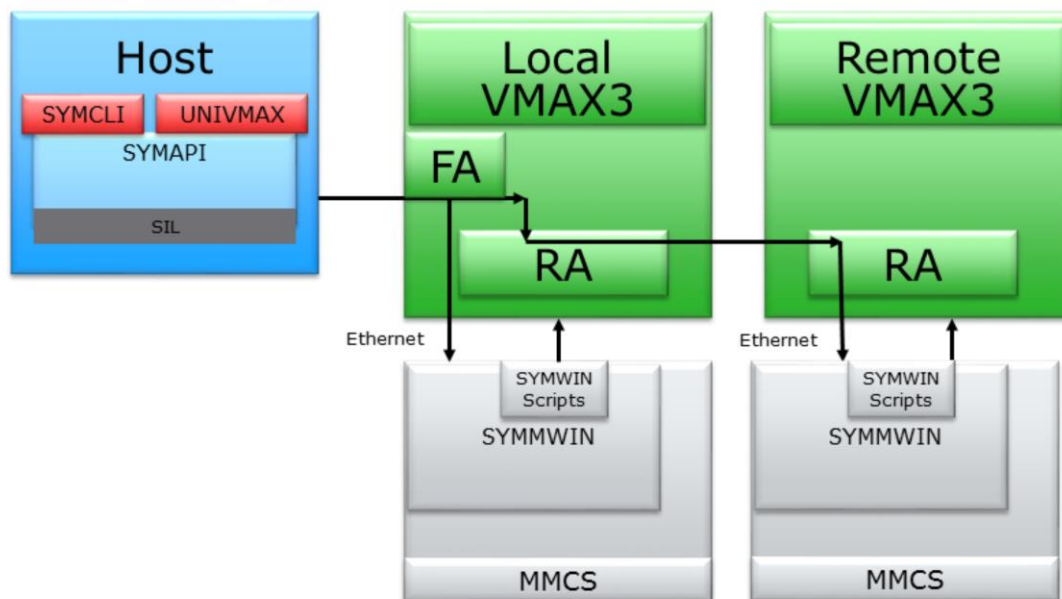
VMAX3 Configuration Management Overview

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Configuration and Provisioning are managed with Unisphere for VMAX or SYMCLI. Unisphere for VMAX has numerous wizards and tasks to help achieve various objectives. The `symconfigure` SYMCLI command is used for the configuration of thin devices and for port management. The `symaccess` SYMCLI command is used to manage Auto-provisioning groups which allow storage allocation to hosts (LUN Masking). The `symmsg` SYMCLI command is used to manage Storage Groups.

We will explore many of these Unisphere tasks and SYMCLI commands throughout this course.

Configuration Architecture



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The Configuration Manager architecture allows it to run SymmWin scripts on the VMAX3 MMCS. Configuration change requests are generated either by the symconfigure SYMCLI command, or a SYMAPI library call generated by a user making a request through the Unisphere for VMAX GUI.

These requests are converted by SYMAPI on the host to VMAX3 syscalls and transmitted to the VMAX3 through the channel interconnect. The VMAX3 front end routes the requests to the MMCS, which invokes SymmWin procedures to perform the requested changes to the VMAX3.

In the case of SRDF connected arrays configuration requests can be sent to the remote array over the SRDF links.

VMAX3 - Gatekeeper Devices

- 3-cyl thin devices (~ 6MB)
- Receives low-level SCSI I/O from SYMCLI/GUI
- Used as target of SYMCLI/SYMAPI commands
 - Commands passed through gatekeepers to VMAX3 for action
 - Locked during the passing of commands
 - Lots of commands flowing to the VMAX3 from many applications on the same host can cause gatekeeper shortage
- Must be accessible from the host executing the commands
- Refer to EMC Knowledgebase solution "Gatekeepers - All You Need to Know" (emc255976) on EMC Support

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VMAX3 Configuration Management Overview



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Solutions Enabler is an EMC software component used to control the storage features of VMAX3 arrays. It receives user requests via SYMCLI, GUI, or other means, and generates system commands that are transmitted to the VMAX3 array for action.

Gatekeeper devices are LUNs that act as the target of command requests to Enginuity-based functionality. These commands arrive in the form of disk I/O requests. The more commands that are issued from the host, and the more complex the actions required by those commands, the more gatekeepers that are required to handle those requests in a timely manner. When Solutions Enabler successfully obtains a gatekeeper, it locks the device, and then processes the system commands. Once Solutions Enabler has processed the system commands, it closes and unlocks the device, freeing it for other processing.

A gatekeeper is not intended to store data and is usually configured as a small three cylinder device (Approx. 6 MB). Gatekeeper devices should be mapped and masked to single hosts only and should not be shared across hosts.

Note: For specific recommendations on the number of gatekeepers required for all VMAX3 configurations, refer to EMC Knowledgebase solution emc255976 available on the EMC Support Website.

Concurrent Configuration Sessions

- Concurrent Provisioning
 - Up to four concurrent non-conflicting configuration change sessions
 - Should not include conflicts of the following
 - Device back-end port
 - Device front-end port
 - Device
- Array manages its own device locking
- Session ID identifies each running configuration session

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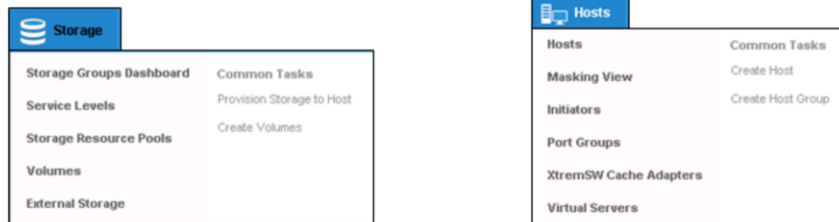
VMAX3 arrays allow, up to four concurrent configuration change sessions to run at the same time, when they are non-conflicting. This means that multiple parallel configuration change sessions can run at the same time as long as the changes do not include any conflicts on the following:

- Device back-end port
- Device front-end port
- Device

The array manages its own device locking and each running session is identified by a session ID.

Configuration Changes – Unisphere for VMAX

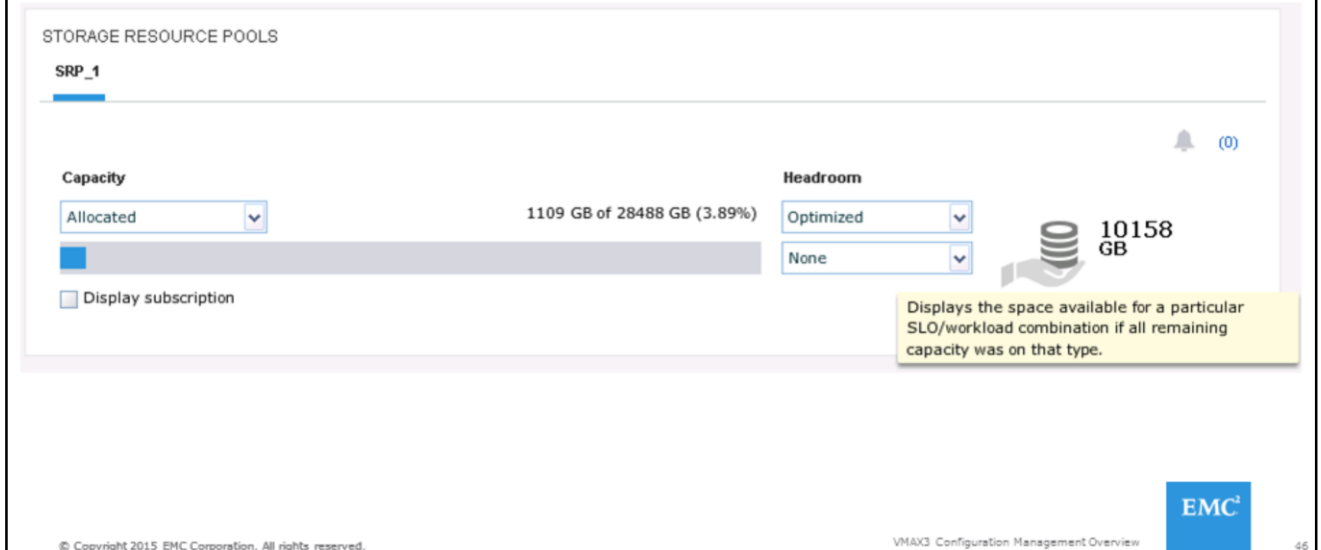
- Multiple ways to invoke configuration changes via Unisphere
 - Depends on the type of configuration change
 - Unisphere has many wizards



- Configuration tasks can be submitted to a job list

Configuration changes can be invoked via Unisphere for VMAX in many different ways. The method depends on the type of configuration change. A number of wizards are available. We will look at specific methods in the later modules of this course. Configuration requests in Unisphere can be added to a job list.

Unisphere: Storage Resource Pool – Headroom



The Storage Groups Dashboard in Unisphere for VMAX shows all the configured Storage Resource Pools and the available headroom for each SLO. Prior to allocating new storage to a host it is a good idea to check the available headroom. We will explore this in more detail later in the course.

To navigate to the Storage Groups Dashboard simply click on the Storage Section button.

Unisphere: Storage Resource Pool Details

000196800225 > Storage > Storage Resource Pools

SRP_1

PROPERTIES

Name	SRP_1
Default Emulation	FBA
Usable Capacity (GB)	28487.81
Allocated Capacity (GB)	1108.64
Free Capacity (GB)	27379.17
Subscription (GB)	1207.3

Apply Cancel

DISK GROUPS

Name	Technology	Speed (RPM)	Usable Capacity (GB)
1 -- GRP_1_300_15K_R1	FC	15000	13412.11
2 -- GRP_2_600_10K_6R6	FC	10000	12875.63
3 -- GRP_3_200_EFD_3R5	EFD	N/A	2200.08

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VMAX3 Configuration Management Overview

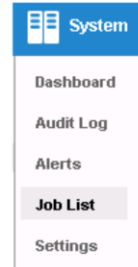
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One can also look at the details of the configured Storage Resource Pools to see the details of Usable, Allocated and Free capacity. To navigate to the Storage Resource Pools click on the Storage Resource Pool link in the Storage section dropdown.

Unisphere: Job List

- List of jobs
 - Yet to be run - Can be run on demand or scheduled for later execution
 - Jobs that are running, successfully completed, or failed
- Job List can be accessed by clicking:
 - Job List link in the System section dropdown
 - Job List link in the status bar 



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VMAX3 Configuration Management Overview

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Most of the configuration tasks in Unisphere for VMAX can be added to the Job List for execution at a later time. The Job List shows all the jobs that are yet to be run (Created status), jobs that are running, jobs that have run successfully, and those that have failed.

You can navigate to the Job List by clicking the Job List link in the System section dropdown or by clicking the Job List link in the status bar.

Unisphere: Job List Example

000196000225 > System > Job List

Name	Status	User Name	Last Modified Time
Create Volumes	CREATED	C:10.126.88.89\vanchi	Tue 12/16/2014 10:11:34 AM GMT-0500

Run View Details Group Stop Delete

000196000225 > System > Job List > Create Volumes

Create Volumes

PROPERTIES

Name: Create Volumes Status: CREATED Scheduled: 

Owner: C:10.126.88.89\vanchi Last Modified: Tue 12/16/2014 10:11:34 AM GMT-0500 Completed:

TASKS

Order	Task
1	Create 6 thin volumes of (TDEV)(PBA)(capacity for each volume = 5462 Cyl)(10.00GB)(SCSI3 Persistent Reservation enabled)

More Up More Down

Run Schedule Delete Stop Ungroup Apply Cancel

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VMAX3 Configuration Management Overview

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This is an example of a Job List. In this example, a Create Volumes job is listed here with a status of Created. You can run the job by clicking Run or View Details to see the job details.

In the Job details, you can see that the this job will create 6 thin volumes, each volume will have a capacity on 10 GB.

You can run the job by clicking the Run button or alternately click the Schedule button to schedule the job for later execution. You can also delete the job.

Configuration Changes Preparation - SYMCLI

- Verify configuration changes can be made safely:
 - `symconfigure verify`
- Check usage of the configured Storage Resource Pools
 - `symcfg list -srp`
- Consider impact on I/O:
 - To make devices not ready use: `symdev not_ready <SymDev>`
- After allocation/de-allocation of storage to a host update the host operating system environment before attempting I/O

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VMAX3 Configuration Management Overview



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Before making configuration changes, it is important to know the current Symmetrix configuration.

Verify that the current Symmetrix configuration is a viable configuration for host-initiated configuration changes. The command:

`symconfigure verify -sid SymmID` will return successfully if the Symmetrix is ready for configuration changes.

The capacity usage of the configured Storage Resource Pools can be check using the command: `symcfg list -srp -sid SymmID`.

Check the product documentation to understand the impact that a configuration change operation can have on host I/O.

After allocating storage to a host, you must update the host operating system environment. Attempting host activity with a device after it has been removed or altered, but before you have updated the host's device information, can cause host errors.

SYMCLI – symconfigure Command

- Command options
 - `preview`, `prepare` or `commit`
- Command execution formats
 - Submit file containing commands as a parameter to `symconfigure`
 - File can have multiple commands separated with semi-colon
 - e.g. `symconfigure -sid 123 -file myfile commit`
 - Enclose commands within quotes following the `-cmd` option
 - e.g. `symconfigure -sid 123 -cmd "delete dev 0015;" commit`
 - On Unix systems enter the commands via *stdin* on the screen
 - `symconfigure -sid 123 -noprompt prepare <<EOF`
`delete dev 0015;`
`EOF`

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VMAX3 Configuration Management Overview

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The symconfigure command has three main options:

Preview ensures the command file syntax is correct and verifies the validity of the command file changes.

Prepare validates the syntax and correctness of the operations. It also verifies the validity of the command file changes and their appropriateness for the specified Symmetrix array.

Commit attempts to apply the changes defined in the command file into the specified array after executing the actions described under prepare and preview.

The symconfigure command can be executed in one of the three formats shown on the slide.

The syntax for these commands is described in Chapter 7 of the EMC Solutions Enabler Symmetrix Array Management CLI User Guide. Multiple changes can be made in one session.

SYMCLI – Query/Abort Configuration Sessions

- Query
 - `symconfigure query -sid ###`
- Abort
 - Configuration change sessions can be terminated prematurely using the `abort` command.
 - Premature termination is only possible before the point of no return
 - `symconfigure -sid ### abort -session_id <SessID>`

Configuration change sessions can be viewed using the `symconfigure query` command. If there are multiple sessions running, all session details are shown. In rare instances, it might become necessary to abort configuration changes. This can be done with the `symconfigure abort` command as long as the point of no return has not been reached. Aborting a change that involves RDF devices in a remote array might necessitate the termination of changes in a remote array.

Lesson Summary

During this lesson the following topics were covered:

- Factory Pre-Configuration
- Service Level Objective Based Provisioning
- Introduction to configuration changes with Unisphere for VMAX and SYMCLI

This lesson covered factory pre-configuration of VMAX3 arrays and VMAX3 storage provisioning concepts. An introduction to configuration changes with Unisphere for VMAX and SYMCLI was also provided.

Lab: Explore VMAX3 Environment with Unisphere for VMAX and SYMCLI

This lab covers

- Exploring a VMAX3 environment with Unisphere for VMAX
- Exploring a VMAX3 environment with SYMCLI

In this Lab you will explore a VMAX3 environment with Unisphere for VMAX and SYMCLI.

Module Summary

Key points covered in this module:

- VMAX3 with HYPERMAX OS 5977 Family of arrays
- Overview of key features
- VMAX3 Storage Provisioning concepts
- Available tools for managing VMAX3 arrays

This module covered an overview of the VMAX³ Family of arrays with HYPERMAX OS 5977. Key features and storage provisioning concepts were covered. The CLI command structure for configuration, and how to perform configuration changes with Unisphere for VMAX were also described.

Module: VMAX3 - Virtual Provisioning and FAST Concepts

Upon completion of this module, you should be able to:

- Provide an overview of Virtual Provisioning and FAST
- Explain FAST elements and terminology
- Describe the algorithms used by FAST
- Describe FAST configuration parameters
- Articulate FAST best practice recommendations

This module focuses on VMAX3 Virtual Provisioning and FAST concepts. The first lesson provides an overview of Virtual Provisioning and FAST. The lesson also covers FAST elements and terminology. The second lesson covers FAST algorithms, configuration parameters and best practice recommendations.

Lesson: Virtual Provisioning and FAST Overview

This lesson covers the following topics:

- Virtual Provisioning Overview
- FAST Overview
- FAST Elements and Terminology

This lesson provides an overview of Virtual Provisioning and FAST. The lesson also covers FAST elements and terminology.

VMAX3 – Storage Provisioning

- 100% Virtually Provisioned
 - Thin Devices are presented to Hosts
- Arrays are pre-configured
 - Disk Groups
 - Data Pools
 - Storage Resource Pool(s)
 - Service Level Objectives
- Back-end placement of all host related data is managed by FAST

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VMAX3 - Virtual Provisioning and FAST Concepts

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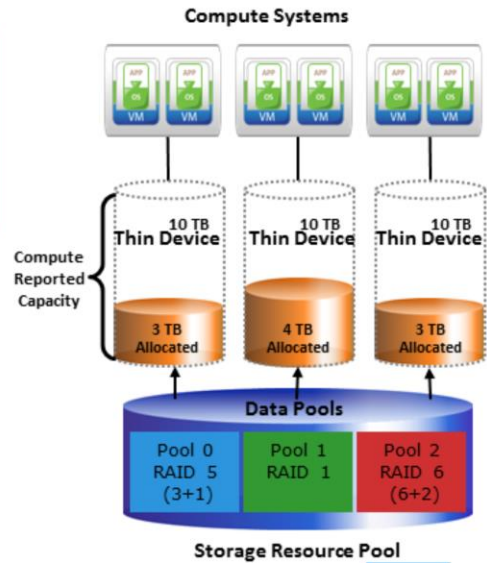
We had covered these concepts in the previous module. The key point to note here is that on VMAX3 arrays Virtual Provisioning and FAST work together all the time and there is no way to separate the two. All host related data is managed by FAST, starting with allocations made to thin devices and movement of data on the back-end as the workload changes over time.

Virtual Provisioning (Thin Provisioning)

Virtual Provisioning (Thin Provisioning)

It is the ability to present a LUN to a compute system with more capacity than what is physically allocated to the LUN.

- Capacity-on-demand from the Storage Resource Pool
 - Physical storage allocated only when the compute system requires it
 - Extent Size – 1 Track – 128 KB



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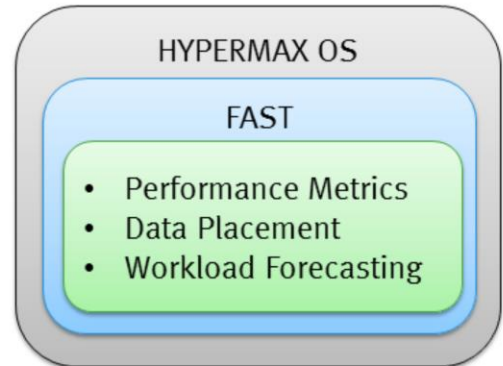
One of the biggest challenges for storage administrators is balancing the storage space required by various applications in their data centers. Administrators typically allocate storage space based on anticipated storage growth. They do this to reduce the management overhead and application downtime required to add new storage later on. This generally results in the over-provisioning of storage capacity, which leads to higher costs, increased power, cooling, and floor space requirements, and lower capacity utilization. These challenges are addressed by Virtual Provisioning.

Virtual Provisioning is the ability to present a logical unit (Thin LUN) to a compute system, with more capacity than what is physically allocated to the LUN on the storage array. Physical storage is allocated to the application "on-demand" from a shared pool of physical capacity. This provides more efficient utilization of storage by reducing the amount of allocated, but unused physical storage.

The shared storage pool, called the Storage Resource Pool is comprised of one or more Data Pools containing internal devices called Data Devices. When a write is performed to a portion of the thin device, the VMAX3 array allocates a minimum allotment of physical storage from the pool and maps that storage to a region on the thin device, including the area targeted by the write. The allocation operation is performed in small units of storage called virtually provisioned device extents. The virtually provisioned device extent size is 1 track (128 KB).

FAST with HYPERMAX OS 5977

- Runs within HYPERMAX OS
 - Always Enabled
- Collects and aggregates performance metrics
- Performs Workload Forecasting
- Plans and executes data movement
- Provides additional core functionality
 - Extent allocation management



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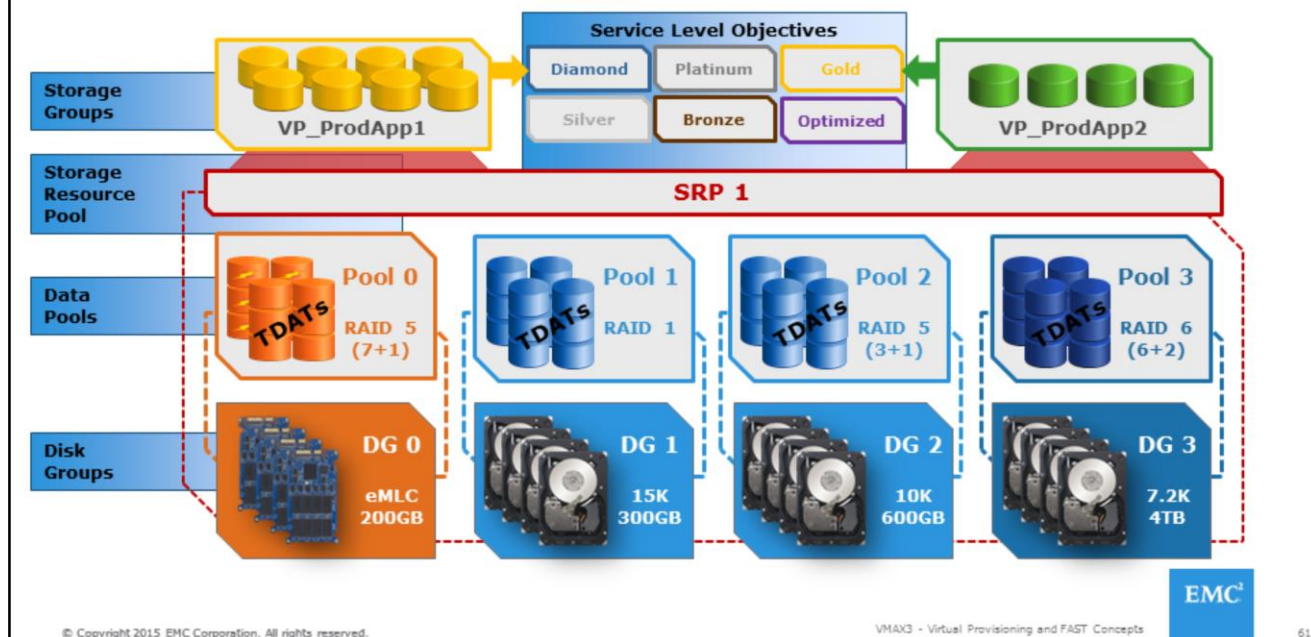
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Fully Automated Storage Tiering (FAST) is permanently enabled on VMAX3 Arrays running HYPERMAX OS. FAST automates the identification of active or inactive application data for the purpose of reallocating that data across different performance/capacity pools within the VMAX3 array. FAST proactively monitors workloads to identify busy data that would benefit from being moved to higher-performing drives, while also identifying less-busy data that could be moved to higher-capacity drives, without affecting existing performance.

VMAX3 arrays are 100% virtually provisioned so FAST on HYPERMAX OS operates on thin devices, meaning that data movements can be performed at the sub-LUN level. Thus a single thin device may have extents allocated across multiple data pools within the storage resource pool.

FAST collects and analyzes performance metrics and controls all the data movement within the array. Data movement is determined by forecasting future system IO workload, based on past performance patterns. This eliminates any user intervention. FAST provides additional core functionality of extent allocation management.

Service Level Provisioning - Elements

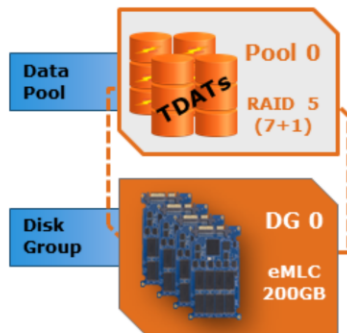


The elements related to FAST and Service Level Provisioning on VMAX3 arrays are - Disk Groups, Data Pools, Storage Resource Pools, Service Level Objectives and Storage Groups.

We had discussed these briefly in the previous module. We will explore them further in this lesson. As we have indicated before Disk groups, Data Pools with Data Devices (TDATs), Storage Resource Pools and Service Level Objectives all come pre-configured on the VMAX3 array and they cannot be modified using management software. Thus Solutions Enabler and Unisphere for VMAX will give the end user visibility to the pre-configured elements, but no modifications are allowed. Storage Groups are logical collections of VMAX3 thin devices. Storage groups and thin devices can be configured (created/deleted/modified etc.) with Solutions Enabler and Unisphere for VMAX. Storage group definitions are shared between FAST and Auto-provisioning groups.

In the example shown on the slide the array has been configured with four Disk Groups, four Data Pools, one Storage Resource Pool and the SLOs. Note that this is just an example.

Disk Group and Data Pool



- Disk Group
 - Collection of physical disks with same characteristics
 - Rotational Speed for HDDs or Flash
 - Capacity
 - Pre-configured with Data Devices (TDATs)
 - Single RAID protection
 - Fixed hyper sizes – minimum 16 hypers per disk
- Data Pool
 - 1:1 relationship with disk group
 - All TDATs in disk group added to data pool
 - Performance capability is known

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A disk group is a collection of physical drives sharing the same physical and performance characteristics. Drives are grouped based on technologies, rotational speed (or Flash), capacity, form factor, and desired RAID protection type. VMAX3 arrays support up to 512 disk groups.

Each disk group is automatically configured with Data Devices (TDATs) upon creation. All the data devices in the disk group are of a single RAID protection type, and are all the same size. Because of this, each drive in the group has the same number of hypers all sized the same. Each drive will have a minimum of 16 hypers. Larger drives may have more hypers.

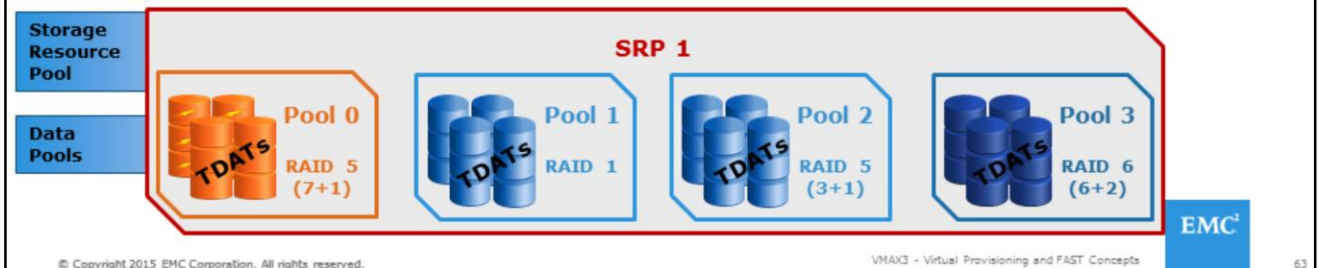
A data pool is a collection of data devices of the same emulation and RAID protection. VMAX3 arrays support up to 512 data pools. All data devices configured in a single physical disk group are contained in a single data pool. Thus there is 1:1 relationship between disk groups and data pools. The performance capability of each data pool is known and is based on the drive type, speed, capacity, quantity of drives and RAID protection.

Data devices provide the dedicated physical space to be used by thin devices. Data devices are internal devices.

Disk group, Data Pools and Data Devices (TDATs) cannot be modified using management software. Thus Solutions Enabler and Unisphere for VMAX will give the end user visibility to the pre-configured elements, but no modifications are allowed.

Storage Resource Pool

- Collection of Data Pools
 - Constitutes a FAST domain
 - A data pool can only be included in one SRP
- Factory pre-configuration includes one SRP
 - Contains all the configured data pools
- Multi SRP case – One SRP must be marked as the default



A storage resource pool (SRP) is a collection of data pools and makes up a FAST domain. This means that data movement performed by FAST is done within the boundaries of the SRP. An SRP can have up to 512 data pools. Individual data pools can only be part of one SRP. By default a VMAX3 array has a single SRP which contains all the configured data pools.

Application data belonging to thin devices can be distributed across all data pools within the SRP to which it is associated. When moving data between data pools, FAST will differentiate the performance capabilities of the pools based on RAID protection and rotational speed (if applicable).

The VMAX3 storage arrays supports a maximum of 2 SRPs. When multiple SRPs are configured one of the SRPs must be marked as the default SRP.

SRP configuration cannot be modified using management software. Solutions Enabler and Unisphere for VMAX will give the end user visibility into the pre-configured SRP(s), but no modifications are allowed.

Display SRP Details

000196800225 > Storage > Storage Resource Pools

SRP_1

PROPERTIES

Name	SRP_1
Default Emulation	FBA
Usable Capacity (GB)	28487.81
Allocated Capacity (GB)	1108.64
Free Capacity (GB)	27379.17
Subscription (GB)	1207.3
Reserved Capacity % (0-80)	10

Apply Cancel

DISK GROUPS

Name	Technology	Speed (RPM)	Usable Capacity (GB)
1 -- GRP_1_300_15K_R1	FC	15000	13412.11
2 -- GRP_2_600_10K_6R6	FC	10000	12875.63
3 -- GRP_3_200_EFD_3R5	EFD	N/A	2200.08

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The configured SRP(s) can be displayed in Unisphere for VMAX (shown on slide) or via SYMCLI (shown below).

```
C:\Users\Administrator>symcfg list -srp -v
Symmetrix ID       : 000196800225
Name               : SRP_1
Description        :
Default SRP       : FBA
Usable Capacity (GB) : 28487.8
Allocated Capacity (GB) : 1108.6
Free Capacity (GB) : 27379.2
Subscribed Capacity (GB) : 1207.3
Subscribed Capacity (%) : 4
Reserved Capacity (%) : 10
Usable by RDFA DSE : Yes
```

Disk Groups (3):

```
{
  -----
                                Usable
                                Capacity
#   Name                        Tech  Speed  (rpm)  (GB)
-----
  1  GRP_1_300_15K_R1          FC    15000   13412.1
  2  GRP_2_600_10K_6R6          FC    10000   12875.6
  3  GRP_3_200_EFD_3R5          EFD      N/A    2200.1
  -----
Total                                28487.8
}
```

Available SLOs (5):

```
{
  Optimized
  Diamond
  Platinum
  Gold
  Silver
}
```

Service Level Objective (SLO)

- Defines expected average response time target for a Storage Group
 - Desired SLO is set on a Storage Group
 - SLO can be combined with a Workload Type to refine performance objective
 - Response time relates to the front-end adapter
- Predefined SLOs
 - Diamond, Platinum, Gold, Silver, Bronze and Optimized
 - Default – Optimized



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A Service Level Objective (SLO) defines an expected average response time target for an application. By associating an SLO to an application (Storage Group), FAST automatically monitors the performance of the application and adjusts the distribution of extent allocations within an SRP in order to maintain or meet the response time target. Note that these SLOs are fixed and cannot be modified.

Available Service Level Objectives

SLO	Performance Behavior	Expected Average Response Time
Diamond	Flash	0.8 ms
Platinum	Between Flash & 15K RPM	3.0 ms
Gold	15K RPM	5.0 ms
Silver	10K RPM	8.0 ms
Bronze	7.2K RPM	14.0 ms
Optimized (default)	System optimized	N/A

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In addition to the default Optimized SLO there are five available service level objectives, varying in expected average response times targets,. The Optimized SLO has no explicit response time target. The optimized SLO achieves optimal performance by placing the most active data on higher performing storage and least active data on the most cost-effective storage.

Diamond emulates Flash drive performance, Platinum emulates performance between Flash and 15K RPM drives, Gold emulates the performance of 15K RPM drives, Silver emulates the performance of 10K RPM drives and Bronze emulates performance of 7.2K RPM drives. The actual response time of an application associated with an SLO vary based on the actual workload. It will depend on the average I/O size, read/write ratio, and the use of local and remote replication.

Note that these SLOs are fixed and cannot be modified. The end user can associate the desired SLO with a storage group. Also note that certain SLOs may not be available on an array if certain drive types are not configured. Diamond SLO will not be available if there are no Flash drives present. Bronze SLO will be unavailable if 7.2K RPM drives are not present.

Available Workload Types

Workload Type	Description
OLTP	Small block I/O workload
OLTP with Replication	Small block I/O workload with local or remote replication
DSS	Large block I/O workload
DSS with Replication	Large block I/O workload with local or remote replication

There are four workload types as shown on the slide. The workload type can be specified with the Diamond, Platinum, Gold, Silver and Bronze SLOs to further refine response time expectations. One cannot associate a workload type with the Optimized SLO.

Display Available SLOs

000196800225 > Storage > Service Levels

Service Level Objectives

SLO is a desired level of performance (response time band) required by the storage workload.

	Optimized	Bronze (Unavailable)	Silver	Gold	Platinum	Diamond
						
Expected Average Response Time Hide Details	System Optimized	14.0 ms	8.0 ms	5.0 ms	3.0 ms	Less than 1 ms
Small I/O OLTP	-	14.0 ms	8.0 ms	5.0 ms	3.0 ms	0.8 ms
OLTP + Replication	-	15.5 ms	9.5 ms	6.5 ms	4.4 ms	2.3 ms
Large I/O DSS	-	15.5 ms	9.5 ms	6.5 ms	4.4 ms	2.3 ms
DSS + Replication	-	16.9 ms	10.9 ms	7.9 ms	5.9 ms	3.7 ms

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The available SLOs can be displayed in Unisphere for VMAX (shown on slide) or via SYMCLI (shown below). In this example Bronze is unavailable because this array does not have any 7.2 K RPM drives. The display also shows the expected average response times.

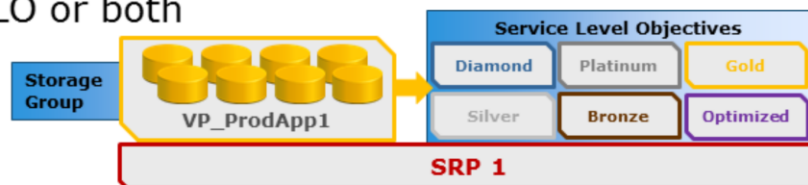
```
C:\Users\Administrator>symcfg list -slo -detail
SERVICE LEVEL OBJECTIVES
```

```
Symmetrix ID : 000196800225
```

```
Approx
Resp
Time
Name      Workload      (ms)
-----
Optimized N/A          N/A
Diamond   OLTP          0.8
Diamond   OLTP_REP      2.3
Diamond   DSS           2.3
Diamond   DSS_REP       3.7
Diamond   <none>        0.8
Platinum  OLTP          3.0
Platinum  OLTP_REP      4.4
Platinum  DSS           4.4
Platinum  DSS_REP       5.9
Platinum  <none>        3.0
Gold      OLTP          5.0
Gold      OLTP_REP      6.5
Gold      DSS           6.5
Gold      DSS_REP       7.9
Gold      <none>        5.0
Silver    OLTP          8.0
Silver    OLTP_REP      9.5
Silver    DSS           9.5
Silver    DSS_REP      10.9
Silver    <none>        8.0
```

Storage Groups

- Logical collection of VMAX3 devices
 - Used for LUN masking and/or FAST
- Can be explicitly associated with an SRP
 - By default an SG is associated with the default SRP
- Can be explicitly associated with an SLO and Workload Type
 - By default SGs are managed by the Optimized SLO
- SG is considered FAST managed if explicitly associated with SRP or SLO or both



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A storage group is a logical collection of VMAX3 Thin devices that are to be managed together. Typically they would constitute the devices used for a single application. Storage group definitions are shared between FAST and auto-provisioning groups (LUN masking).

A storage group can be explicitly associated with an SRP or an SLO or both. Associating an SG with an SRP defines the physical storage to which data in the SG can be allocated on. The association of the SLO and Workload Type defines the response time target for that data. By default devices within a SG are associated with the default SRP and managed by the Optimized SLO. Changing the SRP association on an SG will result in all the data being migrated to the new SRP.

While all the data on a VMAX3 array is managed by FAST, an SG is not considered "FAST managed" if it is not explicitly associated with an SRP or an SLO. Devices may be included in more than one SG, but may only be included in one SG that is "FAST managed". This ensures that a single device cannot be managed by more than one SLO or have data allocated from more than one SRP.

Note that there is a concept of Cascading Storage Groups, wherein a Parent Storage Group has Child Storage Groups as members. Child SGs have thin devices as members. In the case of Cascading Storage Groups, FAST associations are done at the Child SG level. We will discuss these concepts and Storage Groups in even more detail in the Auto-Provisioning Groups module later on in the course.

Thin Device Considerations

- Upon creation
 - By default associated with default SRP and the Optimized SLO
 - Device is automatically in the ready state
- Devices could be added to an existing SG during creation
 - Device will inherit SRP and SLO from SG
- No extents allocated when device is created
 - Extents allocated as a result of host write or pre-allocation request
- A thin device may only be in one SG that is FAST managed
 - Device could be in one FAST managed SG and in other non FAST managed SGs

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When a thin device is created it is implicitly associated with the default SRP and will be managed by the Optimized SLO. As a result of being associated with the default SRP, thin devices are automatically in a ready state upon creation.

During the creation of thin devices, one could optionally add them to an existing storage group. The thin device will then inherit the SRP and SLO set on the SG.

No extents are allocated during the thin device creation. Extents are allocated only as a result of a host write to the thin device or a pre-allocation request.

Devices may be included in more than one SG, but may only be included in one SG that is "FAST managed". This ensures that a single device cannot be managed by more than one SLO or have data allocated from more than one SRP. Trying to include the same device into a second FAST managed SG will result in an error as follows:

"A device cannot belong to more than one storage group in use by FAST"

Lesson Summary

During this lesson the following topics were covered:

- Virtual Provisioning Overview
- FAST Overview
- FAST Elements and Terminology

This lesson provided an overview of Virtual Provisioning and FAST. FAST elements and terminology were also covered.

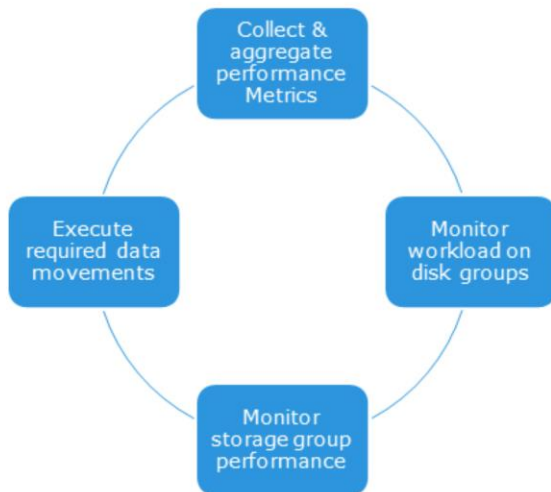
Lesson: FAST Algorithms and Parameters

This lesson covers the following topics:

- FAST Algorithms
- FAST Configuration Parameters
- Best Practice Recommendations

This lesson covers FAST algorithms, configuration parameters and best practice recommendations.

FAST Runtime Implementation



Primary runtime tasks

- Deliver defined storage services
 - based on mixed drive configuration
- Balance capability of storage resources with SG SLOs
- Data movements
 - determined by forecasting future system workload
 - based on observed workload
- Runtime tasks are performed continuously

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The goal of FAST is to deliver defined storage services, namely application performance based on SLOs, based on a hybrid storage array containing a mixed configuration of drive technologies and capacities. Based the configuration of the array FAST balances the capabilities of the storage resources, primarily the physical drives, against the performance objectives of the applications consuming storage on the array. FAST aims to maintain a level of performance for an application that is within the allowable response time range of the associated SLO while understanding the capabilities of each disk group with the SRP.

Data movements performed by FAST are determined by forecasting the future system workload at both the disk group and application level. The forecasting is based on the observed workload patterns.

The primary runtime tasks of FAST are:

- Collect and aggregate performance metrics
- Monitor workload on each disk group
 - Identifies extent groups to be moved to reduce load if necessary
- Monitor storage group performance
 - Identifies extent groups to be moved to meet SLO
- Execute required data movements

All the runtime tasks are performed continuously, meaning performance metrics are constantly being collected and analyzed and data is being relocated within a SRP to meet application SLOs.

Performance Metrics – Collection Levels

- Metrics collected at three levels
 - Disk Group
 - Storage Group
 - Thin Device sub-LUN
- Thin Device sub-LUN – Regions

Region	
Extent	1 track – 128 KB
Extent Group	42 extents – 5.25 MB
Extent Group Set	42 extent groups – 1764 extents – 220.5 MB

- Data movement requests - Extent group - 42 tracks



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Performance Metrics are collected the Disk Group, Storage Group and Thin Device sub-LUN levels. At the sub-LUN level, each thin device is broken up into multiple regions – extents, extent groups and extent group sets.

Each thin device is made up of multiple extent group sets which, in turn, contain multiple extent groups. Each extent group is made up of 42 contiguous thin device extents. Each thin device extent being a single track (128 KB). Thus an extent group is 42 tracks and an extent group set is 1764 tracks.

Metrics collected at each sub-LUN level allow fast to make separate data movement requests for each extent group for the device – 42 tracks.

Performance Metrics

- Read Misses
- Writes
- Prefetch (sequential reads)
- Cache hits
- IO Size
 - Tracked separately for reads and writes
- Workload clustering
 - Based on read-to-write ratio of workloads on specific LBA ranges

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The read miss metric accounts for each DA read operation that is performed. That is data is read from a thin device that was not previously in cache and so needs to be read directly from a drive within the SRP.

Write operations are counted in terms of number of distinct DA operations that are performed. The metric accounts for when writes are destaged.

Prefetch operations are accounted for in terms of the number of distinct DA operations performed to prefetch data spanning a FAST extent. This metric considers each DA read operation performed as a prefetch operation.

Cache hits, both read and write, are counted in terms of the impact such activity has on the front-end response time experienced for such a workload.

The average size of each IO is tracked separately for both read and write workloads.

Workload clustering refers to the monitoring of the read-to-write ratio of workloads on specific logical block address (LBA) ranges of a thin device or data device within a pool.

Data Movement Algorithms

- Capacity
 - SRP capacity compliance
 - Ensures data is on correct SRP
 - SLO capacity compliance
 - Ensures data is on appropriate drive types within SRP
- Performance
 - Disk resource protection
 - SLO response time compliance
 - Both use performance metrics to determine appropriate data pool to allocate data
 - to prevent overloading of a particular disk group
 - to maintain the response time objective of an application

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FAST uses four distinct algorithms as listed on the slide in order to determine the appropriate allocation for data across an SRP. Two are capacity-oriented and the other two are performance-oriented.

The SRP and SLO capacity compliance algorithms are used to ensure that data belonging to specific applications is allocated to the correct SRP and across the appropriate drive types within an SRP, respectively.

The disk resource protection and SLO response time compliance algorithms consider performance metrics collected to determine the appropriate data pool to allocate data in order to prevent the overloading of a particular disk group and to maintain the response time objective to an application.

Capacity Compliance

- SRP Capacity Compliance
 - SRP to SRP movement
 - Invoked when an SG's SRP association is modified
- SLO Capacity Compliance
 - Movement between data pools within an SRP
 - May be invoked when an SG's SLO association is modified

SLO	Flash	15K	10K	7.2K
Diamond	Y	N	N	N
Platinum	Y	Y	Y	N
Gold	Y	Y	Y	Y
Silver	Y	Y	Y	Y
Bronze	N	Y	Y	Y
Optimized (Default)	Y	Y	Y	Y

*When pools are full, to avoid failed allocations, the data may be placed in pools marked "N"

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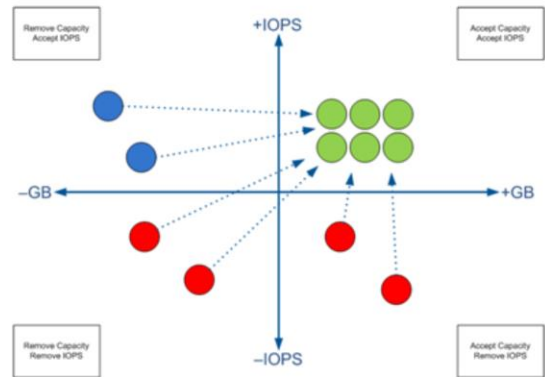
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SRP capacity compliance – Ensures all data belonging to thin devices within a particular SG is allocated within a single SRP. This algorithm is only invoked when an SG's association to an SRP is modified. All data for the devices within the SG will be moved from the original SRP to the newly associated SRP. During the movement, data for the thin devices will be allocated across two SRPs. Note that the removal of an SRP association from an SG may also result in data movement between SRPs if the SG was previously associated with the non-default SRP.

SLO capacity compliance – Ensures all data belonging to thin devices within a particular SG is allocated across the allowed drive types based on the associated SLO. This algorithm is only invoked when an SG's association to an SLO is modified and data currently resides on a drive type not allowed for the new SLO. The table on the slide shows the allowed drive types for each SLO. As an example, if a SG's SLO association is changed from Gold to Diamond, any data allocated for that SG on any spinning drives would be promoted to data pools configured on Flash drives, as this is the only drive type allowed for the Diamond SLO.

Disk Resource Protection

- Protect drives and data pools from being overloaded
 - Esp. 7.2K RPM drives
- Places data on the most appropriate media
 - Heavy read
 - Flash
 - Heavy write
 - RAID 1 (10K or 15 K)
 - No or very low activity
 - 7.2 K
- Basis for Optimized SLO



- Disk Group resources
 - Performance capability IOPS
 - Physical capacity GB
- Aim to maintain operating buffer of both resources

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Disk resource protection algorithm aims to protect disk groups and data pools from being overloaded, with a particular focus on the higher capacity, lower performing drives. Each disk group can be viewed as having two primary resources – performance capability and physical capacity.

The performance capability is measured in terms of IOPS and reflects the workload the disk group is capable of handling. This depends on the number of drives, the drive type, rotational speed (if applicable), capacity and RAID protection. The physical capacity is measured in terms of the total amount of data that can be allocated within the data pool configured on the disk group.

The algorithm aims to maintain an operating buffer of both these resources for each disk group. This is done in such a way as to have overhead available in each disk group to both accept additional data and additional workload should data be moved to the disk group. The picture on the slide illustrates the concept. The vertical axis displays a disk groups ability to accept additional workload or its need to have workload removed (measured in IOPS). The horizontal axis represents the ability to accept additional data from a capacity perspective. The ideal operating quadrant is the upper right hand, where the disk group is capable of accepting additional allocations and workload. The remaining quadrants show situations where FAST will attempt to move data out of a disk group. Greater priority is placed on moving data from disk groups that need to remove IOPS.

When moving data between disk groups to protect these resources FAST attempts to place data on the most appropriate media. Heavy read workloads are targeted for higher performing drives, e.g. Flash. Write heavy workloads are targeted for movement to more write-friendly data pools, e.g. RAID 1 configured on 15 K or 10 K RPM drives. Allocated extents with little or no workload will be targeted for movement to higher capacity, lower performing drives.

The disk resource protection algorithm provides the basis for the default Optimized SLO.

SLO Response Time Compliance

- Provides differentiated performance levels
 - Based on SLO association
 - Tracks overall response time of SG
 - Adjusts data placement to achieve/maintain expected average response time
- Uses response time compliance range
 - If above range – Promote
- Only applies to metal SLOs
 - Platinum, Gold, Silver & Bronze

	SG State	FAST Action
SLO RT Compliance High Threshold	Out Of Compliance	FAST Movements to Reduce Response Time
SLO RT Compliance Low Threshold	In Compliance	No FAST Movements
	Out Of Compliance	No FAST Movements, Response Time can increase

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The SLO response time compliance algorithm provides differentiated performance levels based on SLO associations. The algorithm tracks the overall response time of each storage group that is associated with an SLO and then adjusts data placement to achieve or maintain the expected average response time target.

FAST uses a response time compliance range when determining if data needs to be relocated. When the average response time for the SG is above the desired range, FAST will promote active data to the highest performing data pool, based on the available resources in that pool. The promotion activity continues until the average response time is back within the desired operating range.

Data may also be relocated between spinning drives to achieve the SLO response time target, but this movement will be determined by the disk resource protection algorithm.

The use of the SLO response time compliance algorithm only applies to SGs that are associated with the "metal" SLOs – Platinum, Gold, Silver and Bronze.

Allocation Management

- New extent allocations can come from any data pool in SRP
- Data pools in an SRP have a default ranking according to their ability to handle writes
 - Allocation based on pool rank and SLO
 - Default ranking used for Optimized SLO
 - Ranking is modified for SLOs other than Optimized

Example of Data Pool Ranking for new Allocations

Default	Diamond	Platinum or Gold	Silver or Bronze
1. RAID 1 on 15K	1. RAID 5 on EFD	1. RAID 1 on 15K	1. RAID 1 on 15K
2. RAID 5 on 10K	2. RAID 1 on 15K*	2. RAID 5 on 10K	2. RAID 5 on 10K
3. RAID 5 on EFD	3. RAID 5 on 10K*	3. RAID 5 on EFD	3. RAID 5 on EFD*
4. RAID 6 on 7.2K	4. RAID 6 on 7.2K*	4. RAID 6 on 7.2K	4. RAID 6 on 7.2K

*used only as necessary

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VMAX3 - Virtual Provisioning and FAST Concepts

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New extent allocations, as a result of host write to a thin device, can come from any of the data pools within the SRP to which the thin device is associated. FAST direct the new allocation to come from the most appropriate pool within the SRP. This is based on each data pool's ability to both accept and handle the new write as well as the SLO to which the device allocation is being made or is associated with.

Each data pool within the SRP has a default ranking based on drive technology and RAID protection types in order to better handle write activity. This default ranking is used when making allocations for devices managed by the Optimized SLO. Due to the drive types that are available for each for each SLO, the default ranking is modified for devices managed by SLOs other than Optimized.

Let us consider an example SRP configured with the following data pools - RAID 5 (3+1) on EFD, RAID 1 on 15K RPM drives, RAID 5 (3+1) on 10K RPM drives and RAID 6 (6+2) on 7.2 K RPM drives. The table on the slide shows the data pool ranking for new allocations for this specific combination of data pools for the various SLOs.

As the Diamond SLO only allows extents to be allocated on EFD, the remaining pools in the ranking will only be used in the event that the EFD data pool is full. After the allocation is made to a non-EFD pool, the SLO capacity compliance algorithm will attempt to move the extent into EFD after space has been made available on the pool. Somewhat similarly, in the case of the Bronze SLO, new allocations will come from the EFD pool only if the 15K and 10K pools are full. The allocation is made from the EFD pool in this case even if the 7.4K pool has capacity as this is more beneficial to the overall performance health of the array. The SLO compliance algorithm will subsequently move the EFD allocated extent to a non EFD pool.

New allocations will always be successful as long as there is space available in at least one of the data pools within the SRP to which the device is associated.

FAST Configuration Parameters

- Reserved Capacity
 - Set per SRP
 - Reserves a set percentage of SRP capacity for thin device host allocations
 - Reserved capacity cannot be used by TimeFinder or SRDF/A DSE
 - Valid values - 1 to 80, or NONE
- Usable by SRDF/A DSE
 - Set at SRP level - Only one SRP can be enabled for use by DSE
 - By default, the default SRP is enabled for use by DSE
- DSE Maximum Capacity
 - Set at array level as an absolute capacity in GB
 - Valid values 1 to 100,000, or NOLIMIT

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FAST configuration parameters control the interaction of FAST with both local and remote replication. These parameters only relate to local or remote replication interoperability and thus only apply if TimeFinder and SRDF/A DSE are in use. Note TimeFinder and SRDF are not covered in this course. There are other EMC training offerings which cover TimeFinder and SRDF.

Reserved Capacity: Both TimeFinder snapshot data and SRDF/A DSE related data are written to data pools within an SRP. The reserved capacity parameter allows for the reservation of a percentage of the SRP capacity for thin device host allocations. Capacity reserved by this value cannot be used for TimeFinder snapshot activities or for spillover related to SRDF/A DSE. The reserved capacity is set as a percentage on each SRP. Valid values range from 1 to 80%, or can be set to NONE to disable reserved capacity.

Usable by SRDF/A DSE: One of the SRPs in a VMAX3 array must be assigned for the use of SRDF/DSE. By default, the default SRP is designated for use by SRDF/A DSE. The Usable by SRDF/A DSE parameter can be Enabled or Disabled at the SRP level. It may only be enabled on one SRP at a time. Enabling this parameter on an SRP will automatically disable it on the SRP on which the setting was currently enabled.

DSE Maximum Capacity: In addition to the reserved capacity parameter, the capacity used by DSE can be further restricted by the DSE maximum capacity parameter. This parameter is set at the array level and sets the maximum capacity that can be used by DSE in a spill over scenario. The DSE maximum capacity is set as an absolute capacity in Gigabytes (GB). Valid values are from 1 to 100,000 GB, or can be set to NOLIMIT to disable it.

Managing FAST Configuration Parameters

- symconfigure syntax
 - set srp <srp_name> resv_cap=<value | NONE>;
 - set srp <srp_name> rdfa_dse = <ENABLE | DISABLE>;
 - set symmetrix dse_max_cap = <MaxCap | NOLIMIT>;
- Unisphere for VMAX
 - Properties View of SRP

PROPERTIES	
Usable Capacity (GB)	28487.81
Allocated Capacity (GB)	1108.64
Free Capacity (GB)	27379.17
Subscription (GB)	1227.3
Reserved Capacity % (0-80)	30
Usable by RDFA DSE	☒
Description	

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VMAX3 - Virtual Provisioning and FAST Concepts

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The FAST configuration parameters can be managed with the symconfigure command set or via Unisphere for VMAX. The slide shows the symconfigure syntax. In Unisphere one can navigate to the properties view of an SRP to change the Reserved Capacity and Usable by RDFA DSE parameters.

SRP Configuration Recommendations

- SRP Configuration is designed during ordering process
 - Use as much available information to help the design process
 - EMC personnel use an internal utility called Sizer
 - Estimate the performance capability and cost of mixing different drive types
 - Use performance data from older generation VMAX and Symmetrix arrays to design optimal VMAX3 configurations
- EMC recommends the use of a single SRP
- Multiple SRPs separate and isolate storage resources
 - EMC representatives should be consulted to determine the appropriateness of configuring more than one SRP

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SRPs are pre-configured and their configuration cannot be modified using management software. Thus it is important that the design create for the SRP during the ordering process uses as much information as is available. EMC technical representatives have access to a utility called Sizer that can estimate the performance capability and cost of mixing drives of different technology types, speeds, and capacities, within a VMAX3 array.

Sizer can examine performance data collected from older-generation VMAX and Symmetrix arrays and can model optimal VMAX3 configurations (both for performance and cost). It will also include recommendations for SLOs for individual applications, dependent on the performance data provided. The configurations recommended by Sizer include the disk group/data pool configurations, including drive type, size, speed, and RAID protection, required to provide the performance capability to support the desired SLOs.

EMC recommends the use of a single SRP, containing all the disk groups/data pools configured within the VMAX3. In this way, all physical resources are available to service the workload on the array.

Creating multiple SRPs will separate, and isolate, storage resources within the array. Based on specific use cases, however, this may be appropriate for certain environments. EMC representatives should be consulted in determining the appropriateness of configuring multiple SRPs.

SLO Selection - Recommendations

- Applications being migrated
 - Use existing performance information
 - Average response time
 - Average IO size
 - Translate this to SLO and Workload Type
- Use default Optimized SLO if little/no information is available
 - FAST will provide the best performance based on the availability of resources

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The more information that is available for the applications being provisioned on the VMAX3 array, the easier it will be to select an appropriate SLO for each application. Applications that are being migrated from older storage should have performance information available, including average response time and average IO size. This information can be simply translated to an SLO and Workload Type combination, thereby setting the performance expectation for the application and a target for FAST to accomplish. If little is known about the application, having the default Optimized SLO allows FAST to take most advantage of the resources in the array and provide the best performance for the applications based on the availability and workload already running on the resources.

Associating a non-default SLO to an application, thereby setting a response time target for that application, can limit the amount of capacity allocated on higher performing drives. Once an application is in compliance with its associated SLO, promotions to higher performing drives will stop. Subsequent movements for the application will look to maintain the response time of the application below the upper threshold of the compliance range.

Storage Group Recommendations

- Configure SG for each application
 - Provides most granular management
 - Associate SLO and Workload Type
 - FAST can manage to the response time target for the application
- Use Cascaded Storage Groups
 - If different devices types in the same application require different SLOs
- Non-disruptive Device movement between SGs

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In order to provide the most granular management of applications, it is recommended that each application be placed in its own SG to be associated to an SLO. This provides for more equitable management of data pool utilization and ensures FAST can manage to the response time target for the individual application.

In some cases there may be a need to separately manage different device types within a single application. For example, it may be desired to apply different SLOs to the redo log devices vs the data file devices within the same database. The use of cascaded storage groups is recommended in this case. Cascaded storage groups allow devices to be placed in separate child SGs which can then be placed in the same Parent SG. Each child SG can be associated with a different SLO, while the Parent SG is used in the masking view for the purpose of provisioning devices to the host.

Depending on requirements, it may be necessary to change the SLO of an individual device. This may require moving the device to another SG. Device movement between SGs with different SLOs is allowed and may be performed non-disruptively to the host if the movement does not result in a change to the masking information for the device being moved. That means, following the move, the device is still visible to the exact same host initiators on the same front-end ports as before the move. Devices may also be moved between Child SGs who share the same parent, where the masking view is applied to the parent group.

Lesson Summary

During this lesson the following topics were covered:

- FAST Algorithms
- FAST Configuration Parameters
- Best Practice Recommendations

This lesson covered FAST algorithms, configuration parameters and best practice recommendations.

Module Summary

Key points covered in this module:

- Overview of Virtual Provisioning and FAST
- FAST Elements and Terminology
- FAST Algorithms
- FAST Configuration Parameters
- FAST Best Practice Recommendations

This module covered VMAX3 Virtual Provisioning and FAST concepts. The first lesson provides an overview of Virtual Provisioning and FAST, FAST elements and terminology. The second lesson covered FAST algorithms, configuration parameters and best practice recommendations.

Module: Device Creation and Port Management

Upon completion of this module, you should be able to:

- Create and Delete VMAX3 Thin Devices
- Manage Port Attributes and Associations

This module focuses on VMAX3 device creation and port management.

Lesson: Device Creation

This lesson covers the following topics:

- Device Types
- Creation/Deletion of Devices

This lesson covers VMAX3 device types and the creation/deletion of devices.

VMAX3 – Device Types

- Devices that can be managed via software
 - Thin Devices (TDEV)
 - Thin Gatekeeper Devices
 - Thin BCV Devices (BCV+TDEV)
 - SRDF Thin Devices (RDF1 or RDF2)
- Pre-configured Devices – Cannot be managed via software
 - Data Devices
 - Discussed in Module 1
 - Internal Thin Devices (Int+TDEV)
 - Used by Data Services Hypervisor VMs
 - Tools VMs and eNAS Control Station VMs

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Device Creation and Port Management

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Solutions Enabler and Unisphere for VMAX can be used to create and delete VMAX3 thin devices, thin gatekeeper devices are simply thin devices which have a capacity of 3 cylinders (approximately 6 MB). Thin BCV devices and thin SRDF devices can also be managed with SE and Unisphere on VMAX3 arrays. The VMAX3 arrays come with factory pre-configured devices which cannot be managed with SE and Unisphere, they are the data devices used in the data pools discussed in Module 1 and internal thin devices which are used by Data Services Hypervisor VMs. On VMAX3 arrays the HYPERMAX Operating System provides a data services hypervisor running natively. The Data Services Hypervisor provides storage infrastructure services through virtual machines running on the embedded hypervisor. Storage to these virtual machines is provided by the internal thin devices. We will discuss these services later on in the course.

In this lesson we will focus on the creation and deletion of thin devices and thin gatekeeper devices. SRDF thin devices and thin BCV devices are covered in other EMC training courses.

VMAX3 – Thin Device Attributes

- Attributes can be set at or after device creation
 - SCSI3_persist_reserve – Enabled by default
- All VMAX3 thin devices are dynamic RDF capable
 - No specific attribute needs to be set.

Name	Used by
SCSI3_persist_reserv	Unix and Windows cluster software
DIF1	Oracle to ensure data integrity
AS400_GK	IBM AS400 host control software “STM”

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The attributes listed on the slide can be set on VMAX3 thin devices at or after device creation.

The SCSI3 persistent reservation attribute, sometimes called the PER bit, is used by a number of Unix and Windows cluster software. It is enabled by default.

Data Integrity Field (DIF) is a setting on a device that is relevant to an Oracle environment and all hosts that support the DIF protocol. Oracle objects that are built on devices that have the DIF attribute, send 520 byte CDBs (Command Descriptor Blocks) rather than the normal 512 byte CDBs. The extra 8 bytes are a form of a checksum that validates the 512 bytes of data. When the VMAX3 receives such a CDB on a device that has the DIF attribute, it will validate the Oracle data and honor the write request or reject it if the checksum and the data do not match. The DIF setting is likely to have many different versions of Data Integrity. HYPERMAX OS supports the DIF1 format.

AS400_GK attribute on a VMAX3 thin device is required when a AS400 device is used in conjunction with IBM host control software 'STM'. This attribute is also used in conjunction with the Celerra NAS for Celerra gatekeeper devices.

Note that all VMAX3 thin devices are dynamic RDF capable by default. Thus no specific attribute needs to be set.

Thin Device Creation - SYMCLI

- symconfigure syntax with commonly used options

```
create dev count=<n>, size= <size> [MB | GB | CYL]  
emulation=<Emulation Type>,  
config=TDEV,  
[sg=<SG Name>];
```

- Default size unit is Cylinders
- Emulation type
 - FBA, Celerra_FBA or AS/400_D910_099
- Storage group name can be optionally specified
 - Storage group must exist



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The symconfigure syntax for the creation of devices is shown on the slide. We are only showing the most commonly used options. For the complete list of options please refer to the EMC Solutions Enabler V8.0.1 Array Management CLI User Guide – Chapter 7 Managing Configuration Changes. As discussed in Module 1 the symconfigure command syntax can be submitted using the –file or –cmd options.

The count indicates the number of devices to be created. The size can be specified in megabytes (MB), gigabytes (GB) or in cylinders (CYL). Cylinders is the default. The supported emulations types are FBA, Celerra_FBA and AS/400_D910_099. Celerra_FBA emulation is used for the eNAS solution. The device configuration type for thin devices is TDEV. To create BCV thin devices set config to BCV+TDEV. One can optionally add the newly created devices to a Storage Group by specifying the name of an existing storage group.

Thin Device Creation – SYMCLI – more options

- Other optional options with `create dev`
 - `preallocate size = <ALL>`, `allocate_type = <PERSISTENT>`
 - Only valid preallocate value is ALL - will fully preallocate thin device
 - Allocate type of PERSISTENT will do a persistent preallocation
 - `device_attr = <Attribute Type>`
 - SCSI3_persist_reserve, DIF1, AS400_GK
 - `device_name = <Device Name>`, `number = <n | SYMDEV>`
 - User supplied name for device and suffix

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One can choose to preallocate space for the thin devices in the Storage Resource Pool. The only valid option for the preallocation size is ALL. Thus the entire device will be preallocation. One can set the allocation type to PERSISTENT. Persistent allocations are unaffected by any reclaim operations. The default preallocation is non-persistent.

One can optionally set device attributes previously discussed.

Users can assign a friendly device name to a device at the time of creation. You could use the same name for all the new devices, e.g. mydev, or you can assign the device a name and a numerical suffix that will be incremented for each device. The name plus the suffix may not exceed 64 characters. Setting the number parameter to SYMDEV means that the corresponding VMAX3 device number will be used as the suffix. Solutions Enabler does not check for the uniqueness of names.

Thin Device Creation – SYMCLI - Examples

- Create 5, 10 GB, FBA emulation thin devices and add to storage group dbserver1_oracle
 - `create dev count=5, size =10GB, emulation=FBA, config=TDEV, sg=dbserver1_oracle;`
- Create 10, 10 GB, FBA emulation thin devices with user specified names
 - `create dev count=10, size=10GB, emulation=FBA, config=TDEV, device_name=mydev, number=1001;`
 - First device will be called mydev1001 and the last device will be called mydev1010
 - Can be displayed with `- symdev list -identifier device_name`

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Above are two examples of thin device creation using the symconfigure command.

The device creation request can be placed in a command file “myfile” and the following syntax can be used to commit the change”:

```
#symconfigure -sid ### -file myfile commit
```

To display user defined names on devices use the `symdev list -identifier device_name` command:

```
# symdev list -identifier device_name
```

Symmetrix ID: 000196800225

			Device

Sym	Config	Attr	Device Name

0005B	TDEV		mydev1001
0005C	TDEV		mydev1002
...			

Gatekeeper Creation - SYMCLI

- symconfigure syntax

- `create gatekeeper count=<n>, emulation=<Emulation Type>;`

- Equivalent to

- `create dev count=<n>, size=3 CYL, emulation=<Emulation Type>, config=TDEV;`

- Emulation type

- The AS400_GK attribute is automatically set for the Celerra_FBA and AS/400_D910_099 emulations

- VMAX3 gatekeeper devices are thin devices

- Example – Create 6, FBA gatekeeper devices

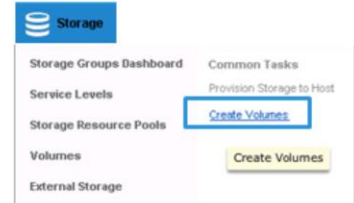
- `create gatekeeper count=6, emulation=FBA;`



The symconfigure create gatekeeper command will result in the creation of VMAX3 thin devices with a capacity of 3 cylinders (approximately 6 MB). The create gatekeeper command is equivalent to the create dev command with the size specified to 3 cylinders and the config set to TDEV. The create gatekeeper command will automatically set the AS400_GK attribute for the AS/400_D910_099 and Celerra_FBA emulations.

Thin Device Creation – Unisphere for VMAX

- Create Volumes Wizard
 - Used to create Thin Devices and Gatekeeper devices
 - Launched by
 - **Create Volumes** common task in the Storage section
 - **Create Volumes** button in Volumes listing
- Provision Storage to Host Wizard
 - Wizard simplifies provisioning storage to hosts
 - Will use existing devices or create new devices as needed
 - We will cover this wizard in an upcoming module



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VMAX3 thin devices and gatekeeper devices can be created in Unisphere for VMAX by using the Create Volumes wizard. Devices can also be created by the Provision Storage to Host wizard. In this lesson we will focus on the Create Volumes wizard. The Provision Storage to Host wizard will be covered in Module 4.

The Create Volumes wizard can be launched from the list of common tasks under the storage section or by clicking on the Create Volumes button in the Volumes listing page.

Create Volume – Thin Devices

The screenshot shows the 'Create Volume' wizard with the following fields and callouts:

- Configuration:** A dropdown menu with 'TDEV' selected. Callouts point to 'TDEV', 'BCV+TDEV', and 'Virtual Gatekeeper'.
- Emulation:** A dropdown menu with 'FBA' selected. Callouts point to 'FBA', 'CELERRA_FBA', and 'AS/400_D910_099'.
- Capacity:**
 - Number Of Volumes:** A text input field with '5' entered.
 - Volume Capacity:** A dropdown menu with '10.00' and 'GB' selected. Callouts point to 'Cyl', 'MB', and 'GB'.
 - Total Capacity:** A text input field showing '50 GB / 27310 Cyl'.
- Add to Storage Group:** A text input field with a 'Select' button. A callout points to it with the text 'Optionally add devices to an existing Storage Group'.
- Volume Identifier:** A dropdown menu with 'None' selected. A callout points to it with a list of options: 'None', 'Name Only', 'Name + VolumeID', and 'Name + Append number'.
- Name:** A text input field with an 'Append Number' button.
- Advanced Options:**
 - ☐ Allocate Full Volume Capacity
 - ☐ Persist preallocated capacity through reclaim or copy
- Buttons:** 'Add to Job List', 'Cancel', 'Help', 'Add to Job List', and 'Run Now'.

On VMAX3 arrays the Create Volume wizard will only allow the creation of thin devices (TDEV), thin BCV devices (BCV+TDEV) or thin gatekeepers (Virtual Gatekeeper).

Configuration: To create thin devices select TDEV in the Configuration drop down selector.

Emulation: FBA is the default, one can also create CELERRA_FBA or AS/400_D910_099 emulation devices.

Capacity:

Number of Volumes: Type in the required number of devices

Volume Capacity: You can type in the required capacity of the devices or use the capacity field drop down to pick an existing device size. You can specify the capacity units in Cyl, MB or GB.

Add to Storage Group: This is an optional field. One can choose to select an existing Storage Group to which the newly created devices will be added. Click on the Select button to choose an existing Storage Group.

The advanced area allows one to optionally give the new devices a Volume Identifier and to optionally allocate the full volume capacity. The Volume Identifier is equivalent to the device name and number specified via SYMCLI.

After specifying the requirements, you can run the job immediately using the Run Now option or alternately add the job to the job list by using the Add to Job List option.

The preferred method is to add the job to the job list as the job list allows running multiple jobs together and also allows scheduling of jobs.

Create Volume – Thin Gatekeepers

Create Volume

* Configuration: Virtual Gatekeeper

Emulation: FBA

* Number Of Volumes: 6

Add to Storage Group: [Select]

Buttons: Add to Job List, Cancel, Help

Callout 1: FBA, CELERRA_FBA, AS/400_D910_099

Callout 2: Add to Job List, Run Now

Callout 3: Optionally add devices to an existing Storage Group

On VMAX3 arrays the Create Volume wizard will only allow the creation of thin devices (TDEV), thin BCV devices (BCV+TDEV) or thin gatekeepers (Virtual Gatekeeper).

Configuration: To create gatekeeper devices select Virtual Gatekeeper in the Configuration drop down selector.

Emulation: FBA is the default, one can also create CELERRA_FBA or AS/400_D910_099 emulation gatekeeper devices. When creating gatekeeper devices with CELERRA_FBA or AS/400_D910_099 emulation, the AS400_GK attribute is automatically set.

Number of Volumes: Type in the required number of gatekeeper devices.

Add to Storage Group: This is an optional field. One can choose to select an existing Storage Group to which the newly created gatekeepers will be added. Click on the Select button to choose an existing Storage Group.

After specifying the requirements, you can run the job immediately using the Run Now option or alternately add the job to the job list by using the Add to Job List option.

The preferred method is to add the job to the job list as the job list allows running multiple jobs together and also allows scheduling of jobs.

Job List – Group Jobs

The screenshot shows the 'Job List - Group Jobs' interface. At the top, there is a breadcrumb trail: '000196800225 > System > Job List'. Below this is a table with columns: Name, Status, User Name, and Last Modified Time. Two rows are visible, both named 'Create Volumes' with status 'CREATED'. Below the table are buttons: 'Run', 'View Details', 'Group' (highlighted with a blue arrow), 'Stop', and 'Delete'. A modal dialog titled 'Group Jobs' is open, asking 'Are you sure you want to group the following jobs into one job?'. It contains a table with the same columns as the main table, showing the two 'Create Volumes' jobs. Below the table is a text input field labeled 'Name for new job' with the text 'Create Thin Devices and Gatekeepers' entered. At the bottom of the dialog are 'OK', 'Cancel', and 'Help' buttons. A blue arrow points to the 'OK' button. Below the dialog, the main table now shows a single row: 'Create Thin Devices and Gatekeepers' with status 'CREATED'. The bottom of the page includes a copyright notice '© Copyright 2015 EMC Corporation. All rights reserved.', the text 'Device Creation and Port Management', the EMC logo, and the page number '99'.

Navigate to the Job List by clicking on Job List big button in the System section or by clicking the Job List link in the status bar. You can group multiple jobs and then run the group of jobs as a single job. Highlight the list of jobs to be grouped and click the Group button.

In the Group Jobs dialog, type a name for the job group and click OK.

The Job Group will now appear in the Jobs List. You can View the details of this Job Group, or Run this job, or Schedule the job to be run at a later time.

Job Group Details

000196800225 > System > Job List > Create Thin Devices and Gatekeepers

Create Thin Devices and Gatekeepers

PROPERTIES

Name: Create Thin Devices and Gatekeepers **Status:** CREATED **Scheduled:** 
Owner: C:\10.126.88.89\vanchi **Last Modified:** Fri 01/02/2015 02:38:12 PM GMT-0500 **Completed:**

TASKS

Order	Task
1	Create 6 thin volumes of (TDEV)(FBA)(capacity for each volume = 3 Cyl)(SCSI3 Persistent Reservation enabled)
2	Create 5 thin volumes of (TDEV)(FBA)(capacity for each volume = 5462 Cyl)(10.00GB)(SCSI3 Persistent Reservation enabled)

Move Up

Move Down

Run **Schedule** **Delete** **Stop** **Ungroup** **Apply** **Cancel**

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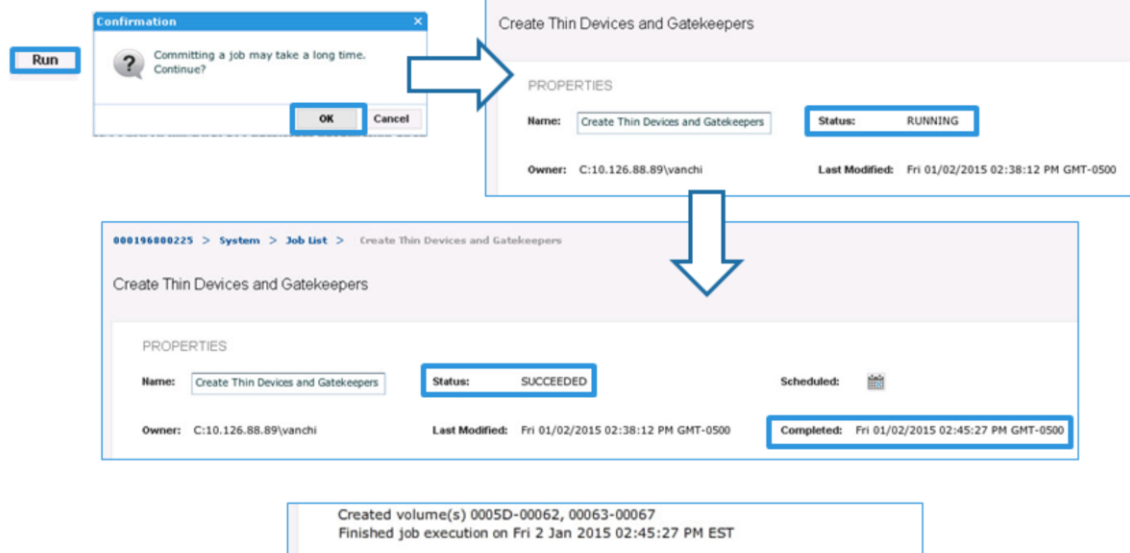
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The details of a Job Group are shown on the slide. If necessary, the grouped job can be ungrouped by clicking the Ungroup button.

As with any other job in the job list, you can Run the job by clicking Run or Schedule the same to be run at later time.

Run Job Group



Click Run either from the Job List view or the Job Details view. Click OK in the Confirmation dialog to run the job. The Status of the job will change to RUNNING. If the jobs complete successfully, the Status will change to SUCCEEDED.

Unisphere - Volumes View

00015688225 > Storage > Volumes

Volume Configuration: TDEV

Capacity equal to: GB

Volume ID: (e.g. 001 or 001-0FF or 001,003-0FF)

Volume Identifier Name:

Additional Criteria: Select Category: Attribute: Is equal to: Value:

Add Another

Find Clear All

Name	Type	Allocated %	Capacity (GB)	Pool State	Status	Emulation	Host Paths	Reserved
- 0005B:mydev1001	TDEV	0 %	10	Bound	Ready	FBA	0	No
- 0005C:mydev1002	TDEV	0 %	10	Bound	Ready	FBA	0	No
- 0005D	TDEV	0 %	0.01	Bound	Ready	FBA	0	No
- 0005E	TDEV	0 %	0.01	Bound	Ready	FBA	0	No
- 0005F	TDEV	0 %	0.01	Bound	Ready	FBA	0	No
- 00060	TDEV	0 %	0.01	Bound	Ready	FBA	0	No
- 00061	TDEV	0 %	0.01	Bound	Ready	FBA	0	No
- 00062	TDEV	0 %	0.01	Bound	Ready	FBA	0	No
- 00063	TDEV	0 %	10	Bound	Ready	FBA	0	No
- 00064	TDEV	0 %	10	Bound	Ready	FBA	0	No
- 00065	TDEV	0 %	10	Bound	Ready	FBA	0	No
- 00066	TDEV	0 %	10	Bound	Ready	FBA	0	No
- 00067	TDEV	0 %	10	Bound	Ready	FBA	0	No

0 Selected 83 items

Create Volumes Delete Create SG View Details >>

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The newly created devices can be seen in the Volumes View. One can navigate to the Volumes View by choosing Volumes from the Storage section dropdown.

Use the Volume Configuration selector to display the desired device type. In this example we have set it to TDEV (thin devices) and then clicked on the Find button. We have scrolled the display to show the newly created devices 005D:0067.

Deleting VMAX3 Devices

- Thin devices must
 - not be mapped to a front-end port
 - not have any allocations or written tracks
- SYMCLI – symconfigure syntax
 - `delete dev SymDevName [:SymDevName];`
- Unisphere
 - Select devices to be deleted in Volume listing and click on Delete



- DATA Devices (TDAT) cannot be deleted with Solutions Enabler or Unisphere for VMAX

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Solutions Enabler or Unisphere for VMAX can be used to delete VMAX3 thin devices. The device to be deleted must not be mapped to a front-end port and also not have any allocations or written tracks.

The symconfigure syntax for the deletion of devices is shown on the slide. The symconfigure command syntax can be submitted using the `-file` or `-cmd` options. To delete devices in Unisphere, navigate to the Volumes listing page, select the devices and then click on Delete. Click Delete in the Delete Volumes confirmation dialog to execute the device deletion.

To free up all allocations or written tracks, you can use the following SYMCLI command - `symdev -sid ## free -all -devs <SymDevStart>:<SymDevEnd>`. To free up all allocations or written tracks in Unisphere, navigate to the Volumes listing page, select the devices and then click on the more button (`>>`) and choose Start/Allocate/Free/Reclaim. In the dialog, choose Free and then check Free all allocations for the volume (written and unwritten).

VMAX3 DATA devices (TDAT) cannot be deleted with Solutions Enabler or Unisphere for VMAX.

Lesson Summary

During this lesson the following topics were covered:

- Device Types
- Creation/Deletion of Devices

This lesson covered VMAX3 device types and the creation/deletion of devices with SYMCLI and Unisphere for VMAX.

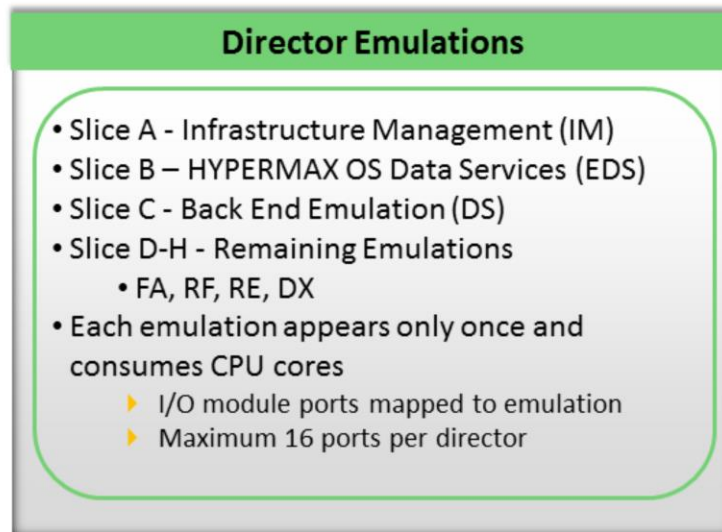
Lesson: Port Management

This lesson covers the following topics:

- Director Emulations
- Port Attributes
- Port Association

This lesson covers VMAX3 director emulations, port attributes and port association.

VMAX3 – Director Emulations



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In the VMAX3 Family of arrays, there are eight slices per director.

Slice A is used for the Infrastructure Manager (IM) system emulation. The goal of the IM emulation is to place common infrastructure tasks on a separate instance so that it can have its own CPU resources. The IM performs all of the environmental monitoring and servicing. All environmental commands, syscalls and FRU monitoring are issued on the IM emulation only. DAE FRUs are monitored by the IM through the DS emulation. If the DS emulation is down, access to DAE FRUs is affected.

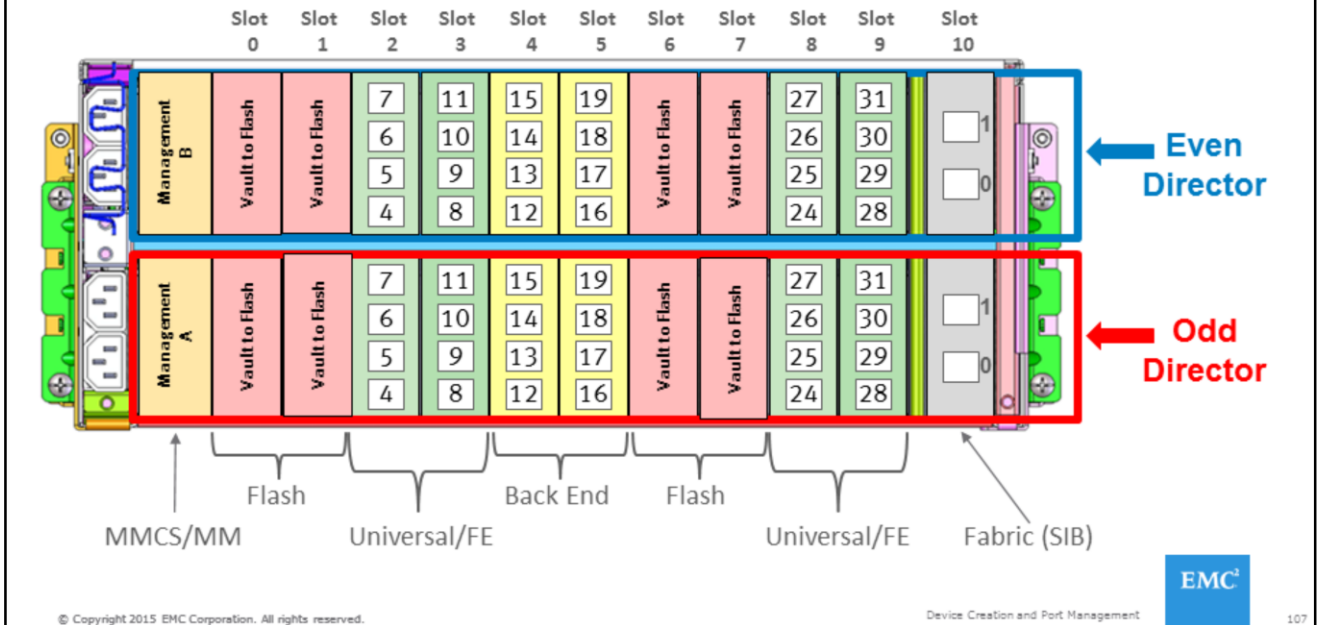
Slice B is used by HYPERMAX OS Data Services (EDS) system emulation. EDS consolidates various HYPERMAX OS functionalities to allow easier and more scalable addition of features. Its main goals are to reduce I/O path latency and introduce better scalability for various HYPERMAX OS applications. EDS also manages Open Replicator data services.

Slice C is used for back end emulation (DS – SAS backend).

Slices D through H are used for the remaining emulations. The supported emulations are Fibre Channel (FA), FC RDF (RF), GigE RDF (RE) and the DX emulation used for Federated Tiered Storage. In the current release of VMAX3, DX emulation is only used for the ProtectPoint solution. Note that only those emulations that are required will be configured.

Each emulation appears only once per director and consumes cores as needed. A maximum of 16 front end I/O module ports are mapped to an emulation. In order for a front end port to be active, it must be mapped to an emulation.

VMAX3 – Logical Port Layout



This is a view of a VMAX3 engine showing the even and odd directors. VMAX3 is designed to support 32 ports per director, ports 0 through 31. These logical ports are numbered left to right, bottom to top, across the eight slots available for front-end and back-end connectivity. Ports 0, 1, 2, 3, 20, 21, 22, and 23 are reserved and not currently used. Ports 4 through 11 and 24 through 31 can be used for front-end connectivity. Ports 12 through 19 are used for back-end connectivity. On the SIB, ports 0 and 1 are used for connectivity to the fabric in each director. Port numbers do not become available unless an I/O module is inserted in the slot. Each FA emulation also supports 32 virtual ports numbered 32-63.

VMAX3 – Director Emulations - Example

```
# symcfg list -dir all -sid 225
```

Symmetrix ID: 000196800225 (Local)

S Y M M E T R I X		D I R E C T O R S			
Ident	Type	Engine	Cores	Ports	Status
IM-1A	IM	1	2	0	Online
IM-2A	IM	1	2	0	Online
ED-1B	EDS	1	5	0	Online
ED-2B	EDS	1	5	0	Online
DF-1C	DISK	1	5	4	Online
DF-2C	DISK	1	5	4	Online
FA-1D	FibreChannel	1	10	11	Online
FA-2D	FibreChannel	1	10	11	Online
RF-1E	RDF-BI-DIR	1	2	1	Online
RF-2E	RDF-BI-DIR	1	2	1	Online

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There is a single emulation instance of a specific type per director. The output from the symcfg list -dir command will display the director emulations. The emulation instances seen in this example output are:

1A & 2A - Infrastructure Manager (IM)

1B & 2B - HYPERMAX OS Data Services (EDS)

1C & 2C - Disk adapter (Output show it as DF – it is the DS backend emulation)

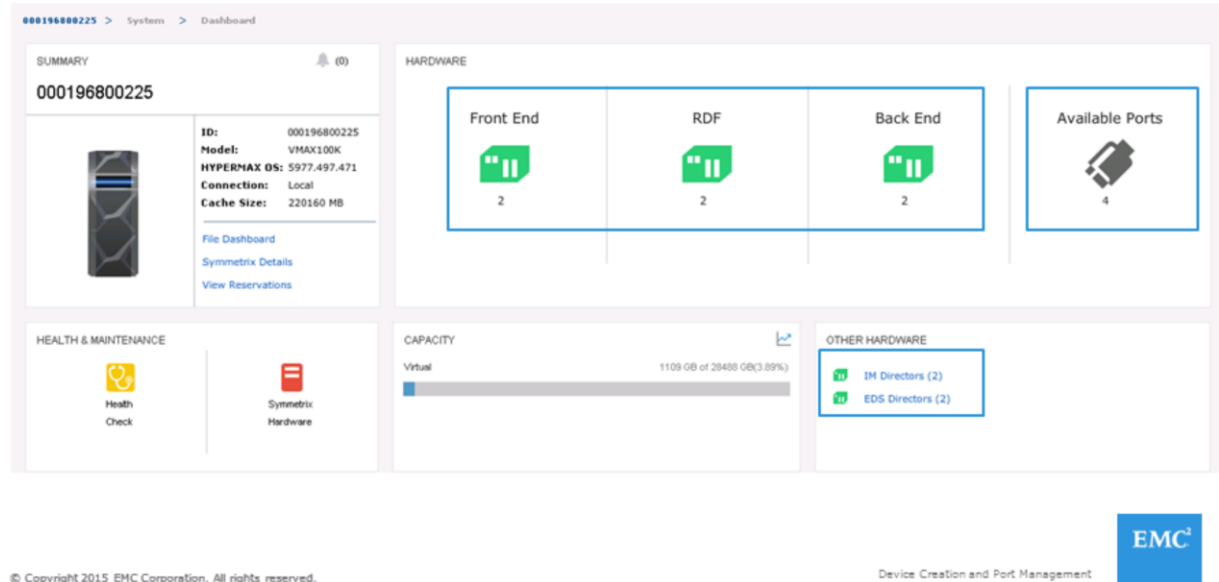
1D & 1D - Fibre Channel Frontend Adapter (FA)

1E & 2E - Fibre RDF (RF).

Also shown are the engine the emulations are running on, the number of cores each emulation is using, number of ports associated with the emulation type and status. Notice the number of ports associated with the FA and RF emulations.

With HYPERMAX OS, all director emulations are capable of supporting multiple cores. The actual number of cores assigned to a director is fixed. In addition, all director emulations support a variable number of ports. Ports are either physical or virtual. Virtual ports are associated with FA directors. IM and EDS are new director emulations introduced in HYPERMAX OS. One can associate and disassociate ports from the FA and RF emulations if needed. We will cover port associations later in this lesson

Unisphere System Dashboard



The Unisphere System Dashboard for a VMAX3 array will show the configured Front End, RDF, Back End, IM and EDS director emulations. The dashboard also shows summary information about the array, one can also run a Health Check. Clicking on the Front End, RDF or Back End icons will show a listing of the relevant ports. Ports that are not associated with any emulations can be seen by clicking on the Available Ports icon.

Host Types

- Physical servers running Unix offered by different vendors
 - HP-UX from Hewlett Packard
 - Solaris from Oracle
 - IBM-AIX from IBM
 - Linux from various companies
- Windows servers running Microsoft Windows
- Virtual Machines running on Hypervisors

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VMAX3 arrays can be attached to a wide variety of operating systems which are too numerous to list here. In the open systems world the most widely used operating systems are MS-Windows and Unix flavors such as Solaris, HP-UX, AIX and Linux. In recent years as VMware has grown in popularity, it is also common to find VMAX3 arrays attached to VMware ESXi servers. For a complete list of supported hosts and operating systems, please consult the E-Lab navigator accessible through the EMC Support Website.

VMAX3 Front-End Port Flag Requirements

- Different Operating Systems need different Bits or Flags set on the front-end port to recognize VMAX3 devices
- ACLX flag allows storage Autoprovisioning for the port
- Port flag settings can be overridden at the initiator group level
- Hosts should access VMAX3 devices over two or more ports
 - With path management software
 - Higher Availability
 - Load balancing

If hosts A & B have the same port flag requirements and host C has different requirements, the initiators on host C can be set to override the port flags on the front end port of the VMAX3



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Many vendors require specific fibre/SCSI flags to be set in order to communicate with the storage array. VMAX3 arrays permit the setting of flags at the front-end port level. Front end ports can be shared by multiple hosts as shown in the picture above. Sometimes hosts sharing the front end ports may have different bit/flag requirements.

To accommodate hosts with different bit/flag requirements, VMAX3 arrays permit port flags to be overridden by flags set at the initiator or initiator group level. The Autoprovisioning `SYMCLI` command `symaccess` or Unisphere for VMAX is used to allocate storage to hosts. The Autoprovisioning process automatically maps and masks the devices. Storage allocation using Autoprovisioning groups is covered later in this course. Most hosts will typically access VMAX3 storage via multiple front-end ports. Host based path management software (e.g. PowerPath) is used to provide higher availability and load balancing.

VMAX3 Simple Support Matrices – EMC E-Lab

The screenshot displays the EMC E-Lab Interoperability Navigator website. The header includes the EMC² ELAB logo, navigation links (HOME, CUSTOM QUERIES, PRODUCT DETAILS, DOCUMENTS), and the URL <https://elabnavigator.emc.com/>. The main content area is titled "SIMPLE SUPPORT MATRICES" and features a grid of product categories: VMAX3, Unified, and Virtualization & Flash. A callout box highlights the "EMC Simple Support Matrix" for "EMC VMAX 400K, VMAX 200K, and VMAX 100K Director Bit Settings", dated "DECEMBER 2014" and "REV 04". The callout also includes the "EMC² ELAB PROVEN" logo. The VMAX3 category lists various storage configurations and their Director Bit settings.

Category	Product	Director Bit Settings
VMAX3	400K/200K/100K	400K/200K/100K Director Bits
	40K	40K Director Bits
	20K	20K Director Bits
	10K	10K Director Bits
Unified	VNX5100/5300/5500/5700/7500	VNX5100/5300/5500/5700/7500 Director Bits
	VNX5200/5400/5600/5800/7600/8000	VNX5200/5400/5600/5800/7600/8000 Director Bits
	ScaleIO	ScaleIO Director Bits
	VPR Software Defined Storage	VPR Software Defined Storage Director Bits
Virtualization & Flash	ScaleIO	ScaleIO Director Bits
	VPR Software Defined Storage	VPR Software Defined Storage Director Bits
	ScaleIO	ScaleIO Director Bits
	VPR Software Defined Storage	VPR Software Defined Storage Director Bits

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Browse to the EMC E-Lab Interoperability Navigator website (<https://elabnavigator.emc.com/>) and then click on the link for the VMAX3 simple support matrix for 400K/200K/100K Director Bits. The Director Bit Settings Simple Support Matrix lists the port flag settings required for the various operating systems.

The host connectivity guides for the different operating systems can also be found on the E-Lab website.

VMAX3 Port Settings for Common Hosts

- HP
 - Volume Set Addressing (V)
 - SPC-2 Compliance (SPC2)
 - SCSI-3 Compliance (SC3)
- IBM AIX, Solaris, Linux, Windows, VMware
 - SPC-2 Compliance (SPC2)
 - SCSI-3 Compliance (SC3)
- Most of the required flags are enabled by default
- ACLX flag is required for Auto-provisioning

These are the common SCSI bus and Fibre port settings used by the common operating systems. To use Autoprovisioning groups on VMAX3 arrays the ACLX flag must be enabled on the port.

VMAX3 ACLX Port Considerations

- ACLX flag is required for Auto-provisioning
 - Enabled by default
- ACLX Device
 - Preconfigured
 - No user management of ACLX device
 - Default LUN Address of 0
 - Visibility on Port
 - Controlled by Show_ACLX_Device attribute
 - Enabled on one FA port by default

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Auto-provisioning groups require the ACLX enabled ports. By default the ACLX flag is enabled on all FA ports. VMAX3 arrays come preconfigured with one ACLX device. A user cannot create, delete or change the attributes of the ACLX device. The device will be visible to hosts at the default address of 000. The device will only be visible on frontend ports that have the Show_ACLX_Device port characteristic set to Enabled.

When VMAX3 arrays comes out of the factory, the first ACLX enabled port will typically have the show ACLX device flag enabled. All other ACLX enabled ports will typically have the flag disabled. As a result is the ACLX device will be visible to hosts only on one port.

Excerpt from VMAX3 Simple Support Matrix

EMC VMAX 400K, VMAX 200K, and VMAX 100K director bit settings for Fibre Channel switches

Category	Flag Description	5977 Factory Default Settings	VPLEX	Windows 2003 SP1 and later	Windows 2008/2012	Linux	HP-UX 11i v1, 11i v2	HP-UX 11i v3	IBM AIX	VMware	Solaris	HP-OpenVMS
FC	Topology	Fabric										
FC	Loop ID	0										
SCSI	Soft Reset	s										
SCSI	Environment Reports to Host	e										
SCSI	Disable Queue Reset on Unit Attention	d ^e				(opt.)					(opt.)	
SCSI	Avoid Reset Broadcast	arb										
SCSI	SCSI3 Interface	SC3 ^{a, c}										
SCSI	SCSI Primary Commands	SPC2 ^{a, c}										
SCSI	OS2007	OS2007 ^e	os2007 ^d			(opt.)	(opt.)	(opt.)		(opt.)	os2007	(opt.)
SCSI	Enable Volume Set Addressing	v ^e					V	V				
FC	Non Participate Hard Addressing	np ^e										
SCSI	Initiator Group	ACLX ^e					(opt.)					
HOST	Open VMS	ovms ^e										OVMS
SCSI	Show ACLX DV	show ^h										
FC	Link Speed	AUTO/2/4/8 Gb ^{b, f}										
		AUTO/4/8/16 Gb ^{b, f}										

For most operating systems the required flags are enabled by default



Here is a excerpt from the VMAX3 Simple Support Matrix for Director Bit Settings in a fibre channel switched environment. For most operating systems the required flags are enabled by default. For HP-UX systems the Volume Set Addressing flag has to be enabled. Please refer to the Simple Support Matrix for more details.

Unisphere – Set Port Attributes

Front End



000196000225 > System > Dashboard > Front End

Director	1 Port	2 Director Status	Port Status	Type	Port ID	Volumes	ACLX	Cores
FA-1D	28	Online	ON	FibreChannel (563)	500009735803841c	12	✓	10
FA-1D	29	Online	PendOn	FibreChannel (563)	500009735803841d	0	✓	10
FA-1D	30	Online	PendOn	FibreChannel (563)	500009735803841e	0	✓	10
FA-1D	31	Online	PendOn	FibreChannel (563)	500009735803841f	0	✓	10
FA-1D	32	Online	ON	FibreChannel (563)	5000097158038400	9	✓	10
FA-1D	33	Online	ON	FibreChannel (563)	5000097158038401	6	✓	10
FA-1D	34	Online	ON	FibreChannel (563)	5000097158038402	17	✓	10
FA-1D	35	Online	ON	FibreChannel (563)	5000097158038403	17	✓	10
FA-1D	36	Online	ON	FibreChannel (563)	5000097158038404	17	✓	10
FA-1D	37	Online	ON	FibreChannel (563)	5000097158038405	17	✓	10
FA-1D	4	Online	ON	FibreChannel (563)	5000097358038404	15	✓	10
FA-1D	5	Online	ON	FibreChannel (563)	5000097358038405	25	✓	10
FA-1D	6	Online	ON	FibreChannel (563)	5000097358038406	1	✓	10
FA-2D	28	Online	ON	FibreChannel (563)	500009735803845c	12	✓	10
FA-2D	29	Online	PendOn	FibreChannel (563)	500009735803845d	0	✓	10
FA-2D	30	Online	PendOn	FibreChannel (563)	500009735803845e	0	✓	10
FA-2D	31	Online	PendOn	FibreChannel (563)	500009735803845f	0	✓	10
FA-2D	32	Online	ON	FibreChannel (563)	5000097158038440	9	✓	10
FA-2D	33	Online	ON	FibreChannel (563)	5000097158038441	6	✓	10
FA-2D	34	Online	ON	FibreChannel (563)	5000097158038442	17	✓	10

1 Selected

Enable Disable Map View Details >>

Set Port Attributes
 Unmap
 Associate
 Disassociate

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VMAX3 front-end port attributes or characteristics can be set via the SYMCLI symconfigure command or with Unisphere for VMAX. The symconfigure syntax is:

```
set port DirectorNum:PortNum FlagName=enable|disable;
```

Please refer to the Solutions Enabler V8.0.1 Array Management CLI User Guide Chapter 7 for more details.

To set port attributes in Unisphere for VMAX navigate to the System Dashboard and then click on the Front End director icon to list the Front End director ports. Select a specific front-end port. One can Enable/Disable the port, View Details or click on the more (>>) icon and choose other options including Set Port Attributes.

In this example we will first click on View Details to see the details of the port and then Set Port Attributes from the details view.

Front-end Port Details – Set Port Attributes

The screenshot shows the 'Front-end Port Details' page for port FA-1D:29. The 'PROPERTIES' table on the left lists various attributes, with 'Volume Set Addressing' highlighted in blue. A blue arrow points from this row to the 'Set Port Attributes' dialog on the right. In the dialog, 'Volume Set Addressing' is checked, and the 'Add to Job List' button is highlighted in blue. The EMC logo is in the bottom right corner.

PROPERTIES	
Port ID	500009735803841d
Fibre Channel Loop ID	N/A
VCM State	N/A
ACLX	Enabled
Common Serial Number	Enabled
Unique WWN	Disabled
Init Point to Point	Disabled
Volume Set Addressing	Disabled
VNX Attached	Disabled
Avoid Reset Broadcast	Disabled
Negotiate Reset	Disabled
Enable Auto Negotiate	Disabled
Environ Set	Disabled
Disable Q Reset on UA	Disabled
Soft Reset	Disabled
SCSI 3	Enabled
SCSI Support1(OS2007)	Enabled
No Participating	Disabled
SPC2 Protocol Version	Enabled

Set Port Attributes

Director Port: FA-1D:29
Copy from Director Port: [v]
☒ ACLX ☐ HP3000 Mode
☐ Show ACLX Volume ☐ Sunapee
☒ Common Serial Number ☐ Siemens
☐ Unique WWN ☐ Sequent
☐ Init Point to Point ☐ Server on AS400
☒ **Volume Set Addressing** ☐ Enable AS400
☐ Avoid Reset Broadcast ☐ Open VMS
☐ Negotiate Reset
☐ Enable Auto Negotiate
☐ Environ Set
☐ Disable Q Reset on UA
☐ Soft Reset
☒ SCSI 3
☒ SCSI Support1
☐ Non Participating
☒ SPC2 Protocol Version

Add to Job List [v] Cancel Help

Highlight a port on the Front End Directors page and click on View Details (see picture on last page) to see the details of a particular port.

In this example we are seeing the details of FA 1D:29. The current port flag settings are shown in the graphic on the left. In this example we see that Volume Set Addressing is disabled.

Some attributes changes may require the port to be offline. One can offline a port by clicking on the Disable button.

Click on the Set Port Attributes button to launch the Set Port Attributes dialog. Make the desired changes in the Set Port Attributes dialog. For example we could choose to enable Volume Set Addressing.

After making the desired changes and click "Add to Job List". This will list the task in the Job List view from where the command can be run. Alternately one can choose Run Now.

Listing Free Ports

```
C:\>symcfg list -free -port -sid 225
```

Symmetrix ID: 000196800225

Slot	Port	Flags FCIS	Speed Gb/sec	Status
---	---	-----	-----	-----
1	30	YY..	16	Powered
1	31	YY..	16	Powered
2	30	YY..	16	Powered
2	31	YY..	16	Powered

Legend:

Flags:

(F)C : Y = Yes, . = No
 F(C)OE : Y = Yes, . = No
 F(I)CON : Y = Yes, . = No
 I(S)CSI : Y = Yes, . = No

Available Ports



000196800225 > System > Dashboard > Available Ports

Slot	Speed(GB/Second)	Port	Type
1	16	30	Fibre
1	16	31	Fibre
2	16	30	Fibre
2	16	31	Fibre

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For VMAX3 arrays running HYPERMAX OS 5977 there is only a single emulation instance of a specific type (FA, DS, RF, etc.) available per director board as we had discussed earlier. If one needs more connectivity, one can add additional ports to an existing emulation instance. That instance uses all cores configured to it to drive the workload across all ports assigned to it.

A capability attribute on each physical port determines the set of front-end emulations to which the port may be assigned. One can associate (assign) unused ports to front-end emulations and disassociate (free) ports from the FA and RF emulation types.

Ports that are available to be associated with an emulation can be listed with SYMCLI or with Unisphere for VMAX as shown on the slide. The Slots numbers refer to the directors.

Associate Ports

- symconfigure syntax

- `associate port <portnum>, [<portnum>, ...] to dir <dirnum>;`
- Example associate ports 30,31 to director 1D
`associate port 30,31 to dir 1D;`

- Unisphere

000196800225 > System > Dashboard > Available Ports

Slot	Port	Speed(GB/Second)	Type
1	30	16	Fibre

Associate



Port Association

Available Directors - Select Director to associate with port

Slot	Type	Director Status
1	FibreChannel	Online
1	RDF-BI-DIR	Online

OK Cancel Help

- Online the port after association

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Free/Available ports can be associated with a desired director emulation. The SYMCLI `symconfigure` syntax is shown on the slide with an example. In Unisphere for VMAX, select an available port from the Available Ports listing and then click on Associate. In the Port Association dialog select the desired emulation to which the port should be associated and then click on OK to complete the association.

Once the port has been associated it must be brought online. Use the SYMCLI `symcfg -fa xx -p xx online` command or use Unisphere for VMAX to enable the port. The port can be enabled from the Front End Director port list view (we saw this view when we were setting port attributes via Unisphere).

Disassociate Ports

- Disassociate considerations
 - Front-end port must not be in a port group
 - RDF port must not have any RDF groups configured
 - Port must be offline
- symconfigure syntax
 - `disassociate port <portnum>, [<portnum>, ...] from dir <dirnum>;`
 - Example disassociate ports 30,31 from director 1D
`disassociate port 30,31 from dir 1D;`
- Unisphere
 - Select desired port from Front End or RDF port listing and click Disassociate

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Prior to disassociating ensure that a front-end port is not in a port group or the RDF port does not have any RDF groups configured. Ports have to be offline before they can be disassociated from a give director. One can offline the port with SYMCLI or Unisphere for VMAX.

The SYMCLI symconfigure syntax is shown on the slide with an example. In Unisphere for VMAX, select the port to be disassociated from the Front End or RDF port listing and then choose Disassociate.

Lesson Summary

During this lesson the following topics were covered:

- Director Emulations
- Port Attributes
- Port Association

This lesson covered VMAX3 director emulations setting port attributes and managing port associations. Port management with SYMCLI and Unisphere for VMAX was covered.

Lab: Port Management with Unisphere and SYMCLI

This lab covers

- Port management with Unisphere for VMAX
- Port management with SYMCLI

This Lab covers Port Management with Unisphere and SYMCLI.

Module Summary

Key points covered in this module:

- Creation and deletion of VMAX3 thin devices
- Management of port attributes and port associations

This module covered VMAX3 device creation/deletion and port management.

Module: Storage Allocation using Auto-provisioning Groups

Upon completion of this module, you should be able to:

- Describe Auto-provisioning Groups
- Explain Host I/O Limits
- Articulate Host Considerations for Storage Allocation
- Perform SLO based provisioning with Unisphere for VMAX
- Perform SLO based provisioning with SYMCLI

This module focuses on storage allocation if VMAX3 storage to hosts using auto-provisioning groups. We will describe auto-provisioning groups, Host I/O limits and host considerations while allocating storage. We will then use Unisphere for VMAX and SYMCLI to perform SLO based storage provisioning.

Lesson: Auto-provisioning Groups Overview

This lesson covers the following topics:

- Auto-provisioning Groups
- Host I/O Limits

This lesson provides an overview of auto-provisioning groups and Host I/O limits. We also introduce the SYMCLI syntax to manage auto-provisioning groups.

Auto-provisioning Overview

- Makes it easy to provision storage in environments with clusters and hosts using multiple paths to the array
- Managed with SYMCLI or Unisphere for VMAX
- SYMCLI
 - `symaccess` command manages all auto-provisioning groups and Masking Views
 - `symmsg` command manages Storage Groups (SGs)
 - Used for auto-provisioning and FAST
 - Performs many of the functions that `symaccess` performs on SGs
 - Also used to set Host I/O limits, SRP, SLO and Workload Type
- Unisphere for VMAX
 - Storage and Hosts sections

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Storage Allocation using Auto-provisioning Groups

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As the number of volumes in a single array continues to climb higher, auto-provisioning offers a flexible scheme for provisioning storage in large enterprises. Auto-provisioning groups allow storage administrators to create groups of host initiators (Initiator Groups), front-end ports (Port Groups), and logical devices (Storage Groups). These groups are then associated to form a masking view, from which all controls are managed. This reduces the number of commands needed for masking devices, and allows for easy management of LUN masking.

Auto-provisioning in the VMAX3 arrays is achieved through the use of the `symaccess` SYMCLI command or with Unisphere for VMAX. The `symaccess` command can manage Storage Groups, Port Groups, Initiator Groups and Masking Views.

The `symmsg` SYMCLI command manages storage groups and is used for auto-provisioning and with FAST (Fully Automated Storage Tiering) to set the required SRP, SLO and Workload Type.

In Unisphere the Storage and Hosts sections are used to manage auto-provisioning. The Storage section has the Storage Groups Dashboard. Port Groups, Hosts (Initiator Groups) and Masking Views are managed under the Hosts section.

Auto-provisioning Groups



Group Names

- Up to 64 characters long
- Case insensitive
- Unique per group type

Initiator Group

Contains WWNs

Port Group

Contains Ports

Storage Group

Contains Devices

Masking View

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Storage Allocation using Auto-provisioning Groups

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Auto-provisioning Groups are used for device masking on VMAX3 family of arrays.

An Initiator Group contains the world wide name of a host initiator, also referred to as an HBA or host bus adapter. An initiator group may contain a maximum of 64 initiator addresses or 64 child initiator group names. Initiator groups cannot contain a mixture of host initiators and child IG names.

Port flags are set on an initiator group basis, with one set of port flags applying to all initiators in the group. However, the FCID lockdown is set on a per initiator basis. An individual initiator can only belong to one Initiator Group.

However, once the initiator is in a group, the group can be a member in another initiator group. It can be grouped within a group. This feature is called cascaded initiator groups, and is only allowed to a cascaded level of one.

A Port Group may contain a maximum of 32 front-end ports. Front-end ports may belong to more than one port group. Before a port can be added to a port group, the ACLX flag must be enabled on the port.

Storage groups can only contain devices or other storage groups. No mixing is permitted. A Storage Group with devices may contain up to 4K VMAX3 logical volumes. A logical volume may belong to more than one storage group. There is a limit of 16K storage groups per VMAX3 array. A parent SG can have up to 64 child storage groups.

One of each type of group is associated together to form a Masking View.

Auto-provisioning Flexibility

- Initiators can be dynamically added or removed from initiator groups
- Ports can be dynamically added or removed from port groups
- Storage can be dynamically added or removed from storage groups
- Automatic session rollback in the event of a session failure

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Once the groups have been created, auto-provisioning represents an easy way to handle provisioning. It allows one to mask multiple devices, ports, and HBAs by placing them into groups. These groups can be dynamically altered to give the host access to new storage.

With the `symaccess` command, all groups and views are backed up to a file, and can be restored from a backup file.

When an auto-provisioning session fails on a VMAX3 array, the system automatically rolls back the ACLX database to the state it was in prior to initiating the session. This rollback feature recovers the database and releases the session lock automatically. The audit log contains any messages relating to the rollback.

VMAX3 Arrays – Provisioning Limits

Object	Configuration Limits – Maximum
Devices	16K per director 4K per storage group
Initiator Group	64 initiators (or 64 child IGs) per IG
Storage Group	16K SGs per array 64 child SGs per parent SG
Port Group	16K PGs per array 32 ports per PG
Masking View	16K MVs per array
LUN Addresses	4K LUN addresses per director port

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The table shows the provisioning limits for VMAX3 arrays.

Storage Groups

- Collection of VMAX3 devices
 - Used for LUN masking and/or FAST
- Can be explicitly associated with SRP, SLO and Workload Type
 - Default – SG is associated with Default SRP and Optimized SLO
 - SG considered FAST managed if explicitly associated with SRP or SLO or both
- A thin device may only be in on SG that is FAST managed
 - Device could be in one FAST managed SG and in other non FAST managed SGs

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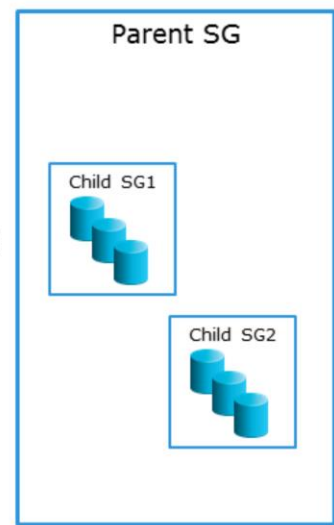
130

This is a review of storage group information we had already covered in an earlier module.

A storage group is a logical collection of VMAX3 Thin devices that are to be managed together. Storage group definitions are shared between FAST and auto-provisioning groups (LUN masking). A storage group can be explicitly associated with an SRP or an SLO or both. By default devices within a SG are associated with the default SRP and managed by the Optimized SLO. While all the data on a VMAX3 array is managed by FAST, an SG is not considered "FAST managed" if it is not explicitly associated with an SRP or an SLO. Devices may be included in more than one SG, but may only be included in one SG that is "FAST managed". This ensures that a single device cannot be managed by more than one SLO or have data allocated from more than one SRP.

Cascaded Storage Groups

- Storage group with other storage groups as members
 - Single level of cascading
- Parent SG
 - Inherits all the devices in the Child SGs
 - Cannot inherit same device from more than one child
- Child SG
 - Contains devices only
 - SRP, SLO & Workload Type set on child
 - May only be contained in a single parent
- Masking is typically done on the parent



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HYPERMAX OS arrays provides the capability for storage groups to contain other storage groups. These groups are called cascaded storage groups. The storage group with the other storage groups as members is called the parent. The storage groups, containing only devices, that is contained within the parent storage group is referred to as the child storage groups. This cascading of storage groups allows for individual FAST policies (SRP, SLO & Workload Type settings) for the child storage groups and a masking view for the parent storage group.

Only a single level of cascading is permitted. A parent storage group may not be a child of another storage group. Storage groups can only contain devices or other storage groups. No mixing is permitted.

Empty storage groups can be added to a parent storage group as long as the parent storage group inherits at least one device when the parent storage group is in a view. A parent storage group cannot inherit the same device from more than one child storage group. A child storage group may only be contained by a single parent storage group.

No parent storage group can be FAST managed. An FAST managed SG is not allowed to be a parent SG.

Masking is not permitted for a child SG which is contained by a parent SG already part of a masking view. Masking is not permitted for the parent SG which contains a child SG that is already part of a masking view.

A child SG cannot be deleted until it is removed from its parent SG.

Create Storage Group – SYMCLI Syntax

- symaccess example - Create SG and add devices

```
#symaccess create -sid 225 -name SG_1 -type storage  
devs 50:52
```

- symsg example - Create SG and set SLO & WL

```
#symsg create -sid 225 SG_1 -slo Gold -wl DSS  
#symsg -sg SG_1 addall devs -range 50:52
```



VMAX3 Devices 50, 51 and 52

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The example shows how to use both symaccess and symsg commands to create storage groups. Note that the symaccess command allows you to create the storage group and simultaneously add devices or child storage groups. The symsg command allows one to create an empty storage group first and then populate it with devices or child storage groups. The symsg command will also allow one to set the SLO and Workload type and Host I/O limits while the storage group is created.

Please refer to the EMC Solutions Enabler V8.0.1 Array Management CLI User Guide for more details and options while creating and managing storage groups with the symaccess and symsg commands.

Other Common SG Operations - SYMCLI

Action	symaccess	symsg
Add devices	<code>symaccess -sid 80 -name MyGrp -type storage add devs CD:F4</code>	<code>symsg -sg MyGrp -sid 80 addall devs -range CD:F4</code>
Remove devices	<code>symaccess -sid 80 -name MyGrp -type storage remove devs CD:F4</code>	<code>symsg -sg MyGrp -sid 80 rmall devs -range CD:F4</code>
Display group info	<code>symaccess list -type storage -sid 80 symaccess show -name MyGrp -type storage -sid 80</code>	<code>symsg list -sid 80 symsg show MyGrp -sid 80</code>
Delete a group	<code>symaccess -sid 80 -name MyGrp -type storage delete</code>	<code>symsg delete MyGrp -sid 80</code>

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Here are some other commonly performed Storage Group operations. Storage Groups can be renamed if needed. Please refer to the EMC Solutions Enabler V8.0.1 Array Management CLI User Guide for more details and options while creating and managing storage groups with the `symaccess` and `symsg` commands.

Set SRP/SLO/Workload Type – symsg syntax

```
symsg -sg <SgName> -sid <SymmID>
```

```
    set [-slo <SLOName> [-wl <WorkloadName>] | -noslo]
```

```
        [-srp <SRPName> | -nosrp]
```

- -slo
 - Diamond, Platinum, Gold, Silver, Bronze, Optimized (default)
- -wl
 - OLTP, OLTP_REP, DSS, DSS_REP
- -noslo – Removes any explicitly set SLO, also removes workload type

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By default Storage Groups will use the default SRP and be managed by the Optimized SLO. The SG is considered FAST managed only if an SLO or SRP is explicitly set. The valid arguments for the -slo and -wl options are listed. Of course the array should be configured with appropriate drives to support the SLO. The -noslo option removes any explicitly set SLO and WL type, the SG is now managed by the Optimized SLO. The -nosrp option removes any explicitly set SRP, the SG will use the default SRP.

Host I/O Limits Overview

- Set limits on the front-end bandwidth and IOPS consumed by applications on VMAX3 arrays
- Limits are set on a per Storage Group basis
 - Storage Group is associated with a Masking View
 - Limits are distributed across the directors in the Port Group of the associated masking view
 - Distribution can be dynamic
 - I/O limits may be placed on parent and child storage groups

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Storage Allocation using Auto-provisioning Groups

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Host I/O Limits feature allows users to place limits on the front-end bandwidth and IOPS consumed by applications on VMAX3 systems.

Limits are set on a per-storage-group basis. As users build masking views with these storage groups, limits for maximum front-end IOPS or MB/s are distributed across the directors within the associated masking view. The VMAX3 system then monitors and enforces against these set limits.

The Host I/O Limits can be managed and monitored using both Solutions Enabler and Unisphere for VMAX.

Host I/O Limits - Benefits

- Ensures that applications cannot exceed their set limit, reducing the potential of impacting other applications
- Provides greater levels of control on performance allocation in multi-tenant environments
- Enables predictability needed to service more customers on the same array
- Simplifies quality-of-service management by presenting controls in industry-standard terms of IOPS and throughput
- Provides the flexibility of setting either IOPS, throughput or both, based on application characteristics and business needs
- Manages expectations of application administrators with regard to performance

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The benefits of Host I/O Limits are listed on this slide. Please take a moment to review them.

Host I/O limits are beneficial whenever a VMAX3 array is shared among multiple tenants by enabling the setting of consistent performance SLAs. They prevent applications from using more than their allotted share of VMAX3 front end resources.

Host I/O Limits - Features

- Cascaded Storage Groups
 - Limits can be set on parent, on child or on both
 - Sum of all child limits may exceed the parent's limit
 - Total I/O rate of all the children will remain limited by parent's limit
 - Individual child limit may not exceed parent's limit
- Dynamic I/O Distribution
 - Mode can be Never, OnFailure or Always
 - Default – Never – Implies static even distribution
 - OnFailure – On a failure I/O Limits are redistributed to online ports
 - Always – I/O Limits are dynamically distributed based on demand

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For Cascaded Storage Groups, users may set up a cascaded SG configuration where there are optional limits assigned to each individual child SG. The parent SG may also have its own assigned limit. The sum of child limits may exceed the parent's limit; however, the I/O rate of all child SG's combined will remain limited by the parent's limit. Also, the individual child SG limits may not exceed the parent's assigned limit.

Host I/O distribution is governed by the Dynamic Mode setting. The default mode is Never which implies a static even distribution of configured limits across the participating directors in the port group. The 'OnFailure' mode causes the fraction of the configured Host I/O limits available to a configured port to be adjusted, based on the number of ports that are currently online. Setting the dynamic distribution to 'Always' causes the configured limits to be dynamically distributed across the configured ports, allowing the limits on each individual port to adjust to fluctuating demand.

As an example if the mode is set to 'OnFailure' in a two-director port group which is part of a masking view, both directors are assigned half of the total limit. If one director goes offline, the other director will automatically be assigned the full amount of the limit, making it possible to insure the application running at full speed regardless of a director failure.

Host I/O Limits – Considerations

- Only one limit per storage group
- Devices in multiple storage groups can only adhere to one limit
- A storage group with a Host I/O Limit can be associated with, at most, one port group in any provisioning view
- In most cases, the total Host I/O Limits may only be achieved with proper host load balancing between directors

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Only one limit can be set per storage group, and devices in multiple storage groups can only adhere to one limit.

At any given time, a storage group with a Host I/O Limit can be associated with, at most, one port group in any provisioning view. This means if the storage group with a Host I/O Limit is in a provisioning view with a port group, the storage group and port group combination have to be used when creating other provisioning views on the storage group.

In most cases, the total Host I/O Limits may only be achieved with proper host load balancing between directors (by multipath software on the hosts, such as PowerPath).

Setting Host I/O Limits – symmsg syntax

- Can be set during SG creation or on existing SG

- During creation

```
symmsg -sid <SymmID> create <SgName>  
    [-bw_max <MBperSec>]  
    [-iops_max <IOperSec>]  
    [-dynamic <NEVER | ALWAYS | ONFAILURE>]
```

- Existing SG

```
symmsg -sg <SgName> -sid <SymmID>  
    set <[-bw_max <MBperSec> | NOLIMIT ]  
        [-iops_max <IOperSec> | NOLIMIT ]  
        [-dynamic <NEVER | ALWAYS | ONFAILURE>]>
```



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Host I/O limits can be set with the symmsg command when the SG is created or on an existing SG.

Options:

-bw_max – Limits the bandwidth specified in Megabytes per sec. The valid range for bandwidth is from 1 MB/Sec to 100,000 MB/Sec. NOLIMIT removes any set limits.

-iops_max – Limits the I/Os per sec. The valid range for IOPs is from 100 IO/Sec to 2,000,000 IO/Sec and must be specified in units of 100 IO/Sec. NOLIMIT removes any set limits.

-dynamic – Sets the mode for the dynamic I/O distribution we had discussed earlier in this lesson. NEVER is the default.

Port Groups

- Contain valid front end ports
- A port can belong to more than one port group
- Ports must have ACLX flag enabled
- Create Port Group – SYMCLI Example



```
# symaccess create -sid 225 -name PG_1 -type port  
-dirport 1D:6,2D:6
```

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Port groups contain front-end director and port identification. A port can belong to more than one port group. On VMAX3 arrays running HYPERMAX OS one cannot mix different types of ports (i.e. physical FC ports and virtual FC ports) within a single port group. Ports must have the ACLX flag enabled – as discussed before ACLX flag is enabled by default.

Ports can be added and removed. When a port group is no longer associated with a masking view, it can be deleted.

The SYMCLI example shown creates a new PG named PG_1 containing two front-end ports.

Please refer to the EMC Solutions Enabler V8.0.1 Array Management CLI User Guide for more details and options while creating and managing port groups with the symaccess command.

Other Common PG Operations - SYMCLI

Action	symaccess
Add port to port group	<code>symaccess -sid 80 -name MyPorts -type port -dirport 1D:6 add</code>
Remove port from group	<code>symaccess -sid 80 -name MyPorts -type port remove -dirport 1D:6</code>
Display group contents	<code>symaccess list -name MyPorts -sid 80</code> <code>symaccess show MyPorts -type port -sid 80</code>
Delete a group	<code>symaccess -sid 80 -name MyPorts -type port delete</code>
List the group(s) that a port belongs to	<code>symaccess list -sid 80 -type port -dirport 1D:6</code>



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These are some of the operations commonly performed on a Port Group. Port Groups can be renamed if needed. Please refer to the EMC Solutions Enabler V8.0.1 Array Management CLI User Guide for more details and options while creating and managing port groups with the symaccess command.

Initiator Groups

- Container of host initiators
 - Can be cascaded
 - Cannot mix host initiators and child IG names
 - Cannot mix host initiator types
- An initiator may belong to only one IG
- A child IG may belong to one or more parent IGs
- Cascaded IG Example
 - Child_IG1 contains WWN1 & WWN2
 - Child_IG2 contains WWN3 & WWN4
 - Parent_IG contains Child_IG1 and Child_IG2

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An initiator group is a container of one or more host initiators (Fibre WWNs). Each VMAX3 initiator group can contain up to 64 initiator addresses or 64 child IG names. Initiator

groups cannot contain a mixture of host initiators and child IG names. Thus an IG contains only host initiators or an IG contains only child IG names.

One cannot mix different types of initiators (i.e. external Fibre Channel WWNs and internal guest Fibre Channel WWNs) within a single Initiator Group. In addition, all child IG names added to a parent initiator group must contain the same Initiator type.

Create Initiator Group – SYMCLI Example

```
#symaccess create -sid 225 -name IG_1 -type initiator -consistent_lun  
-wwn 2100001b321e9dd5  
  
#symaccess -sid 225 -name IG_1 -type initiator add -wwn 2101001b323e9dd5
```

OR

```
#symaccess create -sid 225 -name IG_1 -type initiator -consistent_lun  
-file HBA_WWNS
```

File HBA_WWNS contains

```
wwn:2100001b321e9dd5  
  
wwn:2101001b323e9dd5
```



Initiator WWNs

```
2100001b321e9dd5  
  
2101001b323e9dd5
```

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You can create an initiator group using the HBA's WWN or a file containing WWNs or another initiator group name. Use the `-consistent_lun` option if the devices of a storage group (in a view) need to be seen on the same LUN on all ports of the port group. If the `-consistent_lun` option is set on the initiator group, HYPERMAX OS will make sure that the host LUN number assigned to devices is the same for the ports. If this is not set, then the first available LUN on each individual port will be chosen.

Please refer to the EMC Solutions Enabler V8.0.1 Array Management CLI User Guide for more details and options while creating and managing initiator groups with the `symaccess` command.

Other Common IG Operations - SYMCLI

Action	symaccess
Add initiator to group	<code>symaccess -sid 80 -name MyInit -type initiator add -wwn 10000000c92ab6de</code>
Remove initiator from initiator group	<code>symaccess -sid 80 -name MyInit -type initiator remove -wwn 10000000c92ab6de</code>
Display group contents	<code>symaccess list -name MyInit -sid 80</code> <code>symaccess show MyInit -type initiator -sid 80</code> <code>symaccess show MyInit -type initiator -sid 80 -detail</code>
Delete a group	<code>symaccess -sid 80 -name MyInit -type initiator delete</code>
List the group(s) that an initiator belongs to	<code>symaccess list -sid 80 -type initiator</code> <code>-wwn 10000000c93124ae</code>

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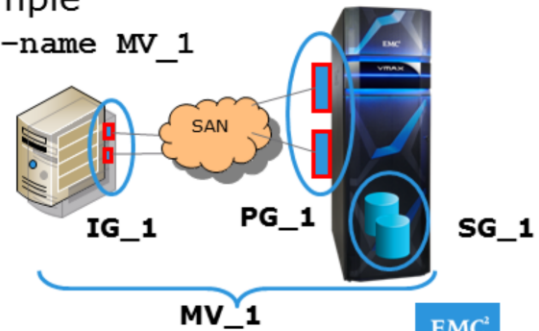
144

These are some of the operations commonly performed on a Initiator Group. Initiator Groups can be renamed if needed. Please refer to the EMC Solutions Enabler V8.0.1 Array Management CLI User Guide for more details and options while creating and managing initiator groups with the symaccess command.

Masking View

- Association of one Initiator Group, one Port Group and one Storage Group
 - Devices in SG become visible to host initiators in the IG via the ports in the PG
- Create masking view – SYMCLI example

```
#symaccess create view -sid 225 -name MV_1  
-sg SG_1 -pg PG_1 -ig IG_1
```



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A Masking View is created by associating one initiator group, one port group and one storage group. So a masking view is a container of a storage group, a port group, and an initiator group. When you create a masking view, the devices in the storage group become visible to the host. The devices are masked and mapped automatically. Please refer to the EMC Solutions Enabler V8.0.1 Array Management CLI User Guide for more details and options while creating and managing masking views with the symaccess command.

Other Common Masking Operations - SYMCLI

Action	symaccess
Rename a masking view	<code>symaccess -sid 80 rename view -name MyView -new_name YourView</code>
Delete a masking view	<code>symaccess -sid 80 -name MyView delete view</code>
Display view info	<code>symaccess list view -name MyView -sid 80</code> <code>symaccess show view MyView -sid 80</code>
Backup	<code>symaccess -f symm80.bak -sid 80 backup</code>
Restore	<code>symaccess -f symm80.bak -sid 80 restore</code>

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These are some of the operations commonly performed on Masking Views. Note that the symaccess backup command will back up the entire VMAX3 masking database.

Please refer to the EMC Solutions Enabler V8.0.1 Array Management CLI User Guide for more details and options while creating and managing masking views with the symaccess command.

Lesson Summary

During this lesson the following topics were covered:

- Auto-provisioning Groups
- Host I/O Limits

This lesson covered an overview of auto-provisioning groups and Host I/O limits. We also introduced the SYMCLI syntax to manage auto-provisioning groups.

Lesson: Host Considerations – Storage Allocation

This lesson covers the following topics:

- HBA Flags
- Rescan SCSI Bus

This lesson covers host considerations related to storage provisioning. We will look at HBA flag settings and the commands to rescan the SCSI bus on common server platforms.

VMAX3 HBA Flag Settings for Common Hosts

- HP
 - Volume Set Addressing (V)
 - SPC-2 Compliance (SPC2)
 - SCSI-3 Compliance (SC3)
- IBM AIX, Solaris, Linux, Windows, VMware
 - SPC-2 Compliance (SPC2)
 - SCSI-3 Compliance (SC3)

In an earlier module we set the required SCSI and Fibre port settings at the VMAX3 Array Port Level. These are the common SCSI bus and Fibre port settings used by the common operating systems. The port flags settings can be overridden at the initiator or initiator group level.

Setting HBA Flags

- HBA flags that can be set on initiator groups
 - Disable_Q_Reset_on_UA [D]
 - Environ_Set [E]
 - Volume_Set_Addressing [V]
 - Avoid_Reset_Broadcast [ARB]
 - OpenVMS [OVMS]
 - SCSI_3 [SC3]
 - SPC2_Protocol_Version [SPC2]
 - SCSI_Support1 [OS2007]
- HBA flags that can be set on initiators
 - All of the above except Volume Set Addressing

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VMAX3 arrays allow you to set the HBA port flags on a per initiator or initiator group basis. This feature allows specific host flags to be enabled and disabled on the director port.

To set (or reset) the HBA port flags on an initiator group, use the following SYMCLI syntax:

```
symaccess -sid <SymmID> -name <GroupName> -type initiator  
  
set ig_flags <on <flag> <-enable |-disable> |off [flag]>
```

A flag cannot be set for the group if it conflicts with any initiator in the group.

After a flag is set for a group, it cannot be changed on an initiator basis.

Please refer to the EMC Solutions Enabler V8.0.1 Array Management CLI User Guide for more details on overriding port flags with the symaccess command.

Commands to Scan SCSI Bus for Devices (1)

- Solaris
 - `devfsadm -C`
- IBM AIX
 - `lsdev -Cc adapter -Fname | grep fc` (identifies the fibre channel directors such as `fcs0`, `fcs1`)
 - `cfgmgr -l fcs?` (? represents the bus number such as 0)
- HP-UX
 - `ioscan -fnC disk` (scans host bus and identifies new devices)
 - `insf -e` (creates device special volumes)

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After VMAX3 devices have been provisioned to a host by the creation of a masking view, the operating system on the host must be made to recognize the device. To accomplish this a SCSI bus rescan must be initiated from the host. The bus rescan commands vary from operating system to operating system.

The commands shown here are taken from the EMC Host Connectivity Guides. While they work reliably in most cases, they may not work for every version of a particular operating system. That is why it is advisable to verify the accuracy of these commands by checking the vendor documentation.

Commands to Scan SCSI Bus for Devices (2)

- Linux (version 2.6 – does not work for all drivers)
 - `cd /sys/class/scsi_host/host? (? represents host bust adapter instance, e.g. 0, 1 etc.)`
 - `ls -al scan`
 - `echo '- - -' > scan` (dashes represent channel, target and LUN numbers)
- Qlogic scan utility available from Qlogic web site
 - `./ql-dynamic-tgt-lun-disc.sh`
- Emulex lun_scan utility from Emulex web site
 - `./lun_scan.sh all`

Since there are several flavors of commercially available Linux, there are a variety of ways that the SCSI bus on those systems can be rescanned. The methods documented here are taken from the Linux host connectivity guide.

Commands to Scan SCSI Bus for Devices (3)

- Windows
 - Uses the DISKPART CLI utility
 - C:\DISKPART
DISKPART> rescan
DISKPART> exit
 - Windows Disk Management GUI can also be used to perform a rescan
- Solutions Enabler commands to rescan the bus
 - symcfg scan
 - symntctl rescan (Windows only)

In addition to the vendor supplied commands, EMC also has some commands in Solutions Enabler that are designed to scan the SCSI bus. The EMC commands are convenient to use but the vendor supplied commands are the most reliable.

Commands to Scan SCSI Bus - VMware

- ESXi Server

- Command issued on ESXi server with esxcli enabled

```
esxcli storage core adapter rescan --all
```

- Command issued from a host that is network attached to the ESXi server and has ESX cli installed – this is the preferred method

```
esxcli -s 10.127.94.252 -u root -p <password> storage  
core adapter rescan --all
```

- VMware vSphere GUI can also be used to rescan for new devices into the ESXi server

The CLI commands shown here are useful for rescanning the SCSI bus. The preferred method of using vCLI (esxcli) is to run it on a host that is network attached to the ESXi console. In addition, the VMware vSphere GUI can be used to rescan the SCSI bus.

Steps to Replace an HBA

- The replace action can be used to allow a new HBA to take over the devices visible to the old HBA.
- View old HBA WWN:
 - `symaccess list logins`
- Swap out the old HBA board with the new HBA.
- Discover the WWN of the new HBA:
 - `symaccess discover hba` or `symaccess list hba`
- Use the replace action:
 - `symaccess -sid 80 replace -wwn <WWN_old> -new_wwn <WWN_new>`
- Use the rename action to establish the new alias for the HBA:
 - `symaccess discover hba -rename`

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In the event a host adapter fails, or needs replacement, you can replace the adapter and assign a set of devices to a new adapter by using the replace action in the following form:

`symaccess replace -wwn wwn -new_wwn NewWWN [-noprompt]`

`symaccess replace -iscsi iscsi -new_iscsi NewiSCSI [-noprompt]`

Lesson Summary

During this lesson the following topics were covered:

- HBA Flags
- Rescan SCSI Bus

This lesson covered host considerations related to storage provisioning. We looked at HBA flag settings and the commands to rescan the SCSI bus on common server platforms.

Lesson: Service Level Objective based provisioning with Unisphere

This lesson covers the following topics:

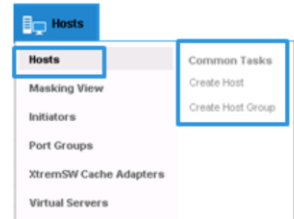
- Managing Hosts (Initiator Groups)
- Storage Provisioning Wizard
- Managing Storage Groups
- Managing Port Groups
- Managing Masking Views

This lesson covers SLO based provisioning of VMAX3 storage using Unisphere for VMAX. We will show how Unisphere is used to manage auto-provisioning groups. We also show the use of the Storage Provisioning Wizard which greatly simplifies storage allocation.

Managing Hosts (Initiator Groups)

- Hosts View

- Create Host, Provision Storage to Host, Set Flags, View Details, Delete



000196800225 > Hosts > Hosts

Name	Masking Views	Initiators	Consistent LUNs	Port Flag Overrides	Last Update
EMBEDDED_NAS_DM_IG	2	8	–	–	Mon 12/08/2014 12:09:56 PM GMT-0500
esxi-88-34	1	2	✓	–	Mon 12/08/2014 02:23:56 PM GMT-0500
esxi-88-36	1	2	✓	–	Mon 12/08/2014 12:09:56 PM GMT-0500
esxi-88-46	1	2	✓	–	Mon 12/08/2014 02:00:15 PM GMT-0500
primaryesxi64	0	1	✓	–	Fri 12/12/2014 03:44:35 PM GMT-0500

1 Selected

Modify
Set Flags
Delete

Create Host Create Host Group Provision Storage to Host View Details >>

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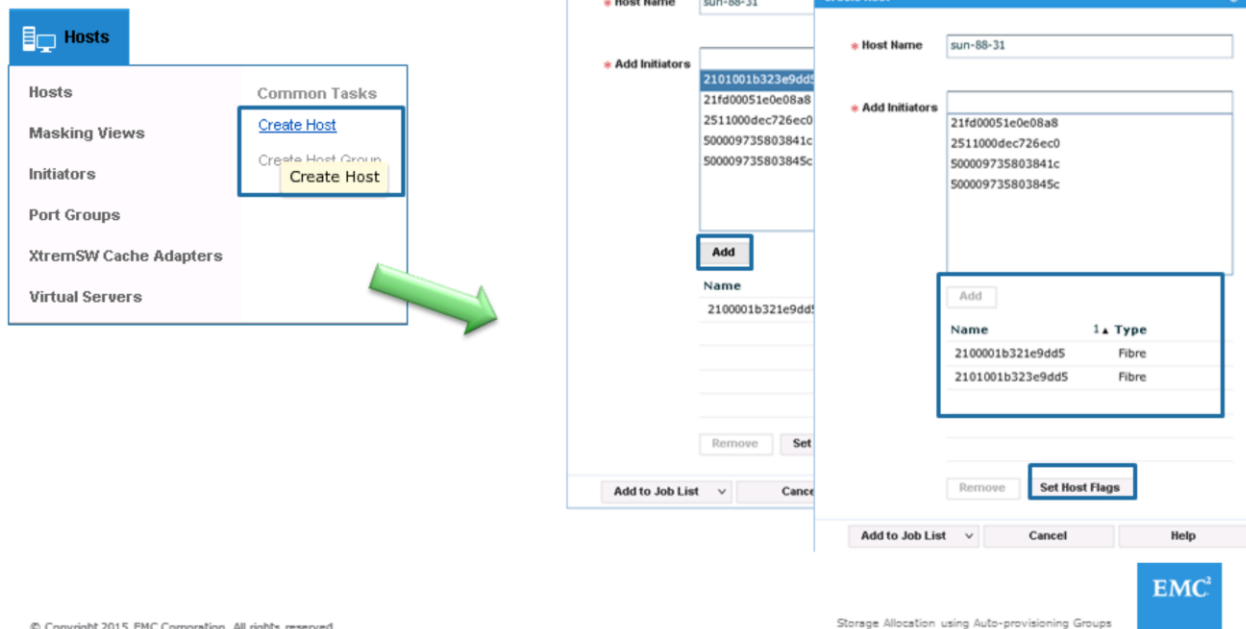
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Storage Allocation using Auto-provisioning Groups

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In Unisphere for VMAX, initiator groups are called Hosts. The hosts currently configured can be listed by clicking on the Hosts section button.. From Hosts view you can create new Hosts, Host Groups (cascaded initiator groups) or click on a Host and Provision Storage to the Host, set flags, delete, or view its details. The detailed view of a Host allows further actions. Hovering on the Hosts section button will also show the Create Host and Create Host Group common tasks. The Create Host button or Create Host common task launches the Create Host Wizard.

Create Host Wizard



In order to provision storage to a Host we first use the Create Host Wizard to create the initiator group for the Host. The Create Host wizard is available as a Common Task under the Hosts menu or by clicking on the Create Host button in the Hosts view.

Click on the Create Host link to launch the Wizard. Then select the WWNs of the HBAs of your host and click on the Add button to add them to the list.

In this example our Host has already been zoned to the VMAX³ array and the WWNs of our host are listed and can be chosen. If a host is yet to be zoned one can type in the WWN into the Add Initiators field.

One can optionally click on the Set Host Flags button to override any port flag settings.

Create Host Wizard – Set Host Flags – Consistent LUNs

The image shows two screenshots of the EMC Create Host Wizard. The first screenshot shows the 'Set Host Flags' dialog box. A green arrow points to the 'Set Host Flags' button in the top left. The dialog box has a title bar 'Set Host/Host Group Flags' and a dropdown menu 'Copy Flags from Host/Host Group'. Below this is a table of 'Port Flags' with columns 'Override' and 'Enable'. The 'Consistent LUNs' checkbox is checked. The second screenshot shows the 'Create Host' dialog box. A green arrow points from the 'Set Host Flags' dialog to this one. The 'Host Name' is 'sun-88-31'. The 'Add Initiators' section shows a list of initiators. The 'Add' button is highlighted. The 'Name' and 'Type' columns are visible. The 'Add to Job List' button is highlighted. The 'Run Now' button is highlighted. The 'EMC' logo is in the bottom right corner.

Set Host/Host Group Flags

Copy Flags from Host/Host Group: [v]

Port Flags	Override	Enable
Volume_Set_Addressing(V)	☐	☐
Avoid_Reset_Broadcast(ARB)	☐	☐
Environ_Set(E)	☐	☐
Disable_Q_Reset_on_UA(I)	☐	☐
SCSI_3(SC3)	☐	☐
SCSI_Support1(OS2007)	☐	☐
SPC2_Protocol_Version(SPC2)	☐	☐
OpenVMS(OVMS)	☐	☐

☒ Consistent LUNs

OK Cancel Help

Create Host

Host Name: sun-88-31

Add Initiators:

21f00051e0e08a8
2511000dec726ec0
500009735803841c
500009735803845c

Add

Name	Type
210001b321e9dd5	Fibre
2101001b323e9dd5	Fibre

Remove Set Host Flags

Add to Job List Add to Job List Run Now

Cancel Help

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This is continuation of the Create Host Wizard. To set host flags one can click on the Set Host Flags button. In this example we want consistent LUNs so we have checked the Consistent LUNs box. One can choose to override any of the other port flags listed as well. In this example we are not doing any overrides. Click on OK to close the Set Host Flags dialog.

To complete Create Host process one can add the task to a Job List or choose to Run Now.

Host – Detailed View

[View Details](#)

000196800225 > Hosts > Hosts > sun-88-31

PROPERTIES

Name	sun-88-31
Number of Host Groups	0
Number of Initiators	2
Number of Masking Views	0
Consistent LUNs	✓
Port Flag Overrides	-
Enabled Port Flags	
Disabled Port Flags	
Last Update	Thu 01/08/2015 03:38:05 PM GMT-0500

RELATED OBJECTS

Contains: [Initiators - 2](#)

Related Objects

Initiators

Host Group – If Host is a Child IG

Hosts – if Host Group (Parent IG)

Masking Views – if Host is in a view(s)

[Provision Storage to Host](#) [Modify](#) [Set Flags](#) [Delete](#) [Apply](#) [Cancel](#)

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Storage Allocation using Auto-provisioning Groups

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To view the details of a Host select the host in the host list view and click on View Details. The Host has two initiators and no Masking views. The Consistent LUNs option is enabled.

From the detailed view of the Host one can Provision Storage to Host, Set Flags, Delete or Modify the same. The Related Objects frame has various links depending on the Host. Clicking on the Initiators link will show a listing of the initiators in the host.

Host – Modify

000196800225 > Hosts > Hosts > sun-88-31

Modify

Modify Host

Host Name

sun-88-31

Add Initiators

Type to filter/add

21fd00051e0e08a8
2511000dec726ec0
500009735803841c
500009735803845c

Add

Name	Type
210001b321e9dd5	Fibre
2101001b323e9dd5	Fibre

Remove

Add to Job List

Cancel

Help

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Storage Allocation using Auto-provisioning Groups

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The Modify button allows one to add or remove initiators from an existing Host. Modify Host can be launched from the detailed view of a Host or from the hosts listing page.

To remove an initiator select the initiator from the lower half of the dialog box and click on Remove. To add a new initiator select an available initiator or type in the WWN in the Add initiators field and click on Add. Then Run Now or Add to Job List.

Provision Storage To Host Wizard

- Wizard simplifies provisioning storage to hosts
 - Creates storage groups with desired
 - SLO, Workload Type
 - Volumes with specified capacity
 - Will use existing devices or create new devices as needed
 - Creates port group or uses existing port groups
 - Creates masking view
- Launched from
 - Hosts listing
 - Detailed view of host

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Storage Allocation using Auto-provisioning Groups

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The Provision Storage to Host wizard simplifies the process of provisioning storage to a host. The wizard will create the desired storage groups, port group and masking view. The storage groups are created with the required service levels, workload type and capacity. The wizard can create stand alone storage groups or cascaded storage groups. The wizard is typically launched from the context of a host (initiator group), either from the hosts listing or the detailed view of a host.

Storage Provisioning Wizard

Provision Storage to sun-88-31

1 Create Storage

2 Select Part Group

3 Review

Storage Group Name: sun-88-31_parent

Storage Resource Pool: SRP_1

Service Level: Optimized

Workload Type: Not Specified

Volumes:

Volume Capacity: GB

Avg. Response Time: System Optimized

Add Service Level

Total Capacity: 0 GB | Total Service Levels: 1

Set Host I/O Limits

Your application can have multiple Service Levels. Select this button to add another Service Level.

Click on Add Service Level to create Child SGs with desired Service Levels

< Back Next > Add to Job List Cancel Help

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In this example the Storage Provisioning Wizard has been launched from the context of an existing Host, hence the Host does not have to be specified. The title of the dialog includes the host we are provisioning to – Provision Storage to sun-88-31.

Type in a name for the Storage Group to be created. Click on Add Service Level if this will be a Cascaded Storage Group with Child Storage Groups. One can specify different Service Levels for each child storage group.

If one desires to simply create a Storage Group with devices then all one has to do is to specify the Service Level, Workload Type, Number of Volumes and Capacity.

Choose Desired Service Level

Provision Storage to sun-88-31

1 Create Storage

2 Select Port Group

3 Review

Storage Group Name: sun-88-31_parent

Storage Resource Pool: SRP_1

Name	Service Level	Workload Type	Volumes	Volume Capacity	Avg. Response Time
sun-88-31_app1	Optimized	Not Specified		GB	System Optimized
sun-88-31_app2	Diamond	Not Specified		GB	System Optimized

Add Service Level

Set Host I/O Limits

Choose Service Level Objective - Default is Optimized

< Back Next > Add to Job List Cancel Help

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Storage Allocation using Auto-provisioning Groups

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In this example the Add Service Level button was clicked once. This created two request entries as shown.

Type in the desired name for each of the Child Storage Groups. In this example one is named sun-88-31_app1 and the other sun-88-31_app2.

Use the Service Level Pick list to choose the desired SLO. In this example we will choose the Platinum SLO for the app1 child SG.

Choose Desired Workload Type

Provision Storage to sun-88-31

1 Create Storage

Storage Group Name: sun-88-31_parent Storage Resource Pool: SRP_1

Name	Service Level	Workload Type	Volumes	Volume Capacity	Avg. Response Time
-88-31_app1	Platinum	Not Specified		GB	3.0 ms
-88-31_app2	Optimized	OLTP		GB	System Optimized

Workload Type Options: Not Specified, OLTP, OLTP + Rep, DSS, DSS + Rep, Not Specified

Callout: Choose Workload Type - Default is None

Buttons: Add Service Level, Set Host I/O Limits, < Back, Next >, Add to Job List, Cancel, Help

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Storage Allocation using Auto-provisioning Groups

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Use the Workload Type pick list to choose the desired workload type. In this example we will choose the OLTP for the app1 child SG.

Specify Number of Volumes and Volume Capacity

Name	Service Level	Workload Type	Volumes	Volume Capacity	Avg. Response Time
-88-31_app1	Platinum	OLTP	2	10.00 GB	3.0 ms
-88-31_app2	Gold	DSS	2	10.00 GB	6.5 ms

Total Capacity: 40.00 GB | Total Service Levels: 2

Enter desired number of volumes and volume capacity

Finally enter the desired number of volumes and the volume capacity for each storage group and then click Next. We can see that we have created the request for two child storage groups. We have set the desired service level, workload type, number of volumes and volume capacity for each. The Avg. Response time column indicates the expected response time for the selected service level and workload type. The volume capacity units can be specified in TB, GB, MB or Cyl by clicking on the units selector.

One can also set the Host I/O Limits if needed.

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Optionally Set Host I/O Limits

Provision Storage to sun-88-31

1 Create Storage

Storage Group Name: sun-88-31_parent Storage Resource Pool: SRP_1

Name	Service Level	Workload Type	Volumes	Volume Capacity	Avg. Response Time
-88-31_app1	Platinum	OLTP	2	10.00 GB	3.0 ms
-88-31_app2	Gold	DSS	2	10.00 GB	6.5 ms

Add Service Level Total Capacity 40.00 GB | Total Service Levels 2

Set Host I/O Limits

Host I/O Limits
The limits for each child cannot exceed that of the parent

Storage Group	MB/Sec	IO/Sec	Dynamic Distribution
sun-88-31_parent			Never
sun-88-31_app1			Never
sun-88-31_app2			Never

OK Cancel

< Back Next > Add to Job List Cancel Help

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Storage Allocation using Auto-provisioning Groups

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To set Host I/O Limits click on the Set Host I/O Limits button. Set the desired values in the Host I/O limits dialog and click OK to return to the Provisioning wizard. Then click Next.

Select Port Group

Provision Storage to sun-88-31

1 Create Storage

2 Select Port Group

3 Review

Select Port Group

☒ New ☐ Existing

Name
sun-88-31_PG

Create New or choose Existing PG

	Dir-Port	Identifier	Initiators Logged In	PGs	Mappings	% Busy
☒	FA-1D:6	5000097358038406	1	0	1	0
☒	FA-2D:6	5000097358038446	1	0	1	0

☐ Include ports not visible to this host

< Back Next > Add to Job List Cancel Help

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Storage Allocation using Auto-provisioning Groups

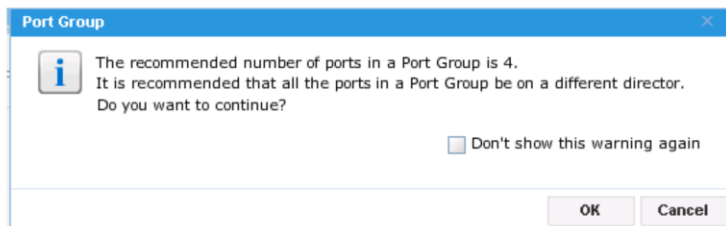
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In the Select Port Group screen one can choose an existing Port Group or create a new one. In this example we are creating a new Port Group – edit the name of the new port groups as needed. Click Next.

Note that ports that an HBA are zoned to show up automatically. One can click on the “Include ports not visible to the host” to show all ports and choose them if necessary.

Port Group – Recommendation Dialog



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The wizard will show the Port Group recommendation dialog if the port selections do not match the recommendation. In our example we had chosen only two ports in the port group, hence the recommendation dialog pops up. Click on OK to dismiss the dialog and continue with the provisioning process.

Run Suitability Check

Provision Storage to sun-88-31

Review & Finish

Masking View	Storage Group	Host	Port Group
sun-88-31_MN	sun-88-31_parent	sun-88-31	sun-88-31_PG

System Suitability

Run Suitability Check

This System Suitability Check will check if the system can handle the new load being created by this Provisioning Request.

100 --- Best Practice Limit
75
50
25
0

Back End Cache RDF

< Back Next > Add to Job List Cancel Help

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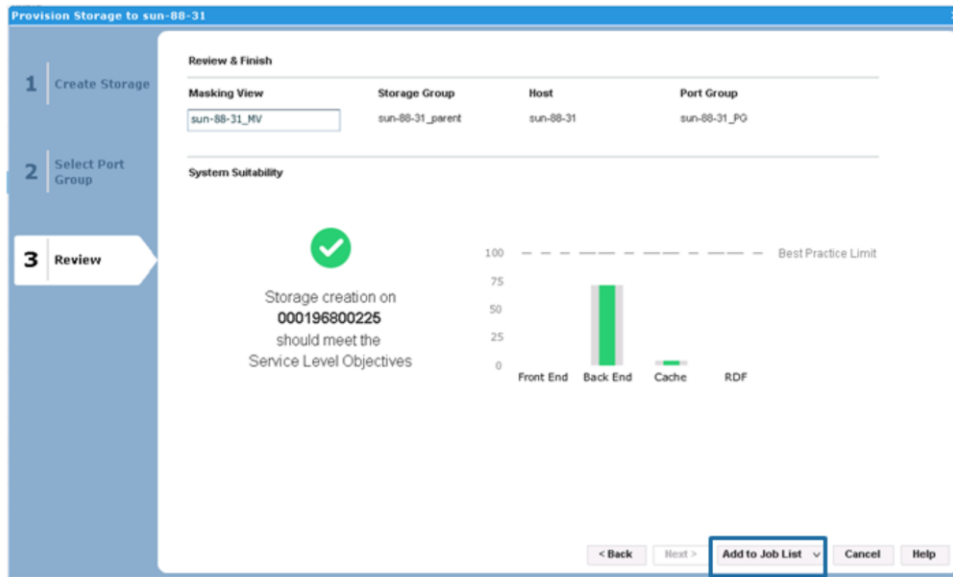
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On the review page click on the Run Suitability Check button to see if the array can meet the Service Level Objectives for the provisioning request. In order for the Suitability check to work the VMAX3 arrays must be registered for performance data collection. The review screen also shows the names of the Storage Group, Host and Port Group. The Masking View name can be edited as needed.

Suitability Check - Successful



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In this example the green check mark indicates that Service Level Objective for provisioning request will be met.

Click on the Add to Job List to add the Provisioning request to the Job List.

Provisioning Job – Run Successfully

000196000225 > System > Job List > Create Masking View sun-88-31_MV

Create Masking View sun-88-31_MV

PROPERTIES

Name: Create Masking View sun-88-31_MV Status: SUCCEEDED Scheduled: 

Owner: C:\10.126.88.89\vanchi Last Modified: Fri 01/09/2015 06:18:01 AM GMT-0500 Completed: Fri 01/09/2015 06:20:23 AM GMT-0500

TASKS

Order	Task
7	Create Port Group :sun-88-31_PG
8	Creating Masking View sun-88-31_MV

RESULT

SUCCEEDED - Started job execution on Fri 9 Jan 2015 06:20:09 AM EST
Finished job execution on Fri 9 Jan 2015 06:20:23 AM EST

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The Job has been successfully executed. The provisioning task will either find existing devices or create new devices as needed to satisfy the provisioning request.

Provisioning Successful – New Masking View

000196800225 > Hosts > Masking View

Name	Host	Port Group	Storage Group
EMBEDDED_NAS_DM_MV	EMBEDDED_NAS_DM...	EMBEDDED_NAS_DM...	EMBEDDED_NAS_DM_SG
eNAS_MV	EMBEDDED_NAS_DM...	EMBEDDED_NAS_DM...	eNAS_SG
esxi-88-34_mv	esxi-88-34	esx_pg	esxi-88-34_parent
esxi-88-36_mv	esxi-88-36	esx_pg	esxi-88-36_parent
esxi-88-46_mv	esxi-88-46	esx_pg	esxi-88-46_parent
sun-88-31_mv	sun-88-31	sun-88-31_PG	sun-88-31_parent
vcenter-88-20_mv	vcenter-88-20	vcenter-88-20_pg	vcenter-88-20_parent

Create Masking View View Connections Delete View Details

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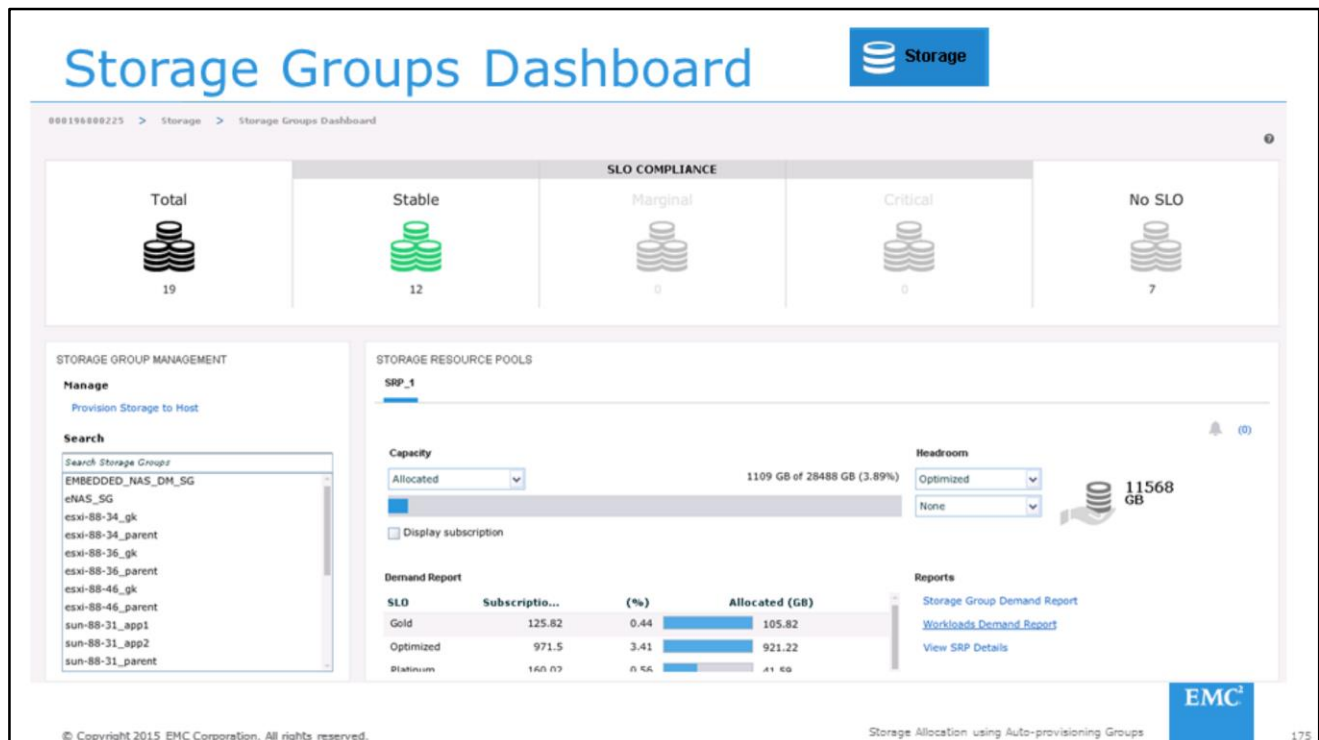
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To see a listing of all masking views click on Masking View in the Hosts menu.

The new masking view sun-88-31_mv is listed. Select the masking view and click on View Connections to see detailed information about the view.



Storage group management is done via the Storage Groups Dashboard. Click on Storage section button to see the Storage Groups Dashboard. The dashboard displays SLO Compliance, a listing of Storage Groups and the Demand Report for the various SLOs. In this lesson we will focus on managing storage groups. Click on the Total icon in the top left to navigate to the Storage Groups listing.

Managing Storage Groups

Total



00019600225 > Storage > Storage Groups Dashboard > Storage Groups

Name	SLO Compliance	SLO	Workload Type	Capacity (GB)	Snapshots	Masking Views
EMBEDDED_NAS_DM_SG		Gold	None	105.82	0	1
eNAS_SG		Platinum	None	100.01	0	1
▼ esxi-88-34_parent	~	None	None	0.07	0	1
esxi-88-34_gk		Optimized	None	0.07	0	1
▼ esxi-88-36_parent	~	None	None	0.04	0	1
esxi-88-36_gk		Optimized	None	0.04	0	1
▼ esxi-88-46_parent	~	None	None	0.04	0	1
esxi-88-46_gk		Optimized	None	0.04	0	1
▼ sun-88-31_parent	~	None	None	40	0	1
sun-88-31_app1		Platinum	OLTP	20	0	1
sun-88-31_app2		Gold	DSS	20	0	1
▼ vcenter-88-20_parent	~	None	None	80.04	0	1
vcenter-88-20_dss		Silver	DSS	40	0	1
vcenter-88-20_gk		Optimized	None	0.04	0	1
vcenter-88-20_oracle		Platinum	OLTP	40	0	1
▼ w2k8r2-88-62_parent	~	None		0.04	0	1
w2k8r2-88-62_gk		Optimized		0.04	0	1
▼ w2k8r2-88-63_parent	~	None		0.04	0	1
w2k8r2-88-63_gk		Optimized		0.04	0	1

1 Selected

Create SG Modify Provision Storage to Host Protect Manage Protection View Details >>

- FAST Array Advisor
- Change SRP
- Set Host I/O Limits
- Replication QOS
- Delete
- Expand ProtectedPoint
- Start Allocate/Free/Reclaim
- Stop Allocate/Free/Reclaim
- Convert To Cascaded

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Storage Allocation using Auto-provisioning Groups

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Click on the Total Icon in the Storage Groups Dashboard to see a listing of all the Storage Groups. From this view you can create new storage groups, modify storage groups, provision an existing storage group to a host, view details, set Host I/O limits etc.

Create SG – Provisioning Wizard

The screenshot shows the 'Provision Storage' wizard window. On the left, there is a sidebar with a 'Create SG' button and a 'Storage' section containing a 'Common Tasks' list with links for 'Provision Storage to Host' and 'Create Volumes'. The wizard itself has a four-step progress bar: 1. Create Storage (active), 2. Select Host/Host Group, 3. Select Port Group, and 4. Review. The main area for step 1 contains fields for 'Storage Group Name' and 'Storage Resource Pool' (SRP_1). Below these are dropdowns for 'Service Level' (Optimized), 'Workload Type' (Not Specified), 'Volumes' (empty), 'Volume Capacity' (empty), and 'Avg. Response Time' (System Optimized). A summary bar shows 'Total Capacity: 0 GB' and 'Total Service Levels: 1'. At the bottom are buttons for '< Back', 'Next >', 'Add to Job List', 'Cancel', and 'Help'.

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New storage groups can be created either by clicking on the Create SG button in the storage groups listing page or clicking on the Provision Storage to Host common task in the Storage section menu. Both will launch the Provisioning wizard shown on the screen. This wizard is identical to the wizard we saw earlier in this lesson, the only difference is that one has the ability to choose the host to which this storage should be provisioned as well.

Modify Storage Group

Modify

Modify Storage Group

Storage Group Name

sun-88-31_parent

Storage Resource Pool

SRP_1

Name	Service Level	Workload Type	Volumes	Volume Capacity	Avg. Response Time
sun-88-31_app	Platinum	OLTP	4	10.00 GB	3 ms
sun-88-31_app	Gold	DSS	2	10.00 GB	6 ms

Add Service Level

Total Capacity

68.00 GB

(Additional Capacity 28.00 GB)

Total Service Levels

2

Run Suitability Check

Add to Job List

Cancel

Help

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Storage Allocation using Auto-provisioning Groups

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To modify a storage group, select a storage group from the storage group listing and click on Modify to launch the Modify Storage Group dialog. Note that for cascaded storage groups, the dialog will always show the parent and child storage groups even if the modify button is clicked from the context of one of the child storage groups.

One can make the desired changes – i.e. Change Service Level, Workload Type or add more volumes, or add a new child by clicking on add Service Level.

One can run the Suitability Check when modifying storage groups. Once the desired changes are made add the job to the job list or run now.

Set Host I/O Limits

Set Host I/O Limits

Selected Storage Group: sun-88-31_parent

Set Host I/O Limit (MB/Sec) ☐ N/A

Set Host I/O Limit (IO/Sec) ☐ N/A

Set Dynamic Distribution Never

Add to Job List Cancel Help

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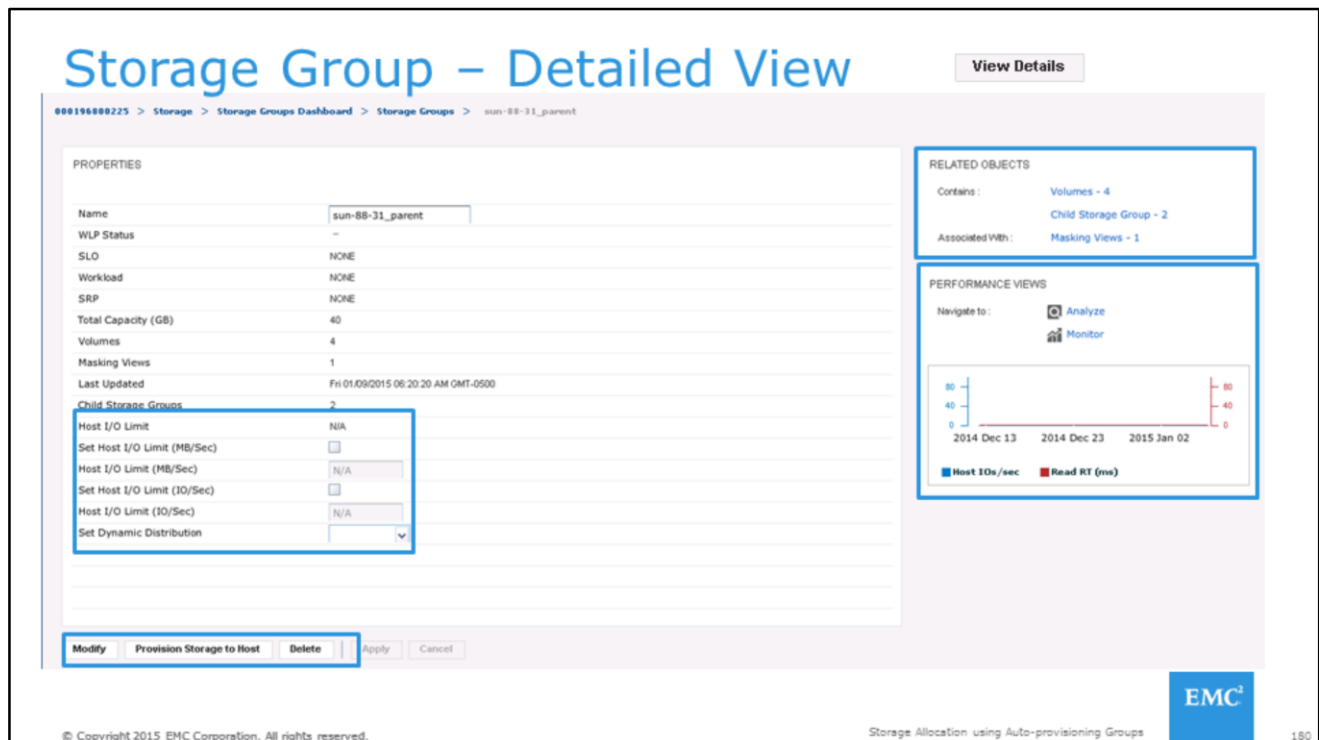
Storage Allocation using Auto-provisioning Groups

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To set Host I/O Limits , select a storage group from the storage group listing and click on the more button (>>) and then choose Set Host O/O Limits to launch the dialog. Note that for cascaded storage groups, you can choose different Host I/O Limits on the parent and children.

Once the desired changes are made add the job to the job list or run now.



To view the details of a storage group, select a storage group from the storage group listing and click on View Details. The detailed view of the storage group shows detailed information on the storage groups and has links to the related objects and to the performance views. The related objects has various links depending on the storage group. It will show the Volumes link – clicking on the volumes link will list the volumes in the storage group. Other possible related objects are, Child Storage Group (for a parent SG), Parent Storage Group (for a child SG), Masking View if the SG is in a masking view, SRP if the SG is a child SG or a standalone SG.

One can also modify the SG or provision this SG to a host from this view. Host I/O limits can also be set.

Managing Port Groups

Hosts

Port Groups

000196800225 > Hosts > Port Groups

Name	Ports	Masking Views	Last Update
EMBEDDED_NAS_DM_PG	8	2	2014-12-08 12:09:52
esx_pg	2	3	2014-12-08 12:09:52
iscsi_bridge_pg	2	2	2014-12-12 10:39:20
sun-88-31_PG	2	1	2015-01-09 06:20:20
unix_pg	2	0	2014-12-08 12:09:52
vcenter-88-20_pg	2	1	2014-12-08 12:09:52

Create Port Group

Delete

View Details

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Storage Allocation using Auto-provisioning Groups

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Choose Port Groups in the Hosts section to show the list of Port Groups currently configured on a VMAX3 array. From this view, you can create new port groups or click a port group and delete or view its details. The detailed view of a port group allows further actions.

Create Port Group

Create Port Group

Dir:Port	Identifier	Port Groups	Masking Views	Volumes	VSA Flag
FA-1D:28	500009735803841c	0	0	12	No
FA-1D:29	500009735803841d	0	0	0	No
FA-1D:34	5000097158038402	0	0	17	No
FA-1D:35	5000097158038403	0	0	17	No
FA-1D:36	5000097158038404	0	0	17	No
FA-1D:37	5000097158038405	0	0	17	No
FA-1D:4	5000097358038404	0	0	15	No
FA-1D:5	5000097358038405	0	0	25	No
FA-1D:6	5000097358038406	0	0	5	No
FA-2D:28	500009735803845c	0	0	12	No

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Storage Allocation using Auto-provisioning Groups

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To create a port group, click the Create Port Group button in the Port Groups view.

In the Create Port Group dialog, type a name for the port group and select ports from the available list.

Click OK to complete the creation of the port group. The new port group will be listed in the Port Groups view.

Port Group Details

000156800225 > Hosts > Port Groups > win_pg

PROPERTIES	
Name	win_pg
Number of ports	2
Number of masking views	0
Last Update	2015-01-09 09:02:27
Host I/O Limit (IO/Sec)	0
Host I/O Limit (MB/Sec)	0
Port Speed (MB/Sec)	1000
Percent Capability (%)	0
Excess (MB/Sec)	1000

DELETE | Apply | Cancel

Related Objects
Ports
Masking Views – if PG is in a view(s)

RELATED OBJECTS
Contains: Ports - 2

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To see the details of a specific port group, select it in the Port Groups view and click View Details.

You can Delete the port group from the detailed view. The details view also shows Host I/O Limit related information.

The Related Objects frame has various links depending on the port group. All port groups will have the Ports link. Clicking the Ports link will show a listing of the ports.

The other possible related object is Masking Views – This link will appear if the port group is part of one or more Masking views.

Port Group – Ports – Add/Remove

RELATED OBJECTS

Contains : [Ports - 2](#)

000196000225 > [Hosts](#) > [Port Groups](#) > [win_pg](#) > [Ports](#)

Dir:Port	Identifier	Port Groups	Masking Views	Mapped Volumes
FA-1D:28	500009735803841c	2	2	12
FA-2D:28	500009735803845c	2	2	12

[Add Ports](#) [Remove](#) [View Details](#)

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Clicking the Ports link in the Related Objects frame of a port group will show the ports listing.

You can remove a port from the port group by selecting the port from the list and clicking Remove.

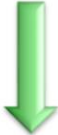
To add ports to the port group, click Add Ports.

Managing Masking Views

 **Hosts**

Masking View

000196800225 > Hosts > Masking View



Name	Host	Port Group	Storage Group
EMBEDDED_NAS_DM_MV	EMBEDDED_NAS_DM...	EMBEDDED_NAS_DM...	EMBEDDED_NAS_DM_SG
eNAS_MV	EMBEDDED_NAS_DM...	EMBEDDED_NAS_DM...	eNAS_SG
esxi-88-34_mv	esxi-88-34	esx_pg	esxi-88-34_parent
esxi-88-36_mv	esxi-88-36	esx_pg	esxi-88-36_parent
esxi-88-46_mv	esxi-88-46	esx_pg	esxi-88-46_parent

Create Masking View

View Connections

Delete

View Details

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In Unisphere for VMAX, Masking View management is done from the Masking Views page. Select Masking View in the Hosts section to show the list of Masking Views currently configured on a VMAX3 arrays. From this list, you can create new masking views or click a masking view and view its details, view its connections, or delete the same. The detailed view of a masking view allows further actions.

As we have already see the Provisioning Wizard will create masking views as part of the provisioning process as well. Creating a masking view from this page requires the manual selection of Host, Storage Group and Port Group.

Create Masking View

Create Masking View

Create Masking View

* Masking View Name: sun-88-31_MV

* Host: Type to filter
primaryesxi64
sun-88-31
vcenter-88-20
w2k8r2-88-62

* Port Group: Type to filter
EMBEDDED_NAS_DM_PG
esx_pg
iscsi_bridge_pg
sun-88-31_PG

* Storage Group: Type to filter
sun-88-31_app1
sun-88-31_app2
sun-88-31_parent
vcenter-88-20_parent

Set dynamic LUNs

OK Cancel Help

Set Dynamic LUN Addresses

Volumes to be masked

Volume	Generated LUN
0005C	001
00064	002
00063	003
00059	004

Starting LUN: 001 Apply starting LUN Next available LUN

LUN Addresses are in hexadecimal

OK Cancel Help

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As we have already see the Provisioning Wizard will create masking views as part of the provisioning process. However one can choose to manually create a masking view by clicking on the Create Masking View button in the masking view listing.

Creating a masking view requires the manual selection of Host, Port Group and Storage Group. The Host, Port Group and Storage Group must already exist.

In the Create Masking View dialog, type a name for the Masking View and pick an Initiator Group, Port Group, and a Storage Group from the list of available groups. Optionally click the Set dynamic LUNs button if you want to change the host LUN address. The Starting LUN number should be specified. Click OK to close the LUN address dialog.

Click OK to complete the creation of the masking view. The new masking view will be listed in the Masking Views page.

Masking View - Connections

View Connections

000196888225 > Hosts > Masking View > sun-88-31_HV

Hosts

Host	Initiator
sun-88-31 (2)	2100001b321e9dd5
	2101001b323e9dd5

Ports

Port Group	Director:Port
sun-88-31_PG	FA-1D:6
	FA-2D:6

Storage

Storage Group	Volume	Capacity (GB)
sun-88-31_parent (4)		
sun-88-31_app1 (2)		
	00059	10.00
	0005C	10.00
sun-88-31_app2 (2)		
	00063	10.00
	00064	10.00

☒ Show Logged In ☐ Show On Fabric

Filtered 8 of 16

LUN Address	Volume	Capacity (GB)	Initiator	Alias	Director:Port	Logged In	On Fabric
0001	00059	10.00	2101001b323e9dd5	2101001b323e9dd5/2101001b323e9dd5	FA-2D:6	Yes	Yes
0001	00059	10.00	2100001b321e9dd5	2100001b321e9dd5/2100001b321e9dd5	FA-1D:6	Yes	Yes
0002	0005C	10.00	2101001b323e9dd5	2101001b323e9dd5/2101001b323e9dd5	FA-2D:6	Yes	Yes
0002	0005C	10.00	2100001b321e9dd5	2100001b321e9dd5/2100001b321e9dd5	FA-1D:6	Yes	Yes
0003	00063	10.00	2101001b323e9dd5	2101001b323e9dd5/2101001b323e9dd5	FA-2D:6	Yes	Yes
0003	00063	10.00	2100001b321e9dd5	2100001b321e9dd5/2100001b321e9dd5	FA-1D:6	Yes	Yes
0004	00064	10.00	2101001b323e9dd5	2101001b323e9dd5/2101001b323e9dd5	FA-2D:6	Yes	Yes
0004	00064	10.00	2100001b321e9dd5	2100001b321e9dd5/2100001b321e9dd5	FA-1D:6	Yes	Yes

- One view to see all the components in a Masking view
- View can be used to troubleshoot connectivity issues

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The masking view connections page allows you to see all the components that make up the masking view. The connections page contains three tree lists for each of the component groups in the masking view - initiators, ports, and storage groups.

The parent group is the default top-level group in each expandable tree view and contains a list of all components in the masking group including child entries which are also expandable.

To filter the masking view, single or multi-select (hold shift key and select) the items in the list view. As each selection is made, the filtered results table is updated to reflect the current combination of filter criteria.

This view can be extremely useful for troubleshooting. As an example, you could filter the view by choosing only one of the initiators and one of the ports and see which of the initiators is logged in to the array.

Masking View - Details

[View Details](#)

000196000225 > Hosts > Masking View > sun-88-31_MV

PROPERTIES

Name	sun-88-31_MV
Host	sun-88-31
Number of initiators	2
Port Group	sun-88-31_PG
Number of ports	2
Storage Group	sun-88-31_parent
Number of volumes	4
Capacity (GB)	40

[Delete](#) [Apply](#) [Cancel](#)

RELATED OBJECTS

Contains : [Host - sun-88-31](#)
[Port Group - sun-88-31_PG](#)
[Storage Group - sun-88-31_parent](#)
Associated With : [Volumes - 4](#)

Related Objects

[Host](#)
[Port Group](#)
[Storage Group](#)
[Volumes](#)

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To see the details of a specific masking view, select it in the Masking Views listing and click View Details.

Click the Delete button to delete the masking view. The Related Objects frame has links for Host, Port Group, Storage Group, and Volumes.

Clicking these links will show a listing of those objects.

Lab: Service Level Objective based provisioning with Unisphere

This lab covers

- SLO based provisioning with Unisphere for VMAX

In this lab the Unisphere for VMAX Storage Provisioning wizard will be used to perform SLO based provisioning to an open systems host.

Lesson Summary

During this lesson the following topics were covered:

- Managing Hosts (Initiator Groups)
- Storage Provisioning Wizard
- Managing Storage Groups
- Managing Port Groups
- Managing Masking Views

This lesson covered SLO based provisioning of VMAX3 storage using Unisphere for VMAX. Management of auto-provisioning groups with Unisphere was covered. We also showed the use of the Storage Provisioning Wizard which greatly simplifies storage allocation.

Lesson: Service Level Objective based provisioning with SYMCLI

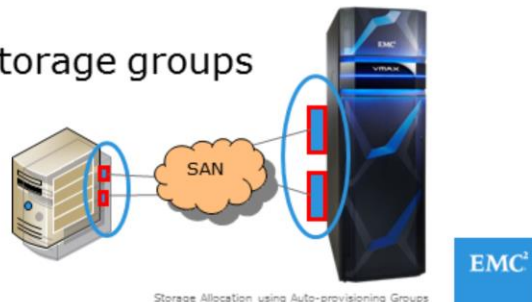
This lesson covers the following topics:

- Provision storage to a host using Cascaded Storage groups
- Manage Host I/O Limits

This lesson covers SLO based provisioning of VMAX3 storage using SYMCLI. We illustrate with an example scenario.

Use Case: SLO Provisioning with SYMCLI

- Application Server
 - Requires storage for 2 applications
 - Each application has different service level requirements
 - 2 HBAs
 - WWNs - 2100001b321e9dd5 & 2101001b323e9dd5
 - Already zoned to a VMAX 100K array SID 225
 - 1D:6 & 2D:6
- Provision storage with cascaded storage groups



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We will illustrate the storage provisioning with SYMCLI with the use of an example scenario. In this example we have an application server configured with two HBAs that required storage for two different applications. The service level requirements for the two applications are different. The server HBAs have already been zoned to a VMAX 100K array. To satisfy the requirement of different service levels we will provision storage to this server by using cascaded storage groups.

High Level Steps

- Confirm HBAs are zoned to the VMAX3 array
- Create an initiator group with the two HBAs
- Create a port group with the two VMAX3 array ports
- Create storage groups
 - Application 1 SG with required devices, SLO and WL type
 - Application 2 SG with required devices, SLO and WL type
 - Parent SG – Application SGs as members
- Create masking view
 - Initiator group, port group and parent SG
- Confirm application server has access to devices

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We will perform these high level steps in the next few slides.

Confirm Zoning

```
C:\>symaccess list logins -dirport 1d:6 -sid 225
```

```
Symmetrix ID : 000196800225
```

```
Director Identification : FA-1D  
Director Port : 006
```

Identifier	Type	Node Name	User-generated Port Name	FCID	Logged In	On Fabric
2100001b321e9dd5	Fibre	2100001b321e9dd5	2100001b321e9dd5	10c00	Yes	Yes

```
C:\>symaccess list logins -dirport 2d:6 -sid 225
```

```
Symmetrix ID : 000196800225
```

```
Director Identification : FA-2D  
Director Port : 006
```

Identifier	Type	Node Name	User-generated Port Name	FCID	Logged In	On Fabric
2101001b323e9dd5	Fibre	2101001b323e9dd5	2101001b323e9dd5	10e00	Yes	Yes

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Zoning of the HBAs to the ports can be confirmed by looking at the switch. In this example we use the symaccess list logins command to confirm that the servers HBAs have been zoned to the ports of the VMAX3 array.

We see that WWN 2100001b321e9dd5 is zoned to 1D:6 and WWN 2101001b323e9dd5 is zoned to 2D:6.

Build Initiator Group

- File containing the WWNs of the application server

```
C:\> more server_wnn.txt
```

```
wwn:2100001b321e9dd5
```

```
wwn:2101001b323e9dd5
```

- Create initiator group with consistent LUN option

```
C:\> symaccess -sid 225 create -name app_server -type initiator -consistent_lun  
-file server_wnn.txt
```

- Confirm creation of initiator group

```
C:\> symaccess -sid 225 list -type initiator -name app_server
```

```
Symmetrix ID          : 000196800225
```

Initiator Group Name	Init Count	View Count
app_server	2	0

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We first create a file with the WWNs of the initiators. Then we create the initiator group with the consistent LUN option. We confirm the creation of the initiator group.

Initiator Group Details

- Show initiator group details

```
C:\>symaccess -sid 225 -type initiator show app_server

Symmetrix ID           : 000196800225

Initiator Group Name    : app_server
Last update time       : 01:06:57 PM on Fri Jan 09,2015
Group last update time  : 01:06:57 PM on Fri Jan 09,2015

Host Initiators
{
  WWN   : 2100001b321e9dd5
        [alias: 2100001b321e9dd5/2100001b321e9dd5]
  WWN   : 2101001b323e9dd5
        [alias: 2101001b323e9dd5/2101001b323e9dd5]
}

---- OUTPUT TRUNCATED -----
```

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We can use the symaccess show command to confirm that the initiator group has the correct WWNs

Build Port Group

- Create port group with the required ports

```
C:\>symaccess -sid 225 create -name app_server_pg -type port -dirport 1D:6,2D:6
```

- Examine new port group

```
C:\>symaccess -sid 225 -type port show app_server_pg
```

```
Symmetrix ID           : 000196800225
```

```
Port Group Name        : app_server_pg
```

```
Last update time       : 01:29:51 PM on Fri Jan 09, 2015
```

```
Director Identification
```

```
{
  Director
  Ident  Port  WWN Port Name / iSCSI Target Name
  -----
  FA-1D   006  5000097358038406
  FA-2D   006  5000097358038446
}
```

```
Masking View Names
```

```
{
  None
}
```

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We create a port group call app_server_pg with ports 1D:6 & 2D:6. We then examine is contents with the symaccess show command.

List available devices

- List available devices not in a storage group

```
C:\>symdev list -sid 225 -notinsg -gb
```

```
Symmetrix ID: 000196800225
```

	Device Name	Dir	Device			
Sym	Physical	SA :P	Config	Attribute	Sts	Cap (GB)
----- Some output truncated -----						
00063	Not Visible	???:???	TDEV	N/Grp'd	RW	10.0
00064	Not Visible	???:???	TDEV	N/Grp'd	RW	10.0
00065	Not Visible	???:???	TDEV	N/Grp'd	RW	10.0
00066	Not Visible	???:???	TDEV	N/Grp'd	RW	10.0
00067	Not Visible	???:???	TDEV	N/Grp'd	RW	10.0

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We use the `symdev list` command with the `-notinsg` option to list devices on the array which are not in any storage groups. The output shows us a listing of devices of such devices.

The question marks in the SA:P columns also indicate that these devices are not mapped to any front-end port. So we can safely assume that these devices are unused.

We use devices 0063:0066 for building the required storage groups.

Build Storage Groups

- Build two child storage groups and populate them with devices
 - Application 1 SG with SLO of platinum and WL type of OLTP

```
C:\>symmsg -sid 225 create app_server_app1 -slo platinum -wl oltp
```

```
C:\>symmsg -sid 225 -sg app_server_app1 addall -devs 63:64
```

- Application 2 SG with SLO of Gold and WL type of DSS

```
C:\>symmsg -sid 225 create app_server_app2 -slo gold -wl dss
```

```
C:\>symmsg -sid 225 -sg app_server_app2 addall -devs 65:66
```

- Build parent storage group and populate with children

```
C:\>symmsg -sid 225 create app_server_parent
```

```
C:\>symmsg -sid 225 -sg app_server_parent add sg app_server_app1,app_server_app2
```

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The storage groups are built as shown on the slide. Each child storage group is given the appropriate SLO and WL and populated with two devices. The parent storage group is populated with the two child storage groups.

Storage Group Listing

```
C:\>symmsg list -detail -sid 225
```

S T O R A G E G R O U P S

```
Symmetrix ID:          000196800225
```

Storage Group Name	Flags	Number	Number	Child			
	E F M S L	Devices	GKs	SGs	SLO Name	Workload	SRP Name
app_server_app1	FX.C.	2	0	0	Platinum	OLTP	<none>
app_server_app2	FX.C.	2	0	0	Gold	DSS	<none>
app_server_parent	F..P.	4	0	2	<none>	<none>	<none>

```
----- Output Truncated -----
```

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The symmsg list -detail command shows the storage groups we just created. We also see that the child storage groups have the correct SLO and WL type set. We also see that the child SGs are shown as FAST managed while the parent is not shown as FAST managed.

Legend:

Flags:

Device (E)mulation A = AS400, F = FBA, 8 = CKD3380,

9 = CKD3390, M = Mixed, . = N/A

(F)ast X = Fast Managed, . = N/A

(M)asking View X = Contained in Mask View(s), . = N/A

Cascade (S)tatus P = Parent SG, C = Child SG, . = N/A

Host IO (L)imit D = Defined, S = Shared, B = Both, . = N/A

Build Masking View

- Create masking view

```
C:\>symaccess -sid 225 create view -name app_server_mv -ig app_server  
-pg app_server_pg -sg app_server_parent
```

- Confirm creation of masking view

```
C:\>symaccess -sid 225 list view -name app_server_mv
```

```
Symmetrix ID          : 000196800225
```

Masking View Name	Initiator Group	Port Group	Storage Group
app_server_mv	app_server	app_server_pg	app_server_parent

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We finally create the masking view with the initiator group, port group and the parent storage groups we had recently created. We can now go to the application host and perform a SCSI bus scan to discover the newly provisioned devices.

Masking View Details (1)

```
C:\>symaccess show view app_server_mv -sid 225
```

```
Symmetrix ID           : 000196800225

Masking View Name       : app_server_mv
Last update time        : 02:30:42 PM on Fri Jan 09, 2015
View last update time   : 02:30:42 PM on Fri Jan 09, 2015

Initiator Group Name    : app_server
```

Host Initiators

```
{
  WWN : 2100001b321e9dd5
      [alias: 2100001b321e9dd5/2100001b321e9dd5]
  WWN : 2101001b323e9dd5
      [alias: 2101001b323e9dd5/2101001b323e9dd5]
}
```

----- Continued on next slide -----



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The symaccess show view command shows us the details of the masking view. The output is long so we have broken the display over three slides.

This slide shows the host initiators.

Masking View Details (2)

----- Continued from previous slide -----

Port Group Name : app_server_pg

Director Identification

```
{  
  Director  
  Ident Port   WWN Port Name / iSCSI Target Name  
  -----  
  FA-1D  006 5000097358038406  
  FA-2D  006 5000097358038446  
}
```

----- Continued on next slide -----

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The symaccess show view command shows us the details of the masking view. The output is long so we have broken the display over three slides.

This slide shows the port details.

Masking View Details (3)

----- Continued from previous slide -----

Storage Group Name : app_server_parent

Number of Storage Groups : 2

Storage Group Names : app_server_app1 (IsChild)
app_server_app2 (IsChild)

Sym Dev	Dir:Port	Physical Device Name	Host Lun	Attr	Cap (MB)
00063	01D:006	Not Visible	1		10241
	02D:006	Not Visible	1		
00064	01D:006	Not Visible	2		10241
	02D:006	Not Visible	2		
00065	01D:006	Not Visible	3		10241
	02D:006	Not Visible	3		
00066	01D:006	Not Visible	4		10241
	02D:006	Not Visible	4		
Total Capacity					40964

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Storage Allocation using Auto-provisioning Groups

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The symaccess show view command shows us the details of the masking view. The output is long so we have broken the display over three slides.

This slide shows the storage group details.

Devices Visible on Application Server

SUN2-88-31/> symlinq

Device		Product			Device	
Name	Type	Vendor	ID	Rev	Ser Num	Cap (KB)
----- SOME OUTPUT DELETED -----						
/dev/rdisk/emcpower0c		EMC	SYMMETRIX	5977	2500064000	10487040
/dev/rdisk/emcpower1c		EMC	SYMMETRIX	5977	2500066000	10487040
/dev/rdisk/emcpower2c		EMC	SYMMETRIX	5977	2500068000	10487040
/dev/rdisk/emcpower3c		EMC	SYMMETRIX	5977	2500063000	10487040

SUN2-88-31/> powermt display ports

Storage class = Symmetrix

Storage System			I/O Paths		Stats	
ID	Interface	Wt_Q	Total	Dead	Q-IOs	Errors
000196800225	FA 1dG	256	4	0	0	0
000196800225	FA 2dG	256	4	0	0	0

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Storage Allocation using Auto-provisioning Groups

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A SCSI rescan was performed on the application server. The symlinq output shows the four VMAX3 devices that were provisioned to this server.

The REV 5977 is the HYPERMAX OS version. The 25 is the Ser Num column represents the last two digits of the VMAX3 array SID. The other highlighted column shows the VMAX3 logical volume numbers of 63:66.

Set Host I/O Limits on Parent SG

```
C:\>symmsg -sid 225 -sg app_server_parent set -bw_max 200 -dynamic always
```

```
C:\>symmsg -sid 225 show app_server_parent
```

```
Name: app_server_parent
```

```
Symmetrix ID           : 000196800225
Last updated at        : Fri Jan 09 16:50:42 2015
Masking Views          : Yes
FAST Managed           : No
SLO Name               : <none>
Workload               : <none>
SRP Name               : <none>
Host I/O Limit         : Defined
Host I/O Limit MB/Sec   : 200
Host I/O Limit IO/Sec   : NoLimit
Dynamic Distribution    : Always
Number of Storage Groups : 2
Storage Group Names     : app_server_app1 (IsChild)
                       : app_server_app2 (IsChild)
```

```
----- Output Truncated -----
```



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Storage Allocation using Auto-provisioning Groups

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In this example we will set Host/IO limits on a parent SG. We have set a bandwidth limit in this example, we have also set the dynamic distribution to always.

SG Listing – Check Host I/O Setting

```
C:\>symmsg list -sid 225
```

S T O R A G E G R O U P S

```
Symmetrix ID:      000196800225
```

Storage Group Name	Flags EFMSL	Number Devices	Number GKs	Child SGs
app_server_app1	FXXCS	2	0	0
app_server_app2	FXXCS	2	0	0
app_server_parent	F.XPD	4	0	2

----- Output Truncated -----



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Storage Allocation using Auto-provisioning Groups

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The symmsg list command shows the storage groups. We can see that that Host I/O limits are defined on the parent indicated by the D in the L column. The S in the L column of the child SGs indicate that the children are currently sharing Host I/O limits, there is no explicit setting for the children.

Legend:

Flags:

Device (E)mulation A = AS400, F = FBA, 8 = CKD3380,

9 = CKD3390, M = Mixed, . = N/A

(F)ast X = Fast Managed, . = N/A

(M)asking View X = Contained in Mask View(s), . = N/A

Cascade (S)tatus P = Parent SG, C = Child SG, . = N/A

Host IO (L)imit D = Defined, S = Shared, B = Both, . = N/A

Set Host I/O Limits on Child SG

```
C:\>symmsg -sid 225 -sg app_server_app2 set -bw_max 100
```

```
C:\>symmsg -sid 225 show app_server_app2
```

```
Name: app_server_app2
```

```
Symmetrix ID           : 000196800225
Last updated at        : Fri Jan 09 17:01:51 2015
Masking Views          : Yes
FAST Managed           : Yes
SLO Name               : Gold
Workload               : DSS
SRP Name               : <none>
Host I/O Limit         : Defined (Shared)
Host I/O Limit MB/Sec  : 100 (200)
Host I/O Limit IO/Sec  : NoLimit (NoLimit)
Dynamic Distribution    : Always
Number of Storage Groups : 1
Storage Group Names    : app_server_parent (IsParent)
----- Output Truncated -----
```



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Storage Allocation using Auto-provisioning Groups

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In this example we are explicitly defining Host I/O limits on a child SG. There is an explicit setting on the parent as well. We have set a bandwidth limit in this example – this is less than that of the parent. The show output shows us that the bandwidth limit for this SG is 100 while that on the parent is 200.

SG Listing – Check Host I/O Setting Again

```
C:\>symmsg list -sid 225
```

S T O R A G E G R O U P S

Symmetrix ID: 000196800225

Storage Group Name	Flags EFMSL	Number Devices	Number GKs	Child SGs
app_server_app1	FXXCS	2	0	0
app_server_app2	FXXCB	2	0	0
app_server_parent	F.XPD	4	0	2

----- Output Truncated -----

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Storage Allocation using Auto-provisioning Groups

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The symmsg list command shows the storage groups. Here we see that the app2 storage group shows a B in the L column indicating that Host I/O limits are defined both on the parent and the child.

Legend:

Flags:

Device (E)mulation A = AS400, F = FBA, 8 = CKD3380,

9 = CKD3390, M = Mixed, . = N/A

(F)ast X = Fast Managed, . = N/A

(M)asking View X = Contained in Mask View(s), . = N/A

Cascade (S)tatus P = Parent SG, C = Child SG, . = N/A

Host IO (L)imit D = Defined, S = Shared, B = Both, . = N/A

Host I/O Limit – Demand Report by PG

```
C:\>symmsg -sid 225 list -demand -by_pg -pg app_server_pg
```

Symmetrix ID: 000196800225

Port Group		IO Limit		Bandwidth Limit				
Name	Flags	Maximum Demand (IO/Sec)	Number NOLimit SGs	Port Grp Speed (MB/Sec)	Maximum Demand (MB/Sec)	Number (%)	Excess SGs	(MB/Sec)
app_server_pg	YY	0	1	2000	200	10	0	+1800

Legend:

Flags:

(H)ost IO Limit Exists Y = Yes, N = No, M = Mixed, . = N/A
(D)ynamic Distribution Y = Yes, N = No, . = N/A

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Storage Allocation using Auto-provisioning Groups

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One can execute `symmsg list -demand -by_pg` command to view quota information sorted by port group. The `-pg` option limits the output to the specified port group. The `-v` option is supported for further detail.

The columns display all the available capacity and IOPS quotas and bandwidth quotas enforced within port groups.

Host I/O Limit – Demand Report by Port

```
C:\>symmsg -sid 225 list -demand -by_port -pg app_server_pg
```

Symmetrix ID: 000196800225

Director		IO Limit		Bandwidth Limit				
		Maximum	Number	Port	Maximum	Number		
		Demand	NoLimit	Speed	Demand	NoLimit		
DIR:PORT	Flags	(IO/Sec)	SGs	(MB/Sec)	(MB/Sec)	(%)	SGs	(MB/Sec)
01D:006	YY	0	1	1000	100	10	0	+900
02D:006	YY	0	1	1000	100	10	0	+900

Legend:

Flags:

(H)ost IO Limit Exists Y = Yes, N = No, M = Mixed, . = N/A

(D)ynamic Distribution Y = Yes, N = No, . = N/A

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Storage Allocation using Auto-provisioning Groups

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One can execute `symmsg list -demand -by_port` command to view quota information sorted by front-end director ports. The `-pg` option limits the output to the ports in the specified port group. The `-v` option is supported for further detail.

The columns display all the available capacity and IOPS quotas and bandwidth quotas enforced by front-end directors.

Non-Disruptive Device Moves Between SGs

- Moving devices from one SG to another SG will not disrupt host visibility for the devices

- Certain conditions must be met*

- **symmsg syntax**

```
symmsg -sg <SgName> -sid <SymmID>
```

```
move dev <SymDevName> <DestSgName> [-force]
```

```
[-devs <<SymDevStart>:<SymDevEnd> | <SymDevName>  
[, <<SymDevStart>:<SymDevEnd> | <SymDevName>>...]> |  
-file <DeviceFileName> [-tgt] ]  
moveall <DestSgName> [-force]
```

*See notes

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Storage Allocation using Auto-provisioning Groups

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VMAX3 arrays running HYPERMAX OS allow moving devices from one SG to another SG without disrupting host visibility for the devices. Moving a device to another SG will not disrupt the host visibility for the device, if any one of the conditions are met:

Moves between child SGs of a parent SG, when the view is on the parent SG.

Moves between SGs when a view is on each SG, and both the initiator group (IG) and the port group (PG) are common to the views.

Moves between SGs when a view is on each SG, and they have a common IG. They have different PGs but the same set of ports or the target PG is a superset of the source PG.

Moves when source SG is not in a masking view.

If none of the conditions are met, the operation will be rejected, but the move can be forced by specifying the '-force' flag. Note that forcing a move may affect the host visibility of the device.

Devices moves between FAST managed SG(s), or between a FAST managed SG and a non-FAST managed SG, is permitted.

The symmsg syntax is shown on the slide.

Non-Disruptive Cascaded SG Conversion

Standalone SG to Cascaded SG

- Parent SG will retain the name of original standalone SG
- If original standalone SG is part of any Masking views, after conversion all views will be moved to the new parent SG
- Existing Host I/O limits can be migrated to the new parent or child
- If original standalone SG was FAST managed, only the child SG will be FAST managed after conversion

Cascaded SG to Standalone SG

- Allowed only if a Cascaded SG has a single child SG
- New standalone SG retains the name of the original parent SG
- If original parent SG is part of any Masking views, after conversion all views will be moved to the new standalone SG
- Existing Host I/O limits on parent SG are migrated to the new standalone SG
- If original child SG was FAST managed, the standalone SG will be FAST managed after conversion

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Storage Allocation using Auto-provisioning Groups

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VMAX3 arrays running HYPERMAX OS allows the conversion of a standalone SG to Cascaded SG or a Cascaded SG to a standalone SG to be performed non-disruptively. This allows FAST-Managed storage groups containing devices with a single Service-Level Objective (SLO) to be expanded to include devices in a second SLO, without disrupting the availability of those devices from host applications.

To convert a standalone storage group to a cascaded configuration, the command supplies the name of the standalone storage group to be converted and the name of the new child storage group. Upon successful completion, the parent storage group retains the name of the standalone group and the child storage group is given the new child name. If the storage group starts in one or more masking views, at the end of the operation all of the views will be moved to the parent storage group. If the storage group starts with Host I/O Limits configured, these limits can be migrated to the parent storage group or to the child storage group. If the storage group starts as FAST-Managed, at the end of the conversion only the child storage group will be FAST-Managed.

To convert a cascaded storage group to a standalone configuration, the command supplies the name of the parent storage group to be converted to a standalone storage group. Note that this conversion is allowed only if the cascaded SG has a single child SG. Upon successful completion, the standalone storage group retains the name of the parent group. If the parent storage group starts in one or more masking views, at the end of the operation all of the views will be moved to the standalone storage group. If the parent storage group starts with Host I/O Limits configured, these limits will be migrated to the standalone storage group. If the child storage group starts as FAST-Managed, the standalone storage group will become FAST-Managed.

Cascaded SG Conversion – symsg Syntax

- Convert standalone SG to cascaded SG

```
symsg -sid <SymmID>  
    convert -cascaded <SgName> <ChildSgName>  
    [-host_IO <on_parent | on_child>]
```

- -host_io must be specified if standalone SG has Host I/O defined

- Convert cascaded SG to standalone SG

```
symsg -sid <SymmID>  
    convert -standalone <SgName>  
    [-host_IO <keep_parent | keep_child>]
```

- -host_io must be specified if Host I/O has been defined on both parent and child SGs

- Unisphere for VMAX can also be used



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Storage Allocation using Auto-provisioning Groups

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The “symsg convert -cascaded” command allows the non-disruptive conversion of a standalone storage group to a cascaded storage group consisting of a parent SG and a single child SG. If the standalone storage group has a Host IO Limit, then the user must specify if after the conversion the limit will be set on the parent or the child storage group.

The “symsg convert -standalone” command allows the non-disruptive conversion of a cascaded storage group consisting of a parent SG and a single child SG to a standalone storage group. If either the parent SG or the child SG has a Host IO limit defined, it will be set on the standalone SG. But if both parent and child SGs have a Host IO Limit, the user must supply the host_IO option.

Lab: Service Level Objective based provisioning with SYMCLI

This lab covers

- SLO based provisioning with SYMCLI

In this lab SYMCLI will be used to perform SLO based provisioning to an open systems host.

Lab: Cascaded Storage Groups – Moving devices non-disruptively and changing SLO

This lab covers

- Cascaded Storage Groups
- Non-disruptive movement of devices between storage groups
- Modifying SLO

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This lab covers Cascaded Storage Groups, moving devices non-disruptively between storage groups and changing the SLO on storage groups.

Lab: Managing Host I/O Limits

This lab covers

- Host I/O Limits

This lab covers the management of Host I/O Limits.

Lesson Summary

During this lesson the following topics were covered:

- Provisioning storage to a host using Cascaded Storage groups
- Managing Host I/O Limits

This lesson covered SLO based provisioning of VMAX3 storage using SYMCLI. We used an example scenario to illustrate the use of cascaded storage groups and the setting of Host I/O limits.

Module Summary

Key points covered in this module:

- Autoprovisioning Groups
- Host I/O Limits
- Host Considerations for Storage Allocation
- SLO based provisioning with Unisphere for VMAX
- SLO based provisioning with SYMCLI

This module covered storage allocation of VMAX3 storage to hosts using auto-provisioning groups. An overview of auto-provisioning groups, Host I/O limits and host considerations while allocating storage was presented. SLO based storage provisioning with Unisphere for VMAX and SYMCLI was covered in detail.

Module: Monitoring and Workload Planning with Unisphere for VMAX

Upon completion of this module, you should be able to use Unisphere for VMAX to:

- Monitor SRP reports
- Monitor Storage Group SLO Compliance
- Perform Workload Planning
 - SRP Headroom
 - Suitability Check
 - FAST Array Advisor

This module focuses on monitoring and workload planning with Unisphere for VMAX. Unisphere for VMAX will be used to monitor SRP and SLO compliance. The workload planning features viz. SRP Headroom, Suitability Check and FAST Array Advisor are also covered.

Lesson: Monitor SRP

This lesson covers the following topics:

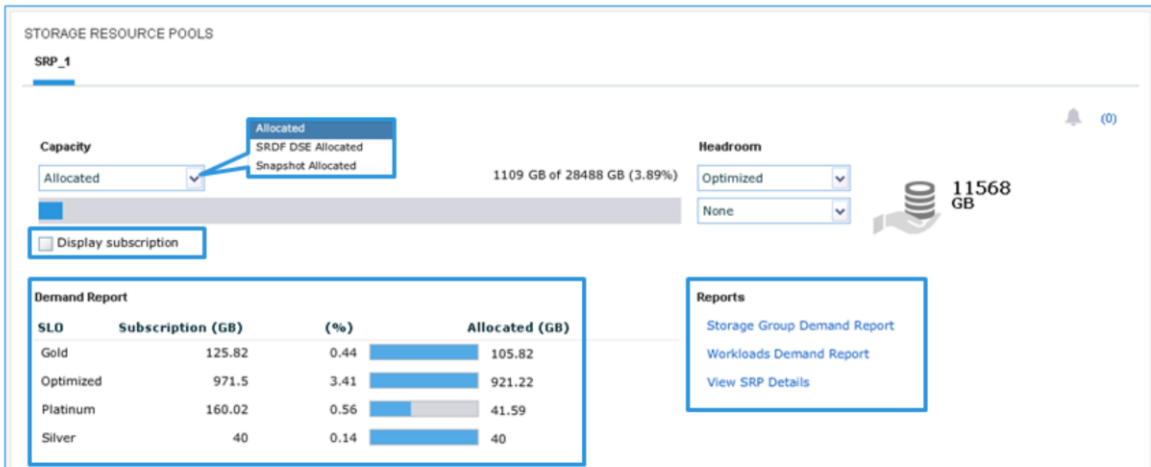
- SRP Reports
 - Storage Group Demand Report
 - Workloads Demand Report
 - SRP Details
- SRP Utilization Alert

This lesson covers the monitoring to SRPs with Unisphere for VMAX. We will use Unisphere to look at SRP reports and the SRP utilization alert.

SG Dashboard – Storage Resource Pools



000196800225 > Storage > Storage Groups Dashboard



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Monitoring and Workload Planning with Unisphere for VMAX

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Navigate to the Storage Groups Dashboard of a VMAX3 array by clicking on the Storage section button. The bottom right part of the dashboard shows information on the configured SRPs. For a given SRP one can see the allocated capacity. The capacity drop down can also be used to see the SRDF DSE and Snapshot allocated capacity. One can choose to check the Display Subscription box to see subscribed capacity as a percentage. In this example 1109 GB of the 28488 GB of usable capacity of the SRP has been allocated.

The Demand Report in the lower half of the output shows the demand from the perspective of the various SLOs that are in use on the array. As an example one can see that 160.02 GB of Platinum SLO has been subscribed and 41.59 GB of Platinum has been allocated. One can click on the Reports links to see the demand reports from a Storage Group and Workloads perspective.

We will cover SRP Headroom in the Workload Planning lesson of this module.

Storage Group Demand Report

Reports

Storage Group Demand Report

Workloads Demand Report

View SRP Details

000196800225 > Storage > Storage Groups Dashboard > Storage Group Demand Report

Storage Group	Subscription (GB)	Allocated (%)	SNAP Allocated (GB)
app_server_app1	20	0 %	0
app_server_app2	20	0 %	0
EMBEDDED_NAS_DM_SG	105.82	100 %	0
eNAS_SG	100.01	1 %	0
esxi-88-34_gk	0.07	0 %	0
esxi-88-36_gk	0.03	0 %	0
esxi-88-46_gk	0.03	0 %	0
vcenter-88-20_dss	40	100 %	0
vcenter-88-20_gk	0.03	0 %	0
vcenter-88-20_oracle	40	100 %	0
w2k8r2-88-62_gk	0.03	0 %	0
w2k8r2-88-63_gk	0.03	0 %	0

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The Storage Group Demand report shows a listing of SGs and subscribed capacity in GB and the allocated % from the perspective of the subscribed capacity. This report can also be generated via SYMCLI:

```
C:\Users\Administrator>symcfg list -srp -demand -type sg
```

STORAGE RESOURCE POOLS

Symmetrix ID : 000196800225

Name : SRP_1
Usable Capacity (GB) : 28487.8
SRDF DSE Allocated (GB) : 0.0
Total Subscribed (%) : 4.6

SG Name	Subscribed (GB)	Allocated (GB)	Allocated (%)	Snapshot Allocated (GB)
EMBEDDED_NAS_DM_SG	105.8	105.8	99	0.0
vcenter-88-20_gk	0.0	0.0	0	0.0
esxi-88-36_gk	0.0	0.0	0	0.0
esxi-88-46_gk	0.0	0.0	0	0.0
esxi-88-34_gk	0.1	0.0	0	0.0
eNAS_SG	100.0	1.6	1	0.0
vcenter-88-20_oracle	40.0	40.0	100	0.0
vcenter-88-20_dss	40.0	40.0	100	0.0
w2k8r2-88-62_gk	0.0	0.0	0	0.0
w2k8r2-88-63_gk	0.0	0.0	0	0.0
app_server_app1	20.0	0.0	0	0.0
app_server_app2	20.0	0.0	0	0.0
<not_in_sg>	971.3	921.2	94	0.0
Total	1297.3	1108.6	85	0.0

Workloads Demand Report

Reports

Storage Group Demand Report

Workloads Demand Report

View SRP Details

000196800225 > Storage > Storage Groups Dashboard > Workload Demand Report

Name	Subscribed (GB)	Subscription (%)	Allocated (GB)
Optimized	971.5	3.41	921.22
▼ Gold	125.82	0.44	105.82
None	105.98	0.37	105.82
DSS	20	0.07	0
▼ Platinum	160.02	0.56	41.59
None	100.01	0.35	1.58
OLTP	60.01	0.21	40
▼ Silver	40	0.14	40
DSS	40.07	0.14	40

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Monitoring and Workload Planning with Unisphere for VMAX

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The Workloads Demand Report shows the SRP demand for each of the SLOs and Workload types. Each row shows the subscribed capacity in GB, the subscription % as a percentage of the overall SRP capacity and the Allocated capacity in GB. This report can also be generated via CLI:

```
C:\Users\Administrator>symcfg list -srp -demand -type slo -detail
```

STORAGE RESOURCE POOLS

Symmetrix ID : 000196800225

```
Name : SRP_1
Usable Capacity (GB) : 28487.8
SRDF DSE Allocated (GB) : 0.0
Snapshots Allocated (GB) : 0.0
```

SLO Name	Workload	Subscribed (GB)	(%)	Allocated (GB)	(%)
Optimized	N/A	971.5	3	921.2	94
Gold	<none>	106.0	0	105.8	99
Gold	DSS	20.0	0	0.0	0
Platinum	<none>	100.0	0	1.6	1
Platinum	OLTP	60.0	0	40.0	66
Silver	DSS	40.1	0	40.0	99
Total		1297.3	4	1108.6	85

View SRP Details

Reports
[Storage Group Demand Report](#)
[Workloads Demand Report](#)
[View SRP Details](#)

000196800225 > Storage > Storage Groups Dashboard > SRP_1

PROPERTIES

NameSRP_1
Default EmulationFBA
Usable Capacity (GB)28487.81
Allocated Capacity (GB)1108.64
Free Capacity (GB)27379.17
Subscription (GB)1297.35
Reserved Capacity % (0-80)10
Usable by RDFA DSE
Description

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☒

Apply

Cancel

DISK GROUPS

Name	Technology	Speed (RPM)	Usable Capacity (GB)
1 -- GRP_1_300_15K_R1	FC	15000	13412.11
2 -- GRP_2_600_10K_6R6	FC	10000	12875.63
3 -- GRP_3_200_EFD_3R5	EFD	N/A	2200.08

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Monitoring and Workload Planning with Unisphere for VMAX

One can also look at the details of the configured Storage Resource Pools to see the details of Usable, Allocated and Free capacity. The Service Level link will show the service levels available for this SRP. The Disk Groups shows the disk groups used by this SRP. Recall that each of the disk groups is pre-configured with Data devices of a specific raid type. The same information can be shown in SYMCLI:

```
C:\Users\Administrator>symcfg show -srp srp_1 -sid 225
```

```
Symmetrix ID           : 000196800225
```

```
Name                   : SRP_1
Description             :
Default SRP            : FBA
Usable Capacity (GB)   : 28487.8
Allocated Capacity (GB): 1108.6
Free Capacity (GB)     : 27379.2
Subscribed Capacity (GB): 1297.3
Subscribed Capacity (%) : 4
Reserved Capacity (%)  : 10
Usable by RDFA DSE     : Yes
```

```
Disk Groups (3):
```

```
{
-----
#   Name                      Tech  Speed  Usable
#   Name                      Tech  (rpm)  Capacity
#   Name                      Tech  (rpm)  (GB)
-----
1 GRP_1_300_15K_R1           FC    15000  13412.1
2 GRP_2_600_10K_6R6           FC    10000  12875.6
3 GRP_3_200_EFD_3R5           EFD     N/A    2200.1
-----
```

```
----- Output Truncated -----
```

SRP Utilization Alert

- SRP Utilization Alert is enabled by default for VMAX3 arrays

All Symmetrix > Home > Administration > Alert Settings > Symmetrix Pool Threshold Alerts

Symmetrix ID	Category	Instance	State	Notification	Warning	Critical	Fatal
000196800225	Symmetrix Resource Pool Utilization	*	enabled		60%	80%	100%

Create Edit Notify Delete

Create Threshold Policies

Symmetrix: 000196800225
Category: Storage Resource Pool Utilization

Instances to enable

Pool Names
SRP_1

Warning: 60%(default)
Critical: 80%(default)
Fatal: 100%(default)

OK Cancel Help

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To configure Pool Threshold Alerts, click the Symmetrix Pool Threshold Alerts button from the Home > Administration > Alert Settings page.

For VMAX³ Arrays Alert Thresholds can be set on the Storage Resource Pools (SRP). The SRP utilization alert is enable by default with the default threshold policies shown.

Please note that the default threshold policies cannot be modified. To setup customized thresholds, click on the Create button. In the Create Thresholds Policies dialog, pick the Symmetrix system from the dropdown menu, then pick the category from the dropdown menu. Then, highlight the pools to which the policy should apply, and choose the threshold levels, then the OK button to create a customized threshold.

Lesson Summary

During this lesson the following topics were covered:

- SRP Reports
- SRP Utilization Alert

This lesson covered the monitoring to SRPs with Unisphere for VMAX. We used Unisphere to look at SRP reports and the SRP utilization alert.

Lesson: Monitor SLO Compliance

This lesson covers the following topics:

- Monitor storage group SLO compliance
- Monitor storage group performance

This lesson covers the monitoring to storage group SLO compliance and storage group performance.

SLO – Expected Average Response Times

000196000225 > Storage > Storage Groups Dashboard > SRP_1 > Service Levels

Service Level Objectives
SLO is a desired level of performance (response time band) required by the storage workload.

	Optimized	Bronze (Unavailable)	Silver	Gold	Platinum	Diamond
Expected Average Response Time Hide Details	System Optimized	14.0 ms	8.0 ms	5.0 ms	3.0 ms	Less than 1 ms
Small I/O OLTP OLTP + Replication	- -	14.0 ms 15.5 ms	8.0 ms 9.5 ms	5.0 ms 6.5 ms	3.0 ms 4.4 ms	0.8 ms 2.3 ms
Large I/O DSS DSS + Replication	- -	15.5 ms 16.9 ms	9.5 ms 10.9 ms	6.5 ms 7.9 ms	4.4 ms 5.9 ms	2.3 ms 3.7 ms

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As we had discussed in an earlier module the available SLOs and the expected average response time for each SLO/Workload type combination can be displayed as shown. Clicking on the Service Levels link in the SRP details page will bring up this view. In this example Bronze is unavailable because this array does not have any 7.2 K RPM drives. For SLO compliance a given storage groups response time must lie within the compliance range of an SLO/Workload type combination.

Home Page – SLO Compliance



The All Symmetrix – Home page as soon as you login to Unisphere for VMAX shows a summary of all the arrays managed by Unisphere for VMAX. The summary view of each VMAX3 array has various sections. One of the sections is the SLO Compliance section which shows SLO compliance of storage groups. The colors of the icons indicate the SLO compliance of the storage groups. Green represents Stable, Yellow represents Marginal and Red represents Critical. The numbers indicate the number of storage groups in each category.

Clicking on the SLO Compliance link will direct one to the Storage Groups Dashboard for the array where one can look at the SLO Compliance in more detail.

SG Dashboard – SLO Compliance



- Total –All SGs
- Stable – SGs which meet SLO
- Marginal & Critical – SGs which do not meet SLO
- No SLO – SGs with no explicit SLO

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Monitoring and Workload Planning with Unisphere for VMAX

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The top part of the Storage Groups Dashboard (shown on slide) shows icons for Total, Stable, Marginal, Critical and No SLO Storage Groups. Clicking on the icon will direct you to the appropriate listing. For example clicking on the Total icon will direct you to a listing of all the storage groups configured on the array. Clicking on Stable will direct you to the listing of storage groups which are performing within the SLO target. Marginal indicates that the performance is below the SLO target, while Critical indicates performance well below the SLO target. No SLO is the listing of storage groups on which an SLO has not been explicitly set. One may expect to see parent storage groups here, as SLOs are set on child storage groups and not the parent storage group.

Stable Storage Groups

Stable



000196800225 > Storage > Storage Groups Dashboard > Stable

Name	SLO Compliance	SLO	Workload Type	Capacity (GB)	Snapshots	Masking Views
▼ app_server_parent	—	None	None	40	0	1
app_server_app1		Platinum	OLTP	20	0	1
app_server_app2		Gold	DSS	20	0	1
EMBEDDED_NAS_DM_SG		Gold	None	105.82	0	1
eNAS_SG		Platinum	None	100.01	0	1
▼ esxi-88-34_parent	—	None	None	0.07	0	1
esxi-88-34_gk		Optimized	None	0.07	0	1
▼ esxi-88-36_parent	—	None	None	0.04	0	1
esxi-88-36_gk		Optimized	None	0.04	0	1
▼ esxi-88-46_parent	—	None	None	0.04	0	1
esxi-88-46_gk		Optimized	None	0.04	0	1
▼ vcenter-88-20_parent	—	None	None	80.04	0	1
vcenter-88-20_dss		Silver	DSS	40	0	1
vcenter-88-20_gk		Optimized	None	0.04	0	1
vcenter-88-20_oracle		Platinum	OLTP	40	0	1
▼ w2k8r2-88-62_parent	—	None	None	0.04	0	1
w2k8r2-88-62_gk		Optimized	None	0.04	0	1
▼ w2k8r2-88-63_parent	—	None	None	0.04	0	1
w2k8r2-88-63_gk		Optimized	None	0.04	0	1

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Monitoring and Workload Planning with Unisphere for VMAX

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This is an example of a listing of Stable storage groups. To see the details of the SLO compliance of a specific storage group simply select the storage group and view its details.

Stable SG Example - Details

000196888225 > Storage > Storage Groups Dashboard > Stable > vcenter-88-20_oracle

Details | Workload

PROPERTIES

Name	vcenter-88-20_oracle
WLP Status	
SLO	Platinum
Workload	OLTP
SRP	SRP_1
Total Capacity (GB)	40
Volumes	4
Masking Views	0
Last Updated	Thu 12/11/2014 01:21:41 PM GMT-0500
Parent Storage Groups	1
Host I/O Limit	N/A
Set Host I/O Limit (MB/Sec)	☐
Host I/O Limit (MB/Sec)	N/A
Set Host I/O Limit (IO/Sec)	☐
Host I/O Limit (IO/Sec)	N/A
Set Dynamic Distribution	☐

RELATED OBJECTS

Contains: Volumes - 4

Associated With: SRP - SRP_1

Parent Storage Group - 1

PERFORMANCE VIEWS

Navigate to: [Analyze](#) [Monitor](#)

Modify Provision Storage to Host Delete Apply Cancel

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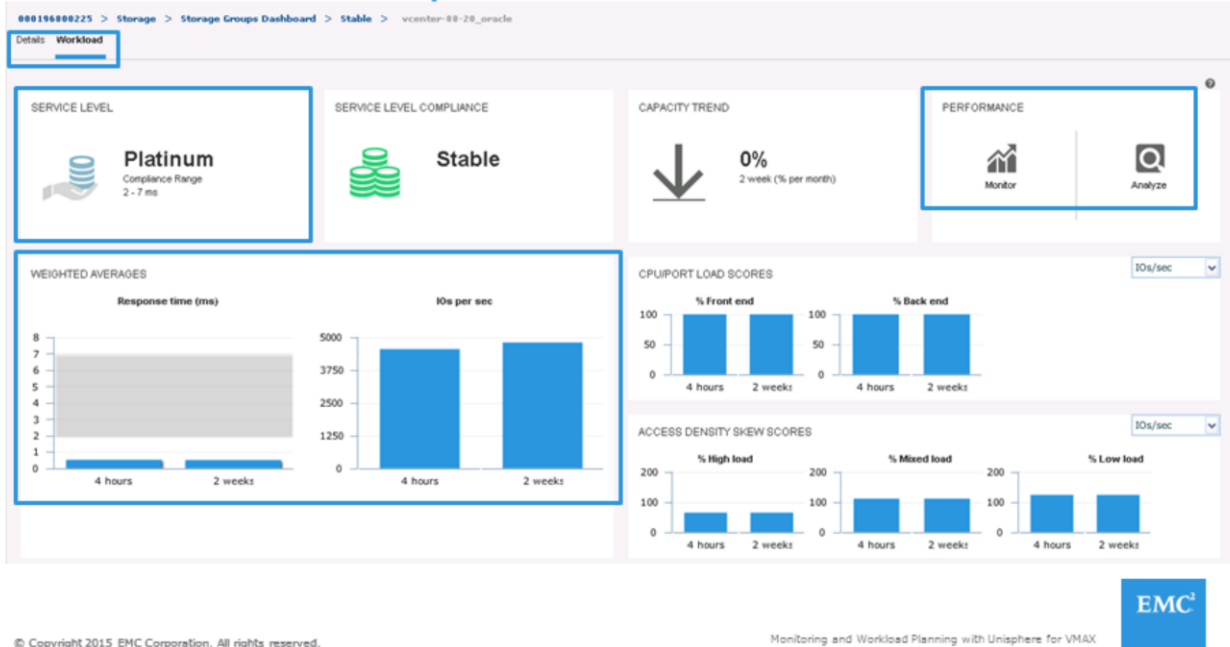
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Monitoring and Workload Planning with Unisphere for VMAX

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To view the details of a storage group, select a storage group from the storage group listing and click on View Details. The detailed view of the storage group shows detailed information on the storage groups and has links to the related objects and to the performance views. Any storage group which is being accessed by a host will also show a Workload tab on the View Details page. Click on the Workload tab to see more details of SLO Compliance for a Storage Group. One can also click on the Analyze and Monitor link to look at the performance views in more detail. Clicking on the Monitor link will direct you to the EMC built-in performance Dashboard for the storage group.

Stable SG Example – Workload Tab

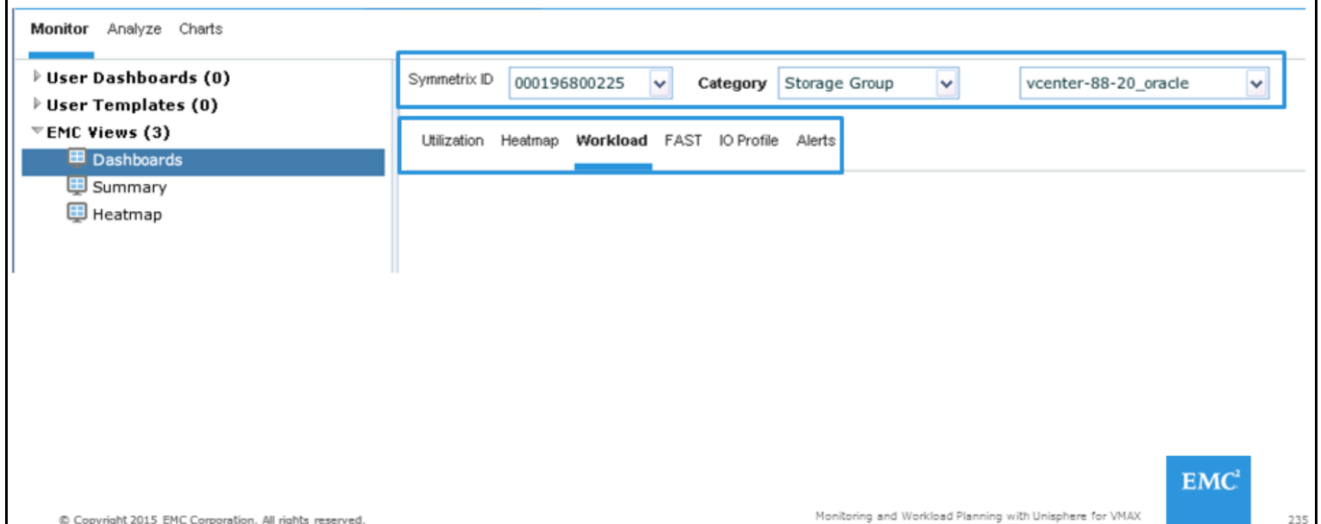


The Workload tab of a storage group shows details of SLO compliance. The display shows the SLO that has been set on this SG along with the expected compliance range. In this example the SLO is Platinum with an expected response time range of 2-7 ms. The actual response time for this SG in the last 4 hours and in the last 2 weeks has been less than 1 ms, as can be seen on the slide. As a consequence this SG is Stable as shown.

The Workload tab also shows the IOs per second and information on CPU/Port Load and Access Density skew. One can also click on the Performance links (Monitor and Analyze) to look at the performance data more thoroughly.

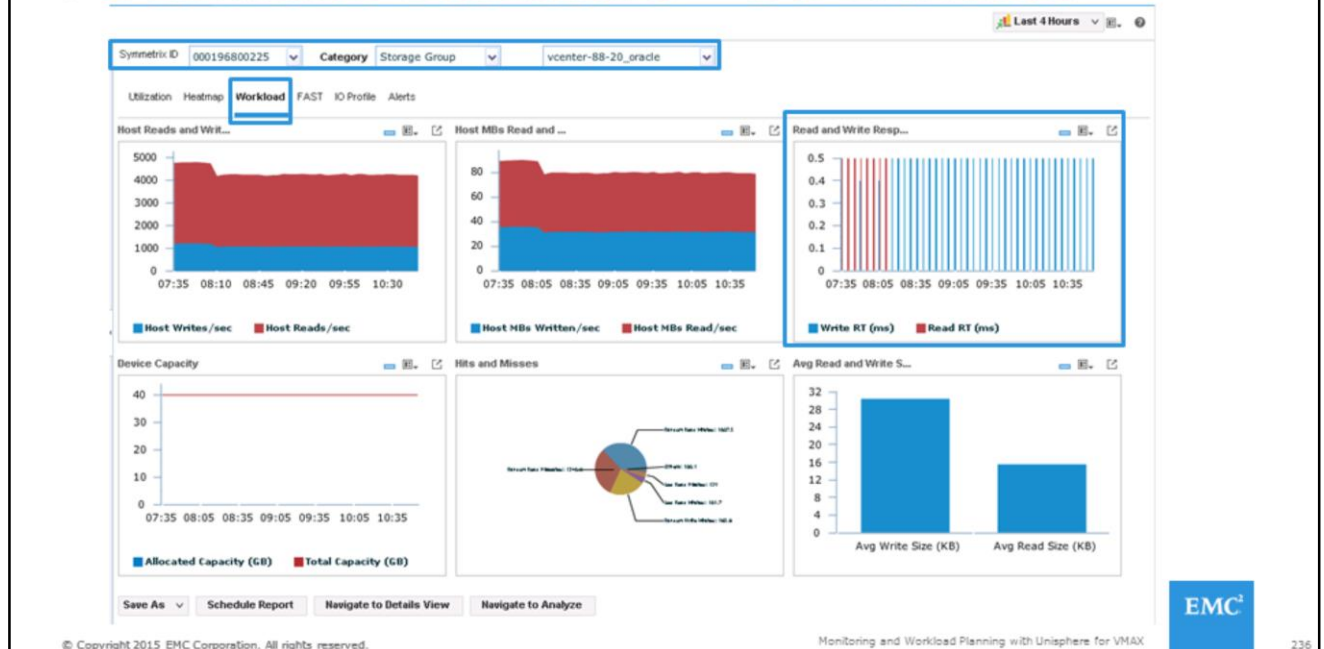
Please refer to the Unisphere online help for more information on the CPU/Port Load and Access Density Skew charts.

Performance Dashboard – Storage Group



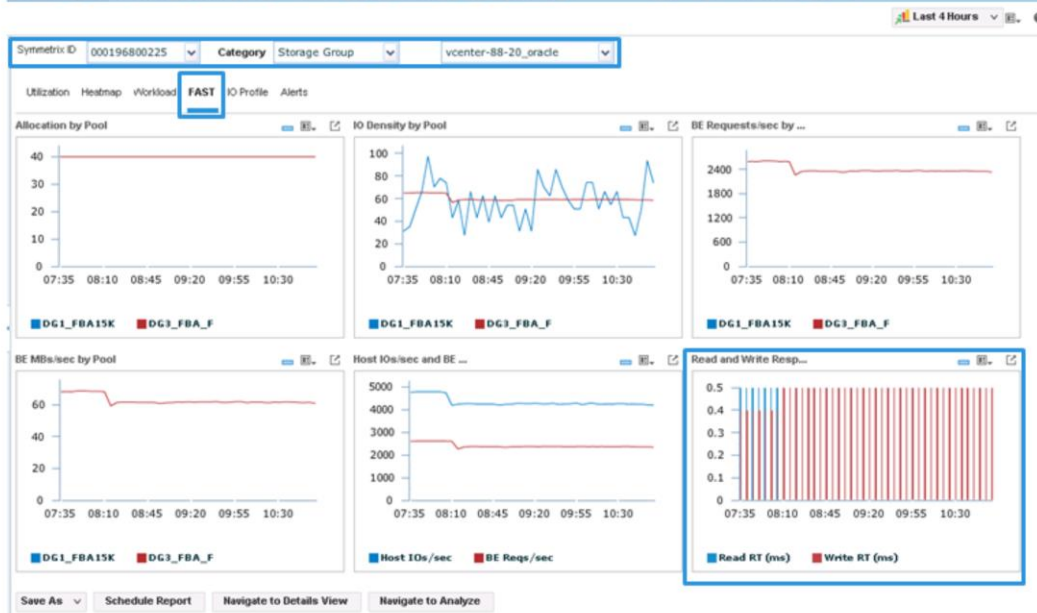
Clicking on Monitor in the Storage Group Workload page directs you to the built in EMC Performance Dashboard for the storage group. In this example we are looking at the performance dashboard of a storage group called vcenter-88-20_oracle. One can look at different views within this dashboard – Utilization, Heatmap, Workload, FAST, IO Profile and Alerts.

Performance Dashboard – SG Workload



Here is an example of the Performance Dashboard for a storage group showing Workload. One can see the graphs in more detail by maximizing each graph individually.

Performance Dashboard – SG FAST



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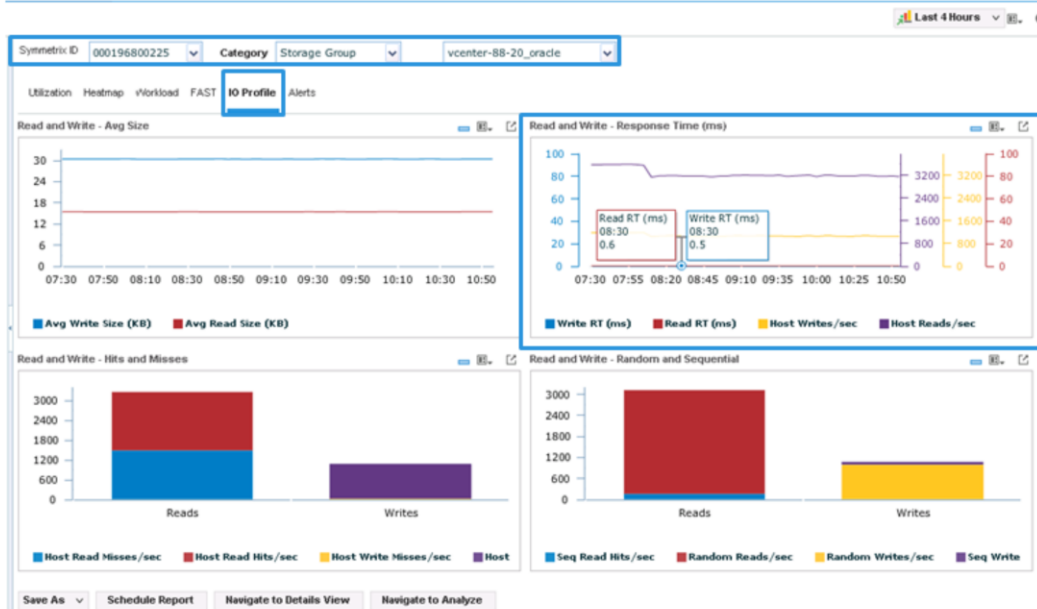
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Monitoring and Workload Planning with Unisphere for VMAX

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Here is an example of the Performance Dashboard for a storage group showing FAST related information. One can see the graphs in more detail by maximizing each graph individually.

Performance Dashboard – SG IO Profile



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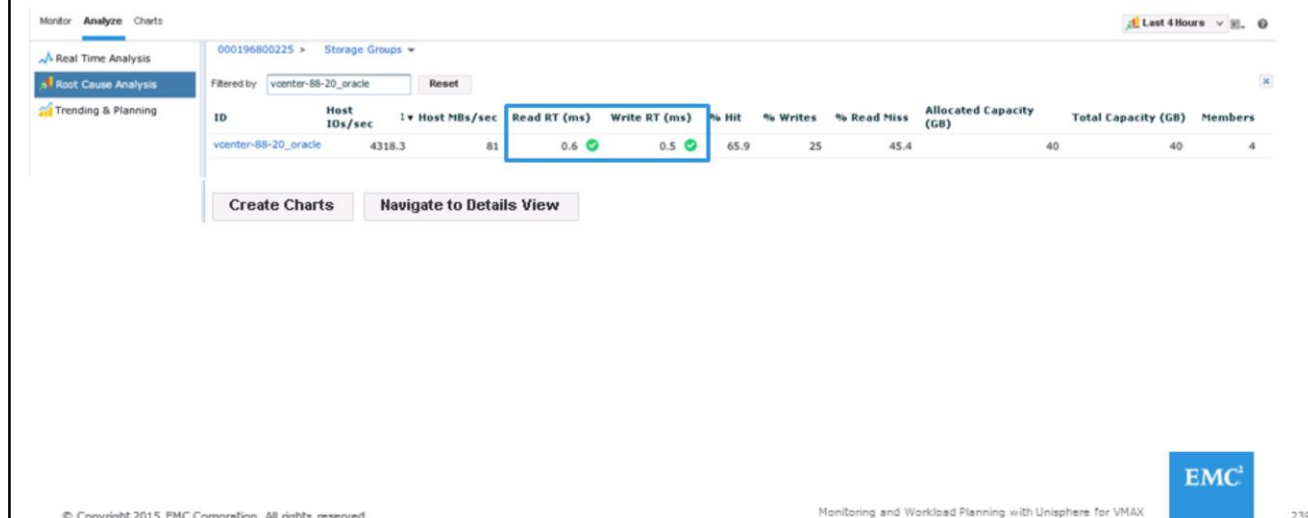
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Monitoring and Workload Planning with Unisphere for VMAX

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Here is an example of the Performance Dashboard for a storage group showing its IO Profile. One can see the graphs in more detail by maximizing each graph individually. One can click on [Navigate to Analyze](#) to go the Analyze page or click on [Navigate to Details View](#) to go back to the details page of the storage group.

Storage Group – Performance Analyze View



Clicking on Analyze in the Storage Group Workload page directs you to the Performance Analyze view for the specific storage group. In this example we are looking at the Analyze view of a storage group called vcenter-88-20_oracle. The Analyze view presents a tabular view of various metrics. To create charts click on the Create Charts button. Or click on Navigate to Details View to return to the details page of the storage group.

Lab: Monitoring SRP and SLO Compliance with Unisphere

This lab covers

- Monitoring SRP with Unisphere for VMAX
- Monitoring SLO Compliance with Unisphere for VMAX

This Lab covers the monitoring of SRP and SLO compliance with Unisphere for VMAX.

Lesson Summary

During this lesson the following topics were covered:

- Monitoring storage group SLO compliance
- Monitoring storage group performance

This lesson covered the monitoring to storage group SLO compliance and storage group performance.

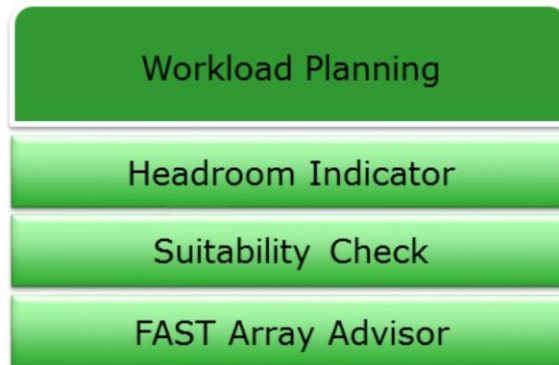
Lesson: Workload Planning

This lesson covers the following topics:

- SRP Headroom
- Suitability Check
- FAST Array Advisor

This lesson covers the workload planning features of Unisphere for VMAX, viz. SRP Headroom, Suitability Check and FAST Array Advisor.

Workload Planning – Unisphere for VMAX



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Monitoring and Workload Planning with Unisphere for VMAX

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The workload planning features supported by Unisphere for VMAX are headroom indicator, suitability check and FAST Array Advisor. These features allow the user to plan based on service level and workload. Headroom indicator gauges the remaining capacity per service level so a user can plan how many more workloads can be provisioned. When the user is ready to provision, a suitability check can be run upfront to determine whether or not the capacity and the service level request can be met by the array. The FAST Array Advisor feature can help determine if a given workload would be better suited on another array.

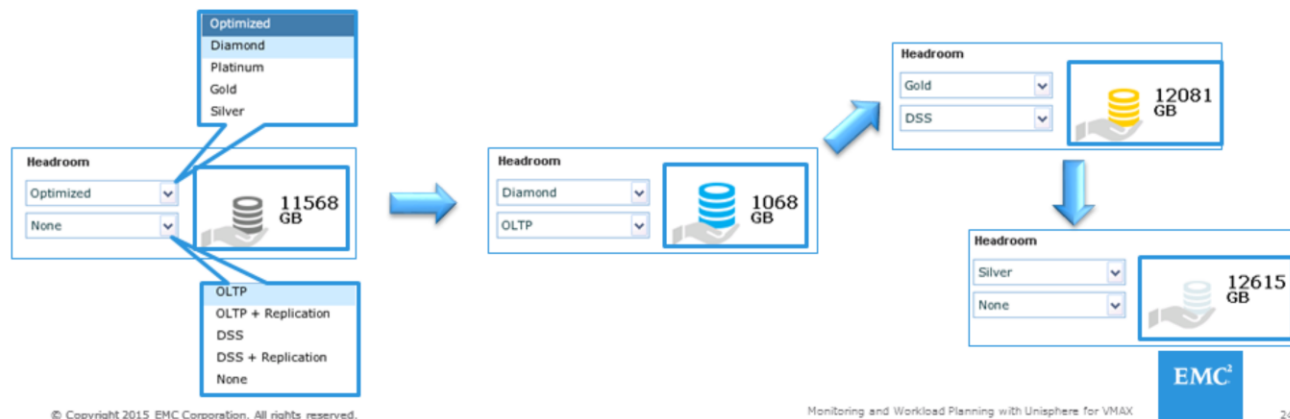
To use the workload planning features the arrays must be registered for performance data collection.

SRP Headroom



000196800225 > Storage > Storage Groups Dashboard

- Useful for workload planning
 - Displays the available headroom for a SLO/workload combination
 - Assuming all the remaining capacity will be this type



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Monitoring and Workload Planning with Unisphere for VMAX



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The SRP Headroom indicator in the Storage Group Dashboard is useful for workload planning. It displays the space available for a particular SLO/workload combination if all remaining capacity was on that type.

The capacity for an SLO/workload combination indicates the amount that one can provision and be assured that the array would be capable of meeting the SLO compliance requirements.

In this example for this particular array and SRP at this specific time we can safely provision:

SLO/Workload	Available Headroom Capacity (GB)
Optimized	11568
Diamond/OLTP	1068
Gold/DSS	12081
Silver/None	12615

Suitability Check

- Part of Provision Storage Wizard
- Suitability Check can be performed when
 - Provisioning storage to a new host with Provision Storage to Host
 - Modifying an existing storage group in a masking view
 - Adding more storage
 - Modifying service level/workload type
- Determines if the VMAX3 array can handle the capacity and service level/workload combination request
- Optional
- Will not prevent provisioning if check fails

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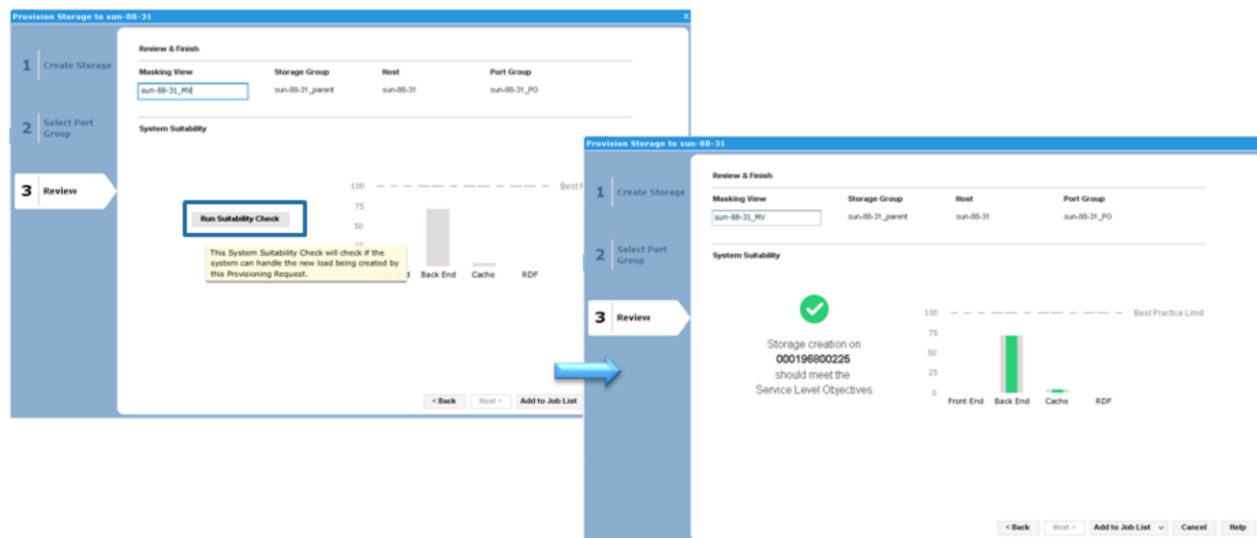
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Suitability Check is an optional step that can be performed by the Provision Storage wizard when provisioning storage to host or when modifying an existing storage group which is part of a masking view. The modification to the storage group could be the addition of more storage or a change to the service level/workload type. Suitability check determines if the VMAX3 array can handle the changes to the capacity and service level/workload type. Note that the provisioning process can be continued even if the suitability check fails.

Suitability Check – Provision Storage to Host



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In one of the earlier modules we had seen the usage of the Suitability Check when provisioning new storage to a host with the Provision Storage wizard. The information is repeated here for the sake of completeness.

Suitability Check is an optional step on the review page of the Provision Storage to Host wizard. Click on the Run Suitability Check button to see if the array can meet the Service Level Objectives for the provisioning request. In order for the Suitability check to work the VMAX3 arrays must be registered for performance data collection. In this example the green check mark indicates that Service Level Objective for provisioning request will be met.

Suitability Check – Modify SG – Add Volumes

The first screenshot shows the 'Modify Storage Group' dialog. It lists two child storage groups: 'app_server_ap1' (Platinum service level, OLTP workload type, 2 volumes, 10.00 GB capacity, 3 ms response time) and 'app_server_ap2' (Gold service level, DSS workload type, 2 volumes, 10.00 GB capacity, 6 ms response time). The total capacity is 40 GB with an additional capacity of 8 GB.

The second screenshot shows the same dialog after adding more volumes. The 'app_server_ap1' group now has 4 volumes, and the 'app_server_ap2' group now has 4 volumes. The total capacity is now 68.88 GB with an additional capacity of 28.88 GB.

The third screenshot shows the 'Suitability Check' results. A green checkmark indicates that the storage modification on 000196800225 should meet the service level objectives. A bar chart shows the utilization of Front End, Back End, Cache, and RDF resources, all well below the Best Practice Limit.

Added more Volumes

Run Suitability Check

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Suitability Check can also be run when modifying a storage group that is a part of a masking view. Any changes to the Service Level, Workload Type or the addition of Volumes will allow one to run the Suitability Check. In this example the we have add more volumes to one of the child storage groups.

Suitability Check – Modify SG – SLO/WL Type

Modify Storage Group

Storage Group Name: app_server_parent | Storage Resource Pool: SRP_1

Name	Service Level	Workload Type	Volumes	Volume Capacity	Avg. Resp.
app_server_ap1	Platinum	OLTP	2	10.00 GB	3 ms
app_server_ap2	Gold	DSS	2	10.00 GB	6 ms

Total Capacity: 40 GB (Additional Capacity 8 GB) | Total Service Levels: 2

Changed Service Level

Suitability Check

Storage modification on 000196800225 should meet the Service Level Objectives

Run Suitability Check | Add to Job List | Cancel | Help

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In this example the we modified the Service Level for one of the child storage groups. The number of Volumes is unchanged.

FAST Array Advisor

- Determines performance impact of migrating workload from one array (source) to another array (target)
- Automatically creates necessary auto-provisioning groups on target array
- Both arrays must be managed by the same Unisphere for VMAX server and registered for performance data collection

Source	Target
Enginuity 5874-5876	Enginuity 5874-5876 or HYPERMAX OS 5977 or higher
HYPERMAX OS 5977 or higher	HYPERMAX OS 5977 or higher

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Monitoring and Workload Planning with Unisphere for VMAX

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The FAST Array Advisor wizard will guide you through the process of determining the performance impact of migrating the workload from one storage system (source) to another storage system (target). If the wizard determines that the target storage system can absorb the added workload, it will automatically create all the necessary auto-provisioning groups to duplicate the source workload on the target storage system. The arrays must be registered for performance data collection. The supported array operating system environments are listed on the table on the slide.

Launch FAST Array Advisor Wizard

000196800225 > Storage > Storage Groups Dashboard > Storage Groups

Name	SLO Compliance	SLO	Workload Type	Capacity (GB)
app_server_parent		None	None	40
app_server_app1		Platinum	OLTP	20
app_server_app2		Gold	DSS	20

1 Selected

Create SG Modify Provision Storage to Host Protect Manage Protection View Details >>

FAST Array Advisor

- Change SRP
- Set Host I/O Limits
- Replication QOS
- Delete
- Expand ProtectPoint
- Start Allocate/Free/Reclaim
- Stop Allocate/Free/Reclaim
- Convert To Cascaded

- Storage Group
 - must be parent or standalone
 - Child SGs are implicitly selected for a parent SG
 - must be associated with a single view

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Monitoring and Workload Planning with Unisphere for VMAX

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FAST Array Advisor can be launched from any Storage Group listing view. To launch the FAST Array Advisor wizard select the storage group that you would like to migrate to a different array and then click on the more (>>) button and then choose FAST Array Advisor.

The storage group must:

Not be a child storage group. Only standalone or parent storage groups can be selected for analysis. If a parent storage group is selected, its child storage groups will be implicitly selected as well, and the analysis will apply to the entire collection of parent and child storage groups as a group.

Be associated with a single masking view.

Only contain FBA volumes. It cannot be empty or contain only gatekeeper volumes.

Be associated with a Service Level Objective (HYPERMAX OS 5977), or associated with a FAST policy (Engenuity 5874 - 5876).

Masking View Associated with Source SG

000196000225 > Hosts > Masking View > app_server_mv

Hosts		Ports		Storage		
Host	Initiator	Port Group	Director:Port	Storage Group	Volume	Capacity (GB)
app_server (2)		app_server_pg (2)		app_server_parent (4)		
	2101001b323e9dd5		FA-1D:6	app_server_app1 (2)		
	2100001b321e9dd5		FA-2D:6		00063	10.00
					00064	10.00
				app_server_app2 (2)		
					00065	10.00
					00066	10.00

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Before using the FAST Array Advisor wizard let us take a look at the masking view associated with the storage group that we want to migrate. The slide shows the masking view connections for masking view app_server_mv. The storage group app_server_parent will be used as the source storage group in the FAST Array Advisor wizard. We can see that the port group has two ports and the initiator group (Host) has two initiators.

FAST Array Advisor – Select Target Array

FAST Array Advisor

1 Select Target Array

Select a target array and SLO

Source: 000196800225

Storage Group	SLO
app_server_parent	
app_server_app1	Platinum
app_server_app2	Gold

→

Target: 000196700483 SRP: SRP_1

Storage Group	SLO
app_server_parent	
app_server_app1	Platinum
app_server_app2	Gold

< Back Next > Finish Cancel

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In this example of FAST Array Advisor both the source and target arrays are VMAX3 arrays running HYPERMAX OS 5977.

Step 1: Select the target array from the Target drop down list, in the example shown the Unisphere for VMAX instance only manages two VMAX3 arrays, so only one array SID 483 is available as a target. Once the target has been selected, choose the SRP and the SLO of the storage groups on the target array.

One can see that the Wizard used the same names for the storage groups on the target array. In this example we have set the SLO on the target the same as the source.

Click Next to Choose Ports.

FAST Array Advisor – Choose Ports

FAST Array Advisor

1 Select Target Array

2 Choose Ports

3 View Results

4 Prepare Migration

Choose ports on target array

Number of ports:

Select ports from:

- ☒ All available ports
The system will select the most suitable ports.
- ☐ Specific ports
Choose a set of ports from which the system will select

< Back Next > Finish Cancel

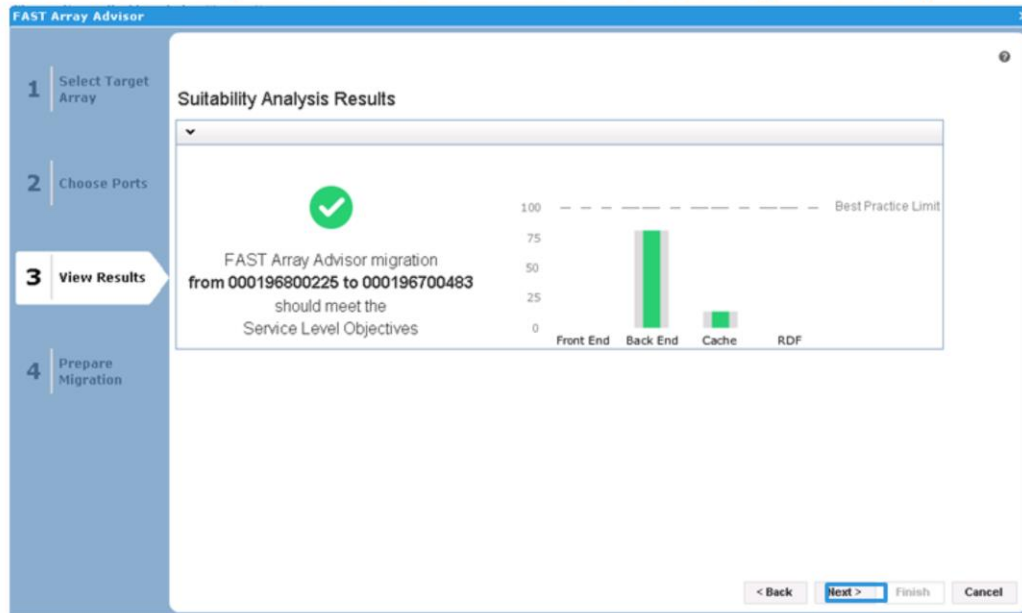
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- We have set number of port to 2 to match the source MV
- Wizard will choose 2 ports on the target array

FAST Array Advisor Wizard Step 2: Choose Ports. In this example the masking view associated with the source SG had a port group with two ports. So we have set the number of ports to 2. Also we will let the wizard pick the ports from all available ports. One can also choose specify the ports by clicking on the Specific Ports radio button. Click Next to go to Step 3.

FAST Array Advisor – Suitability Analysis



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FAST Array Advisor Wizard Step 3: View Results. In this step the wizard performs a suitability analysis to ensure that the workload on the source SG can be handled by the target array. Click Next to go to the next step.

FAST Array Advisor – Prepare Migration

FAST Array Advisor

1 Select Target Array

2 Choose Ports

3 View Results

4 Prepare Migration

Prepare Migration

The following objects will be created on target array 000196700483

Masking View: app_server_mv

Storage Group

Storage Group	Volumes	Capacity (GB)
▼ app_server_parent	4	40
app_server_app1	2	20
app_server_app2	2	20

Port Group

Port Group	Port
▼ app_server_pg	FA-1D:10
	FA-2D:10

Initiator Group

Initiator Group	Initiator
▼ app_server	2101001b323e9dd5
	2100001b321e9dd5

< Back Next > **Finish** Cancel

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FAST Array Advisor Wizard Step 4: Prepare Migration. This step shows a summary of what the wizard will do when the Finish button is clicked.

The wizard will create required storage groups populated with the appropriate devices, create a port group with suitable ports, create an initiator group with the same initiators as the source initiator group and finally a masking view with these groups. The names of groups and masking view will be identical to the source. Click Finish to allow the wizard to create these groups and masking view.

Masking View Created on Target



000196700483 > Hosts > Masking View > app_server_mv

Hosts		Ports		Storage	
Host	Initiator	Port Group	Director:Port	Storage Group	Volume
app_server (2)	2101001b323e9dd5	app_server_pg (2)	FA-1D:10	app_server_parent (4)	
	2100001b321e9dd5		FA-2D:10	app_server_app1 (2)	00055
					10.00
				app_server_app2 (2)	00056
					10.00
					00057
					10.00
					00058
					10.00

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Monitoring and Workload Planning with Unisphere for VMAX

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The FAST Array Advisor sets up job list on the target array and starts executing the tasks as soon as the Finish button is clicked. The Create Masking View success dialog indicates that the Masking view has been created on the target . One can examine the new masking view. We can see that the initiators in the new masking view on the target array are identical to the source. The port group has two ports and the storage groups has the same number and size of devices as the source.

FAST Array Advisor – Next Steps

- FAST Array Advisor does not do the actual data migration
- Data has to be migrated from source to target
- Host has to be zoned to target array

FAST Array Advisor does not actually do the data migration, it prepares the target by creating the required devices, storage groups, port group, initiator group and masking view. The data migration has to be done. The initiators in the new initiator group need to be zoned to the ports in the port group.

Lab: Workload Planning with Unisphere

This lab covers

- Monitoring for available headroom
- Running suitability check when allocating more storage to a host

This Lab covers the workload planning features of Unisphere for VMAX.

Lesson Summary

During this lesson the following topics were covered:

- SRP Headroom
- Suitability Check
- FAST Array Advisor

This lesson covered the workload planning features of Unisphere for VMAX, viz. SRP Headroom, Suitability Check and FAST Array Advisor.

Module Summary

Key points covered in this module:

- Monitoring SRP reports
- Monitoring Storage Group SLO Compliance
- Workload Planning
 - SRP Headroom
 - Suitability Check
 - FAST Array Advisor

This module covered monitoring and workload planning with Unisphere for VMAX. Unisphere for VMAX was used to monitor SRP and SLO compliance. The workload planning features viz. SRP Headroom, Suitability Check and FAST Array Advisor were also covered.

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Module: Management in a Virtualized Environment

Upon completion of this module, you should be able to:

- Manage Virtual Servers with Unisphere for VMAX
- Describe the EMC VSI for VMware vSphere Web Client features for VMAX3 arrays

This module focuses on management of VMAX3 storage in a virtualized environment. We will cover the management of virtual servers with Unisphere for VMAX and describe the EMC VSI for VMware vSphere Web Client features for VMAX3 arrays.

Lesson: Virtual Server Management – Unisphere for VMAX

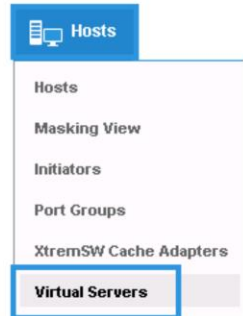
This lesson covers the following topics:

- Virtual Server Management with Unisphere for VMAX

This lesson covers Virtual Server Management with Unisphere for VMAX.

Virtual Servers - Management

- Hosts > Virtual Servers
- Discover VMware ESX/ESXi and Microsoft Hyper-V



- View details of Virtual Servers
 - VMs, Volumes ...
- Add Storage to a VM
 - RDMs for VMware VM

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Management in a Virtualized Environment

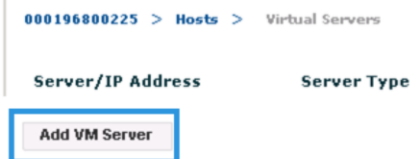
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Using Unisphere for VMAX one can discover VMware ESX/ESXi hosts and Microsoft Hyper-V servers. Once the Virtual Server is discovered one can view its details and also add storage to a VM. We will take a look at some of these features in the next few slides.

Virtual Server management is done under the Hosts section. Hover over the Hosts section button and select Virtual Servers to see a listing of all the discovered virtual servers. This page is also used to add new Virtual Servers.

Virtual Servers – Add new ESXi Host

- Add Virtual Server



- ESXi Host added

000196800225 > Hosts > Virtual Servers

Server/IP Address	Server Type	VMs	Volumes	Last Updated
10.126.88.36	VMware	5	25	Wed 01/21/2015 03:48:09 PM GMT-0500

Add VM Server **Change Password** **Remove** **View Details**

Add New Server

* Server/IP Address: 10.126.88.36

* Username: root

* Password: [masked]

* Confirm Password: [masked]

* Server Type: VMware (selected)

Retrieve Info: ☒

OK **Cancel** **Help**

To add a new virtual server click on the Add VM Server button in the Virtual Servers listing. In this example we are adding a VMware ESXi host. In the Add New Server dialog enter the IP Address and login credentials. Choose the Server Type, this can be VMware or Hyper-V. Check the Retrieve Info box and then click OK. This will initiate the discovery of the Virtual Server and also gather information about it.

ESXi Host - Details

000196800225 > Hosts > Virtual Servers

Server/IP Address...	Server Type	VMs	Volumes	Last Updated
10.126.88.36	VMware	5	25	Wed 01/21/2015 03:48:09 PM GMT-0500

Add VM Server Change Password Remove View Details

000196800225 > Hosts > Virtual Servers > 10.126.88.36

PROPERTIES

Server/IP Address 10.126.88.36

Server Type VMware

Username root

Total Memory (MB) 130996.36

RELATED OBJECTS

Contains:

VMs - 5

Volumes - 25

000196800225 > Hosts > Virtual Servers > 10.126.88.36 > Volumes

Device ID	VM Name	1 Device Name	2 Vendor	Array ID	2 Product Name	Datastore Name	Device Capacity (GB)
005C	win-38-10	naa.60000970000196800225533030303543	EMC	000196800225	SYMMETRIX	VMAX3_SID225_DS1	10
005B	win-38-10	naa.60000970000196800225533030303542	EMC	000196800225	SYMMETRIX	VMAX3_SID225_DS1	10
005A	win-38-10	naa.60000970000196800225533030303541	EMC	000196800225	SYMMETRIX	VMAX3_SID225_DS1	10
0059	win-38-10	naa.60000970000196800225533030303539	EMC	000196800225	SYMMETRIX	VMAX3_SID225_DS1	10
	win-38-10	naa.60030130f0900000195c0033ba0e8e35	LSI		UCSC-RAID2008MBI	Local-88-36	464.73
0028	UVMAX801-88-89	naa.60000970000196800225533030303238	EMC	000196800225	SYMMETRIX		0.01
0027	UVMAX801-88-89	naa.60000970000196800225533030303237	EMC	000196800225	SYMMETRIX		0.01

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Management in a Virtualized Environment

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To see the details of a specific Virtual Server select the server in the Virtual Server listing and click on View Details. The details view has links to the VMs and Volumes on the specific Virtual Server. In this example we can see that the Virtual Server is a VMware host. This ESXi host is hosting 5 VMs and has access to 25 Volumes.

Clicking on the Volumes link will show a listing of all the Volumes accessible to this Virtual Server. A partial listing is shown on the slide. The volume listing also shows information about which VM is using a device and if the device has a datastore on it. The listing also shows the VMAX3 Array ID (Product Name is listed as Symmetrix).

ESXi Host – Details - VMs

000196880225 > Hosts > Virtual Servers > 10.126.88.36

PROPERTIES

Server/IP Address	10.126.88.36
Server Type	VMware
Username	root
Total Memory (MB)	130996.36
Build	799733
Version	5.1.0
Last Updated	Wed 01/21/2015 03:49:46 PM GMT-0500

RELATED OBJECTS

Contains: **VMs - 5**
Volumes - 25

000196880225 > Hosts > Virtual Servers > 10.126.88.36 > VMs

VM Name	VM OS Name	VM State	Num of CPUs	Total Memory (MB)
UVMAX801-88-89	SUSE Linux Enterprise 11 (64-bit)	Power On	2	12288
win-38-10	Microsoft Windows Server 2008 R2 (64-bit)	Power On	1	4096
win-38-11	Microsoft Windows Server 2008 R2 (64-bit)	Power On	1	4096
win-38-12	Microsoft Windows Server 2008 R2 (64-bit)	Power On	1	4096
win-38-13	Microsoft Windows Server 2008 R2 (64-bit)	Power On	1	4096

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Management in a Virtualized Environment

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Click on the VMs link in the Virtual Server details view to see a listing of the VMs hosted on the Server. The VMs listing shows the VM name, OS, VM power state, number of CPUs and the memory. To see the details of a specific VM, select a VM from the listing and click on View Details.

VM - Details

000196800225 > Hosts > Virtual Servers > 10.126.88.36 > VMs

VM Name	VM OS Name	VM State	Num of CPUs	Total Memory (MB)
win-38-10	Microsoft Windows Server 2008 R2 (64-bit)	Power On	1	4096

View Details

000196800225 > Hosts > Virtual Servers > 10.126.88.36 > VMs > win-38-10

PROPERTIES

VM Name	win-38-10
VM OS Name	Microsoft Windows Server 2008 R2 (64-bit)
VM State	Power On
Num of CPUs	1
Total Memory (MB)	4096

RELATED OBJECTS

Contains: Volumes - 5

000196800225 > Hosts > Virtual Servers > 10.126.88.36 > VMs > win-38-10 > Volumes

Device...	Device Name	Vendor	Array ID	Product Name	Datastore Name	Device Capacity (GB)
0059	naa.60000970000196800225533030303539	EMC	000196800225	SYMMETRIX	VMAX3_SID225_DS1	
005A	naa.60000970000196800225533030303541	EMC	000196800225	SYMMETRIX	VMAX3_SID225_DS1	
005B	naa.60000970000196800225533030303542	EMC	000196800225	SYMMETRIX	VMAX3_SID225_DS1	

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To see the details of a specific VM select the VM and click on the View Details button. The details view of the VM has a link to the Volumes used by the VM. Click on the Volumes link to see the volume listing. The volume listing also shows the datastore name.

Add VM Storage

Add VM Storage

Remove VM Storage

- Virtual Server > VMs > VM > Volumes

000196800225 > Hosts > Virtual Servers > 10.126.88.36 > VMs > win-38-10 > Volumes

- Virtual Server > Volumes

000196800225 > Hosts > Virtual Servers > 10.126.88.36 > Volumes

- Volume added as an RDM

Note: Volumes must be presented to the Virtual Server using Autoprovisioning.

Device ID	Device Name	Device Capacity (GB)
007C	naa.600097000196800225533030303743	10.00
007D	naa.600097000196800225533030303744	10.00
007E	naa.600097000196800225533030303745	10.00
007F	naa.600097000196800225533030303746	10.00
0080	naa.600097000196800225533030303830	10.00

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The Add VM Storage button is available under the Volumes listing of a specific VM or in the Volumes listing of a specific Virtual Server.

Click on the Add VM Storage button to launch the dialog shown on the screen. Here, we have launched the dialog from the Volume listing of a specific VM.

Pick the VMAX3 array and then select the desired volumes from the list of available volumes and click on Add to VM. Then, click on OK. The volume will be presented as an RDM to the VM. The list of available volumes will automatically exclude devices which have datastores or those devices which are already presented as RDMs to a VM.

Lesson Summary

During this lesson the following topics were covered:

- Virtual Server Management with Unisphere for VMAX

This lesson covered Virtual Server Management with Unisphere for VMAX.

Lesson: EMC VSI for VMware vSphere Web Client

This lesson covers the following topics:

- EMC VSI for VMware vSphere Web Client features for VMAX3 arrays

This lesson covers the EMC VSI for VMware vSphere Web Client features for VMAX3 arrays.

EMC VSI for VMware vSphere Web Client

- Enables VMware administrators to provision and manage EMC storage systems
 - EMC Symmetrix VMAX and VMAX3 storage arrays
 - EMC VNX series and VNXe 3200 storage arrays
 - EMC XtremIO storage arrays
 - EMC ViPR software-defined storage
- Documentation
 - EMC VSI for VMware vSphere Web Client Product Guide
 - VSI for VMware vSphere Web Client Release Notes
 - Please refer to the documentation for installation and configuration information

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EMC Virtual Storage Integrator (VSI) for VMware vSphere Web Client is a plug-in for VMware vCenter. It enables VMware administrators to provision and manage the EMC storage systems listed on the slide for VMware ESX/ESXi hosts.

Tasks that administrators can perform with VSI include storage provisioning, storage mapping, viewing information such as capacity utilization, and managing data protection systems.

VSI consists of a GUI and the EMC Solutions Integration Service, which is the programming interface that provides communications to the storage and data protection systems. The administrator uses VMware vCenter Web Client to provision and manage storage. Please refer to the listed documentation for detailed information on the installation and configuration process. The deployment and configuration of EMC VSI for VMware vSphere Web Client is beyond the scope of this class.

EMC VSI features for VMAX3 Arrays

- Discover VMAX3 Arrays
- Provision VMFS datastores to ESX/ESXi hosts
- Provision RDM volumes to virtual machines
- View storage properties of datastores and RDMs presented to VMs
- EMC VSI Requirements for VMAX3 Arrays
 - Masking views for the ESX/ESXi hosts must exist on the VMAX3 array
 - EMC SMI-S Provider 64-bit v8.0.1 or later
 - VMAX3 array must be registered

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The EMC VSI plug-in will allow the discovery of VMAX3 arrays. One can provision datastores built on VMAX3 storage to ESX/ESXi hosts. The VSI plug-in will automatically provision VMAX3 storage to the ESX/ESXi host and create a datastore. The VSI plug in can also provision VMAX3 storage as RDM volumes to a virtual machine. The VSI plug-in will automatically provision VMAX3 storage to the ESX/ESXi host that the VM resides on and then it will map the new VAMX3 storage as an RDM to the VM. VSI will show the properties of the datastores and RDM volumes.

To provision and manage VMAX3 arrays, VSI requires the EMC SMI-S Provider (64-bit v8.0.1 or later). The ESX/ESXi hosts must have a masking view on the VMAX3 array. The VMAX3 array must be registered in EMC VSI.

EMC VSI - High Level Deployment Steps

- Download EMC VSI Solutions Integration Service OVA from EMC Support
- Deploy EMC VSI Solutions Integration Service OVA
 - Use VMware vSphere Web Client
- Register VSI plug-in with VMware vCenter
 - Use the Solutions Integration Service web page
- Register the Solutions Integration Service in the vSphere Web Client
- Register the VMAX3 arrays

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These are the high level steps to deploy EMC VSI for VMware vSphere Web Client. Please refer to the EMC VSI for VMware vSphere Web Client Product Guide and

EMC VSI for VMware vSphere Web Client Release Notes for detailed steps. In this lesson we will cover the registration of the VMAX3 array.

Register VMAX Arrays - Retrieve Arrays

The first screenshot shows the vSphere Web Client interface. The left-hand navigation pane is expanded to 'vCenter' > 'Inventory Trees' > 'Storage Systems'. The 'Storage Systems' tile is highlighted. A blue arrow points from this tile to the second screenshot.

The second screenshot shows the 'Storage Systems' view. The 'Actions' menu is open, and 'Register Storage System' is selected. A blue arrow points from this menu item to the third screenshot.

The third screenshot shows the 'Register EMC Storage System' dialog box. The 'Storage system type' is set to 'VMAX'. The 'SMI-S Provider IP/Host name' is '10.126.88.61'. The 'User name' is 'admin' and the 'Password' is masked with asterisks. The 'Max device size (LUNs)' is set to '0'. Below these fields is a table with columns 'System Name', 'Model', and 'Enginuity'. At the bottom right, the 'Retrieve Arrays' button is highlighted. A blue arrow points from this button to the 'Retrieve Arrays' button in the third screenshot.

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To register a VMAX3 array login to the vSphere Web Client and then navigate to Home > vCenter as shown on the left most graphic. Click on Storage Systems under EMC VSI.

This will show a list of storage systems registered under EMC VSI. As the middle graphic shows no systems are register at this tile. Click on Actions and choose Register Storage Systems to launch the Register EMC Storage Systems dialog. Use the Storage System type pick list to choose VMAX. The specify the required SMI-S information. Enter the SMI-S provider host name or IP address, the SMI-S user name and password. Then click Retrieve Arrays to retrieve information about all the VMAX3 arrays known to the SMI-S provider.

Register VMAX3 Arrays - Select Array

The image shows the 'Register EMC Storage System' dialog box on the left. It has fields for 'Storage system type' (set to VMAX), 'SMI-S Provider IP/Host name' (10.126.88.61), 'User name' (admin), 'Password' (masked), and 'Max device size (GB)'. Below these is a table with columns 'System Name', 'Model', and 'Endianness'. The first row is highlighted: 000196800225, VMAX100K, 5977.497.471. At the bottom are 'Retrieve Arrays', 'OK', and 'Cancel' buttons. A blue arrow points from the 'OK' button to a 'Registration Successful' dialog box in the center. This dialog says 'Your registration is successful and you own storage system 000196800225.' with an 'OK' button. Another blue arrow points from this dialog to the 'vSphere Web Client' interface on the right. The interface shows 'Storage Systems' with a table listing the registered array: 000196800225, VMAX100K, 10.126.88.61. The EMC logo is in the bottom right corner.

Register EMC Storage System

Storage system type: VMAX

SMI-S Provider IP/Host name: 10.126.88.61

User name: admin

Password: *****

Max device size (GB):

System Name	Model	Endianness
000196800225	VMAX100K	5977.497.471

Retrieve Arrays OK Cancel

Registration Successful

Your registration is successful and you own storage system 000196800225.

OK

vmware vSphere Web Client

vCenter Storage Systems

Storage Systems Objects

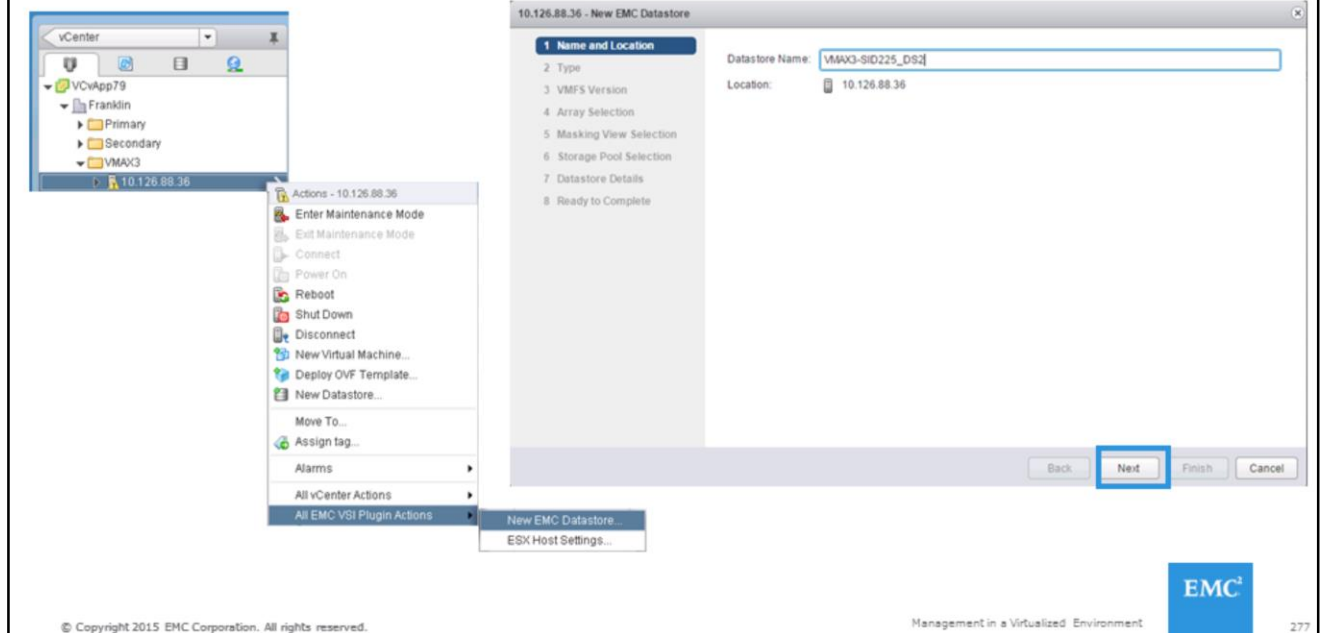
Name	Model	Management IP
000196800225	VMAX100K	10.126.88.61

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This is a continuation of the registration process. Select an array from the list of retrieved arrays and click OK to register the same. Click OK to close the success dialog. The Storage System listing will show the arrays that have been successfully registered. In this example a VMAX 100K array has been registered.

VSI - Provision Datastore with VMAX3 Storage



EMC VSI can be used to provision a new datastore to an ESXi host with VMAX3 storage. In the vSphere Web Client navigate to the hosts and clusters view and then right click on a host or a cluster and then select All EMC VSI Plugin Actions and then select New EMC Datastore to launch the New EMC Datastore dialog. The dialog has a number of steps. In step 1 enter a name for the datastore and then click next.

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Provision Datastore – Steps 2 – 4

The image displays three sequential screenshots of the '10.126.88.36 - New EMC Datastore' wizard, illustrating steps 2, 3, and 4 of the provisioning process.

Step 2: Type
The first screenshot shows the 'Type' selection screen. The 'VMFS' option is selected, with a description: 'Select this option to provision a VMFS datastore on a disk/LUN.' The 'NFS' option is also visible, with a description: 'Select this option to provision an NFS datastore on an NFS share over the network.'

Step 3: VMFS Version
The second screenshot shows the 'VMFS Version' selection screen. The 'VMFS 5' option is selected, with a description: 'VMFS 5 enables 2+TB LUN support and space efficient disks.' The 'VMFS 3' option is also visible, with a description: 'VMFS 3 allows the datastore to be accessed by ESX/ESXi hosts of version earlier than 5.0.' Below the descriptions, the 'Maximum File Size' is set to '256 GB' and 'Block Size' is '1MB'.

Step 4: Array Selection
The third screenshot shows the 'Array Selection' screen. A table lists available storage arrays. The first row is highlighted, showing the selected array.

Name	Model	Management IP	More Info
000196800225	VMAX100K	10.126.88.61	Max device size is unlimited

At the bottom of the wizard, the 'Next' button is highlighted, indicating the progression to the next step.

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This is continuation of the New EMC Datastore dialog. In step 2 select VMFS as the type and then click next. Select the desired VMFS version in step 3. Select the VMAX3 storage array in Step 4 and then click Next.

Provision Datastore – Steps 5 – 6

10.126.88.36 - New EMC Datastore

- ✓ 1 Name and Location
- ✓ 2 Type
- ✓ 3 VMFS Version
- ✓ 4 Array Selection
- ✓ 5 Storage Group
- 6 Ready to Complete

Volumes:

Volume Capacity: GB (Max: 65,536.00 GB)

Storage Resource Pool:

Select a storage group:

Name	Service Level	Workload
esxi-88-36_data	Gold	Not Specified
esxi-88-36_gk	Optimized	Not Specified

10.126.88.36 - New EMC Datastore

- ✓ 1 Name and Location
- ✓ 2 Type
- ✓ 3 VMFS Version
- ✓ 4 Array Selection
- ✓ 5 Storage Group
- ✓ 6 Ready to Complete

General:

Name	VMAX3-SID225_DS2
Type	VMFS5

Storage Details:

Storage System	000196800225
Storage Resource Pool	SRP_1
Service Level	Gold
Workload	Not Specified
Storage Group	esxi-88-36_data
Capacity	10 GB
Volume Count	1
Max FileSize	256 GB, Block Size 1MB

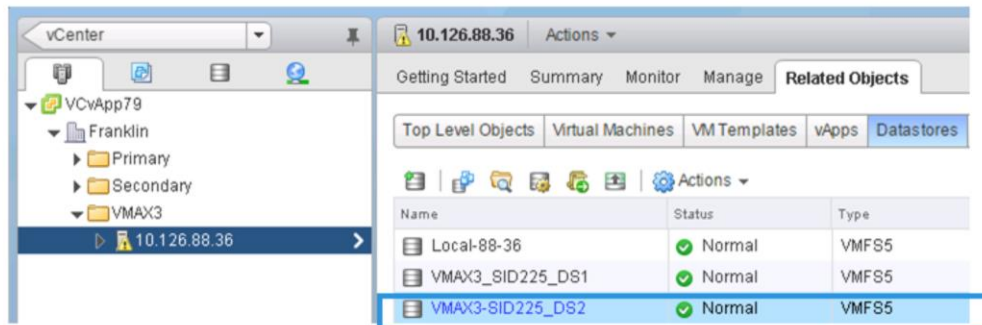
Back Next **Finish** Cancel

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This is continuation of the New EMC Datastore dialog. In step 5 type in the number of volumes, the capacity of the volumes, select the SRP from the pick list and then select the VMAX3 storage group into which the volumes will be placed. Then click Next. Review the selection in the Ready to Complete step. Click on Finish to execute the provisioning task.

EMC VSI will send the provisioning request to the VMAX3 array via the SMI-S provider. The array will receive the request and create the desired number of volumes with the specified capacity and add them to the selected storage group. Once the array has completed its task, EMC VSI will rescan the ESXi host and then create the datastore on the newly presented devices.

EMC VSI - New Datastore Created



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The newly created datastore is now available to the ESXi host.

EMC VSI - Datastore Properties

Details

Location	ds://vmfs/volumes/54c10197-a371ec60-2c89-6c416aa11f52/
File System Type	VMFS5
Hosts	1
Virtual Machines	0

Storage System

Name	000196800225
Product	VMAX
Model	VMAX100K
Revision	5977.497.471

powered by EMC

Capacity

Used	880.00 MB
Free	8.89 GB
Total	9.75 GB
Provisioned	880.00 MB

Storage Device

SLO	Gold
Workload Type	None
Parent Storage Group	esx-89-36_parent
Storage Group	esx-89-36_data
Storage Resource Pool (SRP)	SRP_1
Raid Level	RAID-1
Total Capacity	10.00 GB
Available Capacity	10.00 GB
Used Capacity	0 bytes
Block Size	512 bytes
Is Thin Provisioned	true
WWN	60000970000196800225533030303844
Status	ONLINE
Type	TDEV
Name	0008D/VMAX3-SID225_DS2_2015-01-22_13-54-37-907
Volume Identifier	VMAX3-SID225_DS2_2015-01-22_13-54-37-907
Recover Point Tagged	No
Symmetrix Volume ID	0008D

powered by EMC

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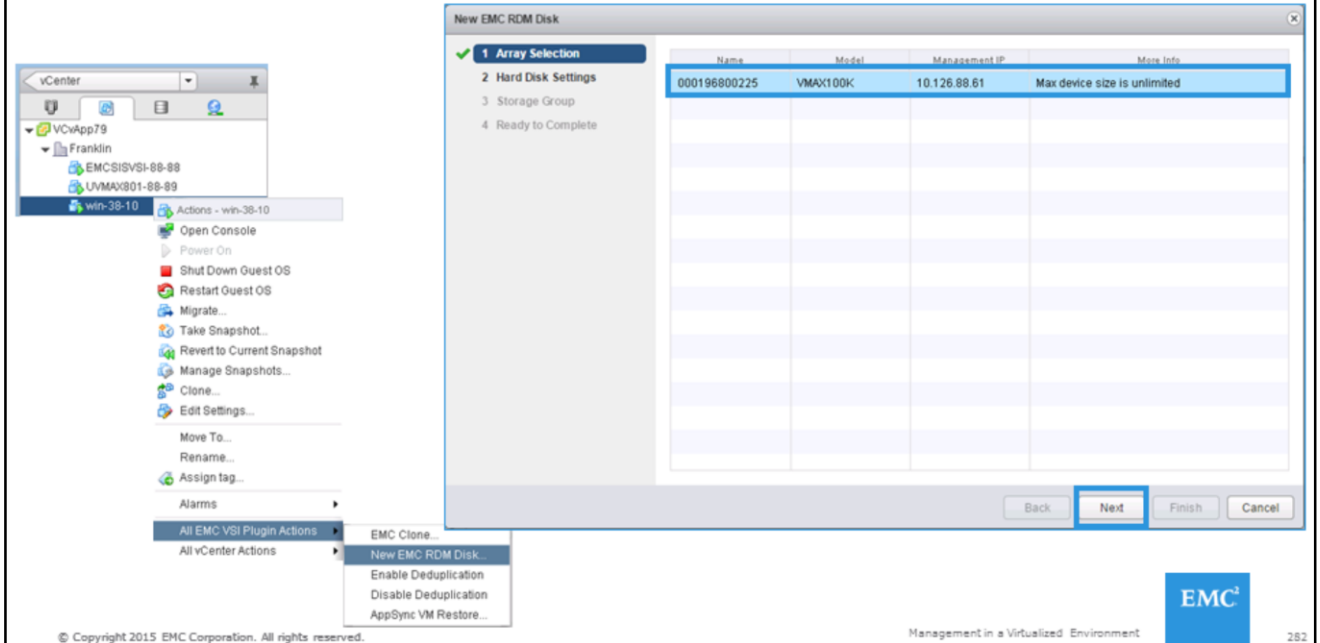
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The properties of the datastore created on VMAX3 storage are shown. EMC VSI provides two tables with information specific to the VMAX3 storage array. The Storage System table indicates that the datastore resides on a VMAX 100K array SID 225. The Storage Device table has information on the SLO, Workload Type, Storage Group, SRP etc.

EMC VSI – Provision VMAX3 Storage as RDM



EMC VSI can be used to provision new VMAX3 storage as RDM volumes to a VM. In the vSphere Web Client navigate to the VMs and Templates view and then right click on a VM and then select All EMC VSI Plugin Actions and then select New EMC RDM Disk to launch the New EMC RDM Disk dialog. The dialog has a number of steps. In step 1 select the VMAX3 array from which the RDM is to be provisioned and then click Next.

Provision RDM – Hard Disk Settings

The screenshot shows the 'New EMC RDM Disk' dialog box with the 'Hard Disk Settings' tab selected. The left sidebar shows a progress bar with four steps: 1 Array Selection, 2 Hard Disk Settings (highlighted), 3 Storage Group, and 4 Ready to Complete. The main area contains the following settings:

- Location: Store with the virtual machine
- Compatibility Mode: Physical
- Shares: Normal, 1000
- Limit - IOPs: Unlimited
- Virtual Device Node: A list of SCSI nodes from SCSI(0:4) to SCSI(0:11). Two nodes, SCSI(0:2) and SCSI(0:3), are highlighted in blue and moved to the right box.
- Disk Mode:
 - ☒ Dependent: Dependent disks are included in snapshots.
 - ☐ Independent - Persistent: Changes are immediately and permanently written to disk. Persistent disks are not affected by snapshots.
 - ☐ Independent - Nonpersistent: Changes to this disk are discarded when you power off or revert to the snapshot.

At the bottom, there are four buttons: Back, Next (highlighted), Finish, and Cancel.

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This is a continuation of the new EMC RDM Disk dialog. In step 2 choose the desired Hard Disk Settings:

Compatibility Mode: Physical or Virtual – In this example we have chosen Physical which will allow the guest operating system direct access to the hardware.

Virtual Device Node: Select an unassigned node and move it to the box on the right by clicking on the arrow button. Choose multiple nodes if you want to present more than one RDM volume. In this example we have chosen to add two RDM volumes.

Disk mode is only applicable if the compatibility mode is virtual.

Click Next to continue the process.

Provision RDM – Capacity and Storage Group

New EMC RDM Disk

✓ 1 Array Selection
✓ 2 Hard Disk Settings
3 Storage Group
4 Ready to Complete

Volume Capacity: 10 GB (Max: 65,536.00 GB)
Storage Resource Pool: SRP_1

Select a storage group:

Name	Service Level	Workload
esxi-88-36_data	Gold	Not Specified
esxi-88-36_gk	Optimized	Not Specified

Back Next Finish Cancel

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This is a continuation of the new EMC RDM Disk dialog. In step 3 type in the capacity of the volumes, select the SRP from the pick list and then select the VMAX3 storage group into which the volumes will be placed. Then click Next.

Provision RDM – Review and Finish

The screenshot shows the 'New EMC RDM Disk' dialog box with the 'Ready to Complete' step selected. The dialog is divided into two main sections: 'Storage Details' and 'Hard Disk Settings'. The 'Storage Details' section includes fields for Storage System, Storage System Type, Storage Resource Pool, Storage Group, Service Level, Workload, and Capacity. The 'Hard Disk Settings' section includes fields for Location, Compatibility Mode, Shares, Limit - IOPs, Virtual Device Node, and Disk Mode. The 'Finish' button is highlighted with a blue border.

Storage Details:	
Storage System	000196800225
Storage System Type	VMAX100K
Storage Resource Pool	SRP_1
Storage Group	esxi-88-36_data
Service Level	Gold
Workload	Not Specified
Capacity	10 GB

Hard Disk Settings:	
Location	Store with the virtual machine
Compatibility Mode	Physical
Shares	1000
Limit - IOPs	Unlimited
Virtual Device Node	SCSI(0:2),SCSI(0:3)
Disk Mode	persistent

Buttons: Back, Next, **Finish**, Cancel

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This is a continuation of the new EMC RDM Disk dialog. Review the selection in the Ready to Complete step. Click on Finish to execute the provisioning task.

EMC VSI will send the provisioning request to the VMAX3 array via the SMI-S provider. The array will receive the request and create the desired number of volumes with the specified capacity and add them to the selected storage group. Once the array has completed its task, EMC VSI will rescan the ESXi host and then assign these newly presented devices as RDM volumes to the VM.

EMC VSI - New RDM Volumes presented to VM

- EMC VSI – EMC Storage Viewer tab for VMs

The screenshot shows the vCenter interface with the 'win-38-10' VM selected. The 'Monitor' tab is active, and the 'EMC Storage Viewer' sub-tab is selected. The table below lists the storage disks presented to the VM.

Name	Capacity	Location	Type
Hard disk 1	40.00 GB	Local-88-36 (299.1 GB free)	VMFS 5
Hard disk 2	10.00 GB	VMAX3_SID225_DS1 (28.1 GB free)	VMFS 5
Hard disk 3	10.00 GB	Local-88-36 (299.1 GB free)	RDM
Hard disk 4	10.00 GB	Local-88-36 (299.1 GB free)	RDM

4 items

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To see the properties on VMAX3 RDM volumes presented to a VM, select the VM from the tree panel from the Hosts and Clusters view or the VMs and Templates view. Then click on the Monitor tab and then the EMC Storage View tab as shown. One can see the RDMs listed. To see the detailed properties select one of the RDMs.

EMC Storage Viewer – RDM Properties

Storage Details: Hard disk 3	
Storage System	
Name	000196800225
Product	VMAX
Model	VMAX100K
Revision	5977.497.471
powered by EMC	
Compression	
Compression details are hosted on EMC VNX datastores	
powered by EMC	
Storage Device	
SLO	Gold
Workload Type	None
Parent Storage Group	esxi-88-36_parent
Storage Group	esxi-88-36_data
Storage Resource Pool (SRP)	SRP_1
Raid Level	RAID-1
Total Capacity	10.00 GB
Available Capacity	10.00 GB
Used Capacity	0 bytes
Block Size	512 bytes
Is Thin Provisioned	true
WWN	60000970000196800225533030303845
Status	ONLINE
Type	TDEV
Name	0008Ewin-38-10_RDM_2015-01-22_14-13-48-270
Volume Identifier	win-38-10_RDM_2015-01-22_14-13-48-270
Recover Point Tagged	No
Symmetrix Volume ID	0008E
powered by EMC	

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This is continuation of the previous slide. Here we are showing the details of a specific RDM. EMC VSI Storage Viewer provides two tables with information specific to the VMAX3 storage array. The Storage System table indicates that the RDM resides on a VMAX 100K array SID 225. The Storage Device table has information on the SLO, Workload Type, Storage Group, SRP etc. The Compression table is not applicable to VMAX3 arrays.

Lesson Summary

During this lesson the following topics were covered:

- EMC VSI for VMware vSphere Web Client features for VMAX3 arrays

This lesson covered the EMC VSI for VMware vSphere Web Client features for VMAX3 arrays.

Module Summary

Key points covered in this module:

- Management of Virtual Servers with Unisphere for VMAX
- EMC VSI for VMware vSphere Web Client features for VMAX3 arrays

This module covered the management of VMAX3 storage in a virtualized environment. We looked at the management of virtual servers with Unisphere for VMAX and described the EMC VSI for VMware vSphere Web Client features for VMAX3 arrays.

Module: eNAS Overview

Upon completion of this module, you should be able to:

- Describe the VMAX3 eNAS solution
- Articulate HYPERMAX OS Hypervisor concepts
- Explain eNAS architecture and configuration
- List eNAS management tools

This module focuses on eNAS. We introduce the eNAS solution and cover the underlying HYPERMAX OS Hypervisor concepts that enable eNAS. We will also look at eNAS architecture, configuration considerations and management tools.

VMAX3 eNAS – Embedded NAS



- NAS solution for VMAX3 arrays
- Virtual instances EMC VNX NAS embedded in HYPERMAX OS
 - Control Stations and Data Movers
 - Based on EMC VNX2 NAS software
- Unified solution – Block and File
- Supports VMAX3 data services
 - SLO provisioning
 - FAST
 - Host I/O limits
- Factory preconfigured

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eNAS Overview

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VMAX3 eNAS (Embedded NAS) is the only NAS solution for VMAX3 family of arrays. Embedded NAS consists of virtual instances of the VNX NAS hardware incorporated into the HYPERMAX OS Architecture. The software data movers and control stations run on virtual machines embedded within the HYPERMAX OS hypervisors. Implementing eNAS creates a unified VMAX3 array. The VMAX3 unified solution eliminates the gateway complexity by leveraging standard VMAX3 hardware and a factory preconfigured eNAS solution.

eNAS operates using VNX2 NAS Software. All VNX2 NAS capabilities are available and functional in eNAS. It also leverages VMAX3 data services with the exception of VMAX local and remote replication software such as SRDF and Time Finder.

eNAS Configuration

- eNAS Systems have to be net new
 - Cannot be added to an existing VMAX3 array
- Supported I/O modules
 - 4-port 1GbE BaseT
 - 2-port 10GbE BaseT
 - 2-port 10GbE Optical
 - 4-port 8Gb FC (For backup to tape - Optional)
- Minimum configuration – 2 Control Stations & 2 Data Movers
- System is pre-configured at the factory
 - "Network ready" upon reaching site

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eNAS Overview

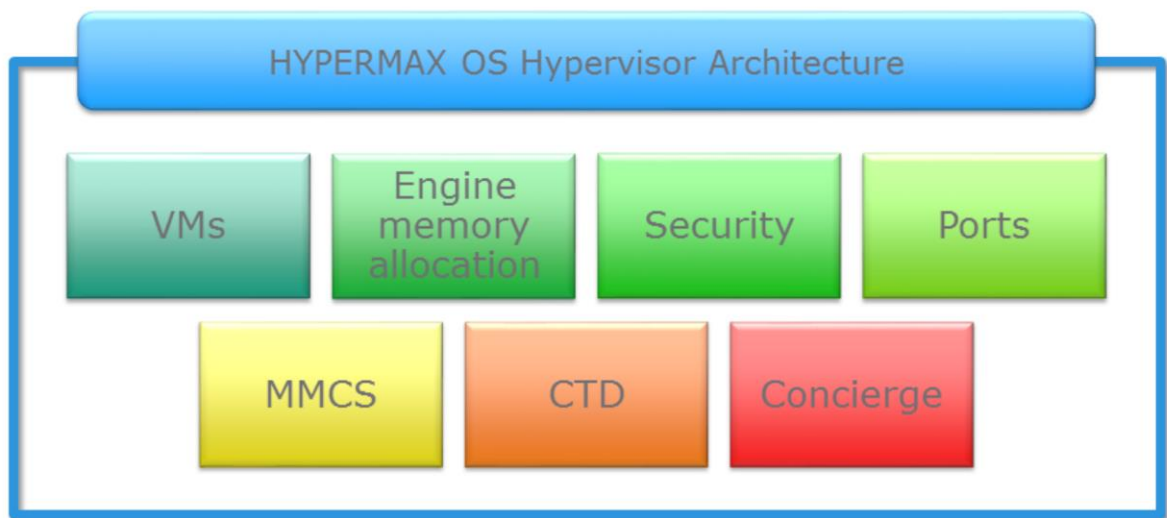


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VMAX3 arrays with eNAS have to be ordered net new at the present time. The eNAS system arrives pre-configured with the a minimum of two control stations and two data movers and is network ready. eNAS systems require additional front-end I/O modules. The GbE modules allow external clients to connect to the exported NAS file systems. The FC module is optional and is used for backup to tape.

Before we look at the eNAS architecture we will first review the HYPERMAX OS hypervisor architecture that allows for eNAS to work within the VMAX3 array.

HYPERMAX OS Hypervisor Concepts



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eNAS Overview

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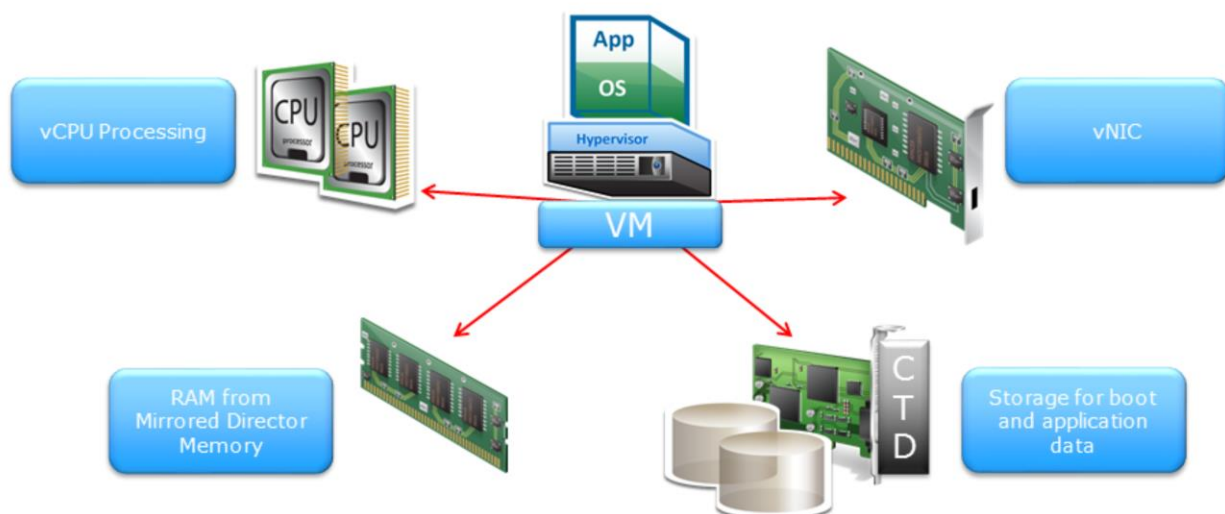
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The HYPERMAX OS incorporates a lightweight hypervisor that allows non-HYPERMAX Operating Environments (i.e. Linux, etc.) to run as a Virtual Machine (VM) within a VMAX3. These VMs run in the FA emulation. We will discuss the HYPERMAX OS hypervisor architectural components in some more detail in the next few slides.

The MMCS is accessible to all embedded VMs on the VMAX internal network. The MMCS is where the install images for the VMs reside. The embedded VMs access the MMCS using TFTP to retrieve the staged install image during install, upgrade and recovery procedures.

The Concierge is a background daemon which manages installation and upgrade operations for the embedded VMs. The concierge takes its instructions from various other sources including Symmwin or other Concierges.

Hypervisor Concepts - VMs



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eNAS Overview

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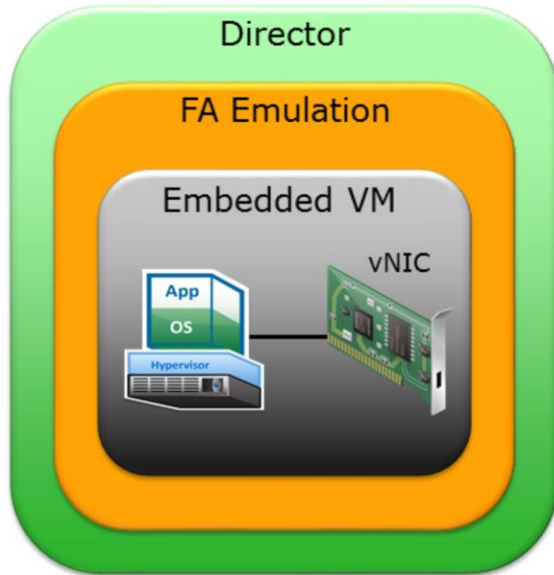
Within the VMAX3 each embedded VM(Guest OS) is provided with vCPU processing capability, memory, storage and network connectivity.

The RAM is allocated from mirrored director memory for the embedded applications during initial setup. Once this memory is allocated it cannot be returned for general use online. A portion of general memory is carved out and allocated to each VM.

Data storage is provided for boot and application data by using a Cut-through device (CTD) which acts like an HBA that accesses LUNs in the VMAX3 array.

vNICs enable network access in and out of the container operating system.

Hypervisor Concepts - Ports



Embedded application ports (virtual ports) provided for use by VMs

Addressed as ports 32-63 per FA emulation

Avoids contention with physical connectivity

One virtual port mapped to only one VM

A VM can map to more than one virtual port

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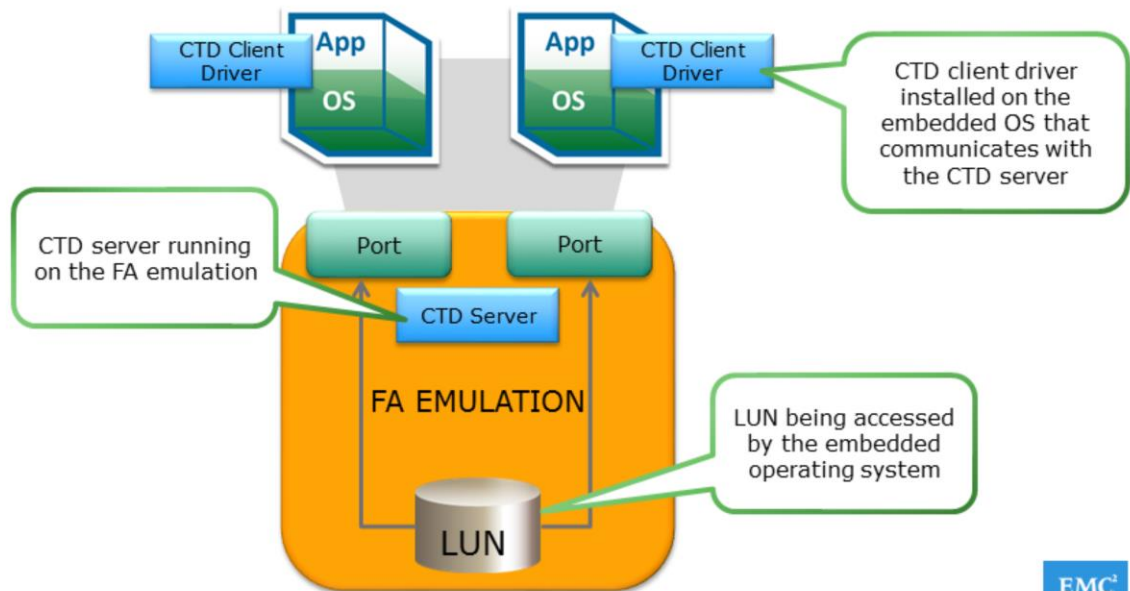
eNAS Overview

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Embedded application ports are virtual ports specifically provided for use by the VMs that contain the applications. They are addressed as ports 32-63 per director FA emulation. The virtual ports are provided to avoid contention with physical connectivity in the VMAX3. As with physical ports, LUNs can be provisioned to the virtual ports. There are two rules that apply with the mapping of virtual ports. One virtual port can be mapped to only one VM. A VM can map to more than one virtual port.

Hypervisor Concepts – Cut-Through Device



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Data storage is provided for boot and application data by using a Cut-through device (CTD) which acts like an HBA that accesses LUNs in the VMAX3 array. The CTD has two components to enable access to the LUNs through an FA port. The first is the CTD Server thread. This runs on the FA emulation. It communicates with the CTD client in the embedded operating system. The second is the CTD Client driver. The CTD client driver is embedded in the host operating system and communicates with the CTD server running on the FA emulation. An operating system running in a VM must have the CTD client driver installed to see the LUNs.

Hypervisor Concepts - Security

HYPERMAX OS

- MAC address filtering
- Logically isolated network subnets

MMCS Serviceability

- SSC credentials authorize Global Services connectivity to the embedded VMs

Embedded Content

- Validate install image signature
- Access is limited to authorized services and network ports

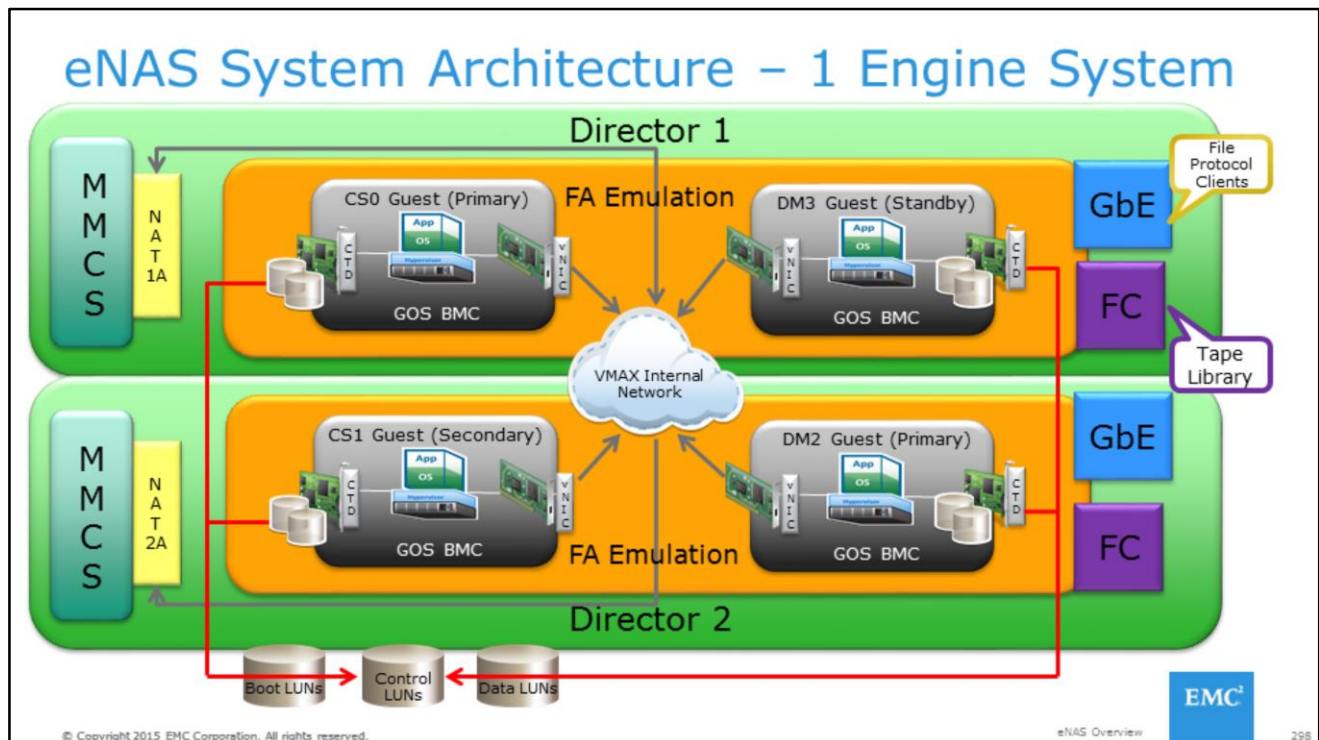


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Hypervisor security for the HYPERMAX OS includes MAC address filtering and logically isolated network subnets. When accessing the MMCS or various tools for the embedded VMs, SSC credentials authorize Global Services connectivity to the embedded VMs. When handling embedded content, install images will be validated. Access is limited to authorized services and network ports.



The VMAX3 eNAS dramatically changes the traditional architecture of a VMAX and NAS solution. The traditional physical data mover and control station hardware is replaced with embedded VMs running on the FA emulation.

The graphic describes the eNAS system architecture for a single Engine VMAX3. There are primarily three interfaces through which an eNAS Guest interacts with the HYPERMAX OS. They are, CTD (Cut Through Driver), GOS BMC, and the vNIC.

CTD: The purpose of CTD is to allow a Guest OS (such as eNAS) to use VMAX3 host addressable devices as 'native' disks. The Guests will be able to treat a VMAX3 device (or multiple VMAX3 devices) as if they were directly attached disk drives.

GOS Baseboard Management Controller (BMC): Each Guests configuration in VMAX3 is associated with IPMI 2.0 compliant virtual BMC accessible (BMC being virtual service hosted by emulation for Container not be confused with the physical BMC of the Engine) using KCS and RMCP interfaces at distinct IP address.

vNIC: The guest virtual interface supported by the Infrastructure which allows the Guests to communicate with other configured Guests instances and components of HYPERMAX OS *(like NAT gateway, SP and PXE boot server etc.).

The external connectivity to the Control Station Guests for management, from customer network is through a HYPERMAX OS component called the NAT Gateway which is part of the IM emulation. **NAT:** Provides translation services between external and internal IP addresses.

Connectivity to the NAS clients is provided using either 1GbE or 10GbE I/O Modules dedicated to the Data Mover Guests inside the Container. There is also an option to use an 8Gb FC I/O Module for tape backup. Access to the NAS management stack on the Control Station Guests uses NAT services provided by the virtual networking infrastructure of the VMAX3 array.

eNAS Configuration Considerations

Default - 2 Control Station VMs and 2 Data Mover VMs

- Additional Data Movers can be added up to a max of 4
- Max of 2 Data Movers for the VMAX³ 100K and a Max of 4 Data Movers for the VMAX³ 200/400K
- Data Movers to be added in pairs initially

Data Mover VMs must have identical configurations

- Core processors, memory, I/O modules, and vFA ports must match on all Data Movers

HW Upgrade Limitations – current release

- Cannot add eNAS to an existing VMAX3 array
- Cannot extend eNAS in an existing configuration

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The slide lists the eNAS configuration considerations that must be followed with the current release (Q4 2014 SR). Two control stations VMs and two data mover VMs are created by default when eNAS is selected. Additional data movers can be added up to a max of four in the VMAX3 200/400K. The max number of data movers in the VMAX3 100K is two. Data movers need to be added in pairs initially. Additionally, all data mover VMs must have identical configurations.

At the current time existing VMAX3 arrays are not able to convert to an eNAS system. Customers need to purchase an eNAS array net new. In addition to this limitation, customers are not able to extend an eNAS configuration by adding I/O modules or data movers in the field.

eNAS Configuration I/O Module Considerations

I/O Module Rule

- Max of 2 I/O modules for the VMAX³ 100K and a max number of 3 I/O Modules for the VMAX³ 200/400K
- Min of 1 of the supported Ethernet I/O modules per Data Mover VM is required
- I/O modules must be in the same slot for each Data Mover VM
- Max of 1 I/O module per Data Mover VM is configured for backup to tape option

Each Data Mover VM requires one of the following I/O modules

- 4-port 1GbE BaseT
- 2-port 10GbE BaseT
- 2-port 10GbE Optical
- 4-port 8Gb FC (backup to tape - optional)

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There are configuration rules regarding the I/O modules that also must be followed. There is a max of two modules for the VMAX3 100K and three I/O modules for the VMAX3 200/400K . A minimum of one of the supported Ethernet I/O modules per Data Mover is required. I/O modules must be in the same slot for each Data Mover VM. A max of one I/O module per data mover can be configured for backup to tape.

The following I/O modules are supported for eNAS:

- 4-port 1GbE BaseT
- 2-port 10GbE BaseT
- 2-port 10GbE Optical
- 4-port 8Gb FC (backup to tape)

eNAS Configuration by Platform

		VMAX 100K	VMAX 200K	VMAX 400K
Data Mover	# of DMs	2	2,4	2,4
	Cores/DM	4	5	8
	Memory/DM	6 GB	24 GB	24 GB
	# I/O Modules	≤2	≤3	≤3
Control Station	# of CSs	2		
	Cores/CS	1		
	Memory/CS	4 GB		

- Data movers are added in pairs
- Disk space required – 680 GB

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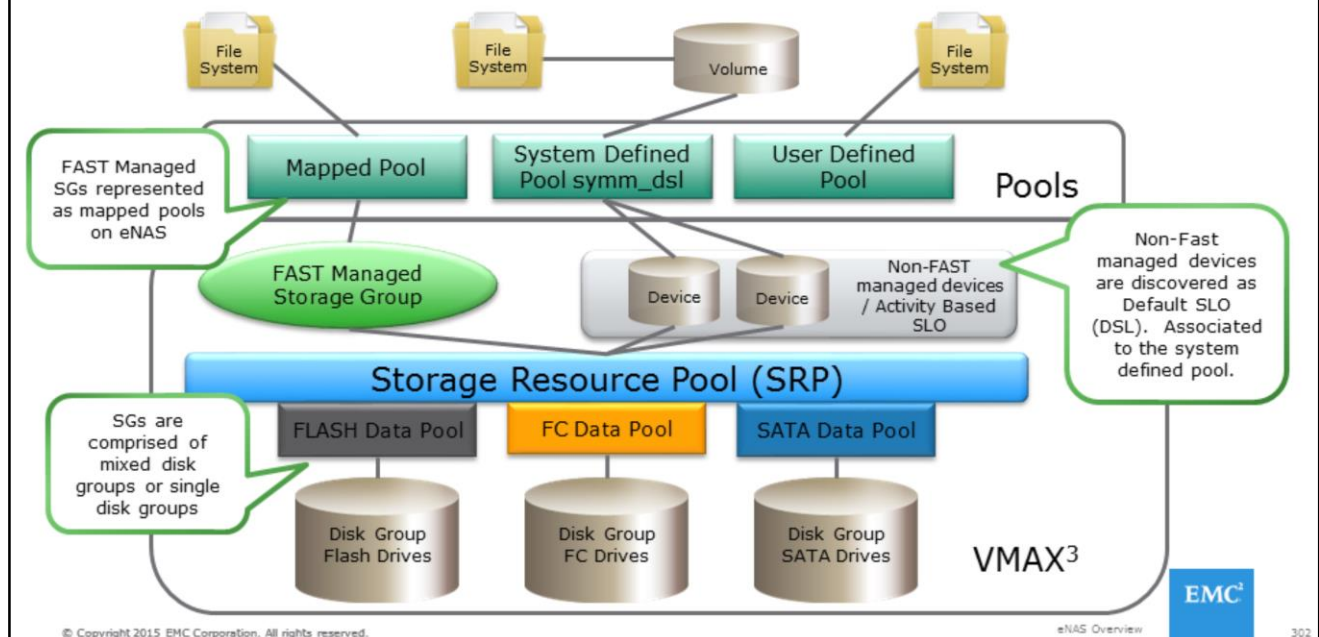
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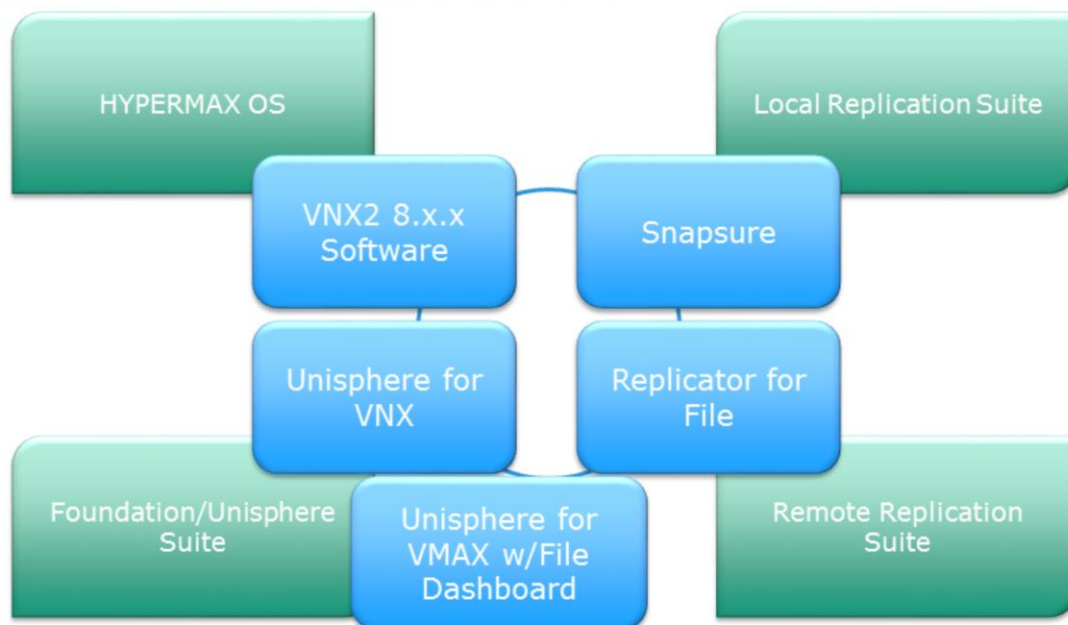
This table breaks down the eNAS component configurations by VMAX3 platform. There are some additional items to note while viewing this table. Data movers are to be added in pairs. Disk space required for the eNAS configurations is the same for each platform, 680GB per NAS system. Finally, eNAS always leaves at least two I/O Module slots per engine for “block” I/O for standard VMAX3 operations.

eNAS - FAST and SLO Support



VMAX3 eNAS supports FAST and Service Level Objective (SLO) features. All FAST managed storage groups are represented as mapped pools on eNAS. If the Storage Group devices are created out of multiple disk groups, the disk technology type is "mixed". For single disk groups, the disk technology type is the physical disk type (ATA,EFD,FC). Non-FAST managed devices are discovered as default SLO (DSL) devices and associated to the system defined pool (symm_dsl).

eNAS Software Overview



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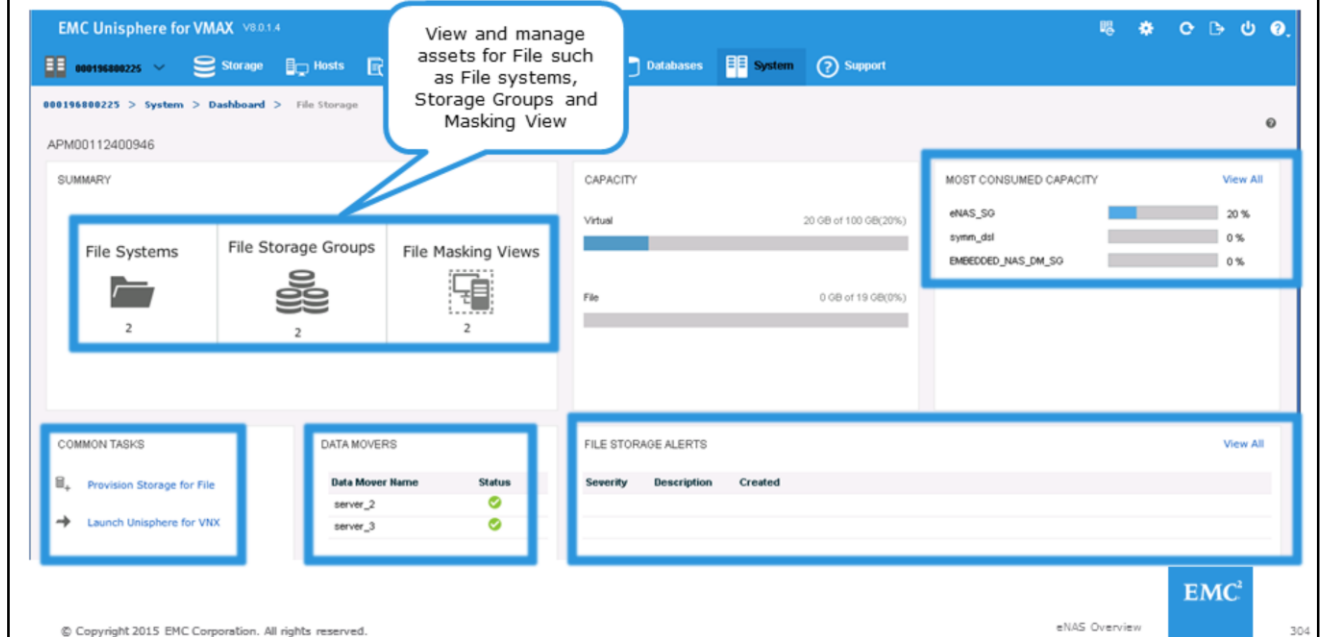
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VMAX3 eNAS arrays use VNX2 8.x.x software version. All eNAS software is included with the standard VMAX Software, except for the optional software. The Unisphere for VNX management tool is bundled in the Foundation Suite or Unisphere Suite. The local replication software, Snapstore, is bundled in the Local Replication Suite. The remote replication software, Replicator for File, is bundled in the Remote Replication Suite. Software such as Events and Retention Suite will be offered through an a la carte menu for VMAX3. Licensing for these software packages is by Right-to-Use Licenses only. Management for eNAS has also been enhanced with the File Dashboard in Unisphere for VMAX and enhancements to link and launch.

Unisphere for VMAX File Dashboard



Unisphere for VMAX includes a File Dashboard for VMAX3 arrays configured with eNAS. The File Dashboard allows the user to perform the following tasks.

- View Capacity details
- View and manage block and file assets
- Displays the mapping of file systems to storage groups
- Allows for provisioning of storage for file systems
- Unisphere Link and Launch to Unisphere for VNX
- View Data Mover status
- View File Storage alerts

Module Summary

Key points covered in this module:

- VMAX3 eNAS solution
- HYPERMAX OS Hypervisor concepts
- eNAS architecture and configuration
- eNAS management tools

This module provided an overview of the VMAX3 eNAS solution. We introduced the eNAS solution and covered the underlying HYPERMAX OS Hypervisor concepts that enable eNAS. We will also look at eNAS architecture, configuration considerations and management tools.

Module: eNAS Management

Upon completion of this module, you should be able to:

- Explore eNAS with Unisphere for VMAX File Dashboard
- Provision Storage to eNAS Data Movers
- Create File Systems and Shares on VMAX3 Storage

This module focuses on VMAX3 eNAS management with Unisphere for VMAX File Dashboard and Unisphere for VNX. We will first use Unisphere for VMAX File Dashboard to provision storage to the eNAS Data Movers and then use Unisphere for VNX to create File Systems and Shares.

Lesson: Unisphere for VMAX File Dashboard

This lesson covers the following topics:

- File Dashboard
- Provisioning Storage to eNAS Data Movers

This lesson covers the Unisphere for VMAX File Dashboard. We will explore the File Dashboard and then provision storage to VMAX3 eNAS Data Movers.

Navigate to File Dashboard

The image shows two screenshots of the EMC Unisphere for VMAX interface. The left screenshot, labeled 'System Dashboard', shows the 'SUMMARY' section for system 000196800225. It includes details like ID, Model (VMAX100K), HYPERMAX OS, Connection, and Cache Size. A blue box highlights the 'File Dashboard' link. A blue arrow points from this link to the right screenshot. The right screenshot, labeled 'File Dashboard', shows the 'File Storage' section for APM00112400946. It displays metrics for File Systems (2), File Storage Groups (2), and File Masking Views (2). It also includes sections for COMMON TASKS, DATA MOVERS, and FILE STORAGE ALERTS. The EMC logo is visible in the bottom right corner.

EMC Unisphere for VMAX V8.0.1.4

000196800225 > System > Dashboard

SUMMARY

000196800225

ID: 000196800225
Model: VMAX100K
HYPERMAX OS: 5977.497.471
Connection: Local
Cache Size: 220160 MB

File Dashboard
Symmetrix Details
View Reservations

EMC Unisphere for VMAX V8.0.1.4

000196800225 > System > Dashboard > File Storage

APM00112400946

SUMMARY

File Systems 2
File Storage Groups 2
File Masking Views 2

COMMON TASKS

Provision Storage for File
Launch Unisphere for VNX

DATA MOVERS

Data Mover Name	Status
server_2	✓
server_3	✓

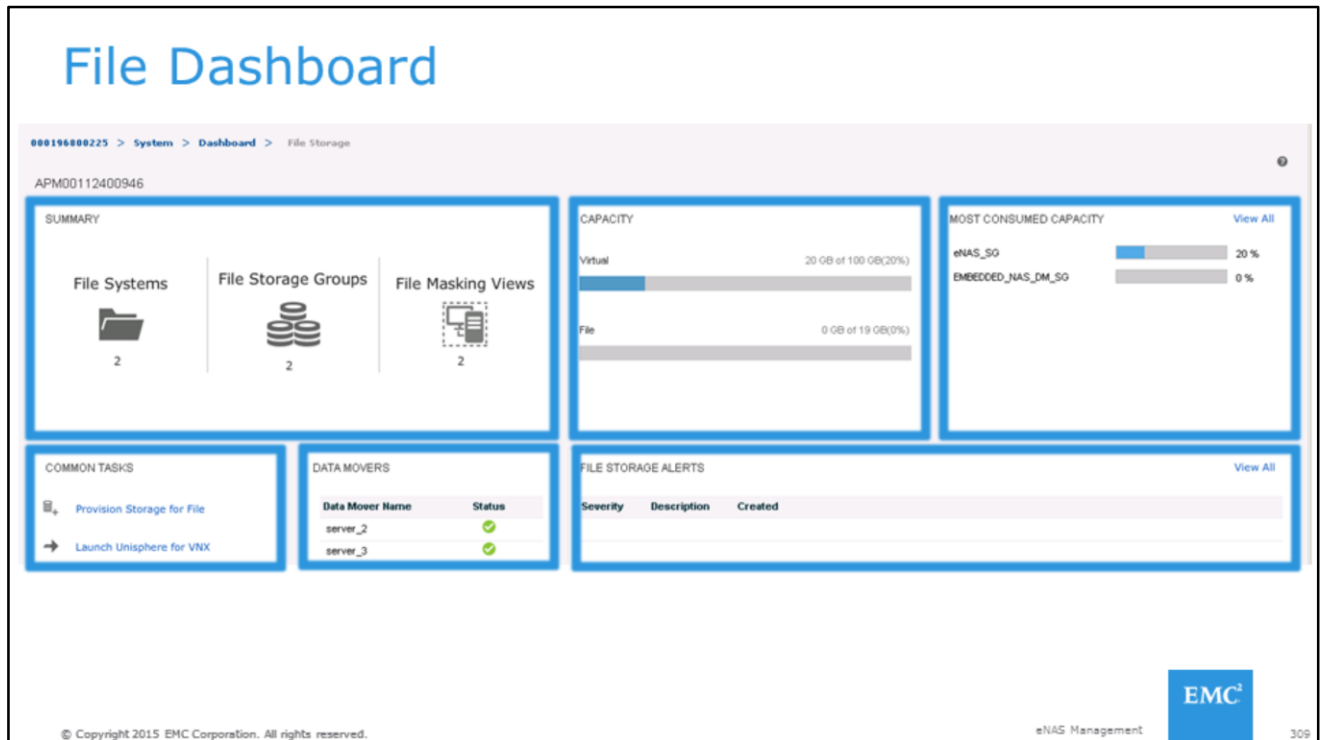
FILE STORAGE ALERTS

Severity	Description
----------	-------------

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The System Dashboard of a VMAX3 eNAS system will show the File Dashboard link in the array Summary section. Click on File Dashboard to navigate to the File Dashboard. You will be challenged for the Unisphere for VNX credentials the first time – enter the VNX credentials.



The Summary panel has icons which one can click to see information on the File Systems, File Storage Groups and File Masking Views.

The Capacity panel displays:

The free versus total capacities of the file storage groups – Virtual.

The free versus total capacities for the file systems associated with the file storage groups on the storage system.

The Most Consumed Capacity panel displays the file storage pools with the most consumed capacity.

The file dashboard also shows the status of the data movers and any file storage alerts.

One can provision storage to the eNAS data movers by clicking on the Provision Storage for File link. To go to Unisphere for VNX click on Launch Unisphere for VNX.

eNAS - Pre-Configured Masking View

File Masking Views

Name	Host	Port Group	Storage Group
EMBEDDED_NAS_DM_MV	EMBEDDED_NAS_DM_IG	EMBEDDED_NAS_DM_PG	EMBEDDED_NAS_DM_SG

View Connections **Delete** **View Details**

Hosts

Host	Initiator
EMBEDDED_NAS_DM_IG	
	5000097158038422
	5000097158038423
	5000097158038424
	5000097158038425
	5000097158038462
	5000097158038463
	5000097158038464
	5000097158038465

Ports

Port Group	Director:Port
EMBEDDED_NAS_DM_PG	
	FA-1D:34
	FA-2D:34
	FA-1D:35
	FA-2D:35
	FA-1D:36
	FA-2D:36
	FA-1D:37
	FA-2D:37

Storage

Storage Group	Volume	Capacity (GB)
EMBEDDED_NAS_DM_SG (7)		
	00013	22.34
	00014	11.35
	00018	4.06
	00019	64.01
	0001A	2.03
	0001B	2.03
	0001C	0.01

Data Mover vHBAs **Virtual Front-end Ports** **Control LUNs** **EMC**

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The eNAS system is pre-configured with a masking view which gives the data movers access to the required control LUNs. The names of the default Host (initiator group), Port Group, Storage Group and Masking View are shown on the slide.

Clicking on the File Masking Views icon will list all the configured masking views related to file storage. EMBEDDED_NAS_DM_MV is a factory pre-configured view. EMBEDDED_NAS_DM_IG is the default eNAS initiator group which contains all the data mover virtual HBAs. EMBEDDED_NAS_DM_PG is the default eNAS port group with all the virtual ports used by the data movers. EMBEDDED_NAS_DM_SG is the default storage group which contains the control LUNs required by the data movers. This view should not be deleted.

Clicking on View Connections after selecting the pre-configured eNAS masking view shows the detailed membership of each of the groups.

eNAS Containers

```
C:\>symcfg list -container -sid 225
```

Symmetrix ID: 000196800225

E M B E D D E D C O N T A I N E R S

Container Name	Type	Dir	Ports		Memory MB	Num CPUs
			Virt	Pass		
TOOLS-0	INTERNAL	FA-1D	1	0	8192	2
TOOLS-1	INTERNAL	FA-2D	1	0	8192	2
CS-0	NAS-CS	FA-1D	1	0	4096	1
CS-1	NAS-CS	FA-2D	1	0	4096	1
DM-3	NAS-DM	FA-1D	4	4	6144	4
DM-2	NAS-DM	FA-2D	4	4	6144	4

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The SYMCLI symcfg list -container command lists the eNAS Control Stations and Data Movers. One can see the port, CPU and memory allocation and the FA emulation that the VMs run on.

eNAS – Data Mover Details

C:\>symcfg show -container DM-2 -sid 225

Symmetrix ID: 000196800225

Container Name : DM-2
 Container Type : NAS-DM
 Director : FA-2D
 Memory Size (MB) : 6144
 CPU Count : 4
 State : Running
 Ports (8)

Port	Type	WWN
8	PASSTHRU	N/A
9	PASSTHRU	N/A
10	PASSTHRU	N/A
11	PASSTHRU	N/A
34	Virtual-FC	5000097158038462
35	Virtual-FC	5000097158038463
36	Virtual-FC	5000097158038464
37	Virtual-FC	5000097158038465

C:\>symcfg show -container DM-3 -sid 225

Symmetrix ID: 000196800225

Container Name : DM-3
 Container Type : NAS-DM
 Director : FA-1D
 Memory Size (MB) : 6144
 CPU Count : 4
 State : Running
 Ports (8)

Port	Type	WWN
8	PASSTHRU	N/A
9	PASSTHRU	N/A
10	PASSTHRU	N/A
11	PASSTHRU	N/A
34	Virtual-FC	5000097158038422
35	Virtual-FC	5000097158038423
36	Virtual-FC	5000097158038424
37	Virtual-FC	5000097158038425

Data Mover vHBAs – in EMBEDDED_NAS_DM_IG

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We can look at the details of each of the data movers to see the vHBAs. Notice that the WWNs listed on this slide are members of the pre-configured EMBEDDED_NAS_DM_IG initiator group (host) that we saw a few slides ago.

- Provision Storage For File Wizard
 - Provisions storage to the data movers
 - Storage group and thin devices are created as required
 - CELERRA_FBA emulation
 - Use the pre-configured Host (initiator group) and Port Group when using the wizard
 - EMBEDDED_NAS_DM_IG
 - EMBEDDED_NAS_DM_PG
 - New masking view is created
- VNX NAS software automatically creates Storage Pool
 - Unisphere for VNX can be used to create File Systems from this Storage Pool

The pre-configured eNAS masking view and storage cannot be used to create file systems. One has to provision storage separately to be used for the creation of file systems. The Provision Storage for File wizard is used to achieve this goal. The wizard will help to create a new storage group with the required service level and populate the same with thin devices which have the CELERRA_FBA emulation. One should use the pre-configured eNAS Host and Port Group. The new masking view will be created. The VNX NAS software will automatically create a Storage Pool with the newly presented storage. One can now use Unisphere for VNX to create file systems and export the same as required.

Provision Storage for File – Create Storage

Provision Storage For File

1 Create Storage

Storage Group Name: France_eNAS Storage Resource Pool: SRP_1

Service Level	Workload Type	Volumes	Volume Capacity	Avg. Response Time
Silver	Not Specified	10	10.00 GB	8.0 ms

Add Service Level Total Capacity: 100.00 GB | Total Service Levels: 1

Set Host I/O Limits

Choose desired Service Level, Workload Type
Enter desired number of volumes and volume capacity

< Back Next > Finish Cancel Help

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The Provision Storage to File wizard is similar to the Provision Storage wizard that we had seen when provisioning block storage. On the Create Storage page type in the name of new storage group. Choose the desired service level, workload type. Type in the desired number of volumes and specify the volume capacity. You can create a cascaded SG if needed by clicking on the Add Service Level button. One can optionally set up Host I/O limits as well. Click Next to proceed.

Provision Storage for File – Select Host

Provision Storage For File

1 Create Storage

2 Select VNX Host

3 Select Port Group

4 Review

Select a VNX Host

Type to filter

EMBEDDED_NAS_DM_IG

Initiators added to VNX Host

Name	Type
5000097158038422	Fibre
5000097158038423	Fibre
5000097158038424	Fibre
5000097158038425	Fibre

< Back Next > Finish Cancel Help

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On the Select VNX Host page select the pre-configured eNAS host (initiator group). Click Next to proceed.

Provision Storage for File – Select Port Group

The screenshot shows a web-based wizard titled "Provision Storage For File". On the left, a vertical sidebar contains four steps: 1. Create Storage, 2. Select VNX Host, 3. Select Port Group (highlighted with a white arrow), and 4. Review. The main content area is titled "Select Port Group" and features a search bar labeled "Type to filter". Below the search bar, a list of port groups is displayed, with "EMBEDDED_NAS_DM_PG" selected and highlighted in blue. At the bottom right of the main area, there are five buttons: "< Back", "Next >" (highlighted with a blue border), "Finish", "Cancel", and "Help".

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On the Select Port Group page select the pre-configured eNAS Port Group. Click Next to proceed.

Provision Storage for File – Review and Finish

The screenshot shows the 'Provision Storage for File' window with the 'Review & Finish' step selected. The left sidebar shows four steps: 1. Create Storage, 2. Select VNX Host, 3. Select Port Group, and 4. Review (highlighted). The main area displays the configuration details for the storage provisioning process.

Masking View	Storage Group	Host	Port Group
Finance_eNAS_MV	Finance_eNAS	EMBEDDED_NAS_DM_J0	EMBEDDED_NAS_DM_P0

System Suitability

Run Suitability Check

Set dynamic LUNs

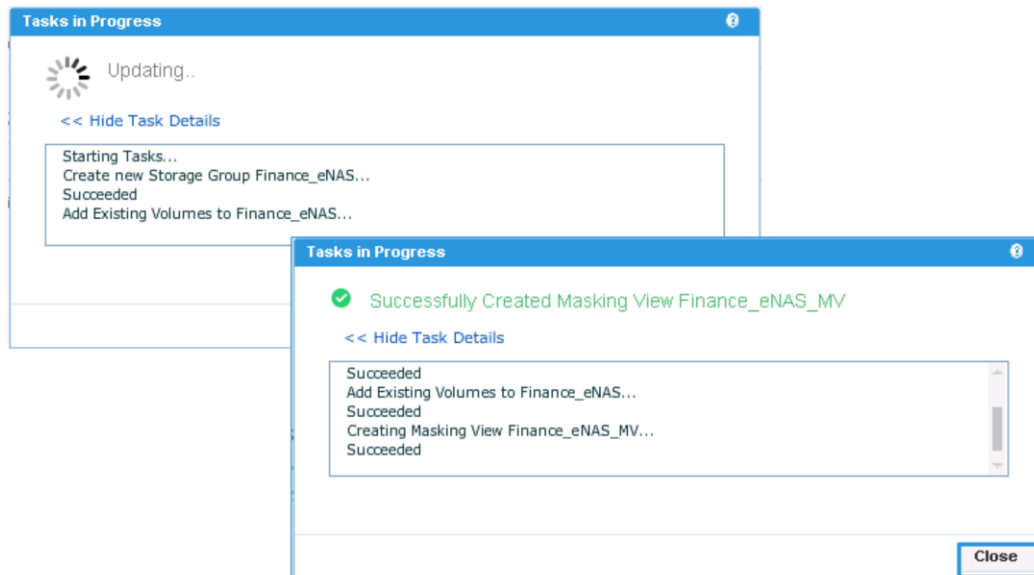
Front End Back End Cache RDF

Best Practice Limit

< Back Next > Finish Cancel Help

On the Review page one can optionally choose to run the suitability check. To complete the provisioning process click Finish. This will immediately start the provisioning process.

Provision Storage for File – Success



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This is a continuation of the provisioning process from the previous slide. Click on Finish on the Provision File to Storage wizard starts the provisioning process. One can monitor the process in the Tasks in Progress screen. Once the tasks are completed a Success message will be displayed as shown. Click on Close to close this dialog.

New File Masking View

File Masking Views



000196880225 > System > Dashboard > File Storage > File Masking Views

Name	Host	Port Group	Storage Group
EMBEDDED_NAS_DM_MV	EMBEDDED_NAS_DM_IG	EMBEDDED_NAS_DM_PG	EMBEDDED_NAS_DM_SG
eNAS_MV	EMBEDDED_NAS_DM_IG	EMBEDDED_NAS_DM_PG	eNAS_SG
Finance_eNAS_MV	EMBEDDED_NAS_DM_IG	EMBEDDED_NAS_DM_PG	Finance_eNAS

View Connections

Delete

View Details



000196880225 > System > Dashboard > File Storage > File Masking Views > Finance_eNAS_MV

PROPERTIES

Name	Finance_eNAS_MV
Host	EMBEDDED_NAS_DM_IG
Number of initiators	8
Port Group	EMBEDDED_NAS_DM_PG
Number of ports	8
Storage Group	Finance_eNAS
Number of volumes	10
Capacity (GB)	100.01

RELATED OBJECTS

Contains :
Host - EMBEDDED_NAS_DM_IG
Port Group - EMBEDDED_NAS_DM_PG
Storage Group - Finance_eNAS

Associated With :
Volumes - 10

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We click on the File Masking Views icon on the File Dashboard to see the File Masking Views. The newly created masking view is seen. One can select the same and click on View Details to see its details. The one can click on the Volumes link to see the volumes that are associated with this view.

Volumes in File Masking View

000196800225 > System > Dashboard > File Storage > File Masking Views > Finance_eNAS_MV > Volumes

Name	Type	Emulation	Allocated %	Capacity (GB)	Pool State	Status	Reserved	Pinned	Multiple SGs
00068	TDEV	CELERRA_FBA	0 %	10	Bound	Ready	No	No	No
00069	TDEV	CELERRA_FBA	0 %	10	Bound	Ready	No	No	No
0006A	TDEV	CELERRA_FBA	0 %	10	Bound	Ready	No	No	No
0006B	TDEV	CELERRA_FBA	0 %	10	Bound	Ready	No	No	No
0006C	TDEV	CELERRA_FBA	0 %	10	Bound	Ready	No	No	No
0006D	TDEV	CELERRA_FBA	0 %	10	Bound	Ready	No	No	No
0006E	TDEV	CELERRA_FBA	0 %	10	Bound	Ready	No	No	No
0006F	TDEV	CELERRA_FBA	0 %	10	Bound	Ready	No	No	No
00070	TDEV	CELERRA_FBA	0 %	10	Bound	Ready	No	No	No
00071	TDEV	CELERRA_FBA	0 %	10	Bound	Ready	No	No	No

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The volume listing show that the thin devices have the CELERRA_FBA emulation. At this stage none of the devices have any allocations because file systems have not yet been created on these volumes.

Launch Unisphere for VNX

→ Launch Unisphere for VNX

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Once storage had been provisioned to the Data Movers one has to use VNX software for NAS management. Click on Launch Unisphere for VNX and then login to Unisphere for VNX with the appropriate credentials. Use Unisphere for VNX to create file systems and then export the file systems to clients as needed.

Lab: Allocate storage to eNAS with Unisphere for VMAX File Dashboard

This lab covers

- Unisphere for VMAX File Dashboard exploration
- Allocating storage to eNAS

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This Lab covers the usage of the Unisphere for VMAX File Dashboard and allocation of storage to eNAS.

Lesson Summary

During this lesson the following topics were covered:

- File Dashboard
- Provisioning Storage to eNAS Data Movers

This lesson covered the Unisphere for VMAX File Dashboard. We explored the File Dashboard and then provisioned storage to VMAX3 eNAS Data Movers.

Lesson: Managing File Systems/Shares

This lesson covers the following topics:

- Using Unisphere for VNX to
 - Explore eNAS Mapped Storage Pools
 - Manage File Systems
 - Manage Shares

This lesson covers the management of VMAX3 eNAS file systems and shares with Unisphere for VNX.

EMC VNX Training for File Management

- Dedicated courses on VNX File Storage Management are available
- VNX File Storage Management

VNX File Procedure Overview



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The process of provisioning File storage for access by users and applications can be broken into a few basic sections. For the purposes of this course, we will group the activities into four parts.

The first stage of our process focuses on networking for File services. The steps in this section set up IP interfaces as well as essential network services, such as DNS and NTP.

The next stage will deal with configuring Virtual Data Movers. The VDMs will be used to share VNX File storage, as well as provide portability to the File configuration.

The third phase of our process will deal with creating file systems. File systems can be made manually, or using VNX's Automatic Volume Manager (AVM). This course will use AVM to produce our file systems.

The final stage makes the storage available to users and applications on the network, either for NFS or CIFS..

Please note that, although all of the steps presented in the module are essential, the actual sequence of steps is very flexible. What is presented in this lesson is merely one option for the sequence.

Note: In this lesson we will only focus on creating file systems and sharing (exporting) the file systems with clients. We will assume that the File Networking and Virtual Data Mover configurations are already in place. Extensive VNX File Storage Management Training is available from EMC Education Services.

eNAS – Mapped Storage Pools

EMC Unisphere

000196800225CS0 > Storage > Storage Configuration > Storage Pools

Storage Pools

Filter for

Name	Description	Storage Capacit...	Storage Used(%)	Type	Disk Type	Automatic Exten...
EMBEDDED_NAS_DM_SG	Mapped Storage Group EMBEDDED_NAS_DM_SG on 000...	0.000		Mapped pool	Mixed	Enabled
eNAS_SG	Mapped Storage Group eNAS_SG on 000196800225	100.010		Mapped pool	Mixed	Enabled
Finance_eNAS	Mapped Storage Group Finance_eNAS on 000196800225	100.010		Mapped pool	Mixed	Enabled
Training_eNAS	Mapped Storage Group Training_eNAS on 000196800225	100.010		Mapped pool	Mixed	Enabled

- VMAX3 storage presented to eNAS
 - FAST managed SGs show up as Mapped Pools
 - Disk type of Mixed – If SRP is made up of different disk technologies

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The graphic shows the listing of Storage Groups in Unisphere for VNX for the eNAS system. All the FAST managed storage groups show up as mapped pools. The disk type will be Mixed if the SRP on the VMAX3 array is made up of different disk technologies and RAID types. In the previous lesson we had created an SG called Finance_eNAS and provisioned it to the eNAS system on SID 225. We can see the same show up as a Mapped Pool in the Storage Group listing in Unisphere for VNX.

eNAS – Storage Pool Properties

Name:	Finance_eNAS
Description:	Mapped Storage Group Finance_eNAS on 000196800225
Type:	Mapped pool
Disk Type:	Mixed
Advanced Data Services:	Thin LUN: Yes Slo: Silver
Storage Systems:	Symmetrix VMAX100K 000196800225
Storage:	Capacity: <1 MB Used: <1 MB (0%) Free: <1 MB (0%)
Predict Full:	Storage pool has filled its current capacity. Based on 2 days of data, it will never fill its maximum capacity.
Automatic Extension Enabled:	☒
Potential Storage:	Capacity: 100.0 GB Used: <1 MB (0%) Free: 100.0 GB (100%)

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The properties of the mapped storage pool shows the SLO that was set on the Storage Group during provisioning. The Storage System lists the VMAX3 storage array.

eNAS – Create File System - Wizard

000196800225C50 - New File System Wizard

Wizards

- Disk Provisioning Wizard
- File System Wizard**
- Share Wizard
- CIFS Server Wizard
- CIFS Services Wizard

Wizard Steps

- Select Data Mover**
- Select Volume Management Type
- Default Quota Settings
- Set User Storage Limits (Optional)
- Set User File Count Limits (Optional)
- Set Group Storage Limits (Optional)
- Set Group File Count Limits (Optional)
- Enforce Hard Limits
- Set Quota Grace Periods
- Overview / Results

Select Data Mover

Select Data Mover

server_2
vdmenas

vdmenas

Select Data Mover or Virtual Data Mover

Select the Data Mover on which the file system needs to be mounted for read-write access.

< Back Next > Cancel

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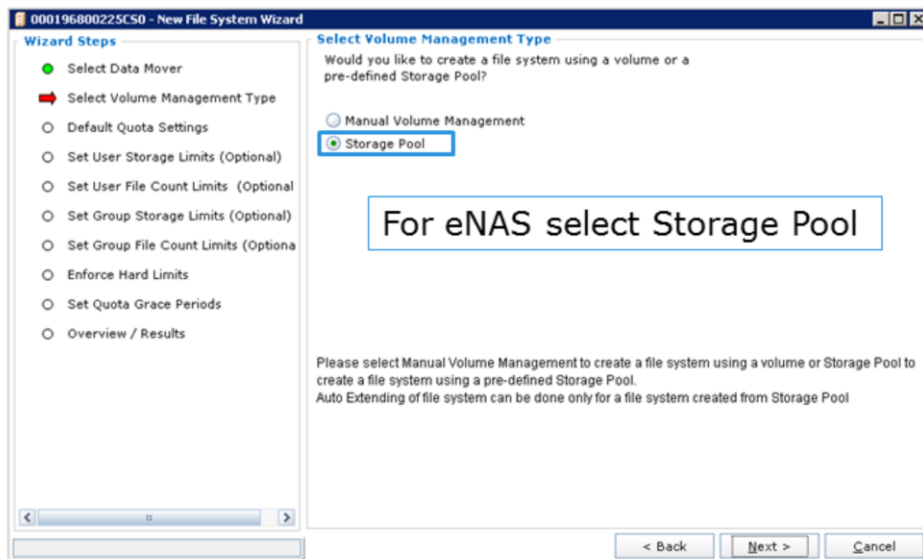
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The Unisphere for VNX File System Wizard Can be used to create a new file system. Alternately one can go to the File Systems listing and click on the Create button to create a new file system. The first step in creating the file system is to select the data mover or virtual data mover. In this example we have chosen a virtual data mover which had already been configured. CIFS exports typically use Virtual Data Movers. Click Next to proceed.

File System – Volume Management Type



For eNAS systems select Storage Pool for the Volume Management type. Click Next to proceed.

File System – Select Storage Pool

000196800225CS0 - New File System Wizard

Wizard Steps

- Select Data Mover
- Select Volume Management Type
- Select a Storage Pool
- Enter File System Info.
- Enable Auto Extension(Optional)
- Default Quota Settings
- Set User Storage Limits (Optional)
- Set User File Count Limits (Optional)
- Set Group Storage Limits (Optional)
- Set Group File Count Limits (Optional)
- Enforce Hard Limits
- Set Quota Grace Periods
- Overview / Results

Select a Storage Pool

Please select a Storage Pool:

Search

Name	Available (MB)	Capacity (MB)	Used (MB)	Slice Volumes
eNAS_SG	81802	102410	20608	false
Finance_eNAS	102410	102410	0	false
Training_eNAS	102410	102410	0	false

Select the Storage Pool from which to allocate storage for the filesystem. Only the Storage Pools with available space appear in the table.
Enter search text and click on Search button to search the Storage Pool(s) displayed in the table.

< Back Next > Cancel

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Select the storage pool from the list of available storage pools. In this example we have selected Finance_eNAS. Click Next to proceed.

File System Info – Specify Name and Capacity

000196800225C50 - New File System Wizard

Wizard Steps

- Select Data Mover
- Select Volume Management Type
- Select a Storage Pool
- Enter File System Info.**
- Enable Auto Extension(Optional)
- Default Quota Settings
- Set User Storage Limits (Optional)
- Set User File Count Limits (Optional)
- Set Group Storage Limits (Optional)
- Set Group File Count Limits (Optional)
- Enforce Hard Limits
- Set Quota Grace Periods
- Overview / Results

Enter File System Info.

Enter the name: FinanceFS

Enter the size of the new File System:(Maximum available size: 102410MB) 20480 MB

Percentage of Storage Pool used by all the File Systems including this File System: 19%

Slice Volumes: ☒ Deduplication Enabled: ☐ VMware VAAI nested clone support: ☐

File-level Retention: ☒ Off ☐ Enterprise ☐ Compliance

Enter the name and the size for the file system. The name has to be unique and can be 240 characters long. The size must be 2 megabytes or larger. Include enough for user data and meta data.
If the Slice Volumes option is not selected, then the file system will have exclusive use of all disk volumes on which it resides. Therefore the space allocated to the file system may be greater than the storage capacity you specified.
The VMware VAAI nested clone support feature must be selected at file system creation time. Select File-level Retention if you want to protect files from modification and deletion until a specific date. Enterprise FLR file systems can be deleted by authorized administrators at any time.

< Back Next > Cancel

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In the File System Info page type in a name for the file system and the desired capacity. Choose other options as needed. In this example we have typed in a name of FinanceFS and a capacity of 20GB, we have also checked the Slice Volume option. Click Next to proceed.

File System – Auto Extend (Optional)

000196800225CS0 - New File System Wizard

Wizard Steps

- Select Data Mover
- Select Volume Management Type
- Select a Storage Pool
- Enter File System Info.
- Enable Auto Extension(Optional)**
- Default Quota Settings
- Set User Storage Limits (Optional)
- Set User File Count Limits (Optional)
- Set Group Storage Limits (Optional)
- Set Group File Count Limits (Optional)
- Enforce Hard Limits
- Set Quota Grace Periods
- Overview / Results

Enable Auto Extension(Optional)

Would you like to enable the automatic extension capability for this file system?

Auto Extend Enabled ☐

Thin Enabled ☐

High Water mark: 90 % (Ranges from 50-99; if left blank defaults to 90)

Maximum Capacity (MB):

This feature will enable the production file system to be automatically extended when file system reaches a threshold level (High Water mark).

< Back Next > Cancel

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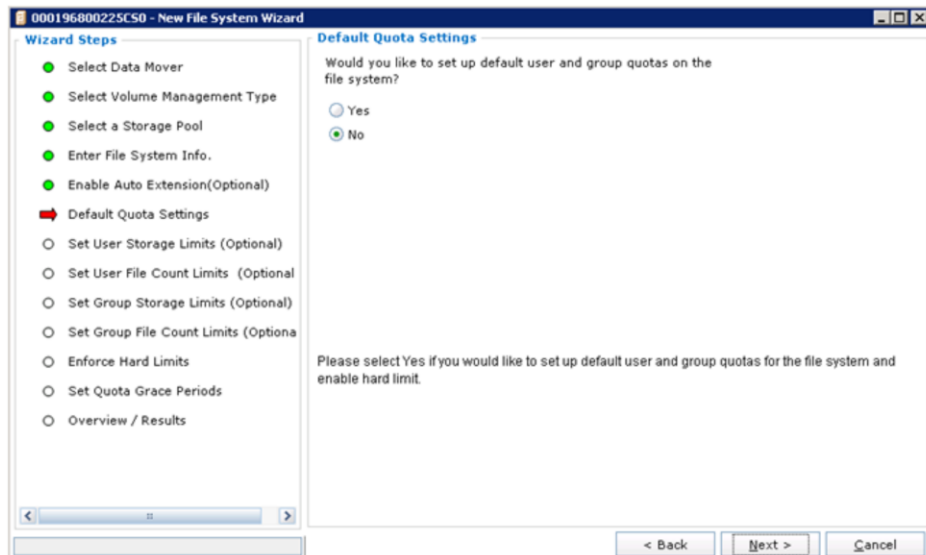
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Optionally enable Auto Extend for the File System during creation time. It can be enabled after creation via the file system properties page. In this example we have not enabled Auto Extend. Click Next to proceed.

File System – Quota Setting



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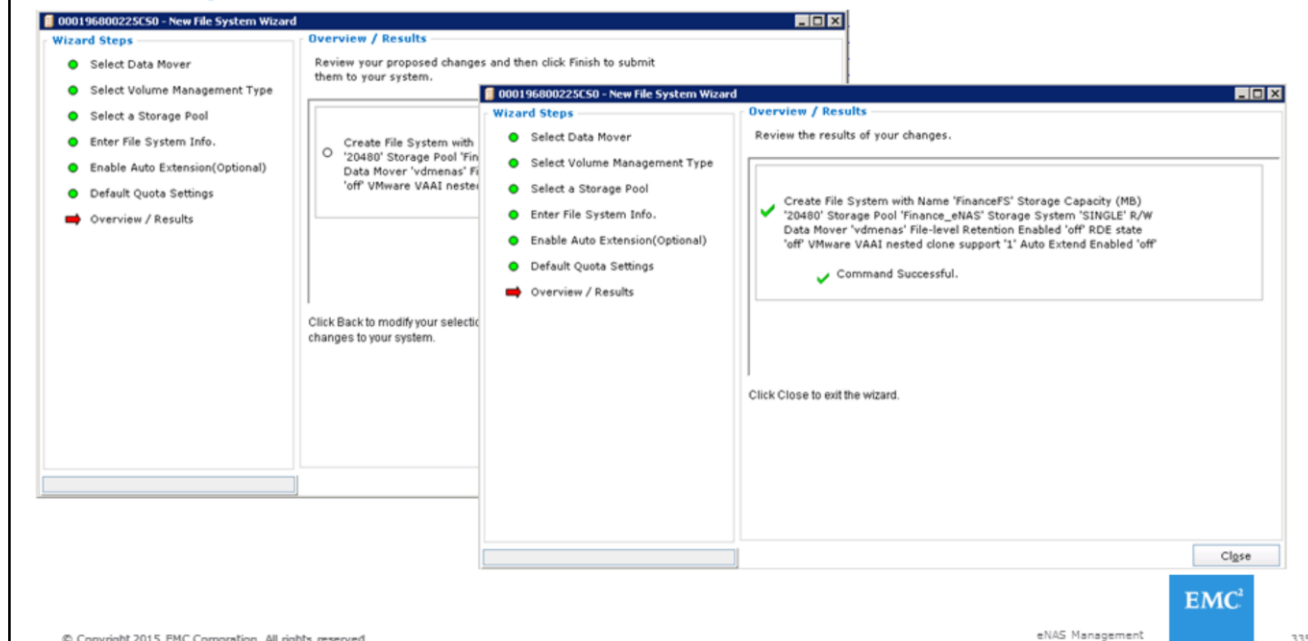
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Setup file system quotas if necessary. In this example we are not setting any quotas. Click Next to proceed.

File System – Review and Finish



Review the proposed file system creation and click on Finish. The review screen will show a success message if the process was successful. Click Close to close the dialog.

File System Created and Mounted

The top screenshot shows the 'File Systems' configuration page in EMC Unisphere. The breadcrumb trail is '000196800225CS0 > Storage > Storage Configuration > File Systems'. The 'File Systems' tab is selected. A table lists the file system 'FinanceFS' with a storage capacity of 20,000 GB and is managed by the 'vdmenas(R/W)' data mover.

Name	Storage Capacity (GB)	Storage Used	Data Movers	Replications
FinanceFS	20,000		vdmenas(R/W)	

The bottom screenshot shows the 'Mounts' configuration page. The breadcrumb trail is '000196800225CS0 > Storage > Storage Configuration > File Systems'. The 'Mounts' tab is selected. A table lists the mount point '/FinanceFS' managed by the 'vdmenas' data mover, with the file system 'FinanceFS' mounted on it. The 'Read Only' status is 'No', and various other options like 'Access-Checking Pol...', 'Virus Checking Enabl...', and 'CIFS Oplocks Enabled' are shown.

Path	Data Mover	File System	Read Only	Access-Checking Pol...	Virus Checking Enabl...	CIFS Oplocks Enabled
/FinanceFS	vdmenas	FinanceFS	No	NATIVE	Yes	Yes

The File System Wizard has created the file system called FinanceFS and mounted the same on a mount point with the same name.

File System Properties

000196800225CS0 - FinanceFS - File System Properties - Windows Internet Explorer

File System | Checkpoint Schedules | Quota Settings | Deduplication Settings

File System Name: FinanceFS

File System Id: 26

File Storage: Capacity: 20.0 GB
Used: 316.0 MB (2%)
Free: 19.7 GB (98%)

Deduplication: ☒ Off
☐ On
☐ Suspended
Status: N/A

Predict Full: Insufficient data is available to make a prediction.

Throughput (Read/Write): Updated data not available.

Auto Extend Enabled: ☐
Thin Enabled: ☐

File-level Retention: Off

Data Movers: vdmnas (R/W)

Storage Pools: Finance eNAS

Advanced Data Services: Thin LUN: Yes
Slo: Silver

Volume: v328

Slice Volumes: Yes

000196800225CS0 - FinanceFS - File System Properties - Windows Internet Explorer

Throughput (Read/Write): Updated data not available.

Auto Extend Enabled: ☐
Thin Enabled: ☐

File-level Retention: Off

Data Movers: vdmnas (R/W)

Storage Pools: Finance eNAS

Advanced Data Services: Thin LUN: Yes
Slo: Silver

Volume: v328

Slice Volumes: Yes

VMware VAAI nested clone support: No

Replications:

Volume	Storage System
d117	Symmetrix VMAX100K_000196800225
d118	Symmetrix VMAX100K_000196800225
d119	Symmetrix VMAX100K_000196800225
d120	Symmetrix VMAX100K_000196800225
d121	Symmetrix VMAX100K_000196800225
d122	Symmetrix VMAX100K_000196800225
d123	Symmetrix VMAX100K_000196800225
d124	Symmetrix VMAX100K_000196800225

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The file system properties shows the Storage Pool and the SLO and the VMAX3 disks.

Create CIFS Share



CIFS

Create and manage CIFS shares and the system CIFS configuration.

The screenshot shows the 'Create CIFS Share' dialog box in the eNAS Management console. The dialog box is titled '000196800225C50 - Create CIFS Share - Windows Internet Explorer'. It contains the following fields and options:

- Choose Data Mover:** A dropdown menu with 'vdmnas' selected.
- CIFS Share Name:** A text input field with 'FinanceFS' entered.
- File System:** A dropdown menu with 'FinanceFS (FinanceFS)' selected.
- Path:** A text input field with '/FinanceFS/data' entered.
- CIFS Servers:** A checkbox labeled 'ENASCIFS' which is currently unchecked.
- User Limit:** A text input field.
- Comment:** A text input field.
- Buttons:** 'OK', 'Apply', 'Cancel', and 'Help' buttons at the bottom right.

A blue arrow points from the 'Create' button in the 'CIFS Shares' table to the 'Create CIFS Share' dialog box.

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To create a CIFS share navigate to the CIFS Shares listing page and click on Create. In the Create CIFS share dialog choose the data mover or the virtual data mover. Give the share a name, select the file systems that needs to be shared and the path that will be shared. Typically one may not share the topmost level of the file system. In this example we are sharing a folder under the top level as show in the path field. If a CIFS server is not selected, all available CIFS server will be used. Click OK to complete the creation.

CIFS Share Created

The screenshot displays the EMC eNAS Management console interface. At the top, a breadcrumb trail shows the navigation path: 000196800225CS0 > Storage > Shared Folders > CIFS. Below this, a tabbed interface includes 'Shares', 'CIFS Servers', 'VDMs', 'DNS', and 'Usermappers'. The 'CIFS Shares' tab is active, showing a table of configured shares. The table has columns for Name, File System, Path, Data Mover, CIFS Servers, and Comment. Two shares are listed: 'FinanceFS' and 'FinanceFS\$'. Both are associated with the 'FinanceFS' file system and the 'vdmenas' data mover. The 'FinanceFS' share has a path of '/FinanceFS/data', while 'FinanceFS\$' has a path of '/FinanceFS'. Both are available to all CIFS servers. The interface also includes a search filter and dropdown menus for filtering shares by data mover and file system.

Name	File System	Path	Data Mover	CIFS Servers	Comment
FinanceFS	FinanceFS	/FinanceFS/data	vdmenas	All	
FinanceFS\$	FinanceFS	/FinanceFS	vdmenas	All	

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The CIFS share has been created. The FinanceFS share can now be mounted from any CIFS client. Mount of the share from a CIFS client is not shown in this lesson.

Create NFS Export

NFS
Create and manage NFS exports.

000196800225CS0 > Storage > Shared Folders > NFS

NFS Exports

Filter for Show NFS Exports for: All Data Movers

Path File System

0 Selected Create Properties Delete

000196800225CS0 - Create NFS Export - Windows Internet Explorer

Choose Data Mover: server_2

File System: TrainingFS (/TrainingFS)

Path: /TrainingFS

Host Access

Read-only Export: ☐

Read-only Hosts:

Read/Write Hosts:

Root Hosts:

Access Hosts:

OK Apply Cancel Help

000196800225CS0 > Storage > Shared Folders > NFS

NFS Exports

Filter for Show NFS Exports for: All Data Movers Select a File Syst

Path File System

/TrainingFS TrainingFS

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To create a NFS export navigate to the NFS Exports listing page and click on Create. In the Create NFS export dialog choose the data mover. Give the export a name, select the file system that needs to be exported and the path that will be shared. One can optionally restrict access to specific hosts or make the export read only. Click OK to complete the process.

Mount of the export from a NFS client is not shown in this lesson.

Lab: Create FS/Share on VMAX3 Storage with Unisphere for VNX

This lab covers

- Creation of eNAS file system with Unisphere for VNX
- Creation of eNAS share with Unisphere for VNX

This Lab covers the usage of Unisphere for VNX to create file systems and shares on the eNAS system.

Lesson Summary

During this lesson the following topics were covered:

- Using Unisphere for VNX to
 - Explore eNAS Mapped Storage Pools
 - Manage File Systems
 - Manage Shares

This lesson covered management of VMAX3 eNAS file systems and shares with Unisphere for VNX.

Module Summary

Key points covered in this module:

- Exploring eNAS with Unisphere for VMAX File Dashboard
- Provisioning Storage to eNAS Data Movers
- Creating File Systems and Shares on VMAX3 Storage

This module covered VMAX3 eNAS management with Unisphere for VMAX File Dashboard and Unisphere for VNX.

Course Summary

Key points covered in this course:

- Overview of VMAX3 configuration and storage provisioning
- Virtual provisioning concepts and automated tiering in VMAX3 arrays
- Creation of VMAX3 thin devices and management of ports and port characteristics
- Service level objective based provisioning to hosts
- Managing Host I/O limits, SLO and Workload Type
- Monitoring Storage Resource Pools and SLO Compliance
- Workload Planning with Unisphere for VMAX
- Overview of the eNAS solution for VMAX3 Arrays and the management of eNAS
- Overview of VMAX3 storage management in a virtualized environment

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Course Summary

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This course provided an in-depth understanding of configuration tasks on the VMAX3 Family of arrays. Key features and functions of the VMAX3 arrays were covered in detail. Topics included storage provisioning concepts, virtual provisioning, automated tiering (FAST), device creation and port management, service level objective based storage allocation to hosts, and eNAS. Unisphere for VMAX and Solutions Enabler (SYMCLI) were used to manage configuration changes on the VMAX3 arrays.



This concludes the Training. Thank you for your participation.