

White Paper

Utilizing VMware vSphere Virtual Volumes (VVOL)

with the FUJITSU Storage ETERNUS AF series and ETERNUS DX series

Reference Architecture for Virtual Platforms

The ETERNUS AF series and the ETERNUS DX series now support VMware vSphere Virtual Volumes (VVOL). This document provides an overview of VVOL and explains how to implement this function.



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Preface

Purpose of this document

This document shows a verified reference architecture for virtual platforms that are created with the FUJITSU Storage ETERNUS AF series and ETERNUS DX series (hereinafter referred to as ETERNUS AF/DX) and FUJITSU Server PRIMERGY using VMware vSphere Virtual Volumes (hereinafter referred to as VVOL).

The following information is provided in this document:

- VVOL configuration procedure
- VVOL operation procedure

Although the ETERNUS DX S3 series is used in the description for "2 VVOL Configuration Workflow" and later, the procedures are the same for other ETERNUS AF series and ETERNUS DX series.

The verification results described in this document are current as of July 2015.

■ Target models

The following models support VVOLs.

- ETERNUS AF series
- ETERNUS DX S3 series or later^{*1}

^{*1} The ETERNUS DX60 S5/S4/S3 and ETERNUS DX8100 S4 are excluded.

■ Target audience

This document is intended for personnel who have knowledge of VMware vSphere and are engaged in designing, configuring, or operating the system.

Therefore, basic information for creating VVOLs such as the procedures from the installation to the setup of VMware ESXI and vCenter Server, and the setup procedure of vSphere HA is omitted here.

■ Other information

Note that because the procedures and screens that are used here are based on our verification machine, different operations may be necessary depending on the system configuration and the environment used.

The information stated in this document is current as of November 2019.

1 VVOL Overview and Implementation Requirements

This chapter provides an overview of VVOLs and the requirements for implementing VVOLs.

1.1 VVOL Overview

1.1.1 What is VVOL?

VMware Virtual Volume (VVOL) is a new storage management technology added to VMware vSphere 6.0.

Conventional storage operations using VMFS required complicated volume assignments and operations while taking into account resource allocations for virtual machines due to multiple VMDK (virtual disk) assignments to a single storage volume (LUN).

In storage operations using VVOLs, a storage volume is assigned to each VMDK of the virtual machine to allow the storage system to manage the storage for each virtual machine.

By allowing the storage to be used by each virtual machine, functions such as backup and performance management that were previously performed only for storage volumes can be set for each virtual machine.

In addition, reducing the administrative workload that is caused by separating the storage administrators from the virtual machine administrators is possible.

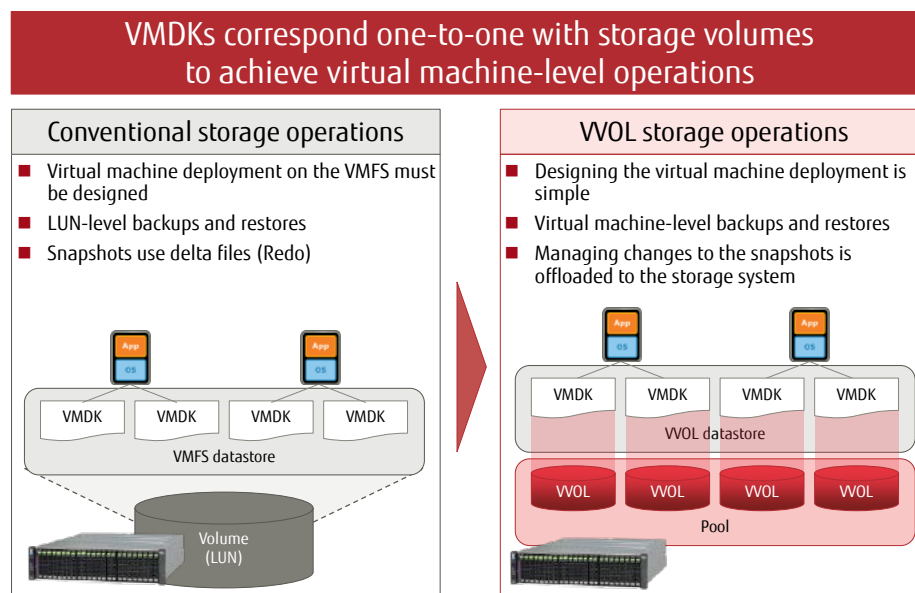


Figure-1 Storage operations with VVOLs

1.1.2 Main Features of the VVOLs that Fujitsu Provides

Fujitsu provides VVOL environments with the implementation of the ETERNUS AF/DX, ETERNUS SF, and ETERNUS VMware vSphere Storage APIs for Storage Awareness (VASA) Provider.

■ ETERNUS SF

General name for Storage Software.

ETERNUS SF Storage Cruiser and ETERNUS SF AdvancedCopy Manager used for implementing VVOLs are described below.

- ETERNUS SF Storage Cruiser

An integrated management software for storage systems. This software ensures stable operations of entire storage systems that are composed of the ETERNUS as the main device and other devices such as SAN network devices by managing the configuration, performance, and failures of the entire storage system.

ETERNUS SF Storage Cruiser can further reduce costs and provide more stable operation in combination with various optional features for different purposes; Automated Storage Tiering to optimize storage investments, Automated QoS to automatically adjust I/O resource allocations according to business requirements, guaranteeing data integrity between storage systems, and automatic switchovers of I/O access paths.

In VVOL environments, VVOL operations that are performed from vCenter Server are run via ETERNUS VASA Provider.

- ETERNUS SF AdvancedCopy Manager

This software allows high-speed backups/restores and replication operations using the Advanced Copy functions. In VVOL environments, clone backups and snapshot backups can be performed.

■ ETERNUS VASA Provider

An API that enables vCenter Server to acquire device information by linking with the storage system.

By installing ETERNUS VASA Provider in the operation management server for ETERNUS SF Storage Cruiser, the ETERNUS AF/DX becomes VASA compatible, and virtual infrastructures of the storage can be integrated and operations can be managed.

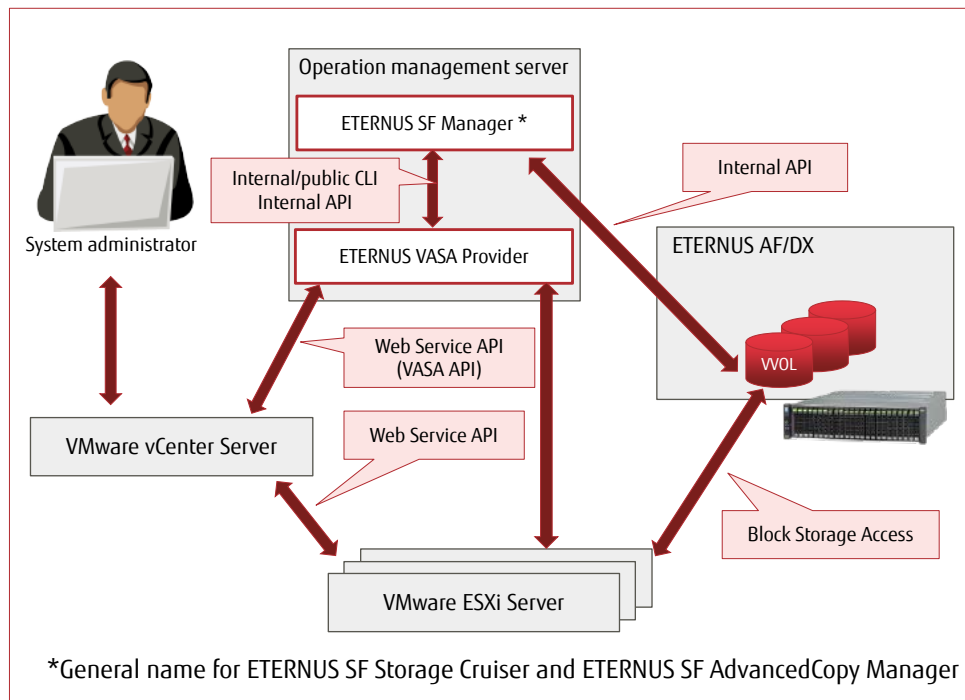


Figure-2 Structure for creating a VVOL environment

For the notes on ETERNUS VASA Provider, refer to "ETERNUS VASA Provider 3.x Release Note".

Implementation of VVOLs can provide the following operational efficiencies:

■ Simple design and scalability

Multiple virtual machines with different operational requirements can be deployed in the same datastore.

Volumes can be properly allocated from the datastore to easily add virtual machines without having to consider VMDK assignments.

When creating virtual machines, the system administrator can also operate and manage the storage simply by operating vCenter Server.

■ Workload reduction during implementation

A complicated design to divide volumes is not necessary since the only requirement for implementing VVOLs is to create a pool. The man-hours are greatly reduced during the configuration since LUN masking only needs to be performed when a pool is created.

Furthermore, the necessary system environment can be easily deployed just by configuring a storage policy while creating virtual machines from vCenter Server.

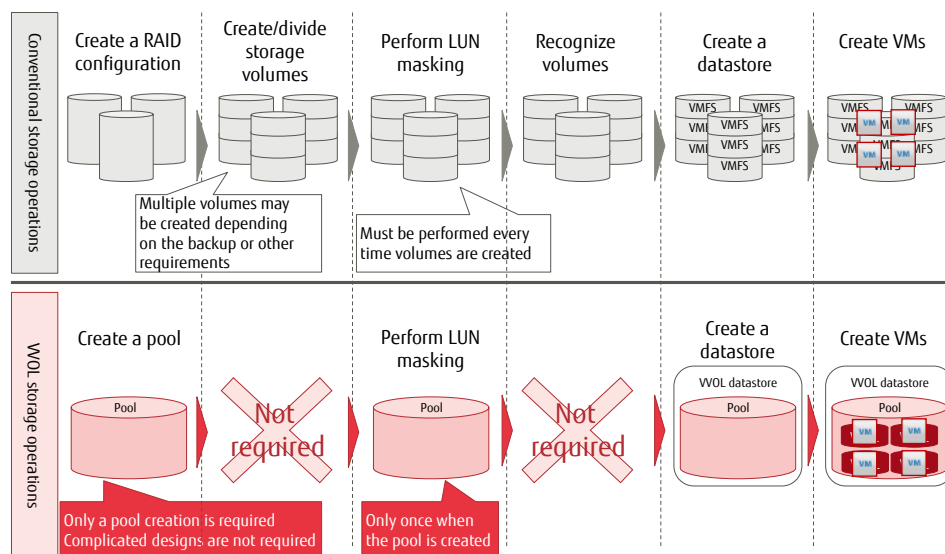


Figure-3 Comparison of implementation works

■ Simple operation from vCenter Server (storage policy)

The service level (such as performance, availability, and backup) that is required for the storage can be set as storage policies from the vCenter Server screens. Virtual machines can be created or volumes can be added simply by selecting storage policies and datastores from the vCenter Server screens.

Operations using storage policies substantially reduce time and effort in the design phase by automatically distributing resources among the virtual machines. In the operation phase, management of the virtual machines and the storage can be unified.

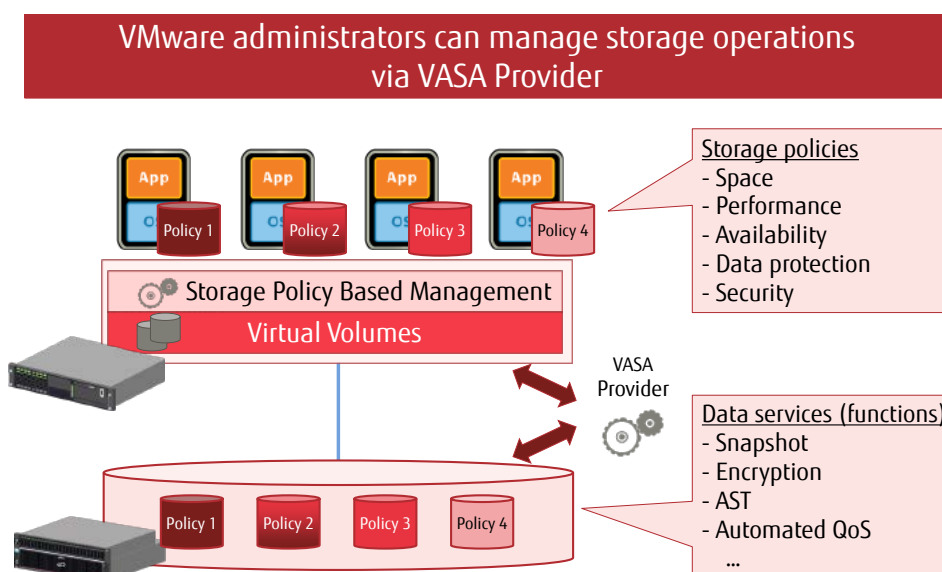


Figure-4 Storage policy

■ Efficient operation using Fujitsu's original policy settings

Items related to storage operations such as backup policies and the priority level of Automated QoS can be easily set as policies from vCenter Server. Simply by applying policies when creating the virtual machines, the VMware administrator can easily assign datastores that match the requirements of the virtual machines without the need to coordinate with the storage administrator. In this way, operational efficiency can be improved.

In addition, with Fujitsu's original user-friendly policy setting screens, various storage functions can be easily set up.

Various storage functions can easily be set up from vCenter

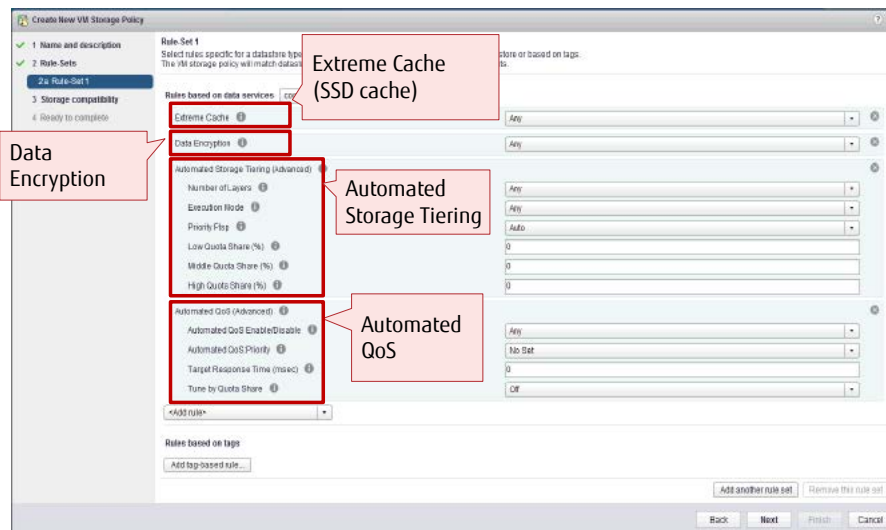


Figure-7 Storage policy setting screen

1.2 Requirements for Implementing VVOLs Using the ETERNUS AF/DX

The following sections describe the requirements for implementing VVOLs using the ETERNUS AF/DX:

1.2.1 Configuration Requirements

The following configuration is required for implementing VVOLs:

- VMware ESXi host (physical server)
VMware vSphere 6.0 or later is required to use VVOLs. The Standard Edition or higher license is also required.
Prepare the required number of physical servers that are compatible with VMware ESXi 6.0.
- Storage system
Prepare the VVOL-compatible ETERNUS AF/DX.
Fibre Channel (FC) and iSCSI connections are supported.
- Management server
 - vCenter server
A server in which vCenter Server is installed. This server can also be installed in a virtual machine.
With VMware vCenter Server Appliance, vCenter Server can be installed as pre-configured virtual machine.
 - Operation management server
A Windows server in which ETERNUS SF Manager (ETERNUS SF Storage Cruiser) and ETERNUS VASA Provider are installed. This server can also be installed in a virtual machine.
Install ETERNUS VASA Provider and ETERNUS SF Manager in the same server. vCenter Server and ETERNUS VASA Provider cannot be installed in the same server.

- DNS server

This server is required for vCenter Server, VMware ESXi hosts, and the operation management server to check the FQDN of one another. An Active Directory server can be used as an alternative.

When using vCenter Appliance, the DNS must be able to resolve the vCenter Server's FQDN during the installation.

- NTP server

A server for synchronizing the clocks of vCenter Server, VMware ESXi hosts, the operation management server, and the ETERNUS AF/DX using the NTP service.

1.2.2 Software Requirements

The following software is required for implementing VVOLs:

- VMware vSphere 6.0 Standard or higher
- VMware vCenter Server 6.0 or vCenter Appliance 6.0
- ETERNUS SF Storage Cruiser (V16.4 or later)
- ETERNUS VASA Provider (V2.0 or later)

The following software is also required to perform snapshot backups using storage policies and clone backups for the virtual machines:

- ETERNUS SF AdvancedCopy Manager (V16.4 or later)

1.2.3 Licenses

The following software licenses are required for implementing VVOLs:

- VMware vSphere 6.0 Standard or higher
- VMware vCenter Server 6.0 Foundation or Standard
- Windows Server 2012 Standard (for the operation management server)
- ETERNUS SF Storage Cruiser Standard Edition

In order to execute functions using storage policies, software licenses corresponding to those functions are required:

- ETERNUS SF AdvancedCopy Manager Standard Edition is required for snapshot backups and clone backups of the virtual machines.
- ETERNUS SF Storage Cruiser Optimization Option is required for Automated Storage Tiering.
- ETERNUS SF Storage Cruiser QoS Management Option is required for Automated QoS.

Install the required number of licenses for VMware vSphere 6.0 and Windows Server 2012 according to the number of CPUs of the physical servers that are to be used.

(Separately install the licenses that are required for the business servers that operate as virtual machines.)

1.2.4 Points to Consider for Implementing VVOLs

This section provides points to consider when implementing VVOLs.

■ Management server

The vCenter server and the operation management server are necessary for the operation of the virtual machines that use VVOLs. In order to configure the vCenter server and the operation management server on the virtual machines, datastores must be created in VMFS volumes.

■ Storage operation

- Storage policy

The ETERNUS AF/DX provides the following storage policies:

- (1) Virtual machine backups (clone backups and snapshot backups)
- (2) Automated QoS
- (3) Automated Storage Tiering (AST)
- (4) Cache (policy related to the Extreme Cache settings or the Extreme Cache Pool settings)
- (5) Security (policy related to encryption)

The corresponding licenses or optional products are required to use the storage policies that are provided by the ETERNUS AF/DX. This document describes virtual machine backups (1).

- Volume management

When VVOLs are used, the number of management volumes is included in the maximum number of volumes that can be created in the storage system. In addition, multiple VVOLs are required for each virtual machine. Therefore, a design that does not exceed the maximum number of volumes is necessary.*

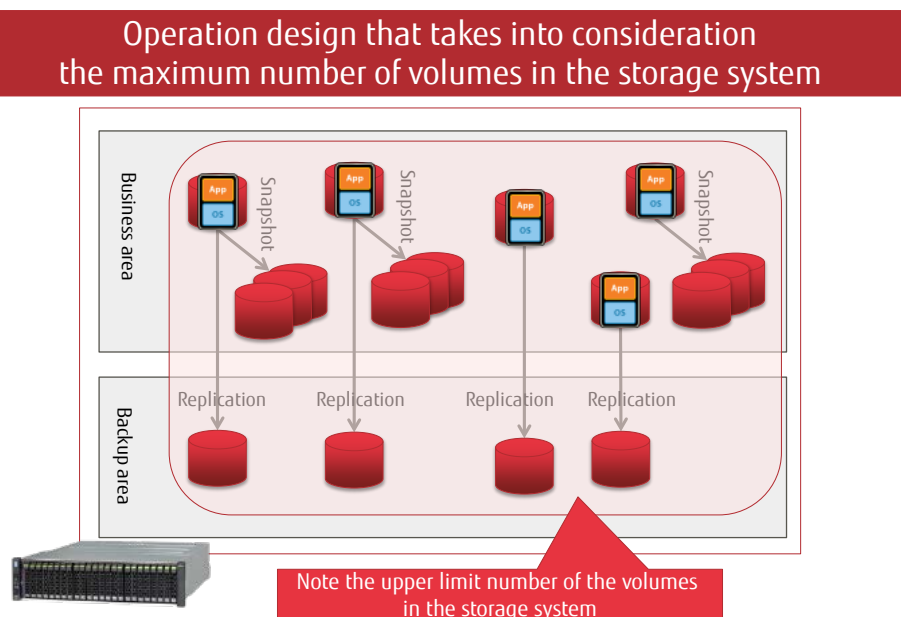


Figure-8 Operation design that takes into consideration the maximum number of volumes in the storage system

* For the number of volumes, refer to "4 Notes".

2 VVOL Configuration Workflow

This chapter describes the VVOL configuration workflow and the procedures to operate VVOLs based on the verified configuration.

2.1 Configuration Environment

For virtual machine operations that use VVOLs, management servers are required. In this configuration, a vCenter server and an operation management server that are required for VVOL operations are configured as virtual machines and redundancy is ensured using vSphere HA. 30 business servers are also configured on the same vSphere HA.

■ System overview

The procedures in this chapter are based on the following system configuration.

The contents in this document are described on the assumption that vCenter Server is installed using vCenter Server Appliance.

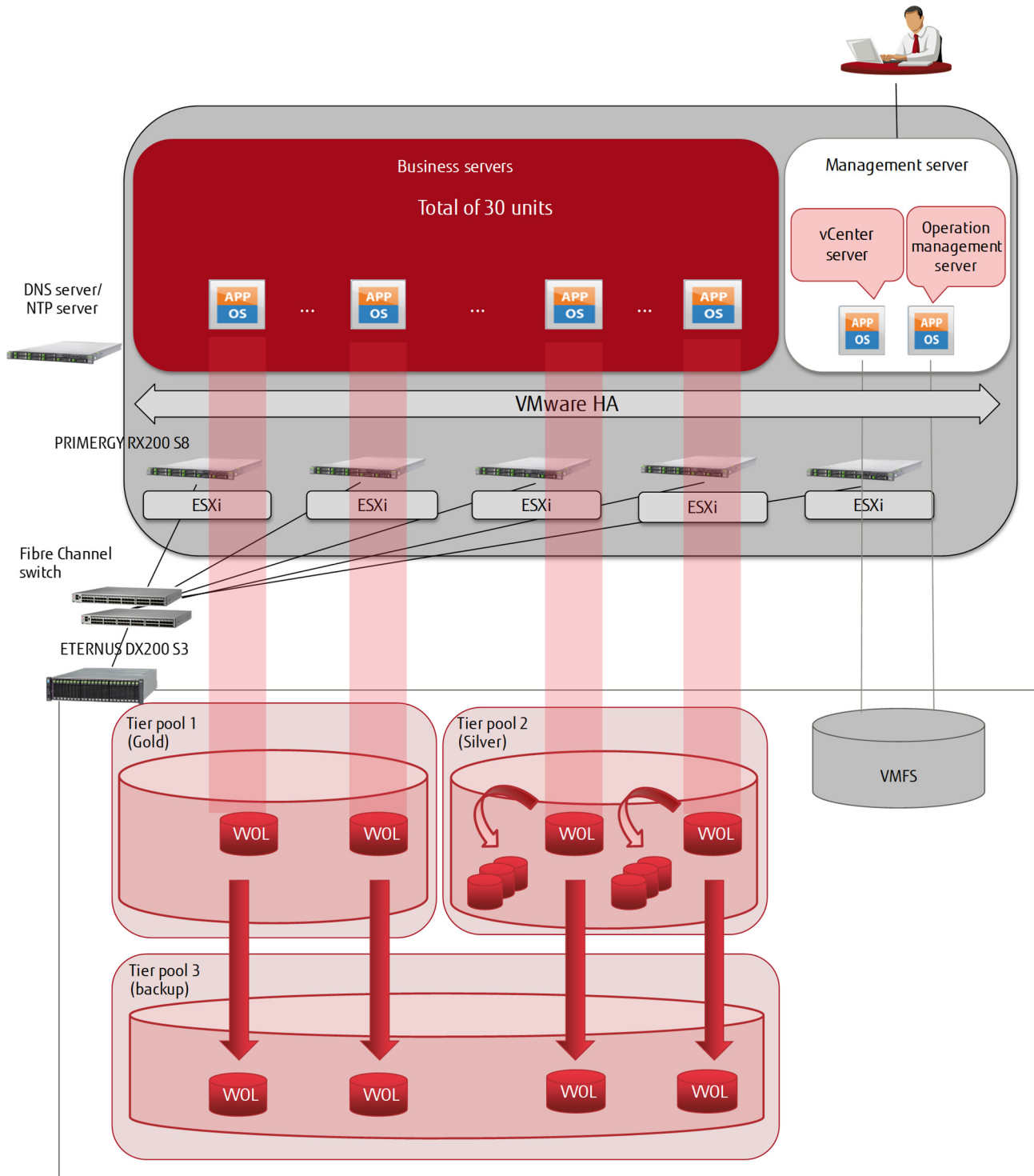


Figure-9 System overview

2.1.1 Component List

■ Hardware/software

- Hardware

- ETERNUS DX200 S3 x 1
- PRIMERGY RX200 S8 x 5
- Brocade 6505 x 2
- SR-X316T2 x 6

- Software

- VMware vSphere 6.0 (ESXi)
- VMware vCenter Server Appliance 6.0
- Windows Server 2012 R2 (for the operation management server)
- ETERNUS SF Storage Cruiser V16.4
- ETERNUS VASA Provider V2.0
- ETERNUS SF AdvancedCopy Manager V16.4 (for clone backups of the virtual machines)

■ Configuration information

- Management servers and business servers (physical machines)

vSphere HA was configured with five PRIMERGY RX200 S8 servers and virtual machines were created with two management servers and 30 business servers.

The following table shows the physical configuration of each physical server.

CPU	Memory	Internal drive [RAID level]	FC port	LAN port
Intel® Xeon® processor 2.40GHz 12 cores x 2 CPUs	128GB	300GB x 2 [RAID1]	16Gbit/s single-channel Fibre Channel card x 2	1GB x 6 ports (onboard LAN 2Port, Quad port LAN card x 1)

Table-1 Physical configuration of each physical server

- Management servers (virtual machines)

A vCenter server and an operation management server were created in a VMFS datastore.

Server type	Software	CPU	Memory	Drive
vCenter server	VMware vCenter Server Appliance 6.0	4vCPU	16GB	150GB (thick)
Operation management server	Windows Server 2012 R2	4vCPU	5GB	50GB
	ETERNUS SF Storage Cruiser V16.4			
	ETERNUS SF AdvancedCopy Manager V16.4			
	ETERNUS VASA Provider V2.0			

Table-2 Configuration of the management servers (virtual machines)

- Business servers* (virtual machines)

30 business servers were created on VVOL datastores.

SQL Server 2014 was set up in two of the servers to use as DB servers for the business.

Server type	Software	CPU	Memory	Drive
AP server (x 28)	Windows Server 2012 R2	2vCPU	8GB	50GB
DB server (x 2)	Windows Server 2012 R2	4vCPU	16GB	50GB
	SQL Server 2014			

Table-3 Configuration of the business servers (virtual machines)

* Although the above business server configuration is used in this document, depending on the virtual machine requirements to be used in actual operations, consider not only the configuration but also the physical resources.

- Storage system

Datstores for all the virtual machines (management servers and business servers) were placed in the ETERNUS DX200 S3.

The management servers were placed in a VMFS datastore. (The management servers are necessary to operate the virtual machines on the VVOLs.)

This document assumes that two storage policies are available for the business servers.

- ✓ Gold datastore policy stores systems such as database servers that have frequently updated data
- ✓ Silver datastore policy stores systems such as AP servers that do not require storage performance

When a virtual machine is created, backup operations that use snapshot backups and clone backups are automatically set with a storage policy. Snapshot backups are created in the same Tier pool as the virtual machine. Clone backups require a Tier pool that is different from the Tier pool for VVOLs. Prepare a Tier pool for clone backups.

The following figure shows the drive configuration.

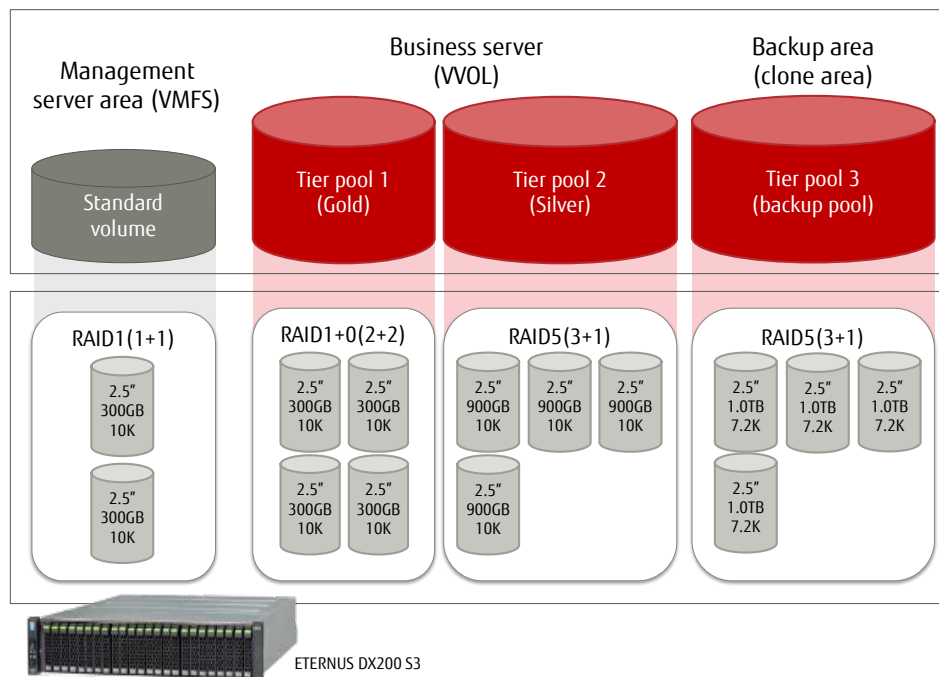


Figure-10 Configuration of the storage system (drives)

Area	Virtual machine usage capacity	Required capacity	Drive	RAID configuration	Available area	Usage
Management server area (VMFS)	200GB	200GB	300GB/10krpm	RAID1(1D+1M)	300GB	vCenter Server, operation management server
Business server area (VVOL)	1,500GB	3,000GB	300GB/10krpm	RAID1+0(2D+2M)	600GB	Pool 1 (VVOL datastore Gold)
			900GB/10krpm	RAID5(3D+1P)	2,700GB	Pool 2 (VVOL datastore Silver)
Backup area (VVOL)	-	3,000GB	1,000GB/7.2krpm	RAID5(3D+1P)	3,000GB	Backup pool (for clone backups)

Table-4 Configuration of the storage system (drives)

- Switches

Fibre Channel switches and network switches for management, business, and vMotion were used.
Each network was redundantly configured.

Type	Model name	Transmission speed / Number of ports	No. of units
Fibre Channel switch	Brocade 6505	16Gbit/s / 24 ports	2
Network switch	SR-X316T2	1Gbit/s / 16 ports	6

Table-5 List of switches

- Storage policies

ETERNUS SF's virtual machine backup policies were used in this configuration.

Snapshot backups and clone backups are available as virtual machine backups and the following policies can be set.

Item	Description
Operation Mode	<p>Select the operation mode that specifies how the virtual machine backup function should operate.</p> <ul style="list-style-type: none"> - Auto: Enables the virtual machine backup function. Backups are automatically performed. - Manual: Enables the virtual machine backup function. Backups are only performed manually. - Disable: Disables the virtual machine backup function. <p>Even if [Auto] or [Manual] is selected for this item, [Disable] is automatically set by the following property settings (or settings that do not take backups).</p> <ul style="list-style-type: none"> - [0] is specified for [Number of Snapshot Backup Generations] and - [Disable] is specified for [Clone Backup]
Execution Period	<p>Select an interval to automatically perform backups.</p> <p>This item is enabled only when [Auto] is specified for [Operation Mode].</p> <ul style="list-style-type: none"> - Hourly: Performs at the specified hourly intervals. If this interval is selected, [Execution Interval(Hour)] must also be set. - Daily: Performs every day at the time specified for [Execution Start Time]. - Weekly: Performs every week on the specified day. If this interval is selected, [Execution Week] must also be set. - Monthly: Performs every month on the specified day. If this interval is selected, [Execution Day] must also be set.
Execution Interval (Hour)	When [Hourly] is specified for [Execution Period], select the hourly execution interval. The time interval that can be selected is 1, 2, 3, 4, 6, 8, or 12.
Execution Week	If [Weekly] is specified for [Execution Period], select an execution day of the week. Multiple days can be selected.
Execution Day	<p>If [Monthly] is specified for [Execution Period], select an execution day. The selectable day is from [1] to [31] or [Last]. Only one day can be selected.</p> <p>When a day is selected from 1 to 31, a backup is performed on the specified day. For the months that do not have the selected day, a backup is not performed.</p> <p>When [Last] is selected, a backup is performed on the last day of the month.</p>
Execution Time (Hour)	<p>Select the time (hour) to start an automatic backup. The selectable value is from 0 to 23.</p> <p>This item is enabled only when [Auto] is specified for [Operation Mode].</p>
Execution Time (Minute)	<p>Select the time (minute) to start an automatic backup. The selectable value is from 0 to 55 (in 5 minute increments).</p> <p>This item is enabled only when [Auto] is specified for [Operation Mode].</p>
Number of Snapshot Backup Generations	<p>Select the number of generations of snapshot backups to store. The selectable generation number is from 0 to 28.</p> <p>When [0] is selected, snapshot backups are not saved.</p> <p>When using single item restore, snapshot backups are required. For this reason, select [1] or a larger number for this item.</p> <p>When performing only clone backups, specify [Enable] for [Clone Backup] and select [0] for this item.</p> <p>This item is enabled only when [Auto] or [Manual] is specified for [Operation Mode].</p> <p>When performing a snapshot backup that exceeds the number of generations to store, the oldest generation is automatically deleted after the backup operation.</p>
Quiesce guest file system	<p>Select whether to maintain the integrity of the file system content when a backup is performed.</p> <p>This item is enabled only when [Auto] or [Manual] is specified for [Operation Mode].</p> <ul style="list-style-type: none"> - Enable: Maintains the integrity of the file system when a backup is performed. - Disable: Does not maintain the integrity of the file system when a backup is performed.
Snapshot the virtual machine's memory	<p>Select whether to include the memory content when snapshot backups are taken.</p> <p>This item is enabled only when [Auto] or [Manual] is specified for [Operation Mode].</p> <ul style="list-style-type: none"> - Enable: Includes the memory content in the snapshot backups. - Disable: Does not include the memory content in the snapshot backups.
Clone Backup	<p>Select whether to take a clone backup.</p> <p>This item is enabled only when [Auto] or [Manual] is specified for [Operation Mode].</p> <ul style="list-style-type: none"> - Enable: Takes a clone backup. - Disable: Does not take a clone backup.

Table-6 Virtual machine backup policies

With virtual machine storage policies, backup operations for virtual machines can be set when the virtual machines are created. In this document, the following storage policies were created for Gold datastores and Silver datastores.

Item	Policy setting for Gold datastore	Policy setting for Silver datastore
Operation Mode	Auto	Auto
Execution Period	Daily	Weekly
Execution Interval(Hour)		
Execution Week		Sun
Execution Day		
Execution Start Time(Hour)	22	1
Execution Start Time(Minute)	30	0
Number of Snapshot Backup Generations	0	1
Quiesce guest file system	Enable	Enable
Snapshot the virtual machine's memory	Enable	Enable
Clone Backup	Enable	Enable

Table-7 Created virtual machine storage policies

For Gold datastores, clone backups are taken with the performance prioritized by setting 0 to the number of snapshot backup generations. For Silver datastores, clone backups are taken and snapshot backups that are available for quick recoveries and single item restores are also taken. By creating multiple policies, the storage policies can satisfy various usages of virtual machines.

■ Physical connection diagram

The business LAN, the operation management LAN, and the LAN for vMotion were connected to all the ESXi hosts. The ETERNUS DX200 S3 was connected only to the operation management LAN. A DNS server and an NTP server that were required for the ESXi hosts, the vCenter server, and the operation management server were connected to the operation management LAN.

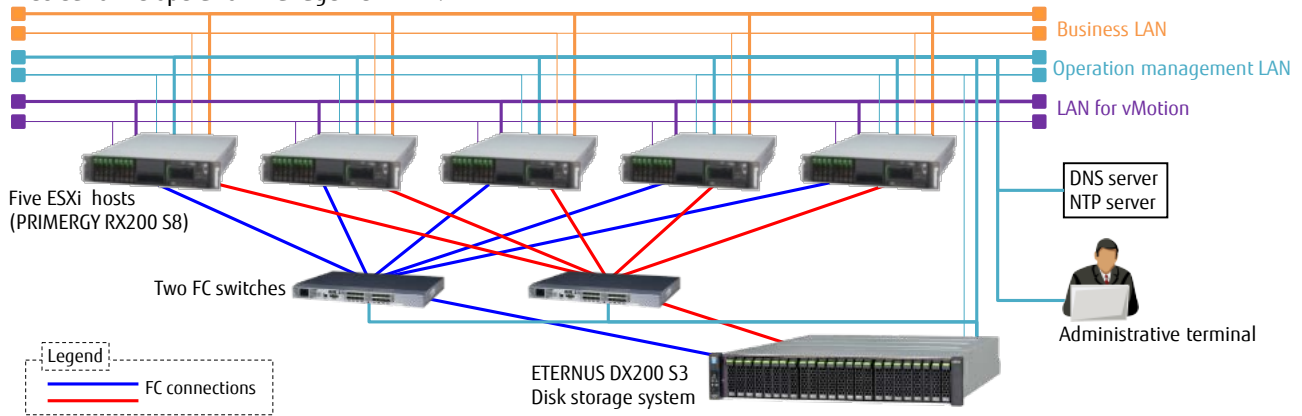


Figure-11 Physical connection diagram

■ Logical connection diagram

The two CMs of the storage system and two HBAs on each ESXi host were connected. For the host affinity settings between the management server area and the ESXi hosts, the ETERNUS SF was used normally. Tier pools 1 to 3 for VVOLs were set as VVOL access paths when VVOL datastores were created.

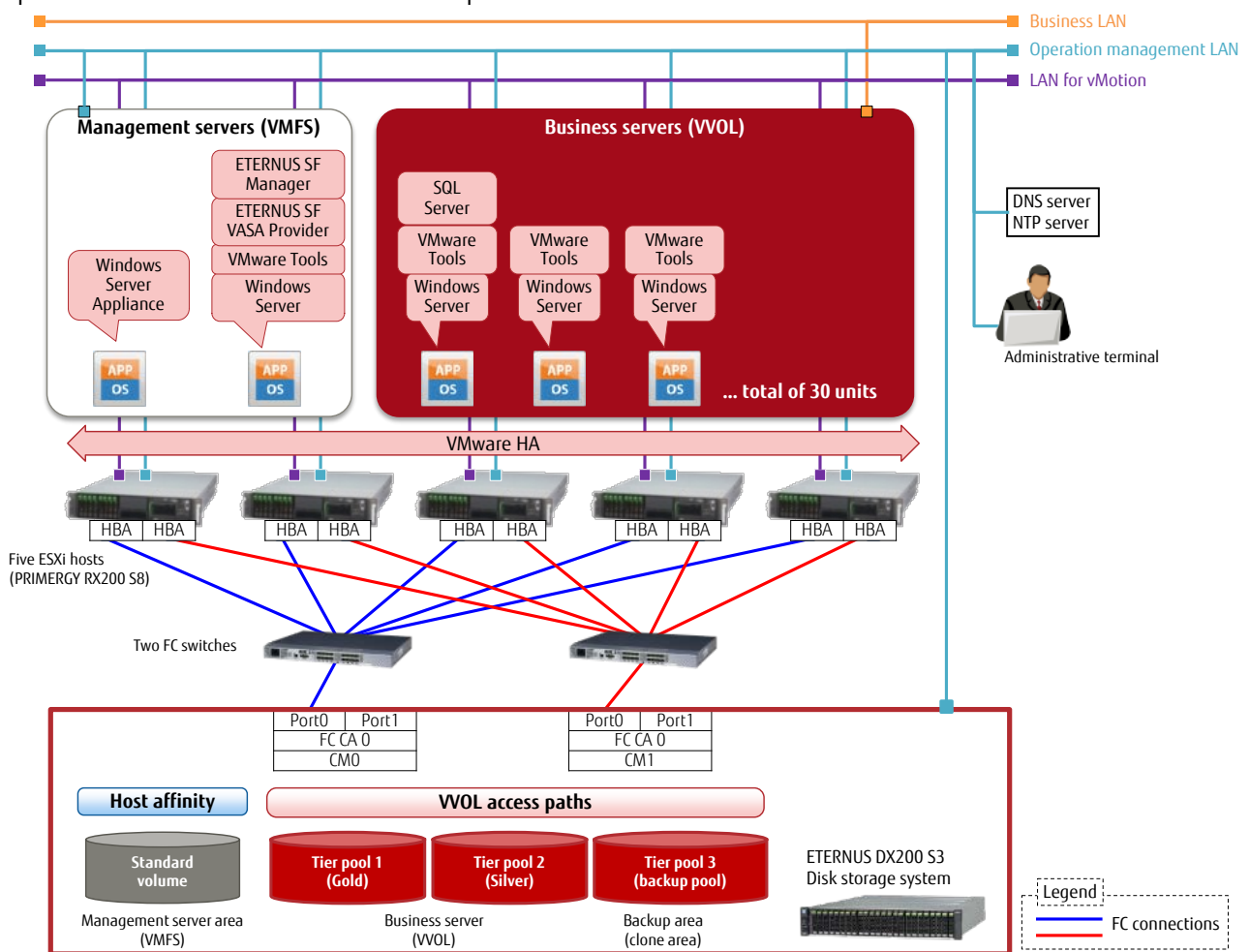


Figure-12 Logical connection diagram

2.2 Configuration Procedures

■ VVOL configuration workflow

The procedures to configure a VVOL environment are described according to the following workflow.

For details, refer to "FUJITSU Storage ETERNUS SF Storage Cruiser V16.4 / AdvancedCopy Manager V16.4 Operation Guide for VMware vSphere Virtual Volumes".

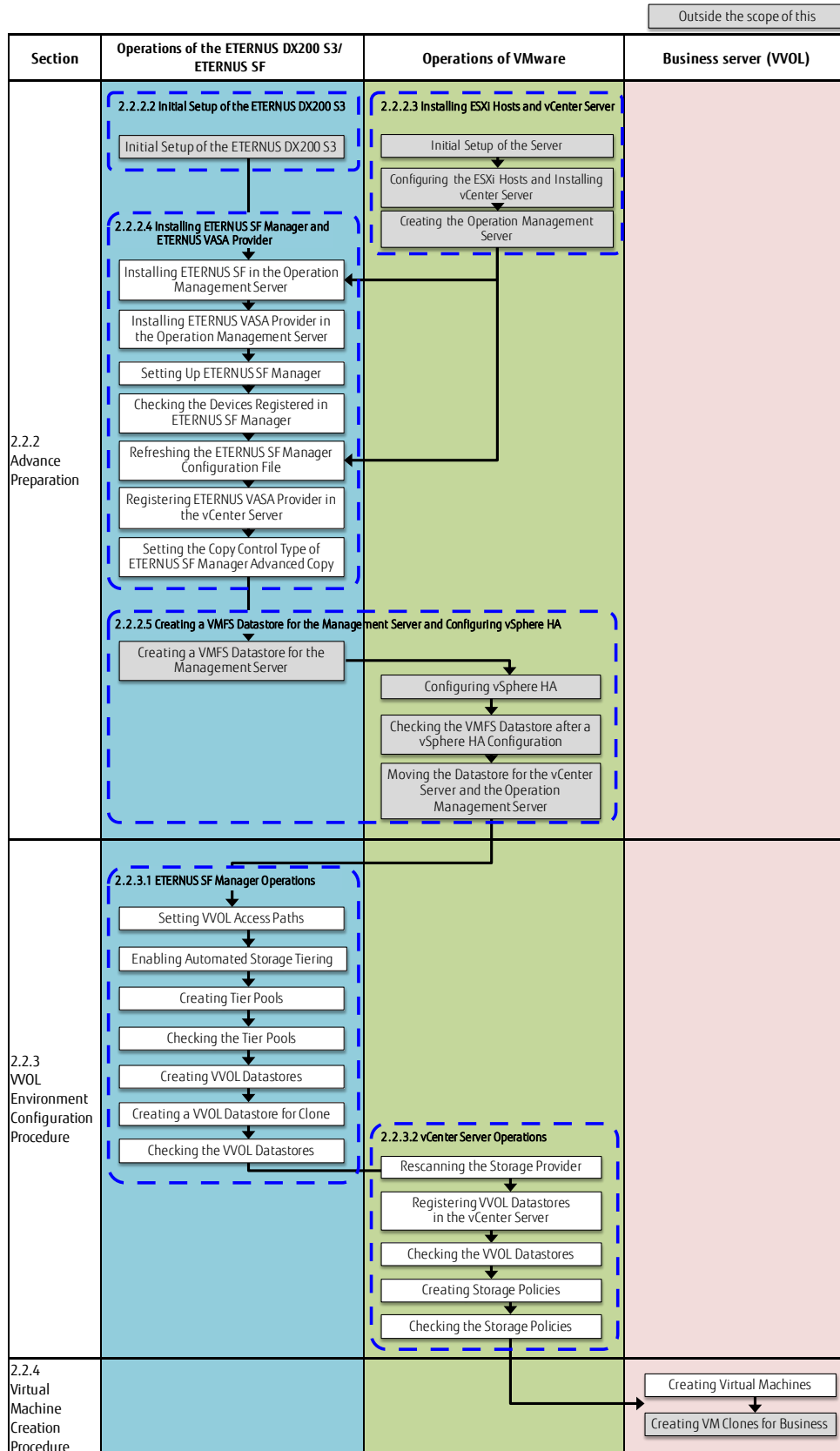


Figure-13 Configuration workflow

2.2.1 Description of ETERNUS SF Web Console

2.2.1.1 Web Console Screen Configuration

The following figure shows the Web Console screen.
This document uses the following screen elements to explain the operations.

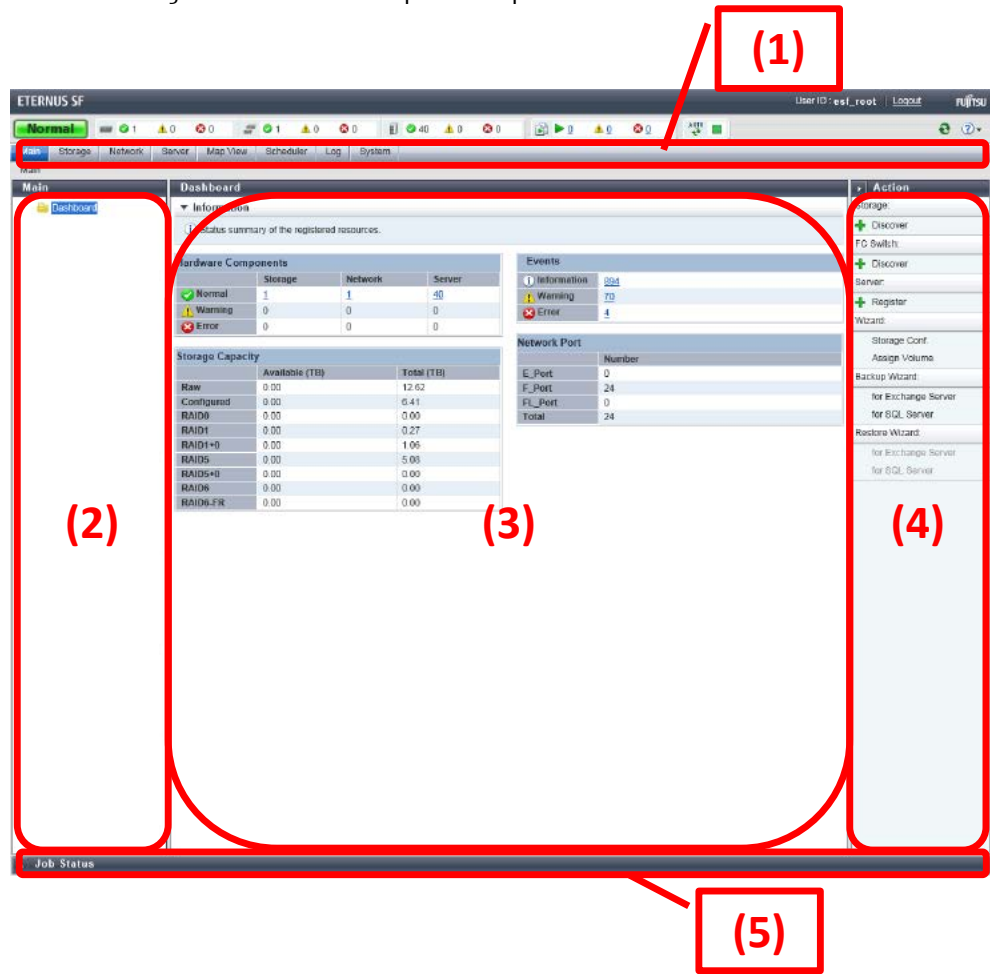


Figure-14 Description of the ETERNUS SF Web Console screen

No.	Item	Description
(1)	Global navigation tab	When a category is clicked in the global navigation tab, the top menu of the category is displayed on the category pane.
(2)	Category pane	Displays a list of categories that can be selected. When each item is clicked, information for the item is displayed on the main pane.
(3)	Main pane	Menus and setting information are displayed. Details of the current main pane are displayed in the [Information] field.
(4)	Action pane	Displays a list of actions that can be performed for an item that is displayed on the main pane.
(5)	Job Status pane	Displays the processing status of the operation that is performed with ETERNUS SF Web Console and a dialog message starting with "The job has been submitted for processing." that can be checked. The bar expands or closes when clicked.

Table-8 Descriptions of the ETERNUS SF Web Console screen

2.2.1.2 Checking the Common Processes of the ETERNUS SF Web Console Operations

The ETERNUS SF displays the message "The job has been submitted for processing." when settings are performed. Whether the setting is successful must be checked by a different operation.

Because this confirmation operation is common to almost all ETERNUS SF Web Consoles, refer to this chapter for the settings confirmation.

Points

Open the Job Status pane to check the result of the process that was performed with ETERNUS SF Web Console. Confirm that "Success" is displayed on the pane and proceed to the next steps.

After a while, the currently running processes are counted as successful or failed and are displayed on the operation status bar on the upper part of the screen.

The screenshot displays the ETERNUS SF Web Console interface. At the top, a status bar shows the overall system status as 'Normal' and includes counters for Success, Warning, and Error. A red circle highlights this status bar, with a callout box stating 'Success and failure counters'. Below the status bar, the main dashboard area is divided into several sections: 'Information' (summary of registered resources), 'Hardware Components' (table with columns for Storage, Network, and Server), 'Storage Capacity' (table with columns for Available and Total TB), 'Events' (table with columns for Information, Warning, and Error), and 'Network Port' (table with columns for E_Port, F_Port, and FL_Port). The 'Job Status' pane is open at the bottom, showing a table of recent operations. A red circle highlights the 'Job Status' pane, with a callout box stating 'Job Status pane'. The 'Job Status' table has columns for Date, User ID, Action, Status, Result, and Target. The 'Result' column shows 'Success' for all listed operations. A red circle highlights the 'Result' column, with a callout box stating 'Success and failure counters'.

Date	User ID	Action	Status	Result	Target
2015/07/14 18:20:23	est_admin	Reload Configuration on Server	Completed	Success	vvolses04
2015/07/14 18:20:08	est_admin	Reload Configuration on Server	Completed	Success	vvolses03
2015/07/14 18:19:53	est_admin	Reload Configuration on Server	Completed	Success	vvolses02
2015/07/14 18:19:39	est_admin	Reload Configuration on Server	Completed	Success	vvolses05
2015/07/14 18:19:24	est_admin	Reload Configuration on Server	Completed	Success	vvolses01
2015/07/14 18:19:12	est_admin	Reload Configuration on FC Switch	Completed	Success	SN206
2015/07/14 15:54:36	est_admin	Single Item Restore Snapshot	Completed	Success	gyomu02
2015/07/14 15:28:37	est_admin	Restore Clone Backup	Completed	Success	gyomu02
2015/07/14 15:11:53	est_admin	Restore Snapshot	Completed	Success	gyomu02
2015/07/14 15:01:03	est_admin	Execute Manually (Virtual Machine Backup)	Completed	Success	gyomu02

Figure-15 Opened Job Status pane

2.2.2 Advance Preparation

This section explains the required settings of the ETERNUS DX200 S3, ETERNUS SF, and VMware vSphere before starting the work related to VVOLs.

2.2.2.1 Checking Prior to Working

Before starting the work, check the following necessary environments.

- The NTP server is available.
- The host names of the ESXi hosts, vCenter server, operation management server (ETERNUS SF/ETERNUS VASA Provider) are compatible with the standard naming convention in RFC952/1123*.
(Windows DNS supports extended ASCII and Unicode characters, but the extended characters cannot be used for the ESXi hosts.)
*Standard naming convention in RFC952/1123: The characters that can be used are "0 to 9", "a to z", "A to Z", "-" (hyphen)", and "." (period [only as domain delimiter]).
- The names of the ESXi hosts, the vCenter server, and the operation management server (ETERNUS SF/ETERNUS VASA Provider) can be resolved (with a forward and reverse mapping) using the DNS server.
- Initial setup for the Fibre Channel switches has been completed.

2.2.2.2 Initial Setup of the ETERNUS DX200 S3

Perform an initial setup so that the ETERNUS DX200 S3 can be operated from ETERNUS SF.

To use VVOLs, the Thin Provisioning Pool function must be enabled.

For details on the settings and procedures, refer to "Disk Storage Systems and All Flash Arrays" under "Environment Configuration" in "FUJITSU Storage ETERNUS SF Storage Cruiser V16.4 Operation Guide".

For details on the settings, refer to "FUJITSU Storage ETERNUS DX, ETERNUS AF Configuration Guide (Web GUI)".

Points

The RAID groups and access paths that are used for the VVOLs must be created and managed with ETERNUS SF Manager.

Therefore, volumes for VMFS that are used by the management server must also be created and managed with ETERNUS SF Manager.

The creation and management of RAID groups and access paths are all performed from ETERNUS SF Manager.

To use VVOLs, the Thin Provisioning Pool function of the ETERNUS DX200 S3 must be enabled.

Checklist

Confirm the following items before proceeding to the next procedure.

- The storage system name has been set.
- The network has been set.
- A user with the Software role has been created.

The following values will be required in "2.2.2.4.3 Setting Up ETERNUS SF Manager".

Item	Parameter
IP address	(IP address of the management LAN)
SNMP community name	(Arbitrary)
User name	(Name of the user that has the Software role)
Password	(Password)

Table-9 Initial setup of the ETERNUS DX200 S3

2.2.2.3 Installing ESXi Hosts and vCenter Server

Set the ETERNUS DX200 S3 using ETERNUS SF Storage Cruiser that is installed in the operation management server.
Configure the operation management server and the vCenter server in the local drives of the ESXi hosts.

Points

The ETERNUS DX200 S3 must be set using ETERNUS SF Manager. Therefore, configure and set the virtual machines of the management server on the local drives of the ESXi hosts, and then move the virtual machines to the ETERNUS DX200 S3.

2.2.2.3.1 Configuring the ESXi Hosts and Installing vCenter Server

Configure the ESXi hosts.

Create a VMFS datastore in a local drive of a single ESXi host.

Install vCenter Server Appliance in the created datastore.

Register the ESXi host to the vCenter server.

(For details on the procedure related to the ESXi hosts and vCenter Server, refer to the VMware vSphere 6.0 documents provided by VMware.)

Checklist

Confirm the following items before proceeding to the next procedure.

- The ESXi host and vCenter Server can communicate with each other correctly.
- A name resolution can be performed correctly.
- The clock has been synchronized.

The following values will be required in "2.2.2.4.3 Setting Up ETERNUS SF Manager".

In this document, root users of vCenter Server are assigned administrator privileges.

Item	IP address	Host name	User name with administrator privileges	Password	Web Client port number	Remarks
vCenter Server	(IP address of the management LAN)	vCenter	root (arbitrary)	*****		Record the Web Client port number if it is changed. Default value: 443
ESXi host 1		vvolesxi01	root (arbitrary)	*****		
ESXi host 2		vvolesxi02	root (arbitrary)	*****		
ESXi host 3		vvolesxi03	root (arbitrary)	*****		
ESXi host 4		vvolesxi04	root (arbitrary)	*****		
ESXi host 5		vvolesxi05	root (arbitrary)	*****		

Table-10 ESXi and vCenter Server initial setup

2.2.2.3.2 Creating the Operation Management Server

Configure a virtual machine for the operation management server in the local drive of the ESXi host.

Install Windows Server 2012 R2 in the virtual machine.

(For details on the procedure related to Windows Server 2012 R2, refer to the documents that are provided on the Microsoft website.)

2.2.2.4 Installing ETERNUS SF Manager and ETERNUS VASA Provider

This section provides the procedures that must be performed before creating VVOLs.

2.2.2.4.1 Installing ETERNUS SF Manager in the Operation Management Server

Install ETERNUS SF Manager in the virtual machine of the operation management server that was configured on the ESXi host.

For details, refer to "FUJITSU Storage ETERNUS SF Express V16.4 / Storage Cruiser V16.4 / AdvancedCopy Manager V16.4 Installation and Setup Guide".

1. Install ETERNUS SF Manager in the operation management server.
Log in to the operation management server with a user that has Administrator privileges.
2. Read "ETERNUS SF SC/ACM/Express Mediapack for Windows Manager Program (1/2)".
3. The initial screen is displayed. Click [Manager installation].
4. The [Choose Setup Language] dialog box is displayed. Select the appropriate language and click the [OK] button.
The language selected in this dialog box will be used during the installation.
5. In the [Welcome to the InstallShield Wizard for ETERNUS SF Manager] screen, click the [Next] button.
6. In the [License Agreement] screen, read the displayed terms and conditions. If the conditions are agreeable, select [I accept the terms of the license agreement], and then click the [Next] button.
7. In the [Install option] screen, select [ETERNUS SF Manager is installed.] and click the [Next] button.
8. In the [Start Copying Files] screen, check the settings. If the settings are correct, click the [Next] button. To change the settings, click the [Back] button.
9. When the [Installation Complete] screen is displayed, click the [Finish] button.

Checklist

Confirm the following item before proceeding to the next procedure.

- [ETERNUS SF Manager] is displayed in the [Programs and Features] screen of Control Panel.

** To use the VVOL functions with FUJITSU Storage ETERNUS SF V16.4, patches must be applied.
For details, contact your Fujitsu sales representative or the support division of your FUJITSU Storage ETERNUS SF V16.4 contract.*

2.2.2.4.2 Installing ETERNUS VASA Provider

Install ETERNUS VASA Provider in the virtual machine for the operation management server that was configured on the ESXi host. For details, refer to "ETERNUS VASA Provider 2.0 User's Guide".

1. Install ETERNUS VASA Provider V2.0.
Run the installer and click the [Next] button in the [Welcome to the InstallShield Wizard for ETERNUS VMware Support Package] screen.
2. In the [Setup Type] screen, select a setup type and click the [Next] button.
[Complete] is selected in this document.
3. In the [License Agreement] screen, read the displayed terms and conditions. If the conditions are agreeable, click the [Yes] button.
4. In the [Create ETERNUS VASA Provider Account] screen, enter the items shown in the following table, and then click the [Next] button.
The account information that is created here will be used to register ETERNUS VASA Provider in vCenter Server.

Item	Information
Provider User name	User name of the administrator account
Provider Password	Password for the administrator account

Table-11 Account creation information

5. In the [Setup Server Certificate] screen, enter the items shown in the following table, and then click the [Next] button.

Item	Information
Common Name (Necessary)	FQDN
Organization Unit	Arbitrary
Organization Name	Arbitrary
Locality Name	Arbitrary
State Name	Arbitrary
Country Code	Arbitrary

Table-12 Server certificate creation

6. In the [Start Copying Files] screen, review the settings and click the [Install] button.
7. When the [InstallShield Wizard Complete] screen is displayed, click the [Finish] button.

Checklist

Confirm the following item before proceeding to the next procedure.

- [ETERNUS VMware Support Package] is displayed in the [Programs and Features] screen of Control Panel.

2.2.2.4.3 Setting Up ETERNUS SF Manager

■ Registration of the target storage system for management

1. Log in to ETERNUS SF Manager of the operation management server.

2. Click the [Storage] tab on the global navigation tab.
On the Action pane, click [Add].

3. Add an ETERNUS AF/DX.

The ETERNUS AF/DX can be added by searching a subnet or specifying an IP address. The IP address method is used in this document. Register the ETERNUS DX200 S3 using the values that were specified in "2.2.2.2 Initial Setup of the ETERNUS DX200 S3".

Select the [IP Address] radio button.

Enter the IP address and SNMP community name of the ETERNUS AF/DX, and click the [Discover] button.

The screenshot shows the 'Discover Storage' window in the ETERNUS SF Manager. The 'Information' section contains instructions: 'Enter the IP Address/Subnet Address and the SNMP Community Name to discover the Disk Array. The Subnet Address should be the Broadcast Address (e.g. 192.168.0.255). Fields marked with * are required.' Below this, the 'Disk Array Information' section has two radio buttons: 'Search on Subnet' and 'IP Address'. The 'IP Address' button is selected and circled in red. To its right, there are three input fields: 'Subnet Address *' (empty), 'SNMP Community Name *' (empty), 'IP Address *' (containing '192.168.100.5'), and 'SNMP Community Name *' (containing 'public'). The 'Discover' button at the bottom right is also circled in red.

Figure-16 ETERNUS AF/DX detection

4. When the target ETERNUS AF/DX is displayed, enter the necessary information and click the [Register] button on the lower right corner of the screen.

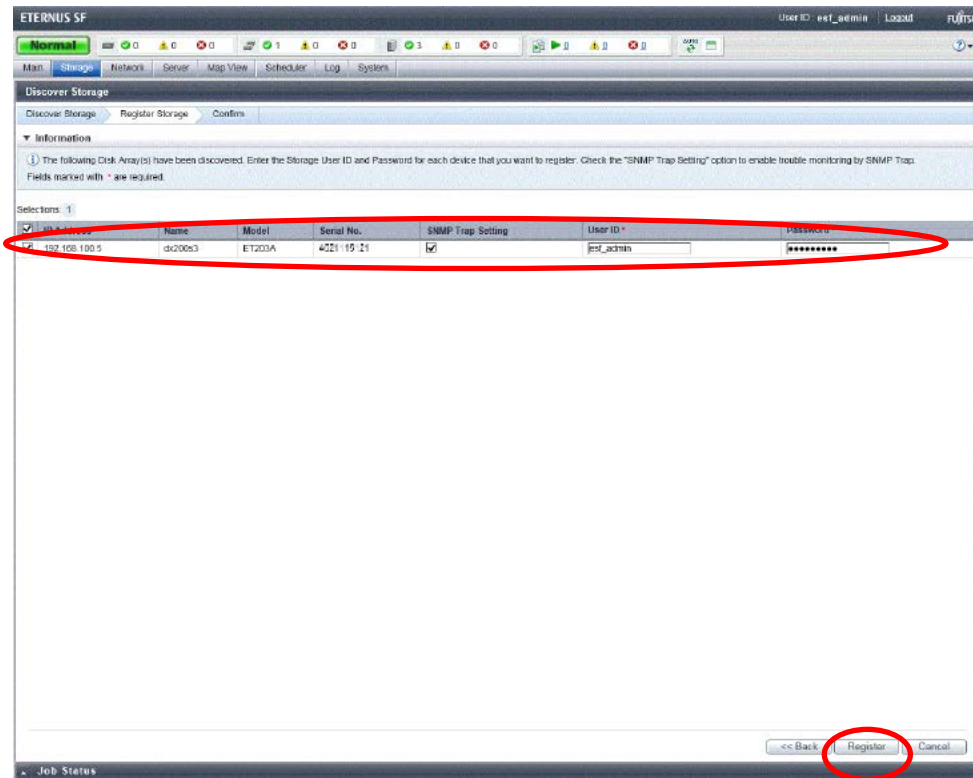


Figure-17 ETERNUS AF/DX registration

Points

Check the Job Status pane and make sure that the result changes to [Success] before proceeding to the next step. For details on how to use the Job Status pane, refer to "2.2.1.2 Checking the Common Processes of the ETERNUS SF Web Console Operations".

The registration process may take several minutes to several tens of minutes depending on the storage system configuration. Wait for the registration process to finish before operating the ETERNUS AF/DX.

5. Register licenses.
Click the [Storage] tab on the global navigation tab.
On the Main pane, click the ETERNUS AF/DX link under [Name].

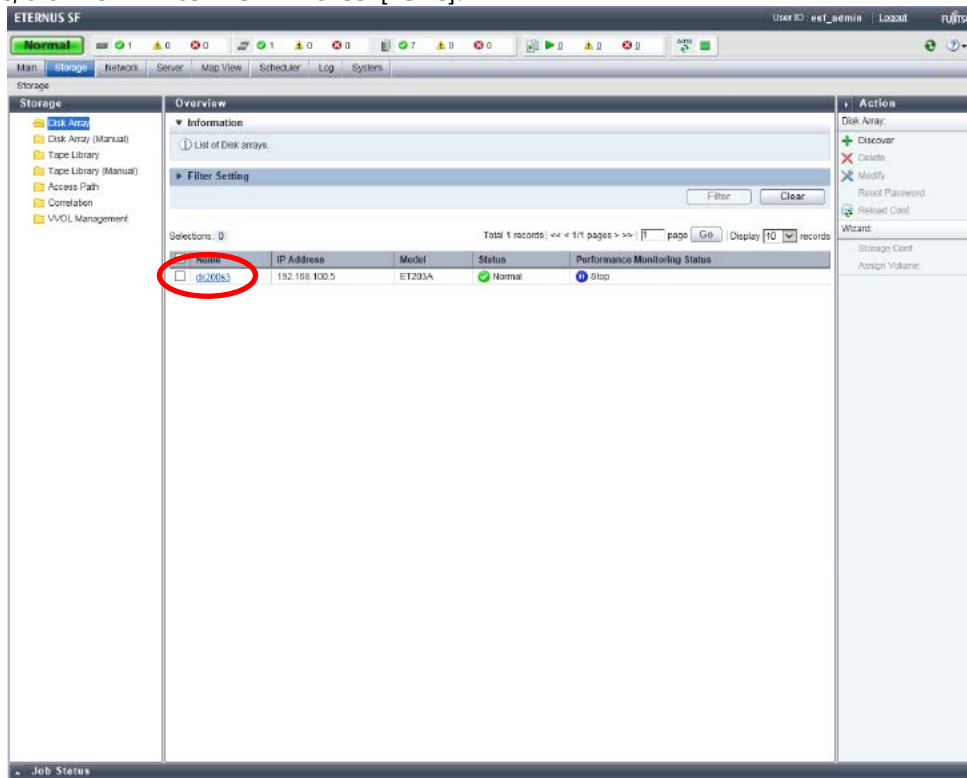


Figure-18 Storage

6. On the Category pane, click [System].

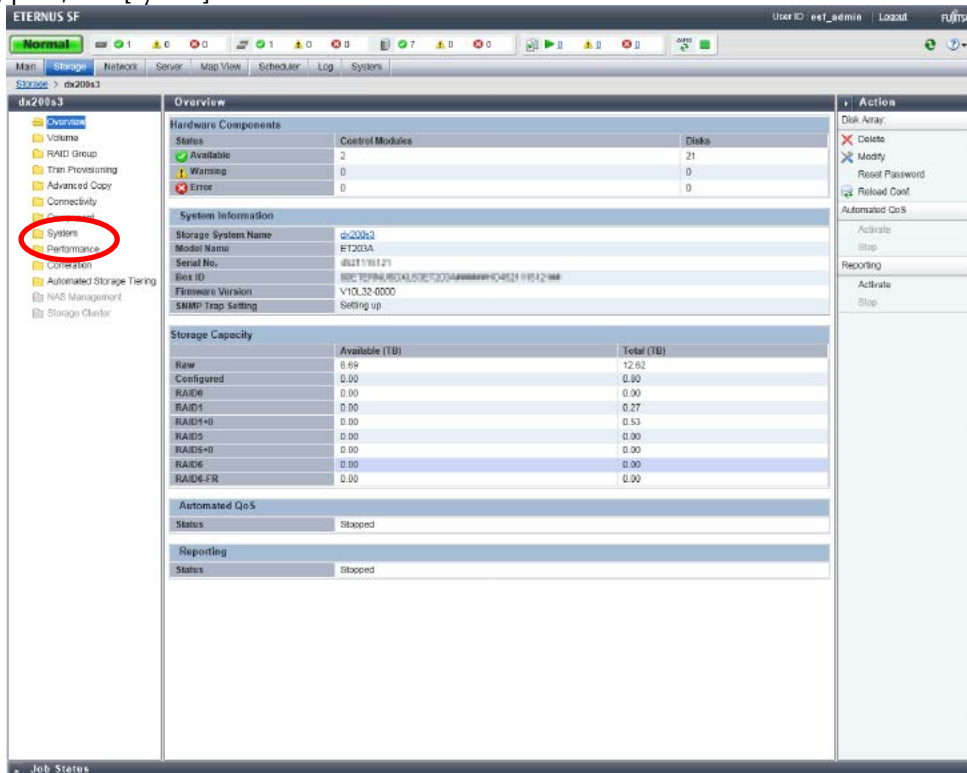


Figure-19 dx200s3

7. Click [License Management] on the Category pane. A list of licenses that can be registered is displayed on the Main pane. Select the checkboxes for the licenses that are to be registered. On the Action pane, click [Register] under [License].

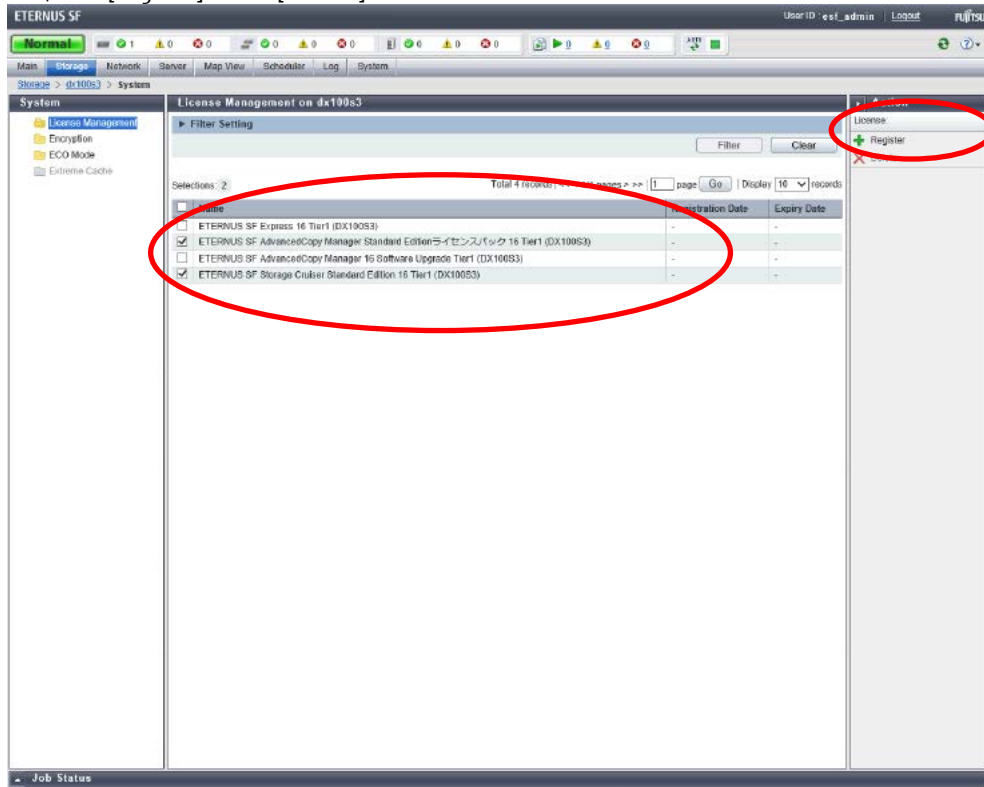


Figure-20 System

The information input screen is displayed.

Enter the license keys, and then click [Register] on the lower right corner of the screen.

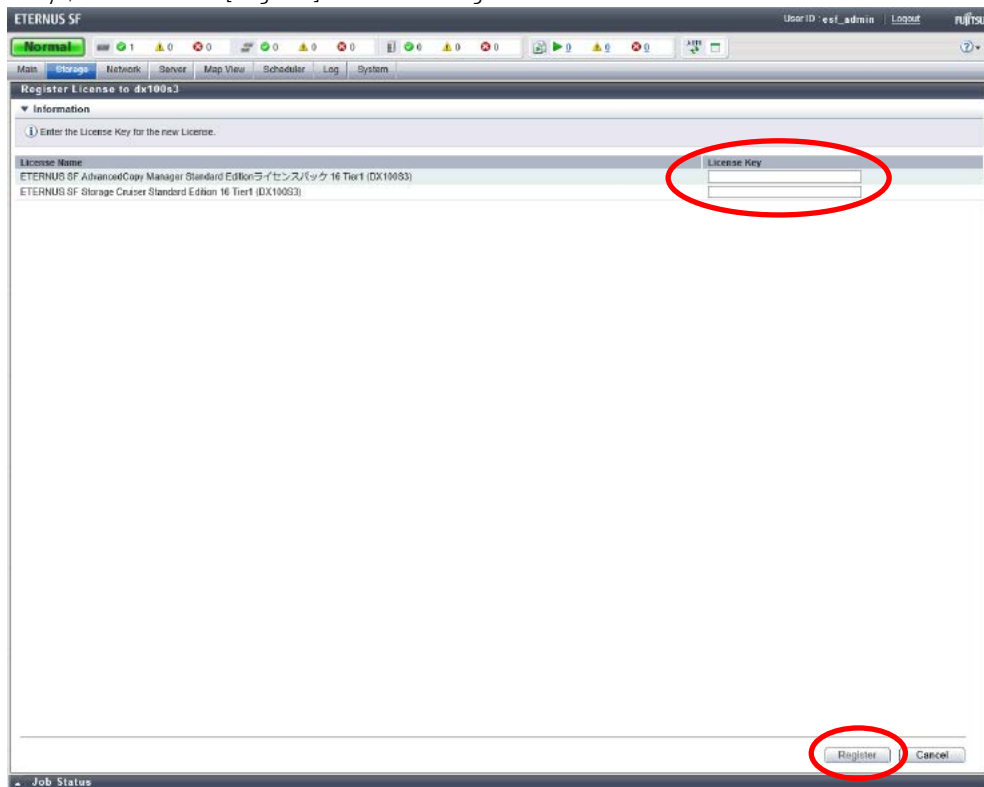


Figure-21 Register License

8. Register the Fibre Channel switch.
After registering the Principal switch first, register all the Fibre Channel switches that configure the Fabric connection.
Click the [Network] tab on the global navigation tab.
On the Action pane, click [Add] to display the information input screen.
9. A Fibre Channel switch can be added by searching a subnet or by specifying an IP address. The IP address method is used in this document.
Select the [IP Address] radio button.
Enter the IP address and SNMP community name of the Fibre Channel switch, and click the [Discover] button.

The screenshot shows the 'Discover Switch' screen in the ETERNUS SF web interface. The 'Discover Switch' tab is active, and the 'Register Switch' sub-tab is selected. The 'Information' section provides instructions on how to discover a Fibre Channel switch. The 'Switch Information' section has two radio buttons: 'Search on Subnet' and 'IP Address'. The 'IP Address' radio button is selected. Below the radio buttons, there are three input fields: 'Subnet Address', 'IP Address', and 'SNMP Community Name'. The 'IP Address' field contains '192.168.100.2' and the 'SNMP Community Name' field contains 'public'. The 'Discover' button is circled in red at the bottom right of the screen.

Switch Information	
<input type="radio"/> Search on Subnet	Subnet Address *
<input checked="" type="radio"/> IP Address	IP Address *
	SNMP Community Name *

Figure-22 Fibre Channel switch detection

10. After entering the necessary information of the target Fibre Channel switch, click the [Register] button on the lower right corner of the screen.

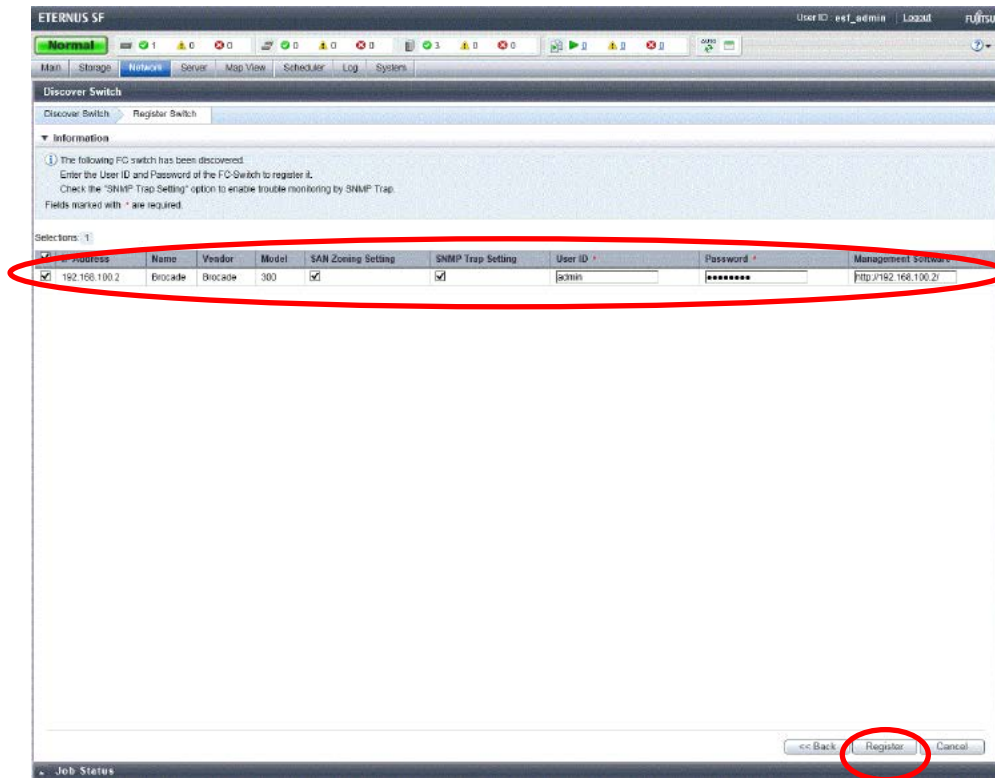


Figure-23 Fibre Channel switch registration

Points

Check the Job Status pane and make sure that the result changes to [Success] before proceeding to the next step. For details on how to use the Job Status pane, refer to "2.2.1.2 Checking the Common Processes of the ETERNUS SF Web Console Operations".

11. Register the VMware ESXi host.
Click the [Server] tab on the global navigation tab. On the Action pane, click [Register] to display the information input screen. Register the ESXi host using values that were specified in "2.2.2.3.1 Configuring the ESXi Hosts and Installing vCenter Server".

12. Select [Yes] for [VMware ESX].
A user ID and password can be entered in the VMware Options field.
Enter the necessary information and click the [Next] button.

The screenshot shows the 'Add Server' wizard in the ETERNUS SF interface. The 'Enter Server Details' tab is active. Under the 'VMware Options' section, the 'VMware ESX' checkbox is selected (Yes). Below it, the 'User ID' field contains 'root' and the 'Password' field is masked with asterisks. A red circle highlights this entire section. Another red circle highlights the 'Next >>' button at the bottom right of the wizard.

Figure-24 Input of information on VMware ESXi host server

13. Enter an IP address and click the [Register] button.

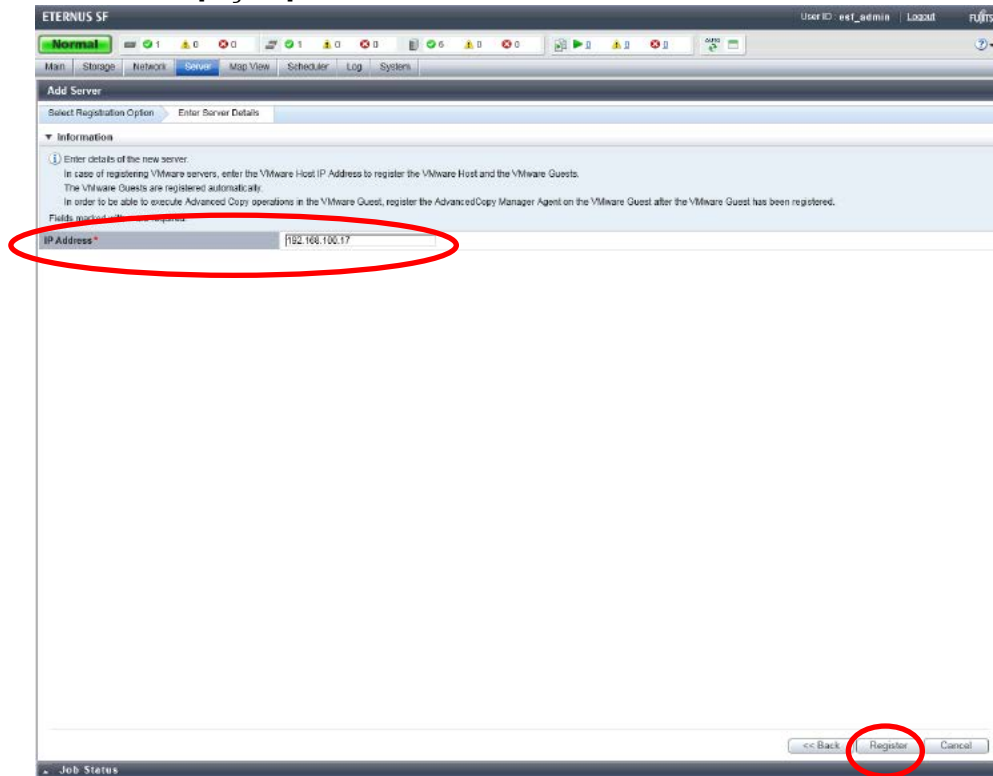


Figure-25 Registration of VMware ESXi host server

Points

Check the Job Status pane and make sure that the result changes to [Success] before proceeding to the next step. For details on how to use the Job Status pane, refer to "2.2.1.2 Checking the Common Processes of the ETERNUS SF Web Console Operations".
Wait for the registration process to finish before operating the server.

Repeat Steps 8 through 10 for every VMware ESXi host server.

14. Register vCenter Server.
Click the [Storage] tab on the global navigation tab, and then the link of the target ETERNUS AF/DX under [Name].

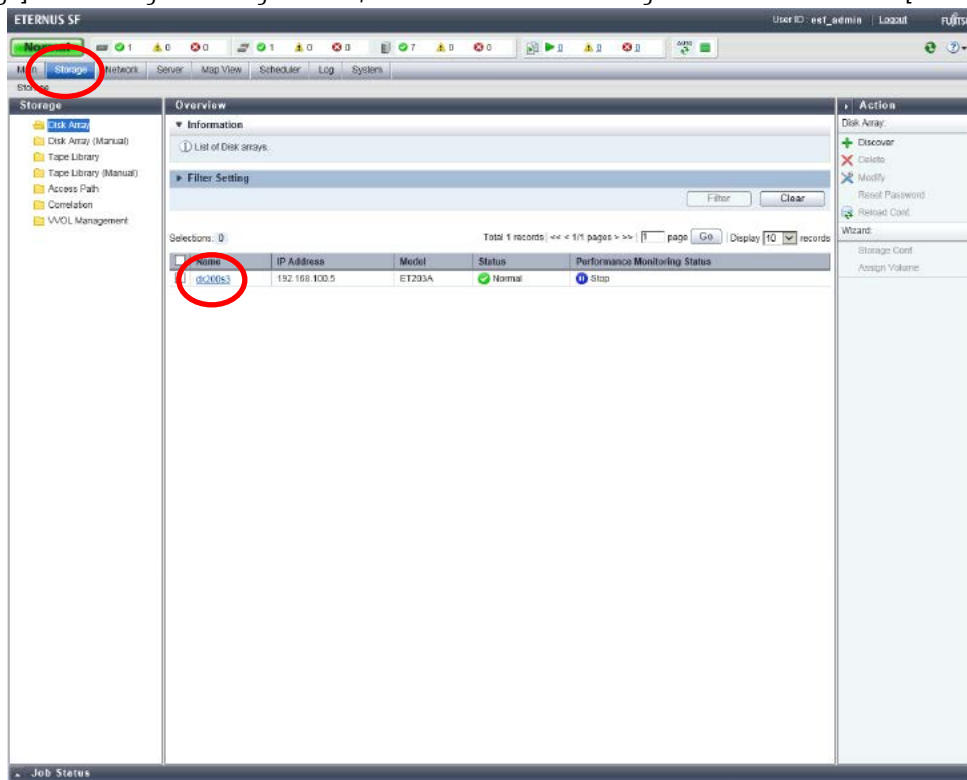


Figure-26 vCenter Server registration

15. On the Category pane, click [Correlation].

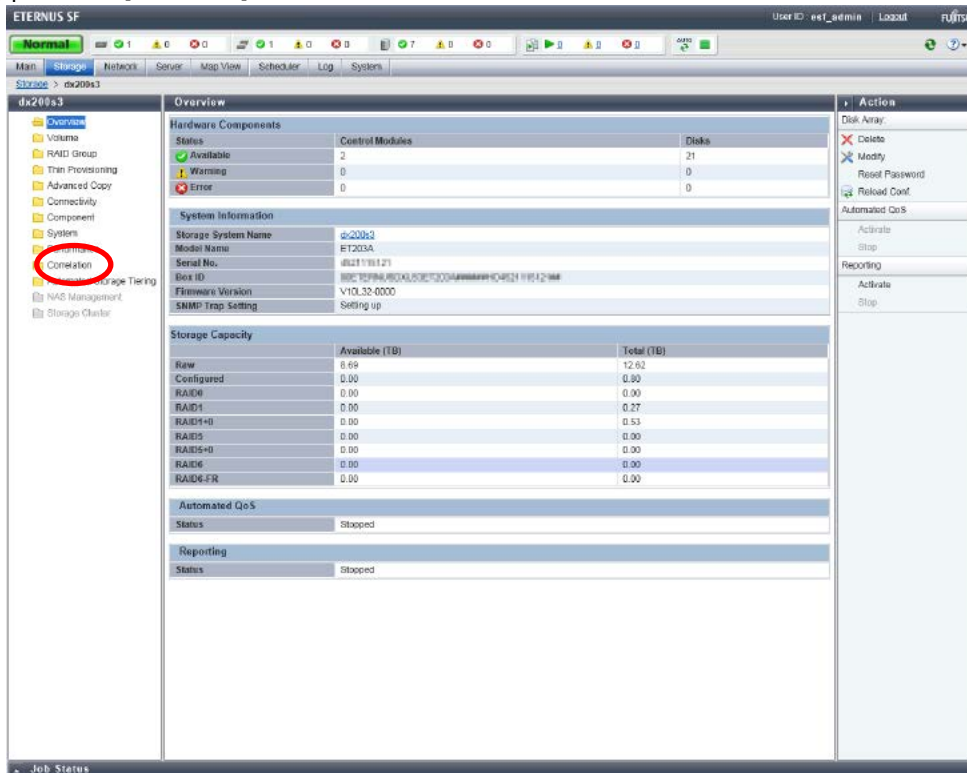


Figure-27 Correlation

16. On the Category pane, click [End to End View (VMware)].

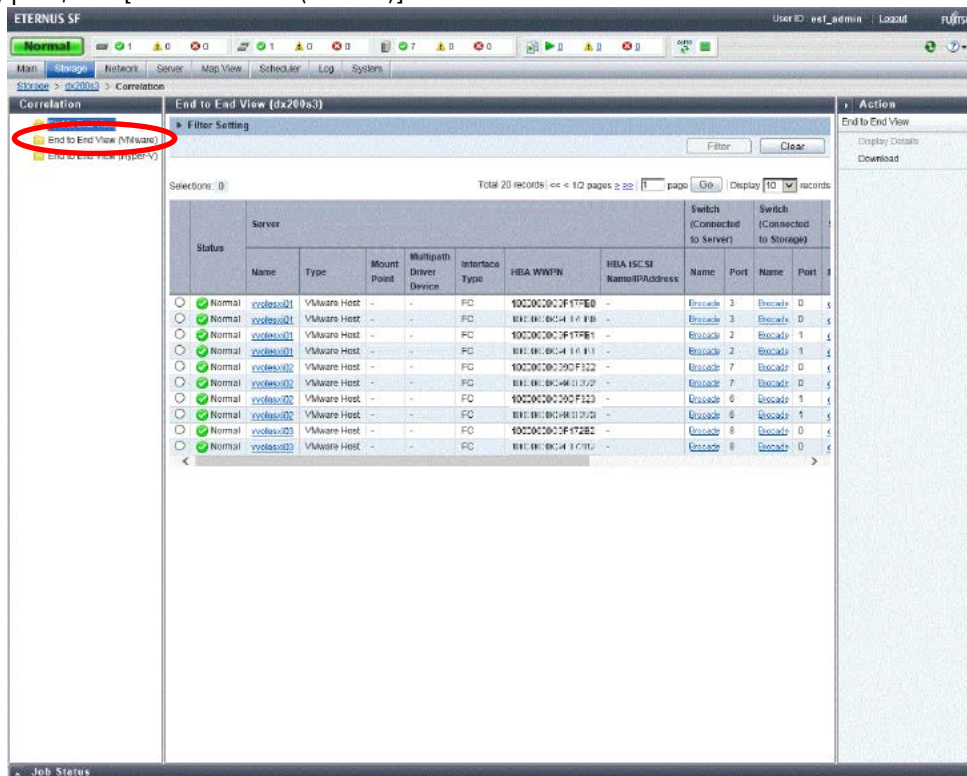


Figure-28 End to End View

17. On the Action pane, click [Register/Reload] under [VMware vCenter Server].

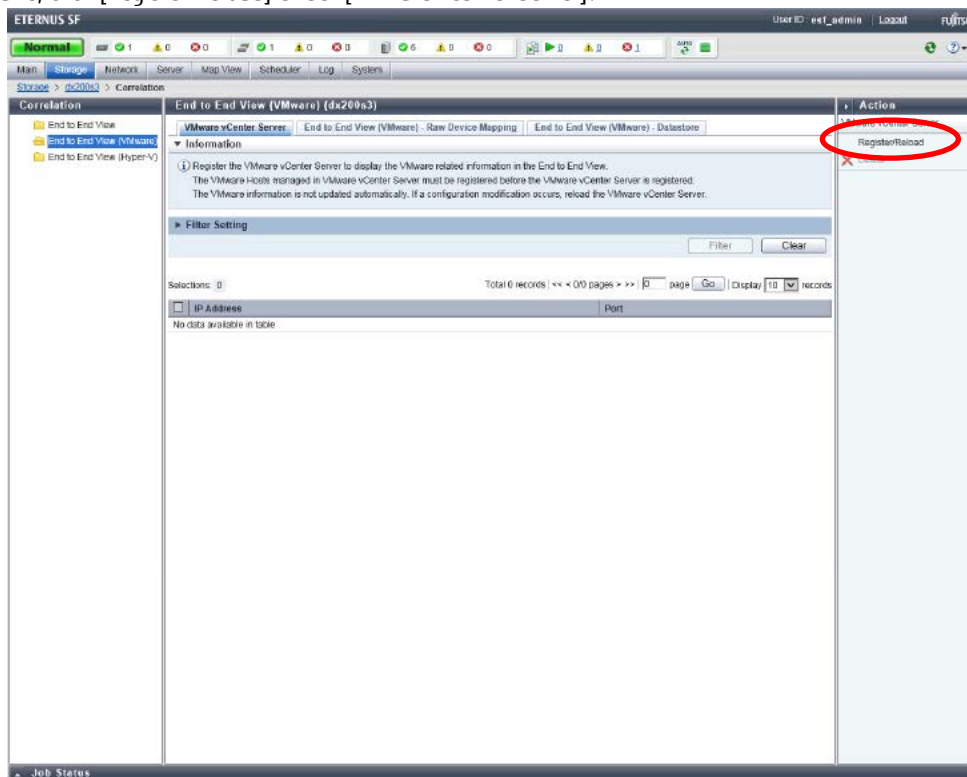


Figure-29 End to End View (VMware)

18. Enter the following required information for vCenter Server, and then click the [Confirm] button on the lower right corner of the screen.

The screenshot shows the ETERNUS SF web console interface. The main content area is titled "VMware vCenter Server Register/Reload". It contains an "Information" section with instructions and a "VMware vCenter Server Register/Reload Option" section with the following fields:

IP Address *	192.168.100.31
Port *	443
User Name *	root
Use saved access information *	<input type="radio"/> Yes <input checked="" type="radio"/> No
Password *	*****

At the bottom right, there are two buttons: "Confirm" and "Cancel". The "Confirm" button is highlighted with a red circle.

Figure-30 Register/Reload option for the VMware vCenter server

Points

Check the Job Status pane and make sure that the result changes to [Success] before proceeding to the next procedure. For details on how to use the Job Status pane, refer to "2.2.1.2 Checking the Common Processes of the ETERNUS SF Web Console Operations".

2.2.2.4.4 Checking the Devices Registered in ETERNUS SF Manager

Check that all the devices are registered.

Devices to check	Confirmation screen	Devices to check	Check <input checked="" type="checkbox"/>
ETERNUS DX200 S3	Click the [Storage] tab on the global navigation tab. Check that the registered ETERNUS AF/DX is displayed on the Main pane.	dx200s3	<input type="checkbox"/>
Fibre Channel switch	Click the [Network] tab on the global navigation tab. Check that the registered Fibre Channel switches are displayed on the Main pane.	Brocade1	<input type="checkbox"/>
		Brocade2	<input type="checkbox"/>
ESXi host	Click the [Server] tab on the global navigation tab. Check that the registered ESXi hosts are displayed on the Main pane.	vwolesxi01	<input type="checkbox"/>
		vwolesxi02	<input type="checkbox"/>
		vwolesxi03	<input type="checkbox"/>
		vwolesxi04	<input type="checkbox"/>
		vwolesxi05	<input type="checkbox"/>
vCenter Serer	Check that the registered vCenter Server is displayed on the Main pane in the [End to End View (VMware)] screen.	vCenter	<input type="checkbox"/>

Table-13 Checking the devices registered in ETERNUS SF Manager

After checking that the devices are registered, proceed to the next procedure.

2.2.2.4.5 Refreshing the ETERNUS SF Manager Config File

Enable the synchronization between ETERNUS VASA Provider and the device event information.

1. Log in to ETERNUS SF Manager of the operation management server.
2. Click the [System] tab on the global navigation tab.
On the Category pane, click [System Settings].
3. On the Action pane, click [Refresh Config File].

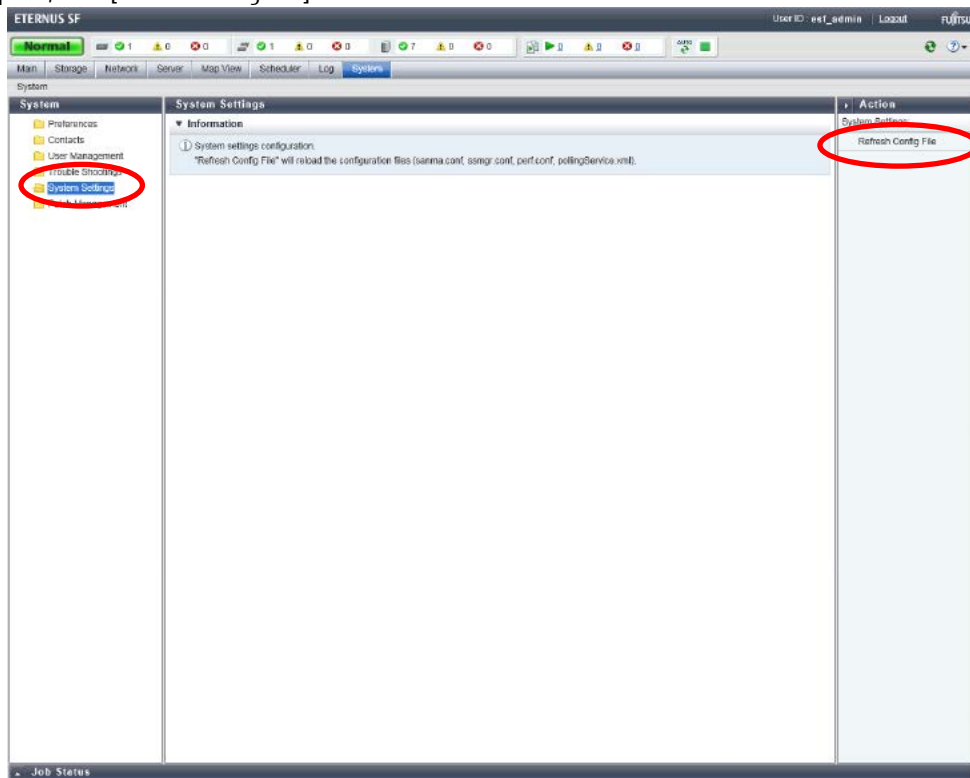


Figure-31 Refreshing the config file (system)

4. Check the [Information] screen and click the [Refresh] button.

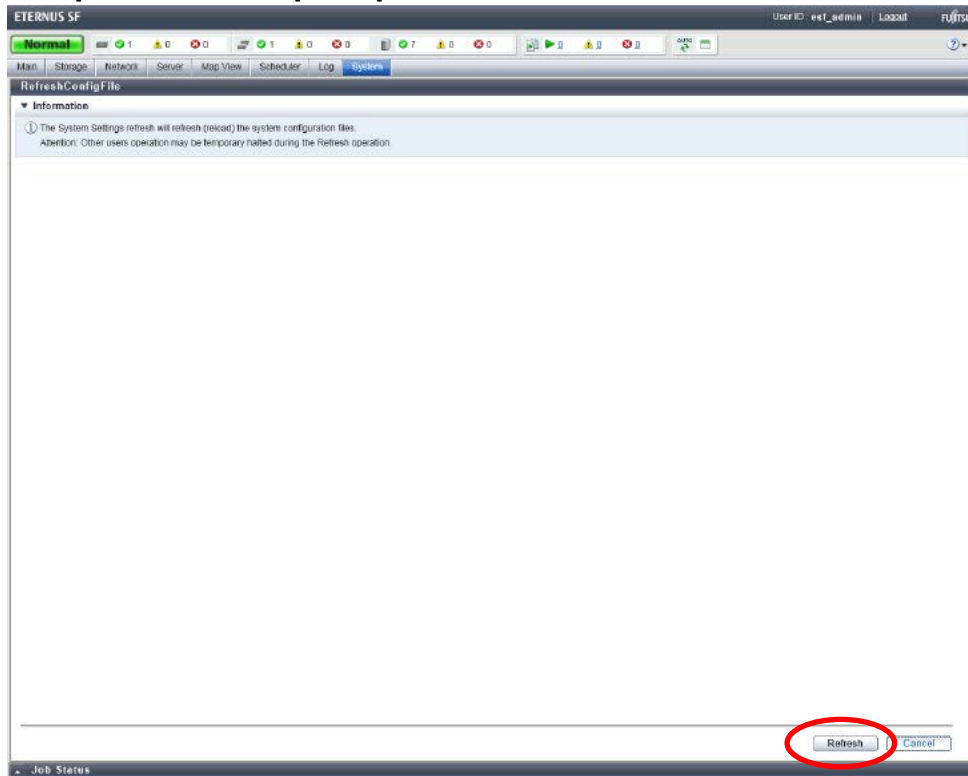


Figure-32 Refreshing the config file

5. Confirm that the "Refresh Config File successful" message is displayed and click the [OK] button.

2.2.2.4.6 Registering ETERNUS VASA Provider in vCenter Server

1. Register ETERNUS VASA Provider in vCenter Server.
Log in to vCenter Server from vSphere Web Client.
2. Click [vCenter Inventory Lists] in the [Home] screen.

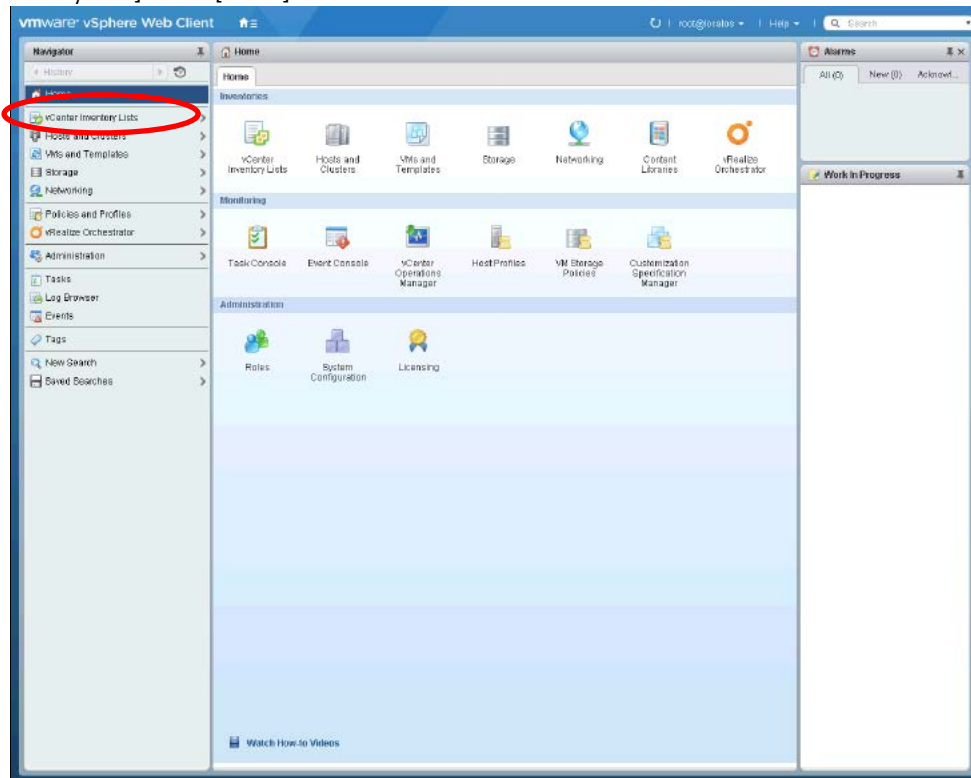


Figure-33 vSphere Web Client home

3. Click the [Manage] tab.

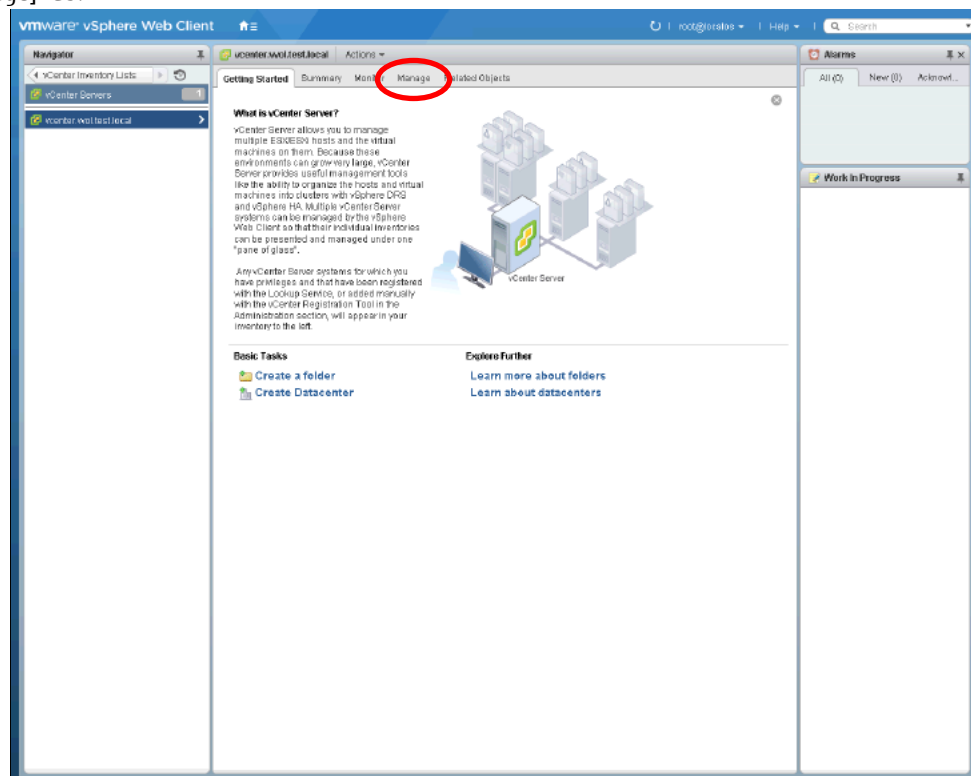


Figure-34 vCenter inventory list

4. Click [Storage Providers].

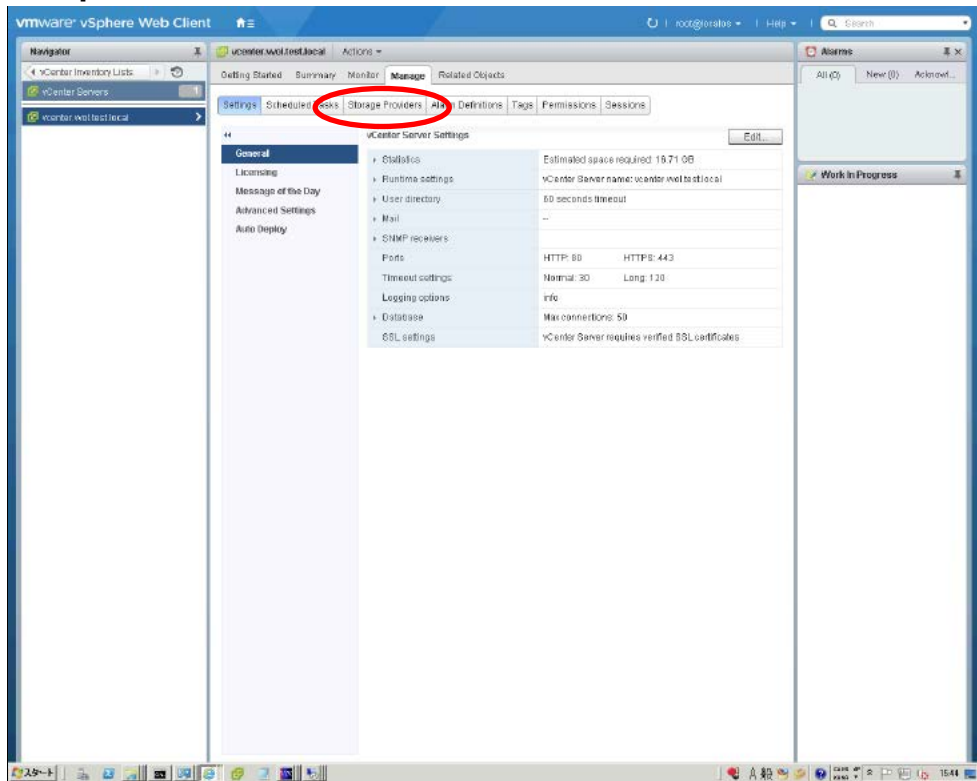


Figure-35 Manage

5. Click the [+] (register) button.

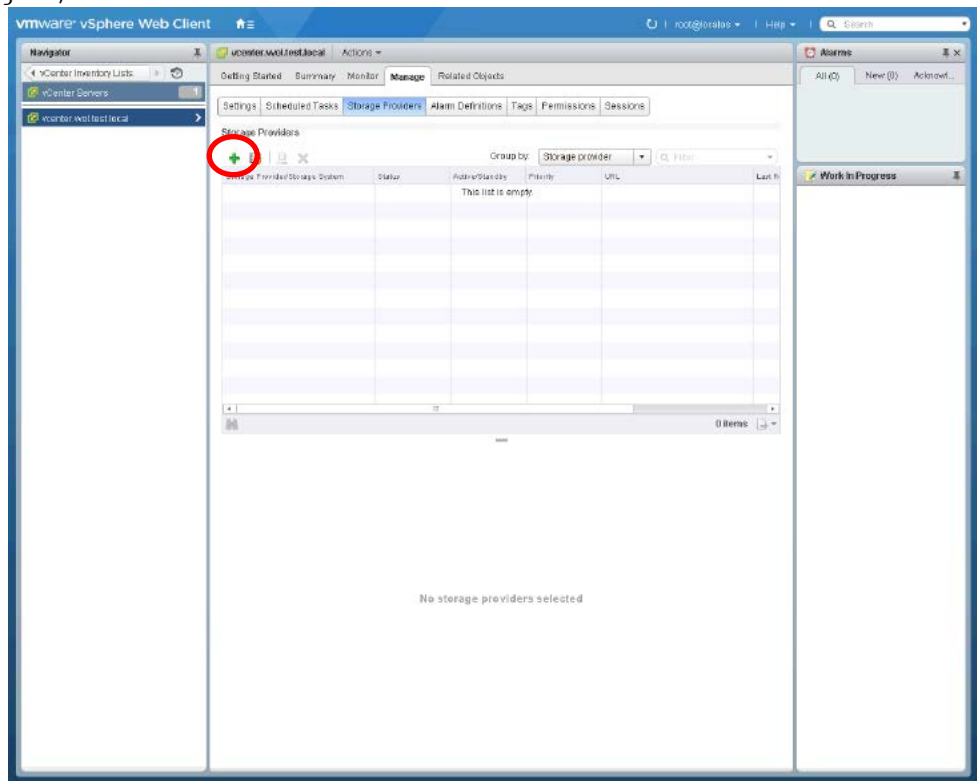


Figure-36 Registering storage providers

6. Enter the items shown in the following table and click the [OK] button.

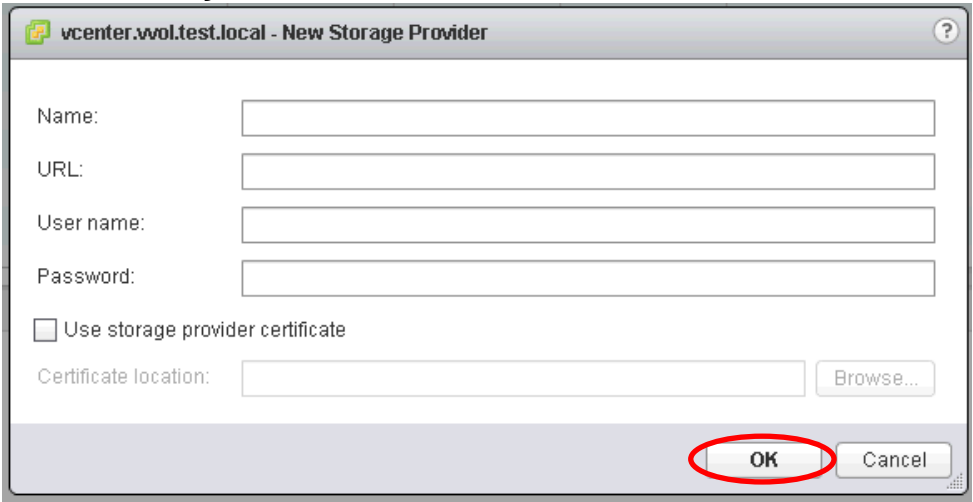


Figure-37 New Storage Provider

Item	Information
Name	Arbitrary
URL	https://"FQDN that was registered when installing ETERNUS VASA Provider":31443/vasa/version.xml
User name	The use name that was registered when installing ETERNUS VASA Provider
Password	The password that was registered when installing ETERNUS VASA Provider

Table-14 Settings for a new storage provider

Checklist

- Confirm the following item before proceeding to the next procedure.
- The ETERNUS VASA Provider that was registered is displayed in the [Storage Providers] screen.

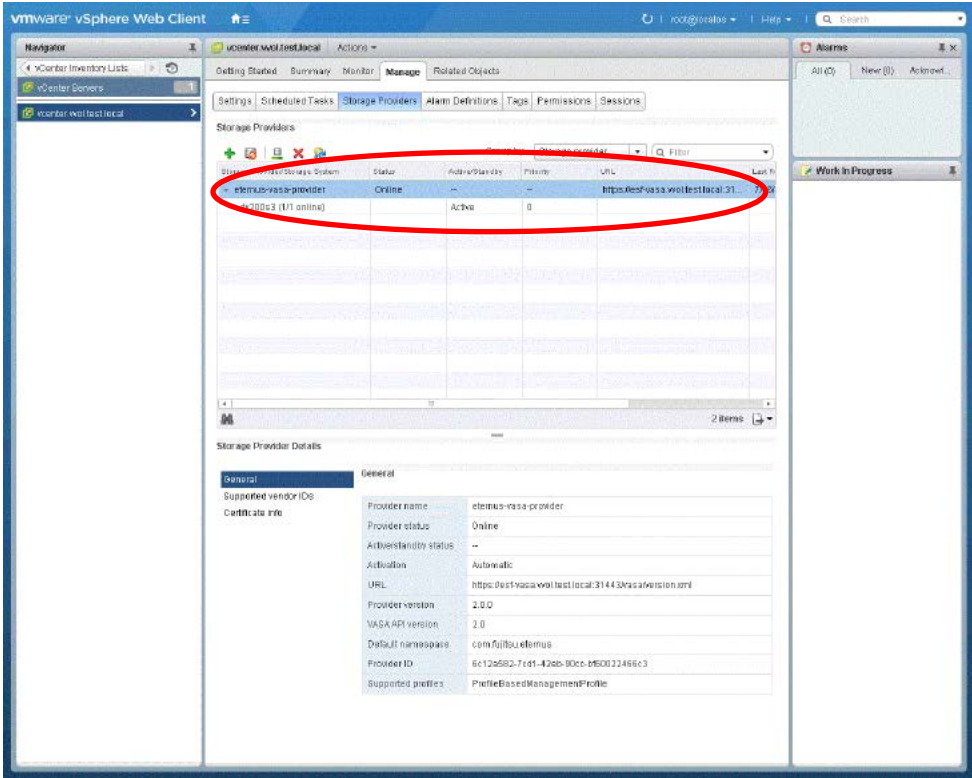


Figure-38 Checking the registered storage provider

2.2.2.4.7 Setting the Copy Control Type of ETERNUS SF Manager Advanced Copy

Configure the settings that are required to use ETERNUS SF AdvancedCopy Manager.

1. Set the copy control type of the Advanced Copy functions that is required to back up virtual machines.
Click [Storage] on the global navigation tab of ETERNUS SF Web Console.
2. On the Main pane, click the ETERNUS AF/DX link under [Name].

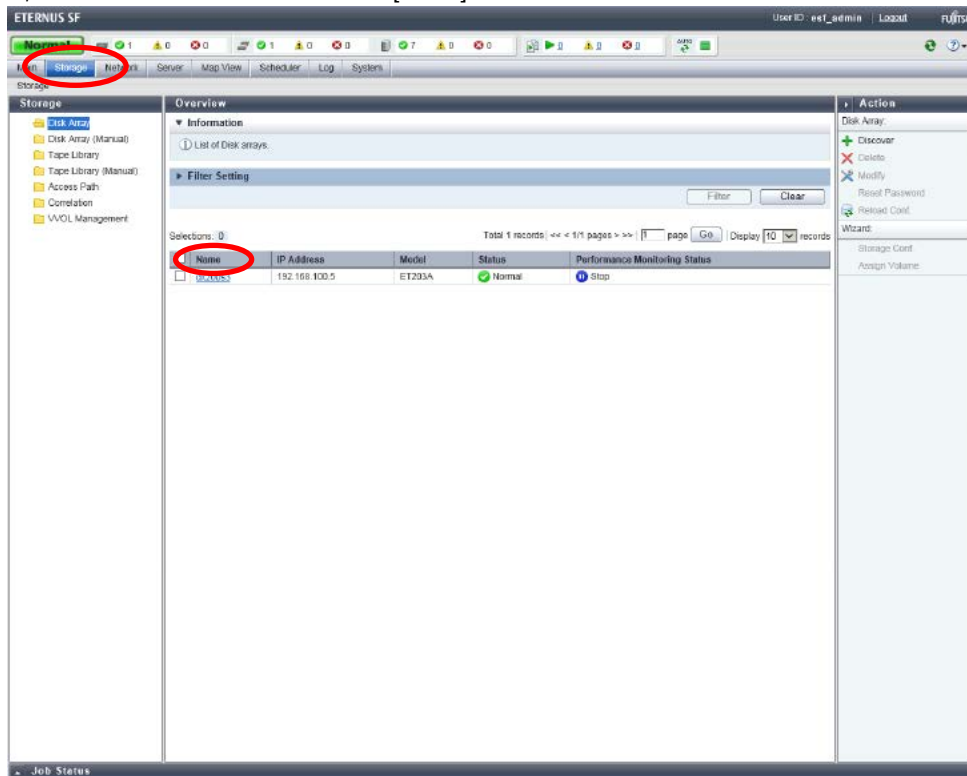


Figure-39 Storage

3. On the Category pane, click [Advanced Copy].

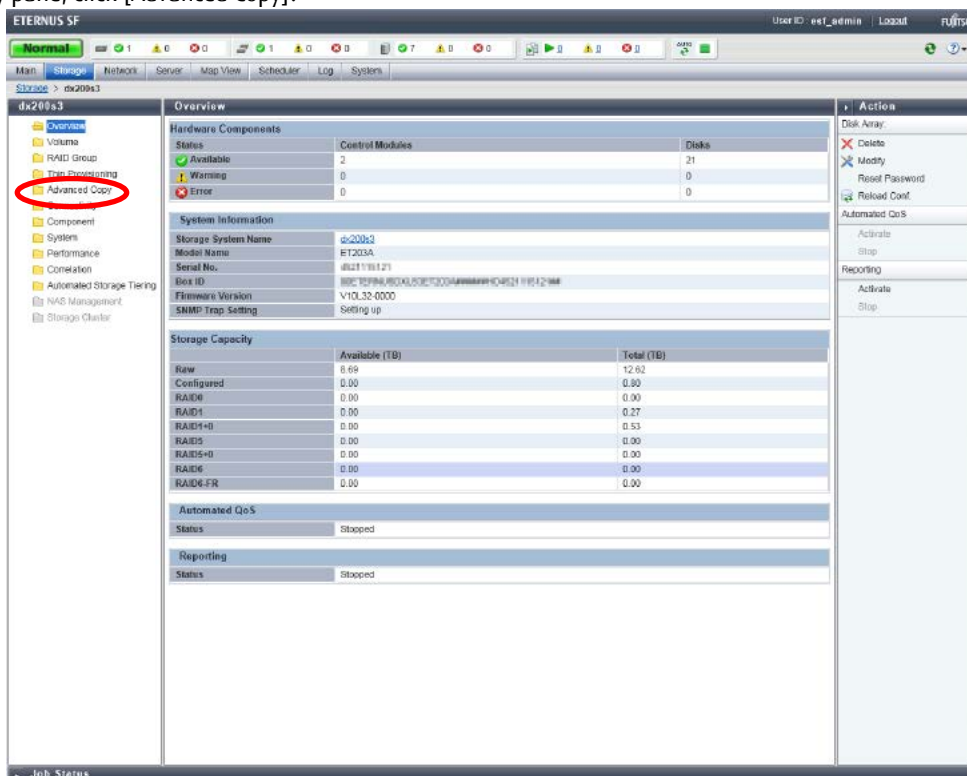


Figure-40 Advanced Copy (storage)

4. On the Category pane, click [Configuration].

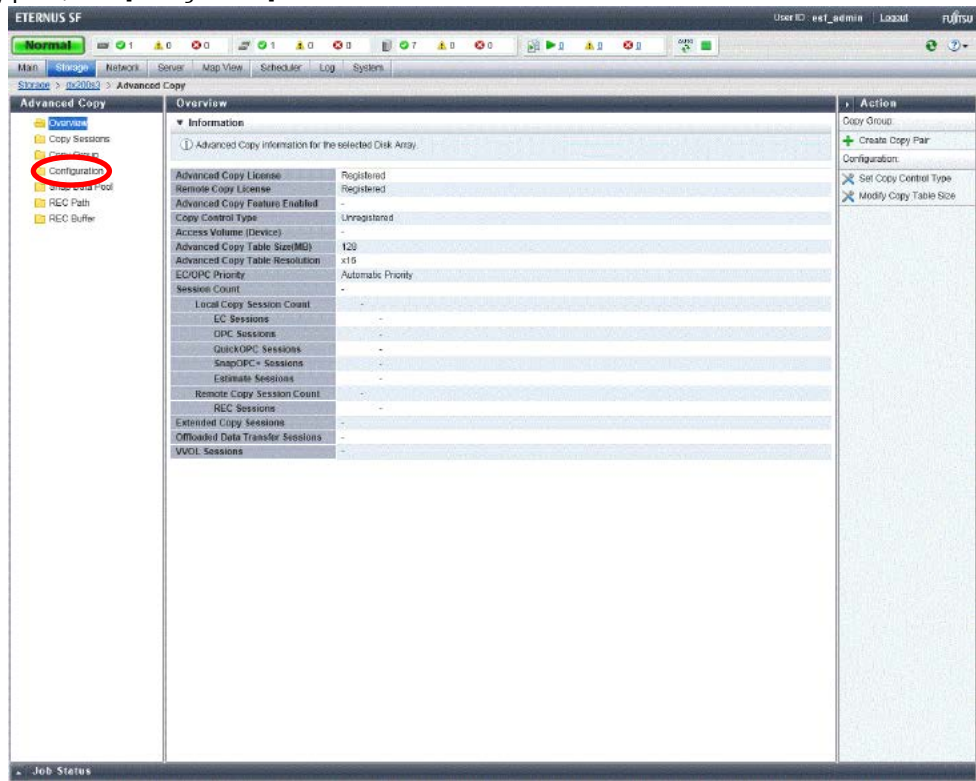


Figure-41 Advanced Copy (Advanced Copy)

5. On the Action pane, click [Set] under [Copy Control Type].

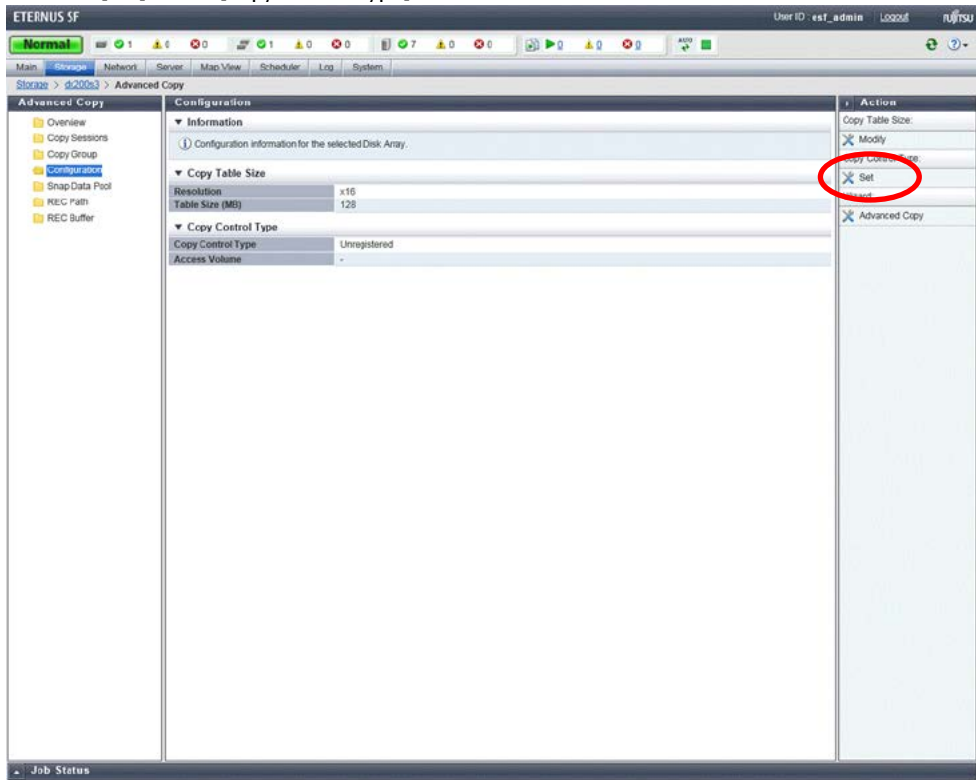


Figure-42 Advanced Copy (set)

6. Select [Access through network] and click the [Set] button on the lower right corner of the screen.

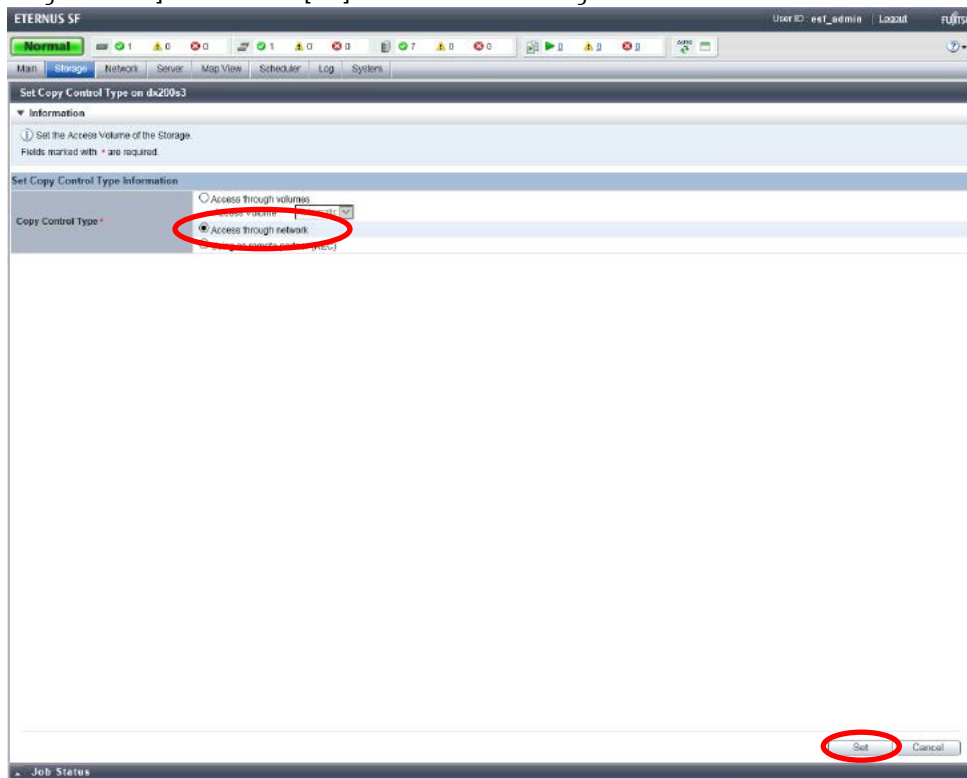


Figure-43 Setting the copy control type

Points

Check the Job Status pane and make sure that the result changes to [Success] before proceeding to the next procedure. For details on how to use the Job Status pane, refer to "2.2.1.2 Checking the Common Processes of the ETERNUS SF Web Console Operations".

Checklist

- Confirm the following item before proceeding to the next procedure.
- On the Main pane in the [Advanced Copy] screen, [Access through Network] is displayed for [Copy Control Type].

2.2.2.5 Creating a VMFS Datastore for the Management Server and Configuring vSphere HA

Create a VMFS datastore where the management servers are assigned and configure vSphere HA.

Because the following procedure describes general operations for standard volumes, only a brief explanation is provided here.

2.2.2.5.1 Creating a VMFS Datastore for the Management Server

Create a standard volume for the VMFS where the management servers are assigned.

Create a RAID group in the ETERNUS DX200 S3 using ETERNUS SF Manager and create a standard volume in the RAID group.

Refer to "Create Volume" in "ETERNUS SF Web Console Guide" for the procedure to create volumes.

- Log in to ETERNUS SF Manager of the operation management server.
Click the [Storage] tab. On the Main pane where [Storage] is displayed, click the registered "dx200s3" storage system.
On the Category pane where [dx200s3] is displayed, click [RAID Group].
On the Action pane where [RAID Group] is displayed, click [Create].
In the [Create RAID Group] screen, create the following RAID group.

Name	RAID Type	Drive Type	Creation Mode	RAID Group Capacity	RAID group settings				
					Enclosure No.	Slot No.	Disk Type	Capacity	Speed (rpm)
rgp001	Mirroring (RAID1)	Online	Manual	300GB	-	0	SAS	300GB	10000
					-	1	SAS	300GB	10000

Table-15 RAID group for VMFS

- Click the [Storage] tab. On the Main pane where [Storage] is displayed, click the registered "dx200s3" storage system.
On the Category pane where [dx200s3] is displayed, click [Volume].
On the Action pane where [Volume] is displayed, click [Create].
In the [Create Volume] screen, create the following volume.

Name	Capacity	Type	RAID Group Setting	
			RG Name	Number of Volumes
vol001	272.5 GB	Standard	rgp001	1

Table-16 Volume for VMFS

- Set access paths for the ESXi host and the volume that was created using ETERNUS SF Manager.
For details on the procedure, refer to "Assign ETERNUS Disk Storage System Volumes to Server" in "ETERNUS SF Web Console Guide".
- Perform settings for the FC ports of the ETERNUS DX200 S3.
Click the [Storage] tab. On the Main pane where [Storage] is displayed, click the registered "dx200s3" storage system.
On the Category pane where [dx200s3] is displayed, click [Connectivity].
On the Category pane where [Connectivity] is displayed, click [Port].
On the Main pane where [Port] is displayed, click the number for ports for the FC type.
Select one FC port on the Main pane where [FC Port] is displayed and click [Modify FC Port] on the Action pane.
In the [Set Port Parameters] screen, set the following values.

Port (display only)				Port (settings)					
Port	Type	SFP Type	Mode	Host Affinity	Connection	Transfer Rate	Frame Size	Reset Scope	Release Reservation if Chip is Reset
CM#0 CA#0 Port#0	FC	16G SPF+ (MMF)	CA	Enable	Fabric	16Gbit/s	2048	I_T_L	Disable
CM#1 CA#0 Port#0									

Table-17 FC port settings for the ETERNUS DX200 S3

- Create an affinity group or a LUN group.
Click the [Storage] tab. On the Main pane where [Storage] is displayed, click the registered "dx200s3" storage system.
On the Category pane where [dx200s3] is displayed, click [Connectivity].
On the Category pane where [Connectivity] is displayed, click [Affinity/LUN Group].
In the [Affinity/LUN Group] screen, click [Create] under [Affinity/LUN Group] on the Action pane.
In the [Create Affinity/LUN Group] screen, set the following values.

Name	Number of LUNs (display only)	Assigned Volumes				
		LUN No.	Volume No.	Name	Type	Capacity
kanri01	1	0	0	vol001	Standard	272.50 GB

Table-18 Creating a LUN group of the volume for VMFS

- Set the access path.
Click the [Server] tab. On the Category pane where [Server] is displayed, click [Access Path].
On the Action pane, click [Add (ETERNUS)] under [Access Path].
In the [Create Access Path] screen, set the following values.

Select Server	Select HBA			Select Storage	Select Host Response and Port		Select Affinity Group	Affinity Group Details
Name	Logical No.	Interface Type	WWPN	Name	Host Response	Port	Name	Name
wvolesxi01	vmhba1	FC	(Check that the displayed value matches the actual connection.)	dx200s3	Default	CM#0 CA#0 Port#0	kanri01	VVOL001
	vmhba2					CM#1 CA#0 Port#0		
wvolesxi02	vmhba1					CM#0 CA#0 Port#0		
	vmhba2					CM#1 CA#0 Port#0		
wvolesxi03	vmhba1					CM#0 CA#0 Port#0		
	vmhba2					CM#1 CA#0 Port#0		
wvolesxi04	vmhba1					CM#0 CA#0 Port#0		
	vmhba2					CM#1 CA#0 Port#0		
wvolesxi05	vmhba1					CM#0 CA#0 Port#0		
	vmhba2					CM#1 CA#0 Port#0		

Table-19 List of access path values for VMFS

2.2.2.5.2 Configuring vSphere HA

In the vCenter server, configure a single vSphere HA in all the ESXi hosts.

For details on the procedure, refer to the VMware vSphere manuals.

- In vCenter Server, mount the created standard volume on the ESXi hosts as a VMFS datastore.
- Check that the datastore can be referred to from all the ESXi servers.
- In vCenter Server, configure all the ESXi hosts and the vSphere HA.

2.2.2.5.3 Checking the VMFS Datastore after a vSphere HA Configuration

After a vSphere HA configuration, check that the VMFS datastore that was created in the ETERNUS DX200 S3 can be used by all the ESXi hosts.

1. Confirm that all the ESXi hosts are synchronized with the NTP server clock by checking the following items;

- The NTP client of the ESXi host is started.
- The NTP client is set to synchronize with the host.
- The other NTP clients are set to start.

2. Check if VMware Tools is installed in the vCenter server and the operation management server that consist of virtual machines.

3. Check if the vCenter server and the operation management server that consist of virtual machines are synchronous with the NTP server's or the ESXi host's clock.

4. Create virtual machines for tests that use the VMFS datastore for the operation management server.

Check that the created virtual machines can be moved to all the ESXi hosts (vwolesxi01 to vwolesxi05).

After checking, delete the virtual machines that were created for the test.

In addition, perform a separate check of the vSphere HA configuration.

2.2.2.5.4 Moving the Datastore for the vCenter Server and the Operation Management Server

Move the virtual machines for the vCenter server and the operation management server that were created on the local drives of the ESXi host to the VMFS datastore that was created on the ETERNUS DX200 S3.

Assigning the virtual machines to the VMFS datastore that was created in the ETERNUS DX200 S3 provides redundancy with vSphere HA.

Checklist

Confirm the following items before proceeding to the next procedure.

- The operation management server and the vCenter server are running on the VMFS datastore that was created in the ETERNUS DX200 S3's volume.
- vCenter Server and ETERNUS SF Manager are running normally.

2.2.3 VVOL Environment Configuration Procedure

2.2.3.1 ETERNUS SF Manager Operations

2.2.3.1.1 Setting VVOL Access Paths

1. From ETERNUS SF Web Console, click [Storage] on the global navigation tab.
2. On the Category pane, click [VVOL Management].
3. On the Category pane, click [VVOL Access Path].
On the Action pane, click [Set] under [VVOL Access Path].

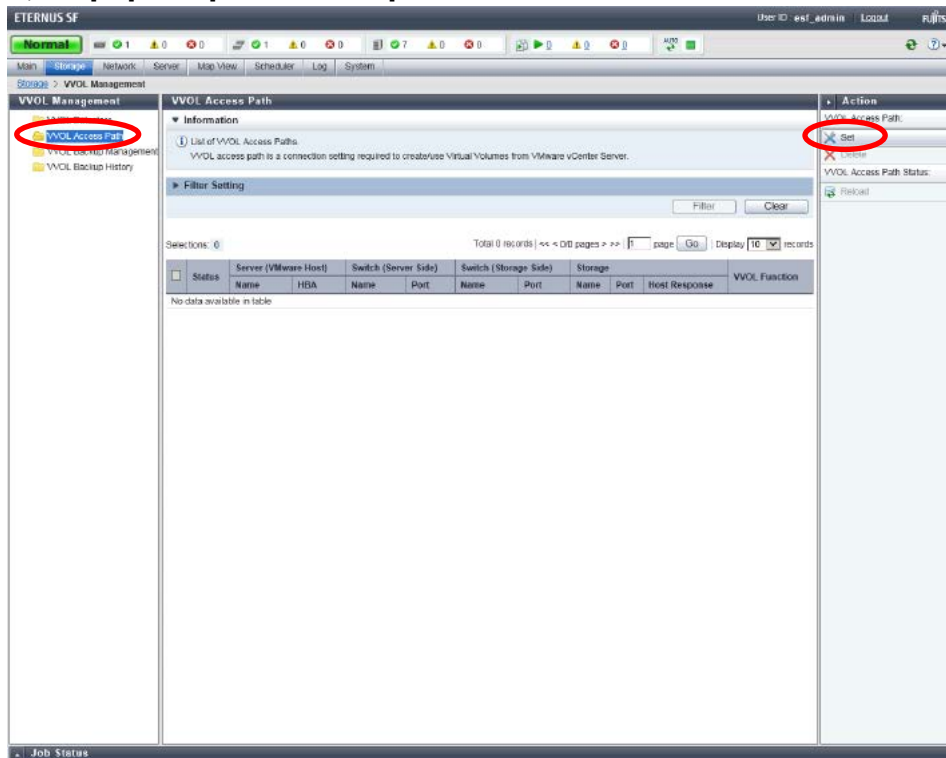


Figure-44 VVOL Access Path

4. The Welcome screen of [VVOL Access Path Setting] is displayed.
Click the [Next] button.

5. On the [Select Disk Array and Server] screen, select the ETERNUS AF/DX and the server for setting the VVOL access path, and then click the [Next] button.

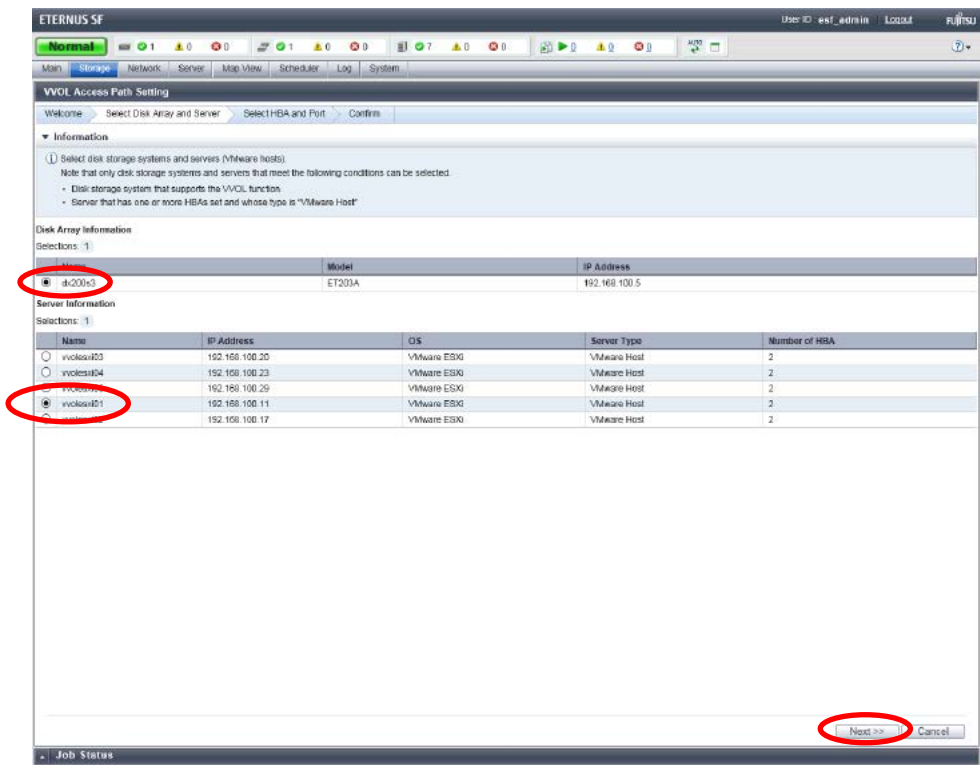


Figure-45 Select Disk Array and Server

Points

Check that the storage system and the ESXi hosts that were registered with "2.2.2.4.3 Setting Up ETERNUS SF Manager" are displayed.

Display area	Displayed device	Check <input checked="" type="checkbox"/>
Disk Array Information	dx200s3	<input type="checkbox"/>
Server Information	vvolesxi01	<input type="checkbox"/>
	vvolesxi02	<input type="checkbox"/>
	vvolesxi03	<input type="checkbox"/>
	vvolesxi04	<input type="checkbox"/>
	vvolesxi05	<input type="checkbox"/>

Table-20 Checklist for the storage system and servers

6. In the [Select HBA and Port] screen, perform the following settings.
 - For [Zoning Setting], select [Yes].
 - Select the [Set Access Path] checkbox of the HBA where the setting is performed.
 - For the other settings, enter the items shown in the following table.
- After setting all the paths that are displayed on the screen, click the [Next] button.

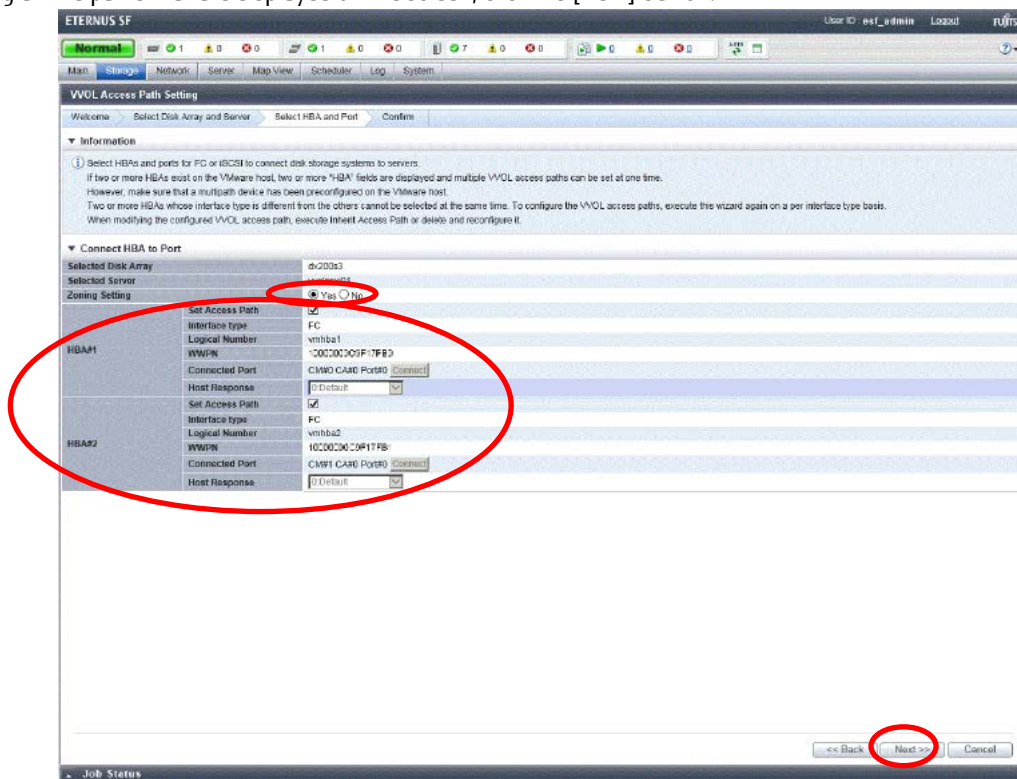


Figure-46 Select HBA and Port

Host name	Item	Information	
vvolesxi01	HBA#1	Connected Port	CM#0 CA#0 Port#0
		Host Response	0:Default
	HBA#2	Connected Port	CM#1 CA#0 Port#0
		Host Response	0:Default
vvolesxi02	HBA#1	Connected Port	CM#0 CA#0 Port#0
		Host Response	0:Default
	HBA#2	Connected Port	CM#1 CA#0 Port#0
		Host Response	0:Default
vvolesxi03	HBA#1	Connected Port	CM#0 CA#0 Port#0
		Host Response	0:Default
	HBA#2	Connected Port	CM#1 CA#0 Port#0
		Host Response	0:Default
vvolesxi04	HBA#1	Connected Port	CM#0 CA#0 Port#0
		Host Response	0:Default
	HBA#2	Connected Port	CM#1 CA#0 Port#0
		Host Response	0:Default
vvolesxi05	HBA#1	Connected Port	CM#0 CA#0 Port#0
		Host Response	0:Default
	HBA#2	Connected Port	CM#1 CA#0 Port#0
		Host Response	0:Default

Table-21 List of VVOL access path settings

7. The information confirmation screen is displayed. Confirm the information, and then click the [Set] button on the lower right corner of the screen.

Points

Check the Job Status pane and make sure that the result changes to [Success] before proceeding to the next procedure.

For details on how to use the Job Status pane, refer to "2.2.1.2 Checking the Common Processes of the ETERNUS SF Web Console Operations".

Repeat Steps 3 to 7 to set all the VVOL access paths.

Checklist

Confirm the following item before proceeding to the next procedure.

- On the Main pane of the [VVOL Access Path] screen, the VVOL access paths for all the ESXi hosts are displayed.

2.2.3.1.2 Enabling Automated Storage Tiering

1. On the ETERNUS SF Web Console screen, click [Storage] in the global navigation tab, then click the ETERNUS AF/DX link under [Name] on the Main pane.
2. On the Category pane, click [Automated Storage Tiering].

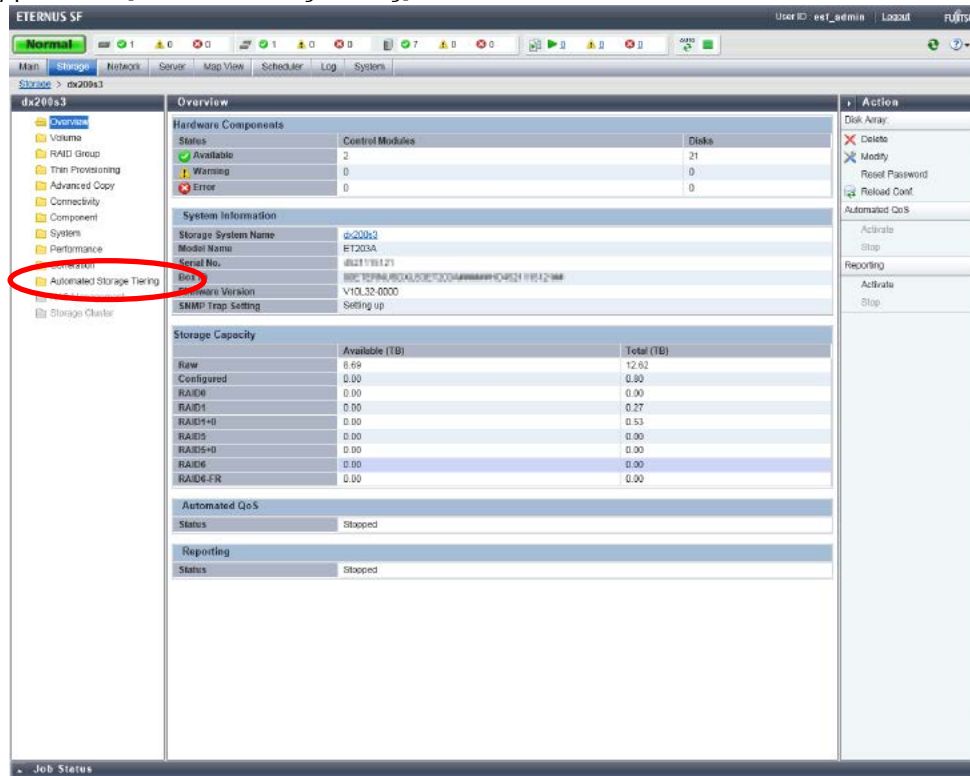


Figure-47 Automated Storage Tiering

3. On the Category pane, click [Setting].
On the Action pane, click [On].

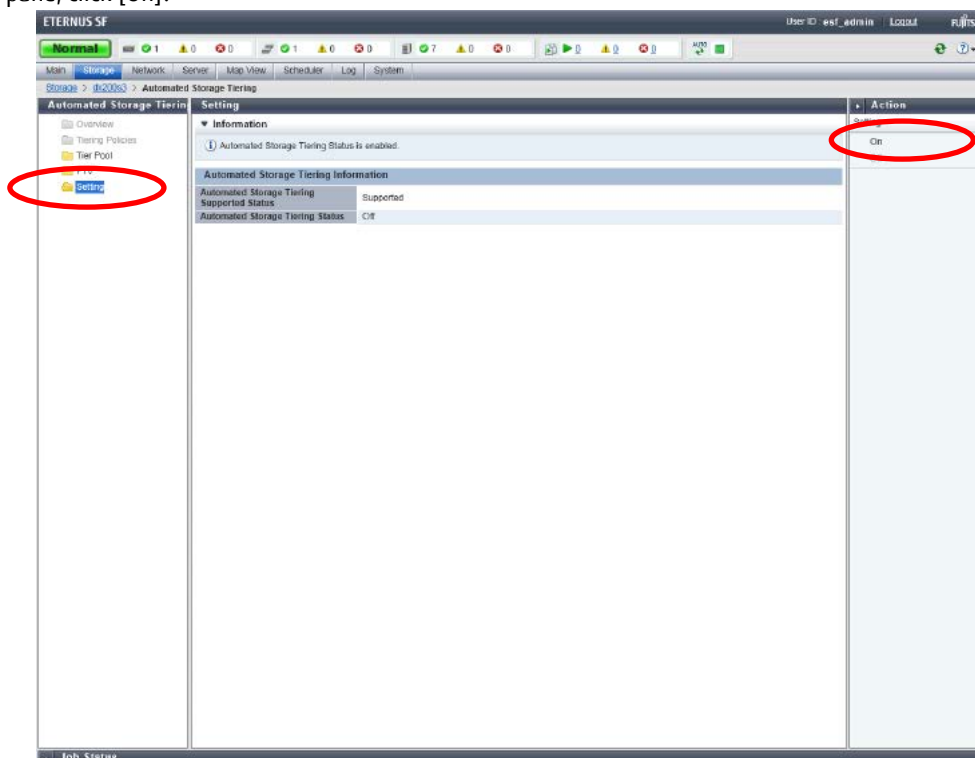


Figure-48 Enabling Automated Storage Tiering

2.2.3.1.3 Creating Tier Pools

1. Create a Tier pool (gold) for VVOL datastores.
On the ETERNUS SF Web Console screen, click [Storage] in the global navigation tab.
2. On the Category pane, click [VVOL Management].
On the Action pane, click [Create (One Layer)].

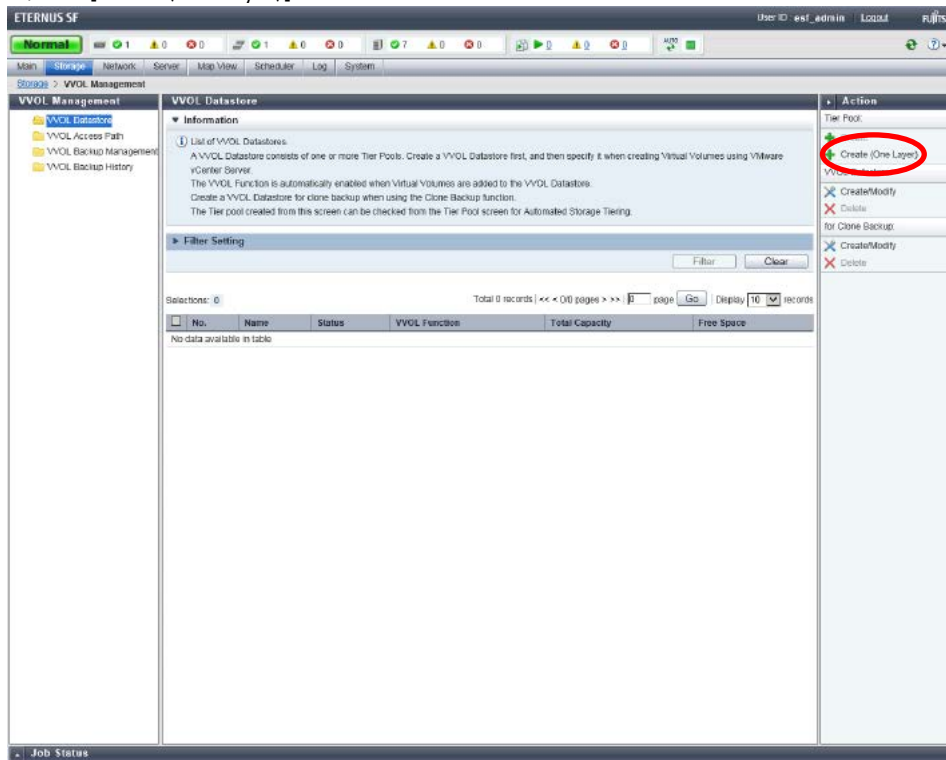


Figure-49 VVOL Management

3. The [Select Disk Array] screen is displayed. Select the ETERNUS AF/DX for creating the Tier pool, and then click the [Next] button.

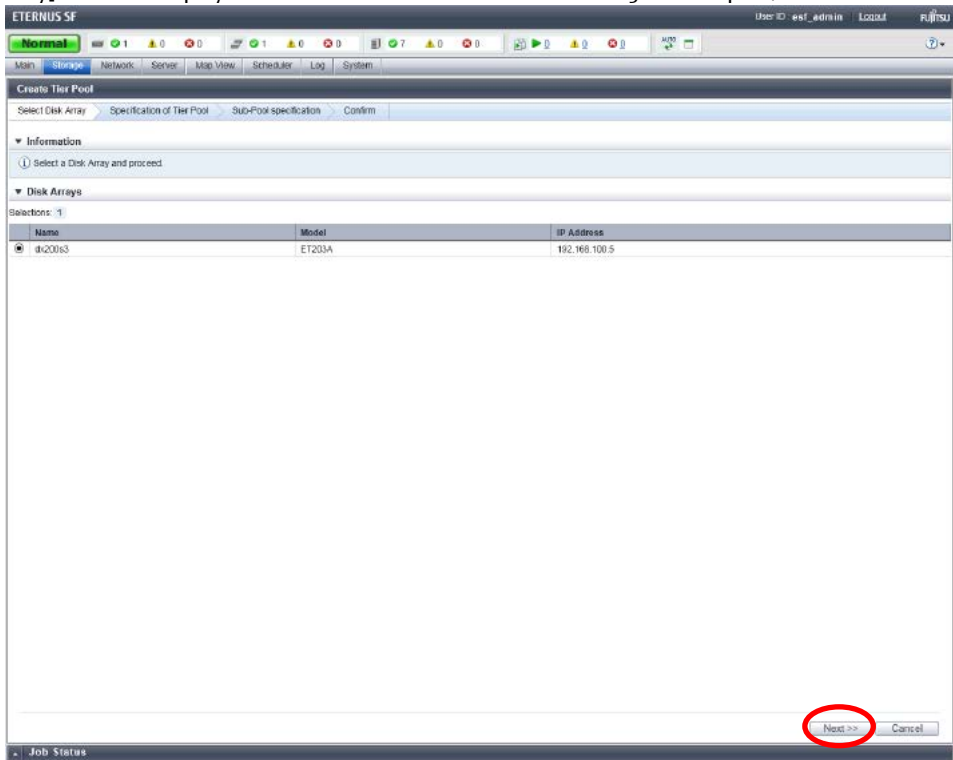


Figure-50 Select Disk Array

4. The information input screen is displayed. Enter the items shown in the following table, and then click [Next] on the lower right corner of the screen.

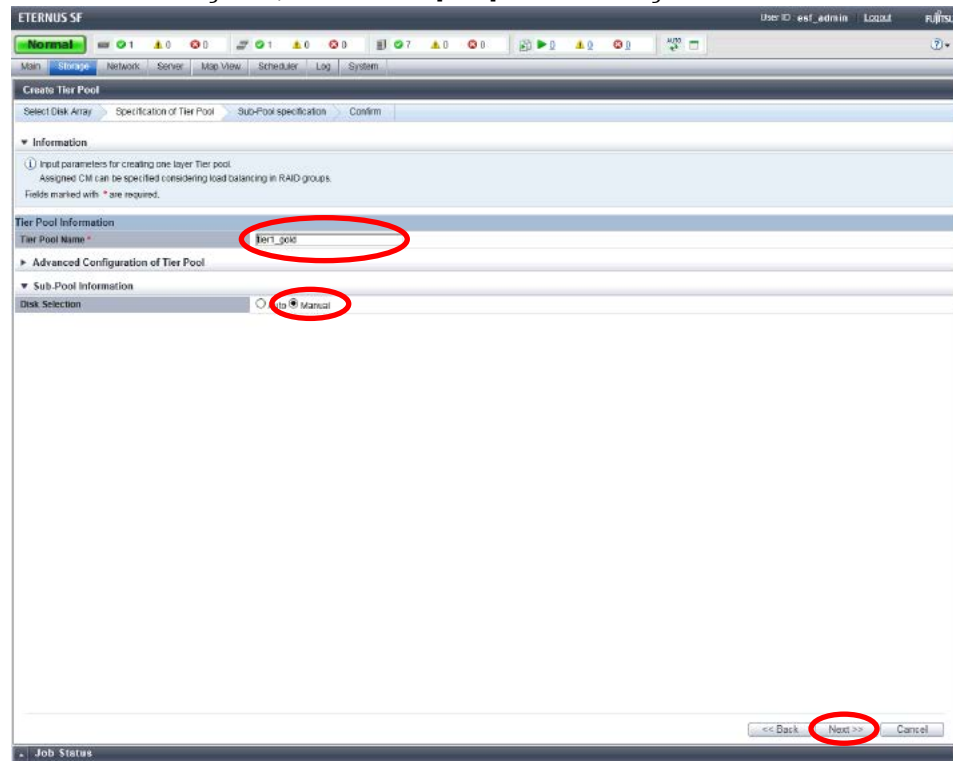


Figure-51 Specification of Tier Pool

Item	Description	Value in this document
Tier Pool Name	Specify a unique pool name in the ETERNUS SF system. Any alphanumeric character (from 1 to 16 characters), a hyphen (-), an underscore (_), and a pound symbol (#) can be specified. The characters are case insensitive.	tier1_gold
Disk Selection	Specify the method for the selection of disks that configure the sub-pool. The default setting is [Auto] (automatic selection). When [Auto] is selected, the minimum required capacity for the Low sub-pool, Middle sub-pool, and High sub-pool must be specified in the screen to configure each of these sub-pools. When [Manual] is selected, the disks for configuring the Low sub-pool, Middle sub-pool, and High sub-pool must be specified in the screen to configure each of these sub-pools.	Manual

Table-22 Values for specifying a Tier pool (gold)

5. Enter the items shown in the following table, and then click [Create]. A RAID group is created.

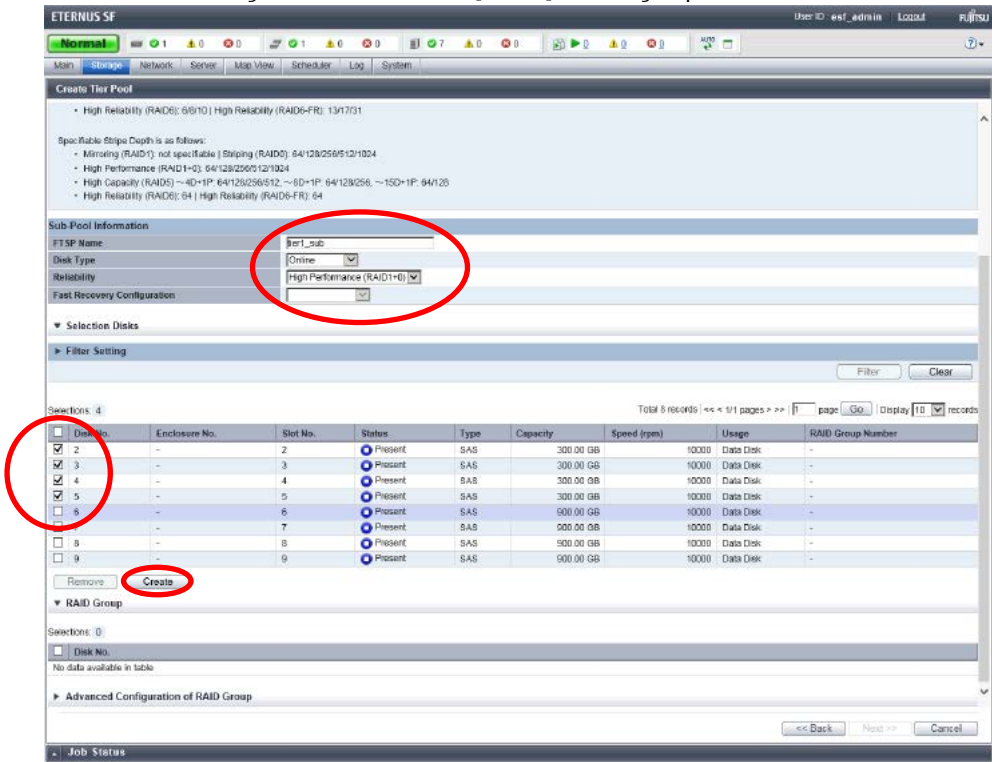


Figure-52 Specifying a sub-pool (gold)

Item	Description	Information
FTSP Name	Specify a unique sub-pool name in the storage system. Any alphanumeric character (from 1 to 16 characters), a hyphen (-), an underscore (_), and a pound symbol (#) can be specified. The characters are case insensitive.	tier1_sub
Disk Type	Specify the type of disk that configures the sub-pool. Make a selection from the disk types (Online, Nearline, SSD, SED-SAS) that are displayed in the pull-down list.	Online
Reliability	Specify the RAID level of the sub-pool. Select one of the following options that are displayed in the pull-down list. - High Performance(RAID1+0) - High Capacity(RAID5) - High Reliability(RAID6) - High Reliability(RAID6-FR) - Mirroring(RAID1) - Striping(RAID0)	High Performance(RAID1+0)
Fast Recovery Configuration	Set this item when [High Reliability(RAID6-FR)] is selected for [Reliability]. A RAID group must be created based on the number of disks for the specified configuration. When a level other than [High Reliability(RAID6-FR)] is selected for [Reliability], specification is not necessary.	Unspecified
Disk No.	Number of the disk for configuring the sub-pool.	2, 3, 4, and 5

Table-23 Values for specifying a sub-pool (gold)

Points

Not all available combinations of the RAID levels and the number of member disks are supported for RAID groups that can be used as Tier pools.

For details, refer to "FUJITSU Storage ETERNUS SF Storage Cruiser V16.4 Operation Guide for Optimization Function".

6. Select the created RAID group, and then click [Next].

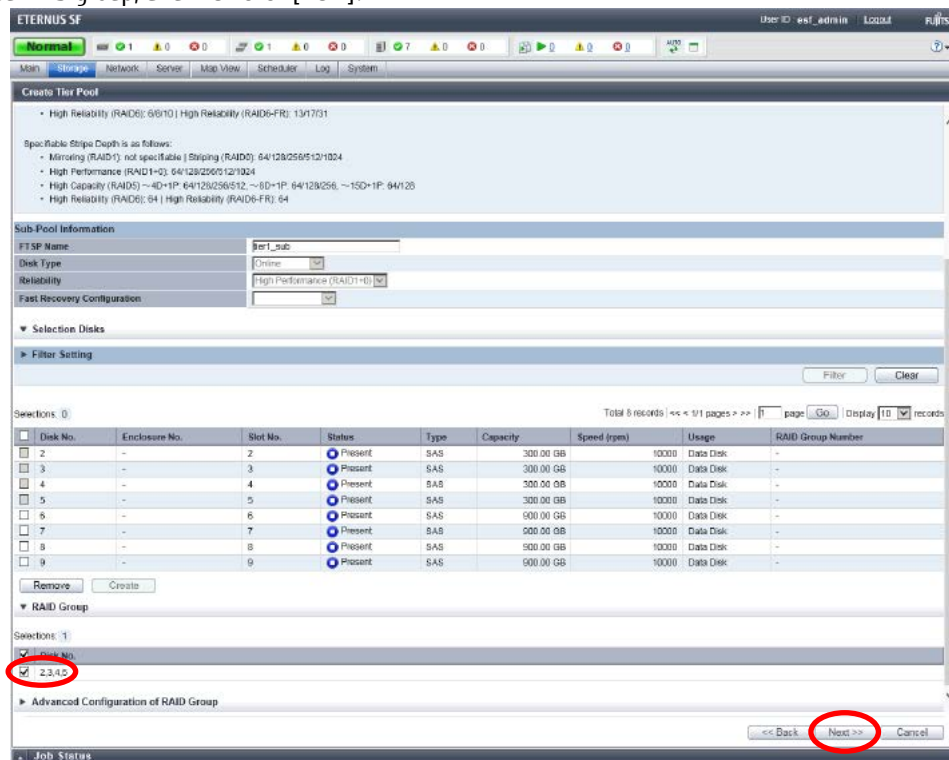


Figure-53 Disk No. for configuring the RAID group

7. The information confirmation screen is displayed.
Confirm the information, and then click the [Create] button on the lower right corner of the screen.

Points

Check the Job Status pane and make sure that the result changes to [Success] before proceeding to the next step.
For details on how to use the Job Status pane, refer to "2.2.1.2 Checking the Common Processes of the ETERNUS SF Web Console Operations".

8. Repeat Steps 1 to 7 to create a Tier pool (silver) for the VVOL datastores.
For each setting, enter the items shown in the following table.

Item	Information
Tier Pool Name	tier2_silver
Disk Selection	Manual

Table-24 Values for specifying a Tier pool (silver)

Item	Information
FTSP Name	tier2_sub
Disk Type	Online
Reliability	High Capacity(RAID5)
Fast Recovery Configuration	Unspecified
Disk No.	6, 7, 8, and 9

Table-25 Values for specifying a sub-pool (silver)

9. Repeat Steps 1 to 7 to create a Tier pool (clone backup) for the VVOL datastores.
For each setting, enter the items shown in the following table.

Item	Information
Tier Pool Name	tier3_bkup
Disk Selection	Manual

Table-26 Values for specifying a Tier pool (backup)

Item	Information
FTSP Name	tier3_sub
Disk Type	Nearline
Reliability	High Capacity(RAID5)
Fast Recovery Configuration	Unspecified
Disk No.	10, 11, 12, and 13

Table-27 Values for specifying a sub-pool (backup)

2.2.3.1.4 Checking the Tier Pools

Confirm that the Tier pools are created.

1. In the global navigation tab, click [Storage].
2. On the Main pane, click the ETERNUS AF/DX link under [Name].

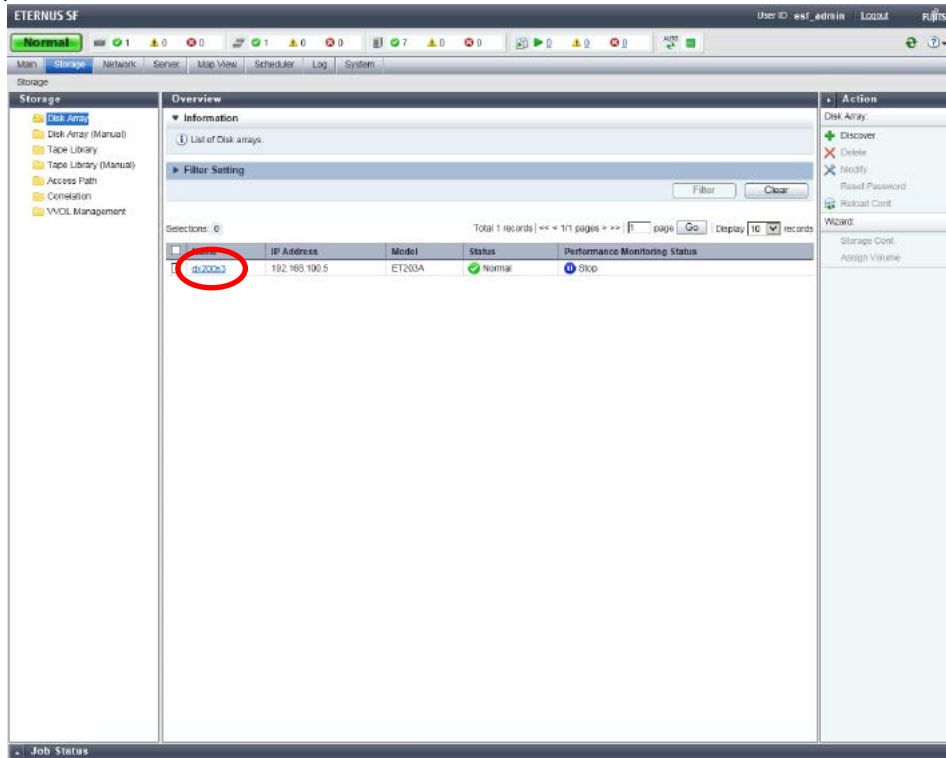


Figure-54 Storage

3. On the Category pane, click [Automated Storage Tiering].

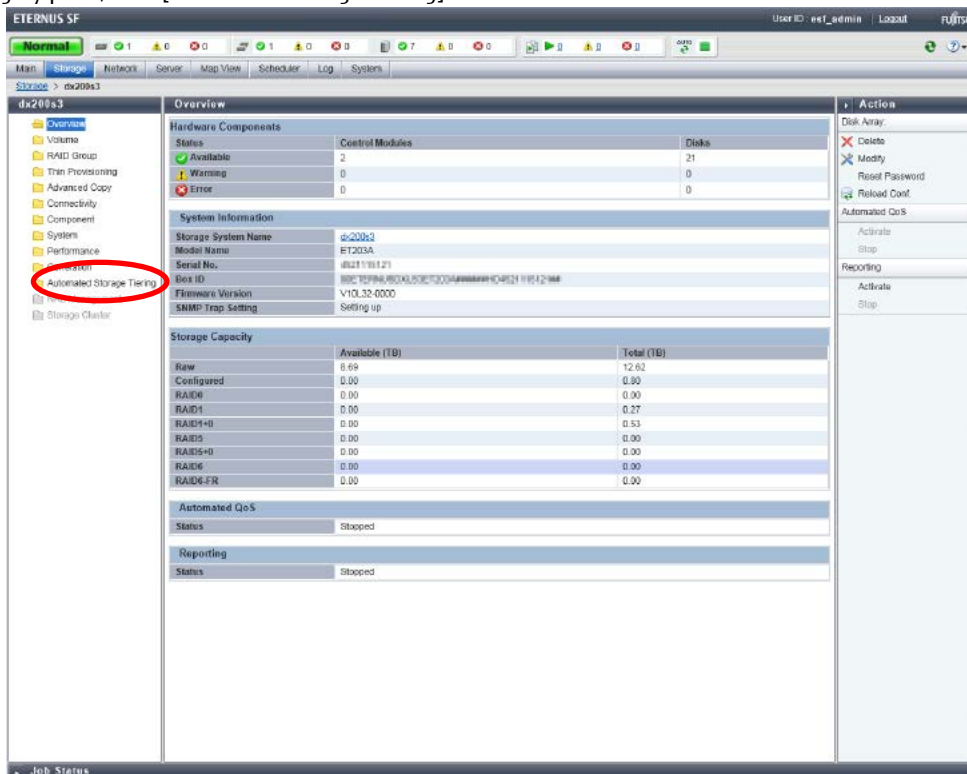


Figure-55 dx200s3

4. On the Category pane, click [Tier Pool].
The registered Tier pools are displayed on the Main pane.

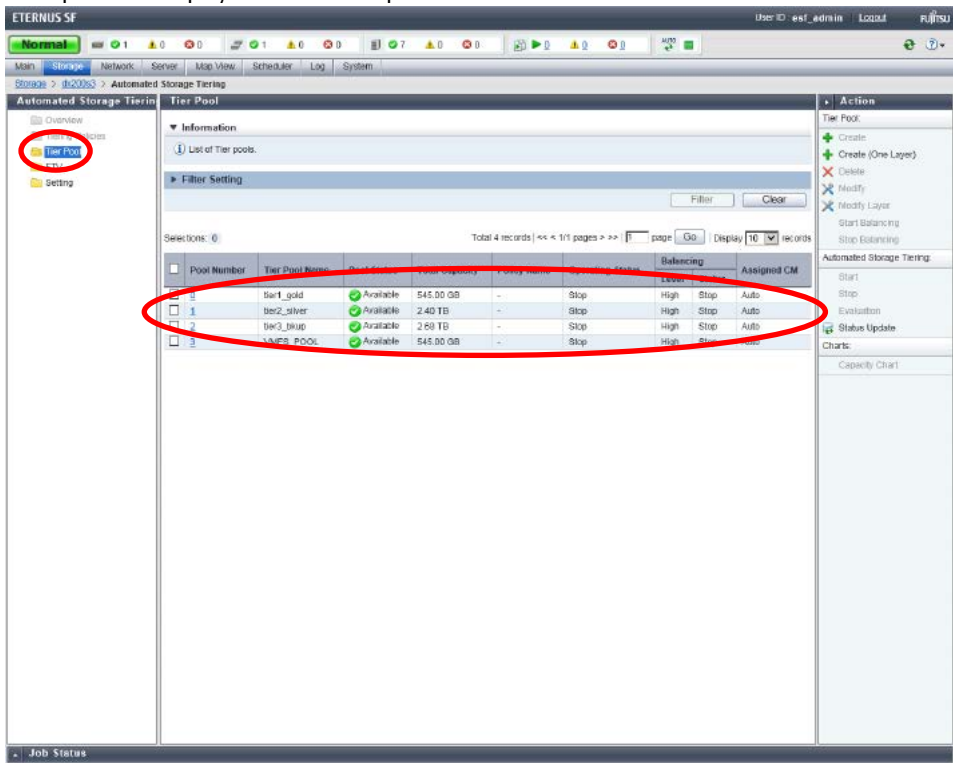


Figure-56 List of Tier pools

5. Check that the pools that were created in "2.2.3.1.3 Creating Tier Pools" are registered.

Tier Pool Name	Pool Status	Check <input checked="" type="checkbox"/>
tier1_gold	Available	<input type="checkbox"/>
tier2_silver	Available	<input type="checkbox"/>
tier3_bkup	Available	<input type="checkbox"/>

Table-28 Checklist for the created Tier pools

Check that all the Tier pools are created and that the status is [Available], and then proceed to the next procedure.

2.2.3.1.5 Creating VVOL Datastores

1. Create a VVOL datastore (gold).
From ETERNUS SF Web Console, click [Storage] on the global navigation tab.
On the Category pane, click [VVOL Management].
2. On the Action pane, click [Create/Modify] under [VVOL Datastore].

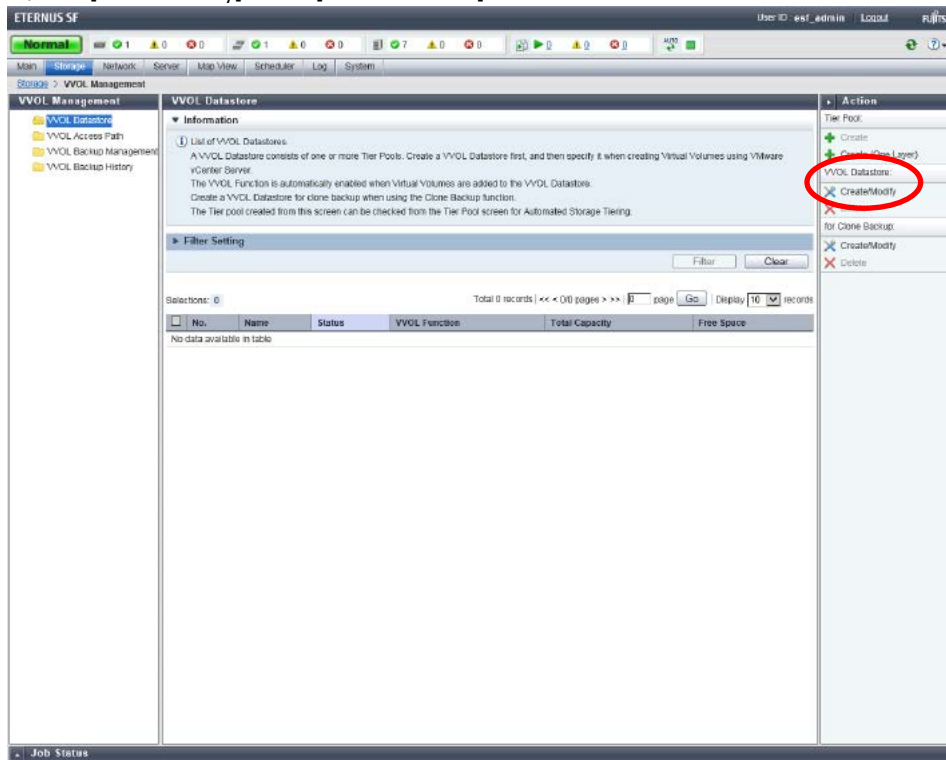


Figure-57 VVOL Management

3. Enter the items shown in the following table, and then click [Add].

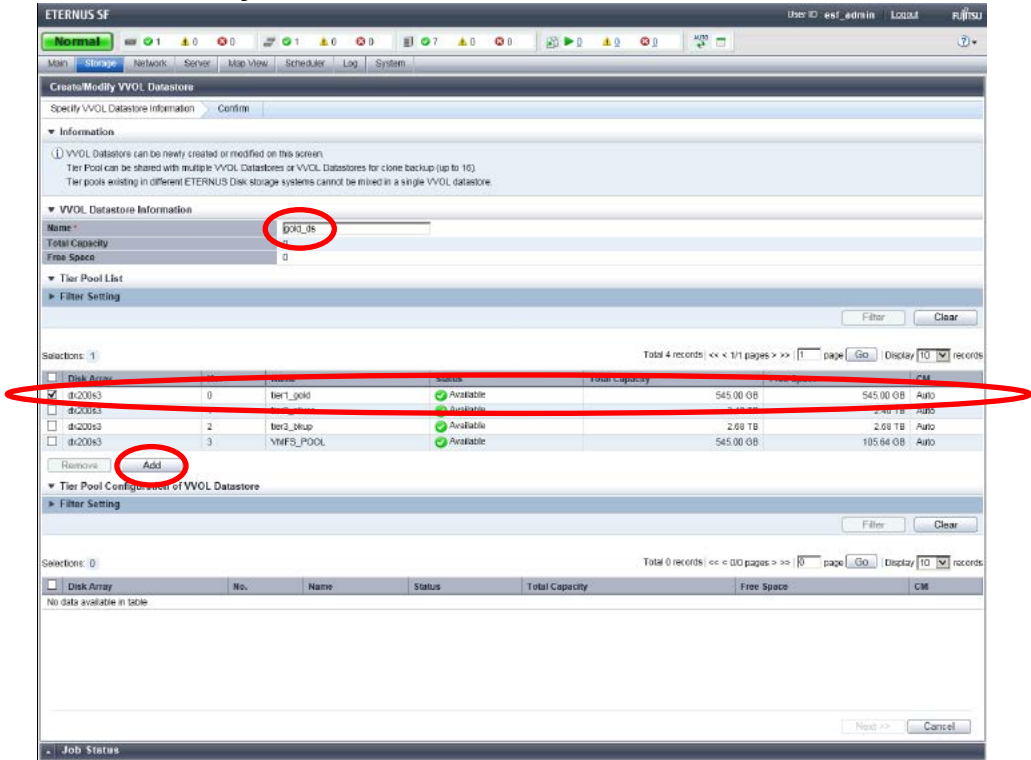


Figure-58 Specify VVOL Datastore Information

Item	Information
Name	gold_ds
Tier Pool List	tier1_gold

Table-29 Values for the "Specify VVOL Datastore Information" setting (gold)

4. Select the checkbox for the added Tier pool, and then click the [Next] button.

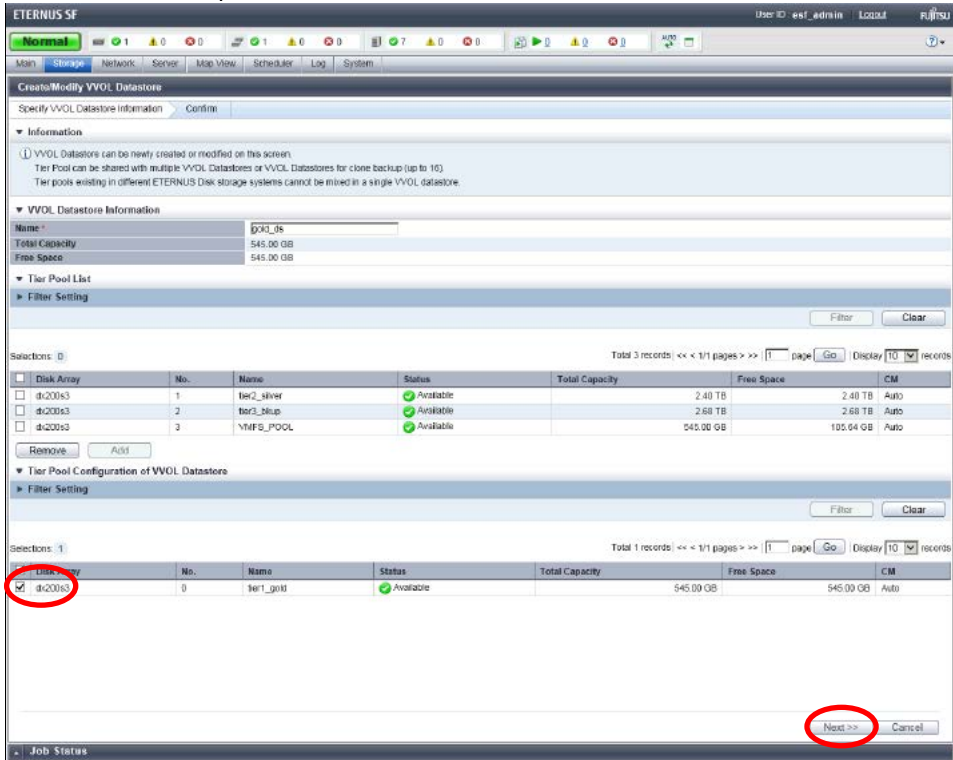


Figure-59 Tier Pool Configuration of VVOL Datastore

5. The information confirmation screen is displayed. Confirm the information, and then click [Create / Modify] on the lower right corner of the screen.

Points

Check the Job Status pane and make sure that the result changes to [Success] before proceeding to the next step.

For details on how to use the Job Status pane, refer to "2.2.1.2 Checking the Common Processes of the ETERNUS SF Web Console Operations".

6. Repeat Steps 2 to 5 to create VVOL datastores (silver).
For each setting, enter the items shown in the following table.

Item	Information
Name	silver_ds
Tier Pool List	tier2_silver

Table-30 Values for the "Specify VVOL Datastore Information" setting (silver)

2.2.3.1.6 Creating a VVOL Datastore for Clone Backups

1. Create a VVOL datastore for clone backups.
On the ETERNUS SF Web Console screen, click [Storage] in the global navigation tab.
On the Category pane, click [VVOL Management].
2. On the Action pane, click [Create/Modify] under [for Clone Backup].

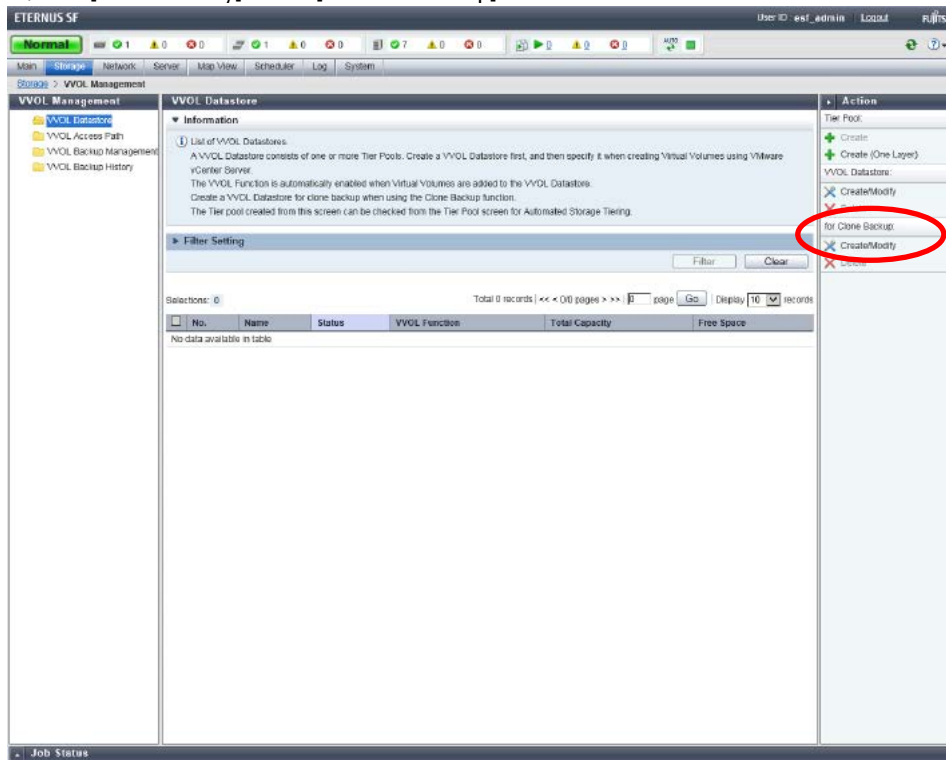


Figure-60 VVOL Management

3. Enter the items shown in the following table, and then click [Add].

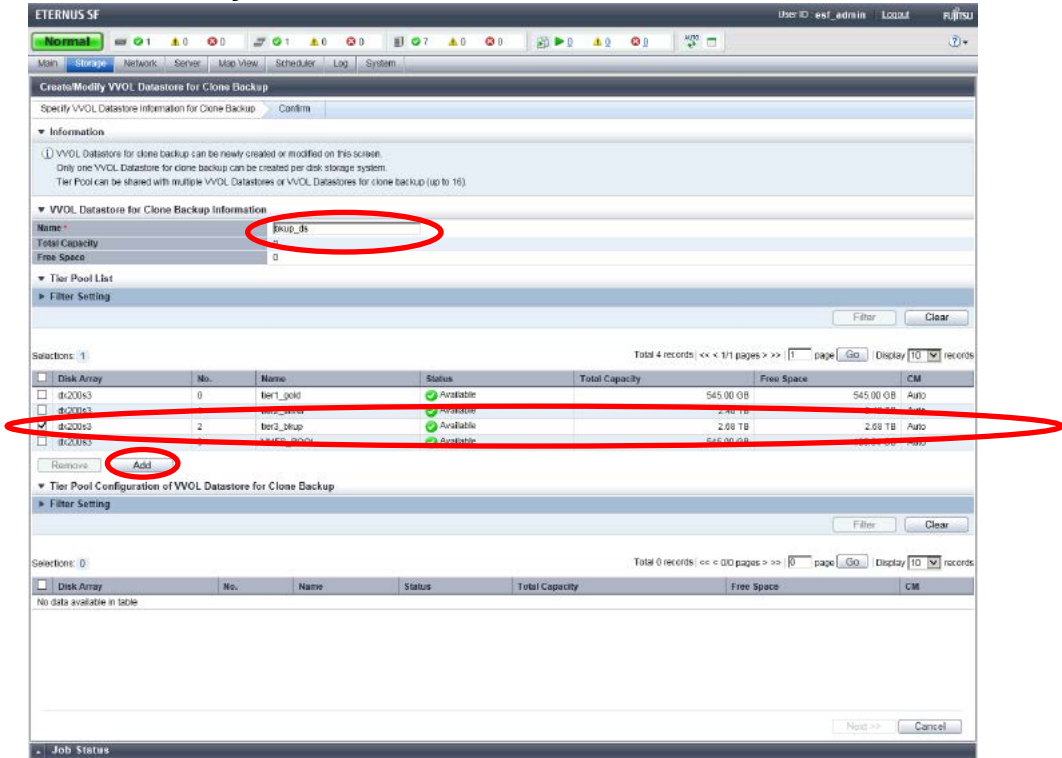


Figure-61 Specify VVOL Datastore Information for Clone Backup

Item	Information
Name	bkup_ds
Tier Pool List	tier3_bkup

Table-31 Values for the "Specify VVOL Datastore information for Clone Backup" setting

4. Select the checkbox for the added Tier pool, and then click the [Next] button.

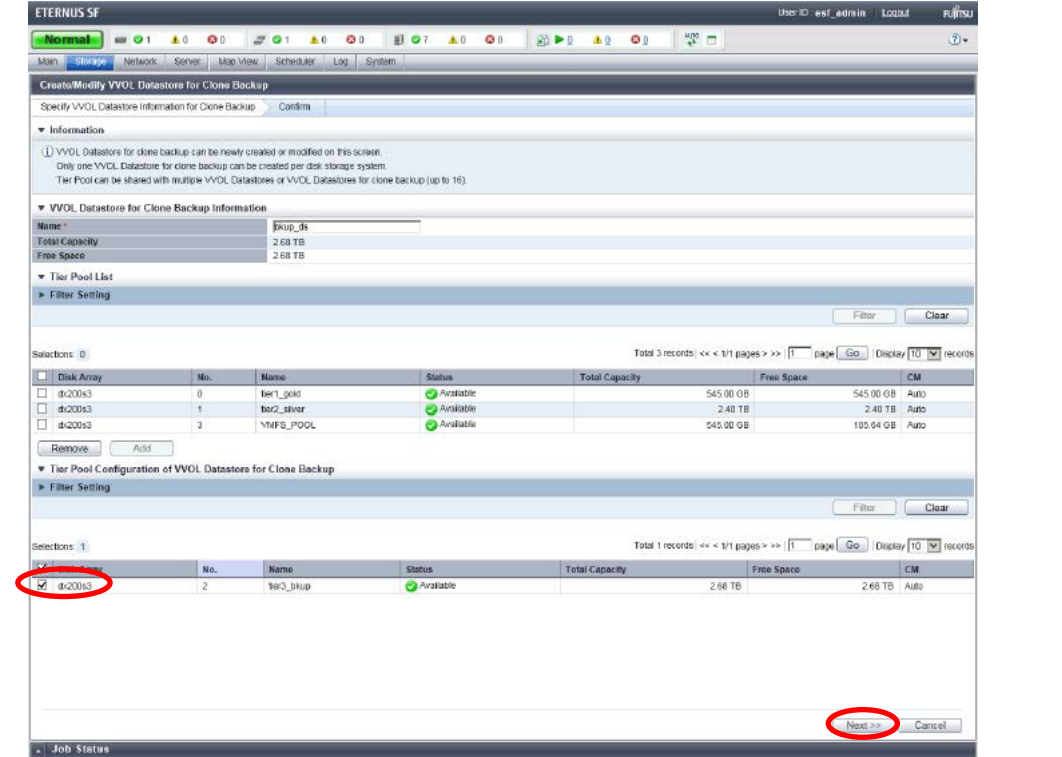


Figure-62 Tier Pool Configuration of VVOL Datastore for Clone Backup

- 5. The information confirmation screen is displayed. Confirm the information, and then click [Create / Modify] on the lower right corner of the screen.

Points
Check the Job Status pane and make sure that the result changes to [Success] before proceeding to the next procedure.
For details on how to use the Job Status pane, refer to "2.2.1.2 Checking the Common Processes of the ETERNUS SF Web Console Operations".

2.2.3.1.7 Checking the VVOL Datastores
Confirm that the VVOL datastores are created.

- 1. In the global navigation tab, click [Storage].
- 2. On the Category pane, click [VVOL Management].
The registered VVOL datastores are displayed on the Main pane.

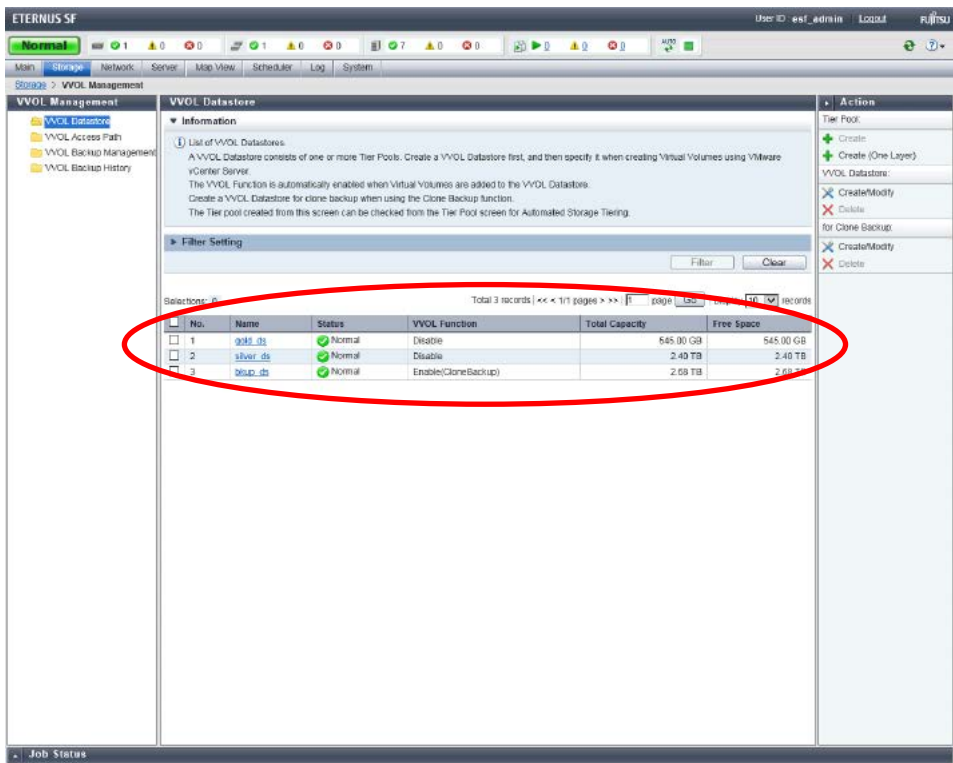


Figure-63 List of VVOL datastores

- 3. Check that the VVOL datastores that were created in "2.2.3.1.5 Creating VVOL Datastores" are registered.

Name	Status	VVOL Function	Check <input checked="" type="checkbox"/>
gold_ds	Normal	Disable (or Enable(VVOL))	<input type="checkbox"/>
silver_ds	Normal	Disable (or Enable(VVOL))	<input type="checkbox"/>
bkup_ds	Normal	Enable(CloneBackup)	<input type="checkbox"/>

Table-32 Checklist for the created VVOL datastores

Check that all of the VVOL datastores are created, and then proceed to the next procedure.

2.2.3.2 vCenter Server Operations

2.2.3.2.1 Rescanning the Storage Provider

1. Make the vCenter server recognize the VVOL datastores that were created in "2.2.3.1.5 Creating VVOL Datastores". Click the [Rescan] button on the [Storage Providers] screen.

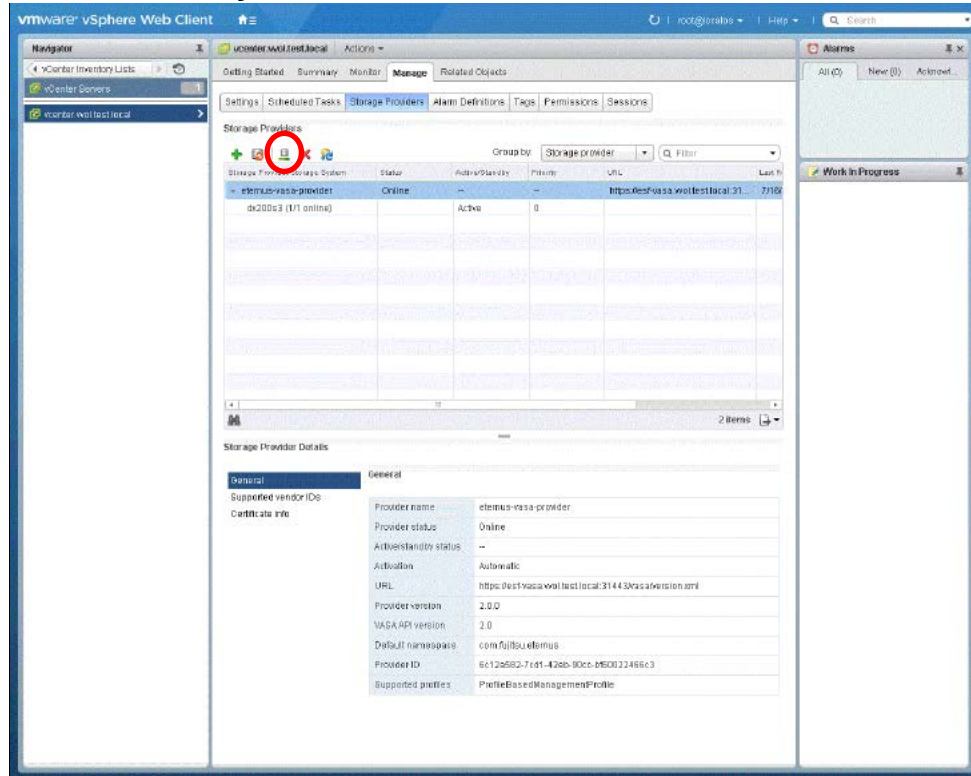


Figure-64 Storage Providers

2.2.3.2.2 Registering VVOL Datastores

1. Register the VVOL datastore (gold) in the vCenter server.
Click [Actions] - [Storage] - [New Datastore].

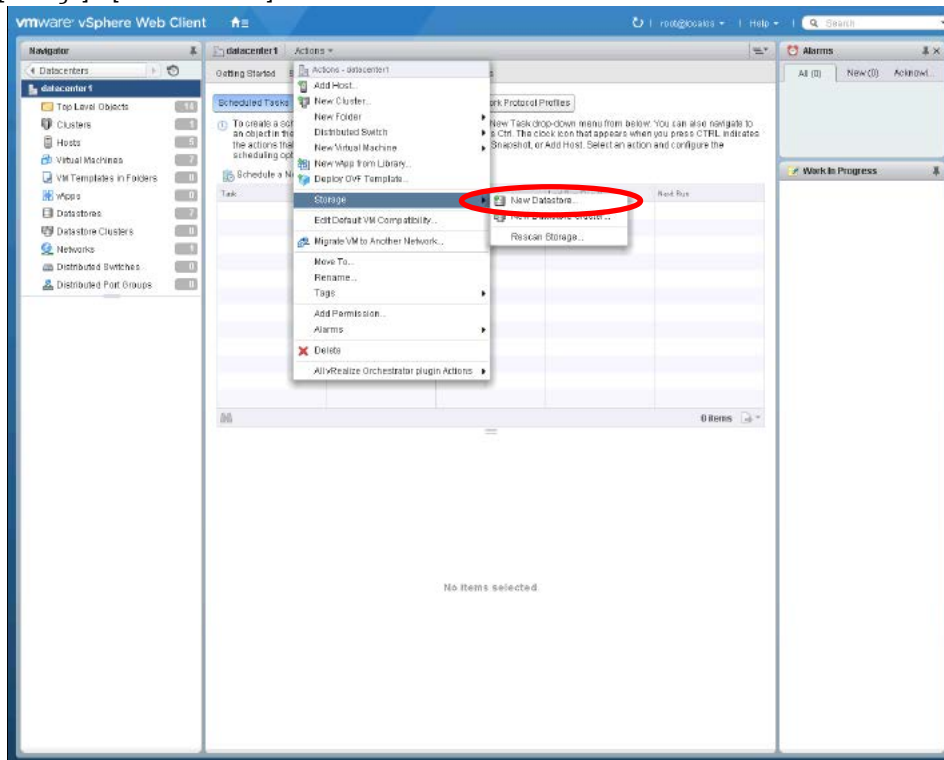


Figure-65 New Datastore

2. Confirm the location, and then click [Next].

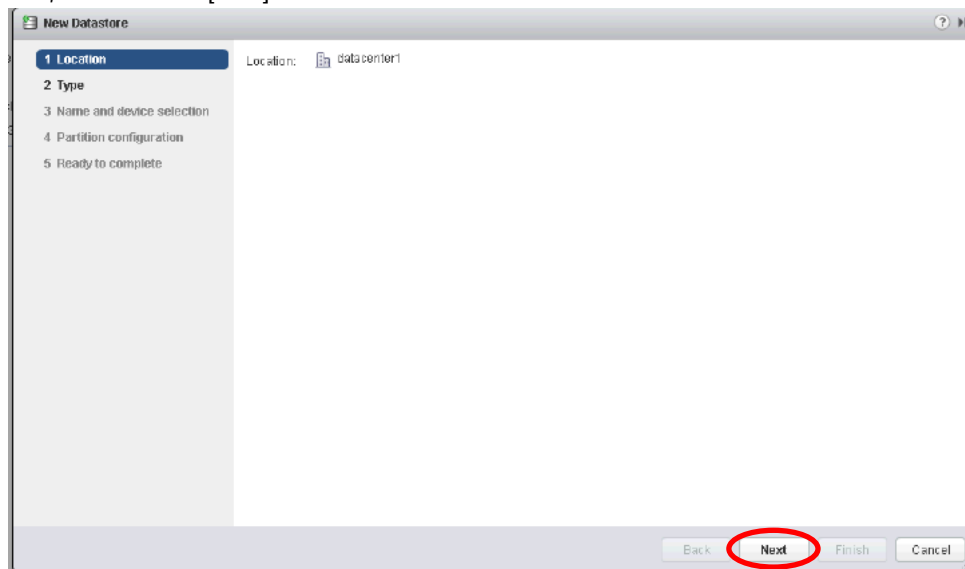


Figure-66 Location

3. Select [VVOL], and then click [Next].

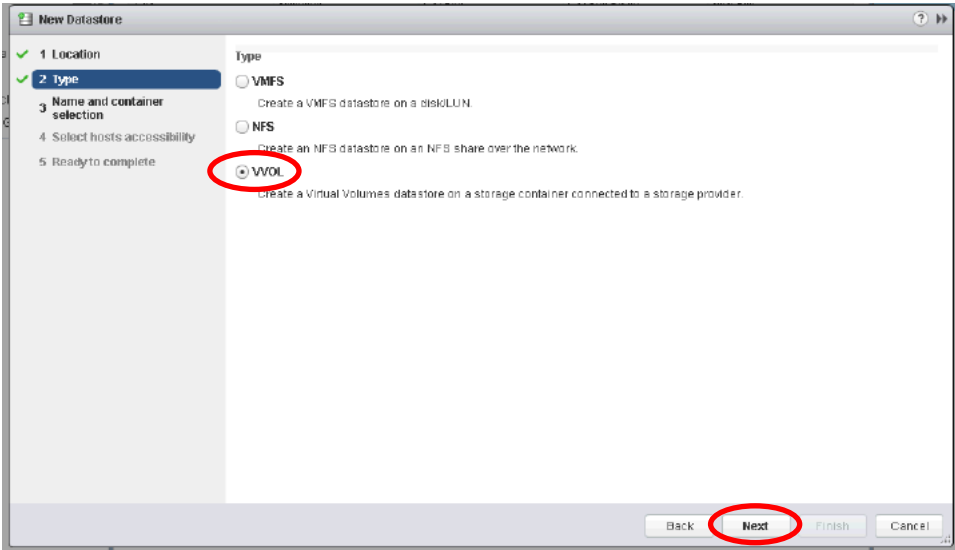


Figure-67 Type

4. Type "g_datastore" for [Datastore name], select [gold_ds] in [Backing Storage Container], and then click [Next].

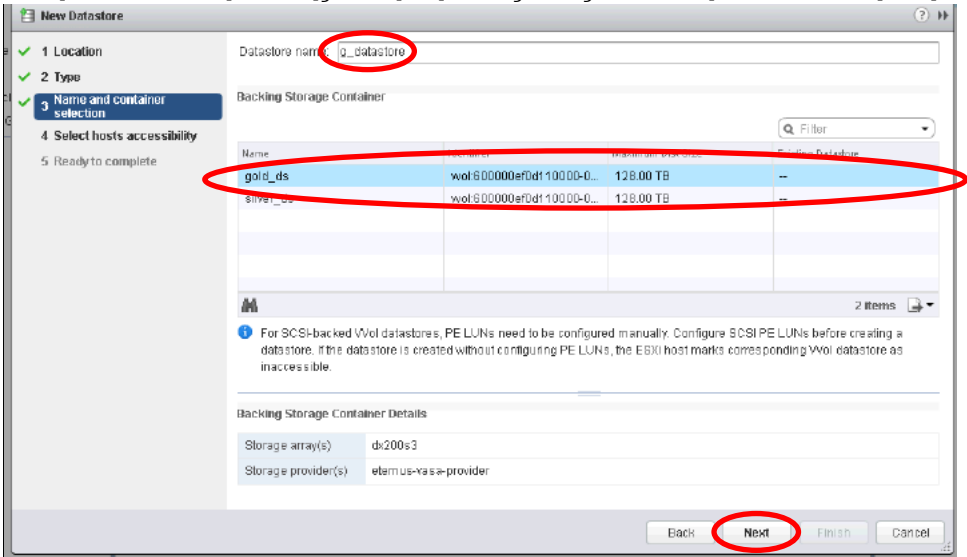


Figure-68 Name and container selection

5. Select the hosts, and then click [Next].

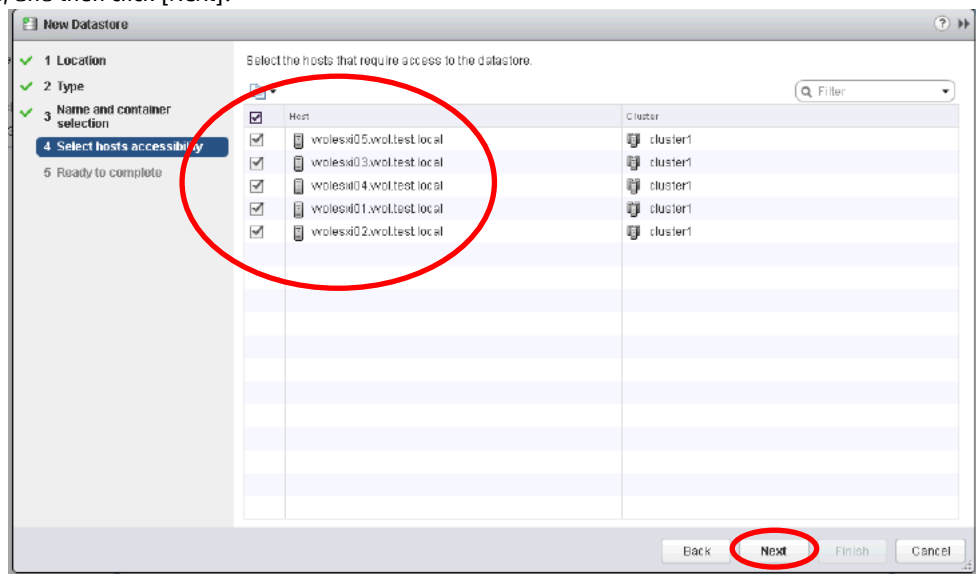


Figure-69 Select hosts accessibility

6. Check the configuration values, and then click [Finish].

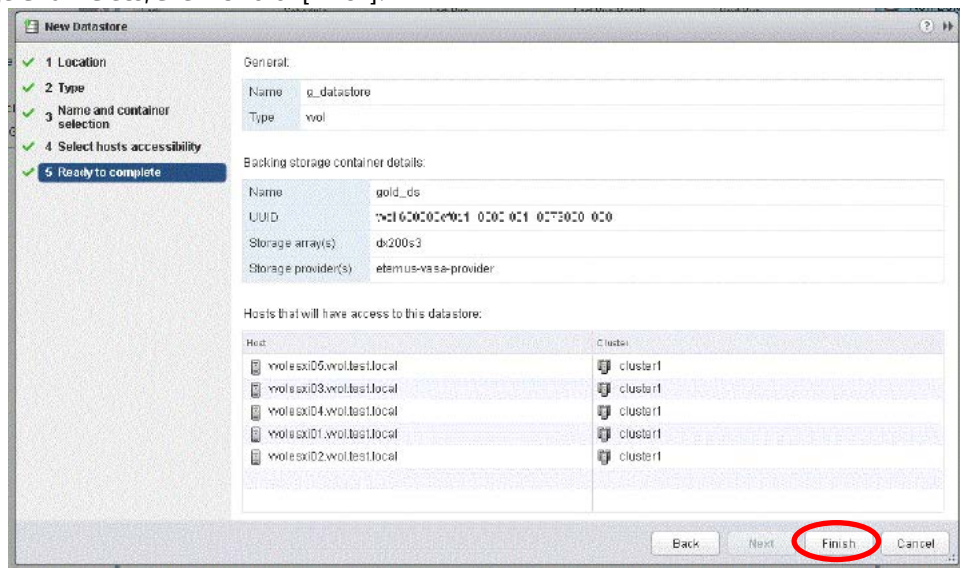


Figure-70 Ready to complete

For each setting, enter the items shown in the following table.

Item	Information
Location	Datacenter1
Type	VVOL
Datastore name	g_datastore
Backing Storage Container	gold_ds
Host	vvolcsi01 - vvolcsi05

Table-33 Values for registering VVOL datastores (gold)

7. Register the VVOL datastore (silver).

For each setting, enter the items shown in the following table.

Item	Information
Location	Datacenter1
Type	VVOL
Datastore name	s_datastore
Backing Storage Container	silver_ds
Host	vvolesxi01 - vvolesxi05

Table-34 Values for registering VVOL datastores (silver)

2.2.3.2.3 Checking the VVOL Datastores

Confirm that the registered VVOL datastores are mounted on all the ESXi hosts.

1. From Navigator, click [Hosts and Clusters].
2. From the Navigator tree, click an ESXi host.
3. For the ESXi host, select [Related Objects] - [Datastores].

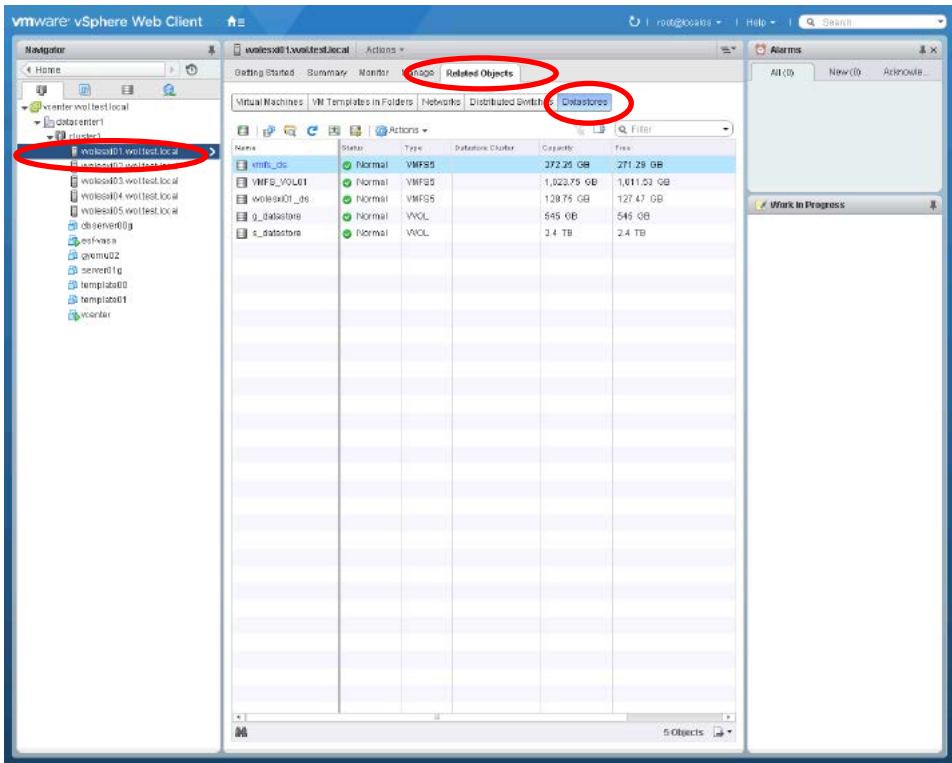


Figure-71 Checking the created vCenter Server VVOL datastores

Check that the VVOL datastores that were mounted on the ESXi hosts in "2.2.3.2.2 Registering VVOL Datastores" are mounted on each ESXi host.

ESXi host	VVOL datastore	Check <input checked="" type="checkbox"/>
vwolesxi01	g_datastore	<input type="checkbox"/>
	s_datastore	<input type="checkbox"/>
vwolesxi02	g_datastore	<input type="checkbox"/>
	s_datastore	<input type="checkbox"/>
vwolesxi03	g_datastore	<input type="checkbox"/>
	s_datastore	<input type="checkbox"/>
vwolesxi04	g_datastore	<input type="checkbox"/>
	s_datastore	<input type="checkbox"/>
vwolesxi05	g_datastore	<input type="checkbox"/>
	s_datastore	<input type="checkbox"/>

Table-35 Checklist for the VVOL datastores mounted on the ESXi hosts

Check that the VVOL datastores are mounted on all the ESXi hosts, and then proceed to the next procedure.

2.2.3.2.4 Creating Policies

1. Create a policy for "g_datastore".
In vSphere Web Client, click [VM Storage Policies] in [Home].

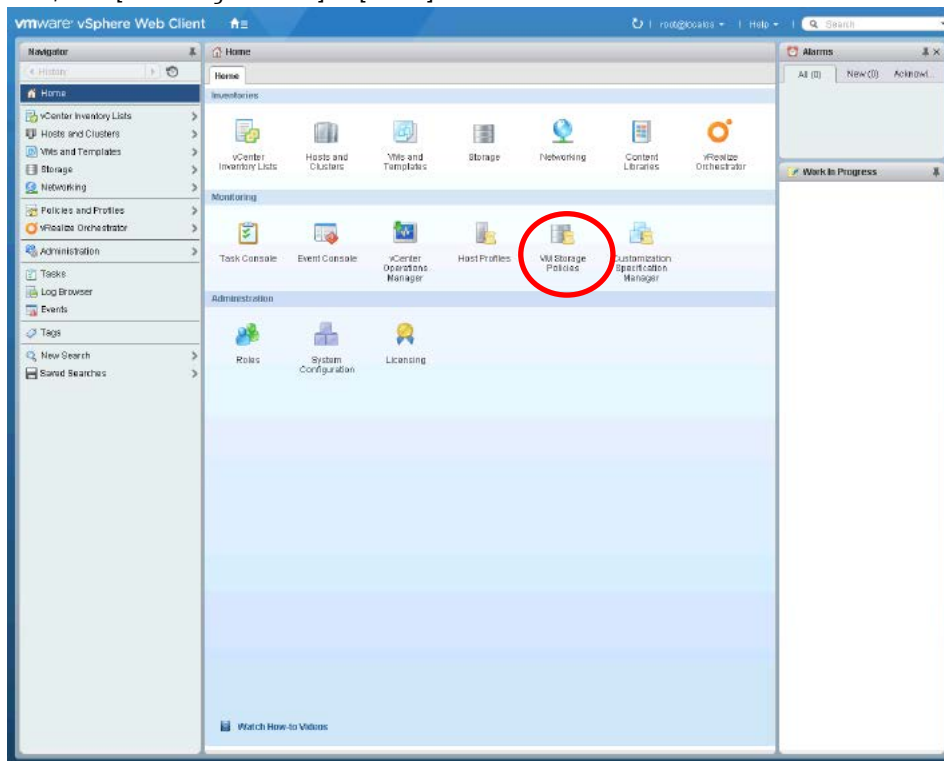


Figure-72 Home

2. Click the [Create New VM Storage Policy] icon.

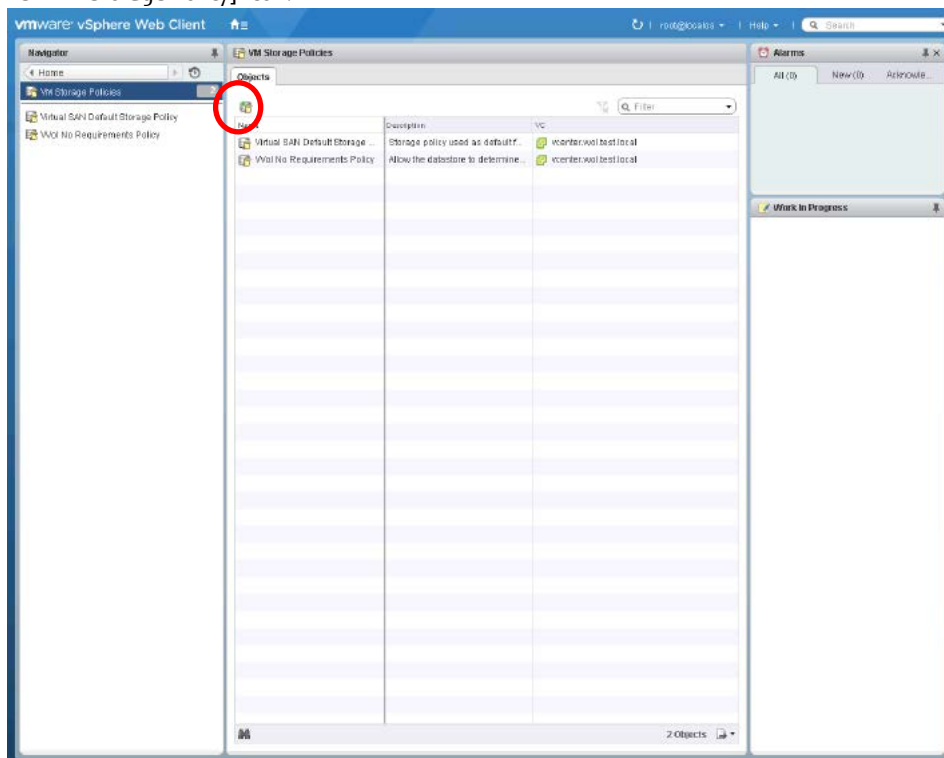


Figure-73 Creating a new virtual machine storage policy

3. In [Name and description], type "gold_policy" in [Name], and then click [Next].

The screenshot shows the 'Create New VM Storage Policy' dialog box. On the left, a sidebar lists four steps: 1 Name and description (selected), 2 Rule-Sets, 3 Storage compatibility, and 4 Ready to complete. The main area is titled 'Name and description' and contains a 'vCenter Server' dropdown set to 'vcenter.wol.test.local', a 'Name' text box containing 'gold_policy', and a larger 'Description' text box. At the bottom right, there are four buttons: 'Back', 'Next' (highlighted with a red circle), 'Finish', and 'Cancel'.

Figure-74 Name and description

4. In [Rule-Sets], specifying [Rules based on data services] as [com.fujitsu.etrernus] displays the [Add rule] pull-down list. Use this pull-down list to specify the values for the virtual machine backup settings. For each setting, enter the items shown in the following table.
After entering the information, click [Next].

The screenshot shows the 'Create New VM Storage Policy' dialog box at Step 2: Rule-Sets. The sidebar shows '2 a Rule-Set 1' selected. The main area is titled 'Rule-Set 1' and contains a 'Rules based on data services' dropdown set to 'com.fujitsu.etrernus'. Below this, there are several settings for 'Virtual Machine Backup': 'Operation Mode' (Auto), 'Execution Period' (Daily), 'Execution Interval' (12 hours), 'Execution Week' (Sun), 'Execution Day' (1), 'Execution Start Time (Hour)' (22), 'Execution Start Time (Minute)' (30), 'Number of Snapshot Backup Generations' (0), 'Quiesce guest file system' (Enable), 'Snapshot the virtual machine's memory' (Enable), and 'Clone Backup' (Enable). At the bottom right, there are four buttons: 'Back', 'Next' (highlighted with a red circle), 'Finish', and 'Cancel'.

Figure-75 Virtual machine backup policy (Rule-Set 1)

Item	Information
Name	gold_policy
Operation Mode	Auto
Execution Period	Daily
Execution Start Time(Hour)	22
Execution Start Time(Minute)	30
Number of Snapshot Backup Generations	0
Quiesce guest file system	Enable
Snapshot the virtual machine's memory	Enable
Clone Backup	Enable

Table-36 Values for the virtual machine backup settings (gold)

- In [Storage compatibility], [Compatible storage] displays the VVOL datastores that can fulfill the created policy. Click the [Next] button.

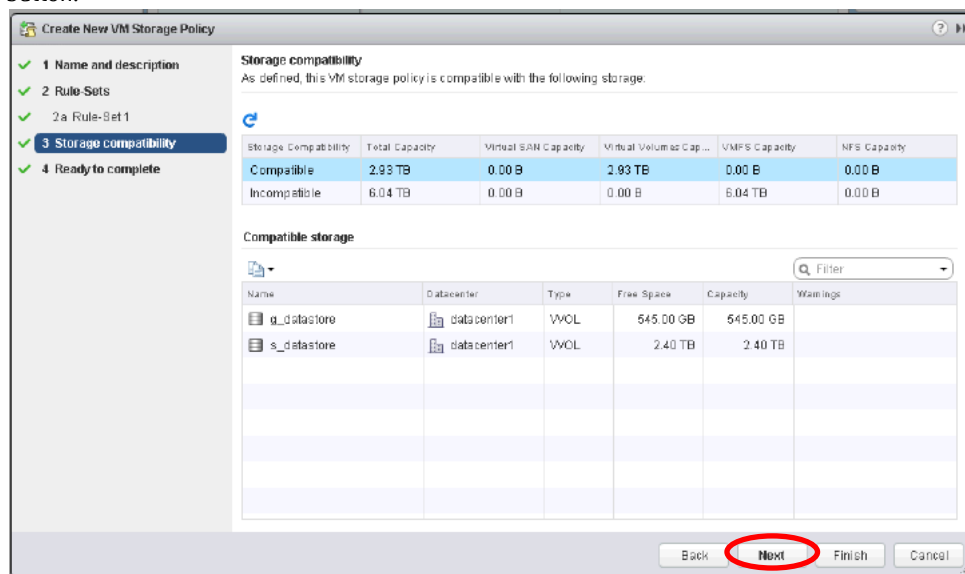


Figure-76 Storage compatibility

- In [Ready to complete], click [Finish].

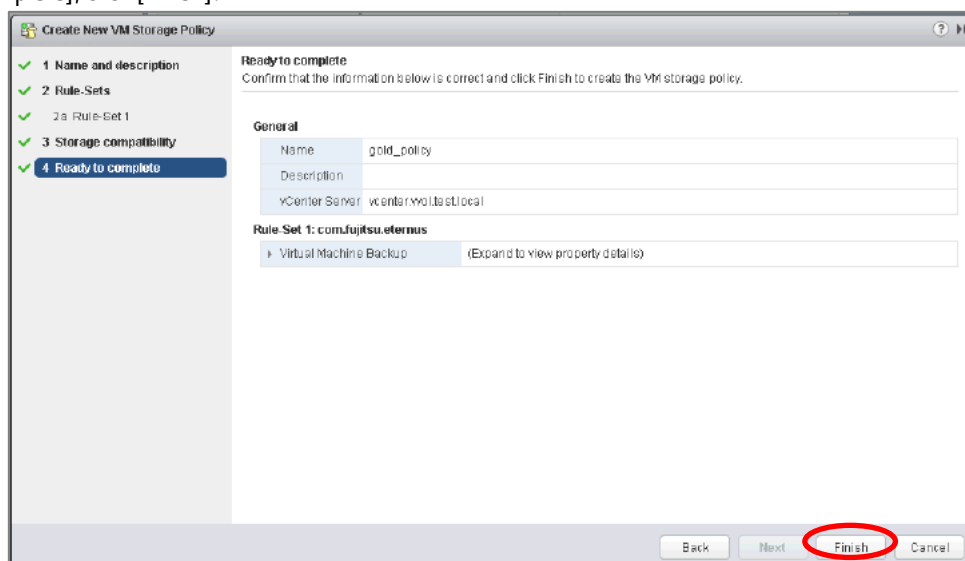


Figure-77 Ready to complete

7. Create a policy for "s_datastore".

For each setting, enter the items shown in the following table.

Item	Information
Name	silver_policy
Operation Mode	Auto
Execution Period	Weekly
Execution Week	Sun.
Execution Start Time(Hour)	01
Execution Start Time(Minute)	00
Number of Snapshot Backup Generations	3
Quiesce guest file system	Enable
Snapshot the virtual machine's memory	Enable
Clone Backup	Enable

Table-37 Values for the virtual machine backup settings (silver)

2.2.3.2.5 Checking the Policies

Check that the virtual machine storage policies are registered correctly.

- 1. From Navigator, click [Home].
- 2. In [Home], click [VM Storage Policies] under [Monitoring].
- 3. Check that [VM Storage Policies] displays the created policies.

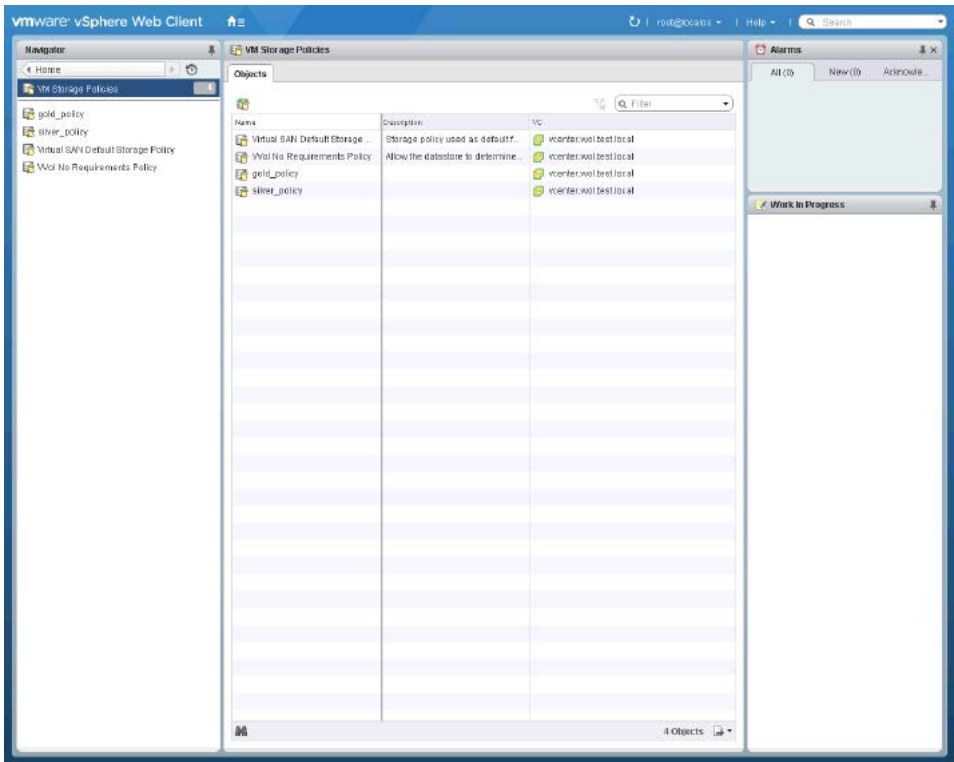


Figure-78 Checking the virtual machine storage policy of vCenter Server

Check that the VVOL datastores that were mounted on ESXi hosts in "2.2.3.2.2 Registering VVOL Datastores" are mounted on each ESXi host.

Name	Check <input checked="" type="checkbox"/>
gold_policy	<input type="checkbox"/>
silver_policy	<input type="checkbox"/>

Table-38 Checklist for the virtual machine storage policies

Check that the virtual machine storage policies are created, and then proceed to the next procedure.

2.2.4 Virtual Machine Creation Procedure

Create virtual machines to be used as business servers.

As an example, this procedure creates a virtual machine named "gyomu01".

1. Click [Actions] - [New Virtual Machine] - [New Virtual Machine].

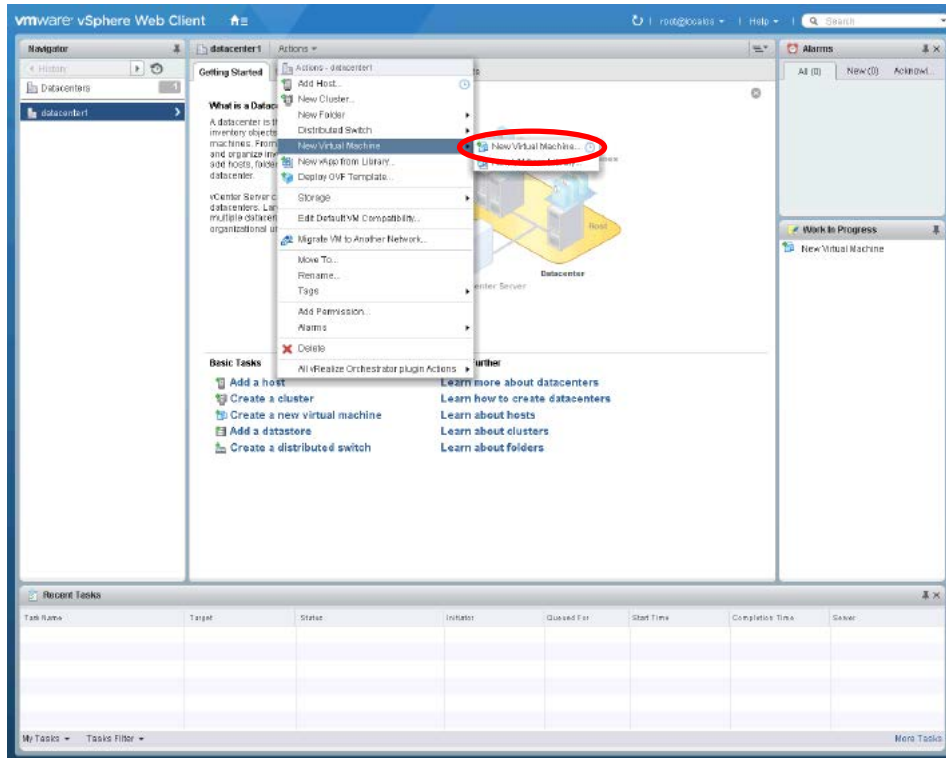


Figure-79 Creating a new virtual machine

2. In [Select a creation type], select [Create a new virtual machine], and then click [Next].

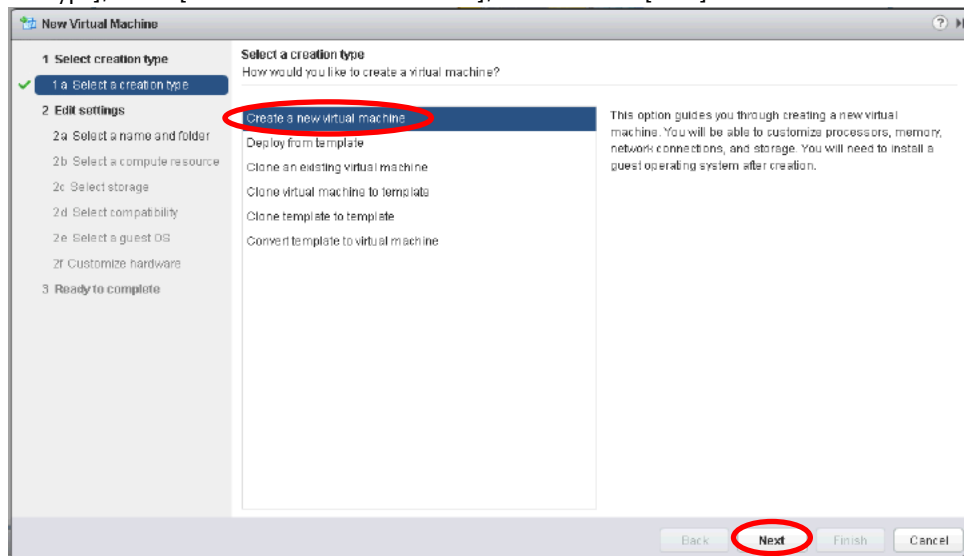


Figure-80 Select a creation type

3. In [Select a name and folder], type "gyomu01", and then click [Next].

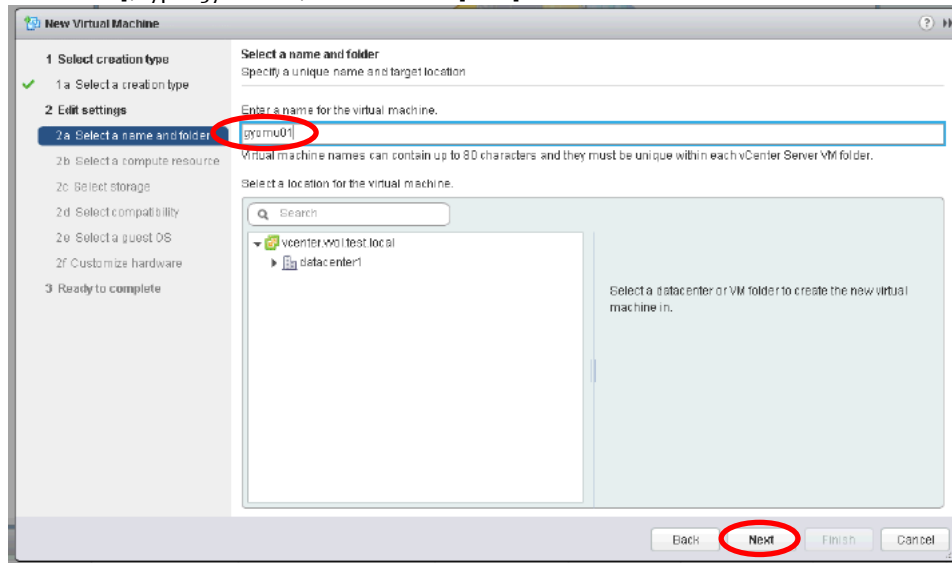


Figure-81 Select a name and folder

4. In [Select a compute resource], select a host, and then click [Next].

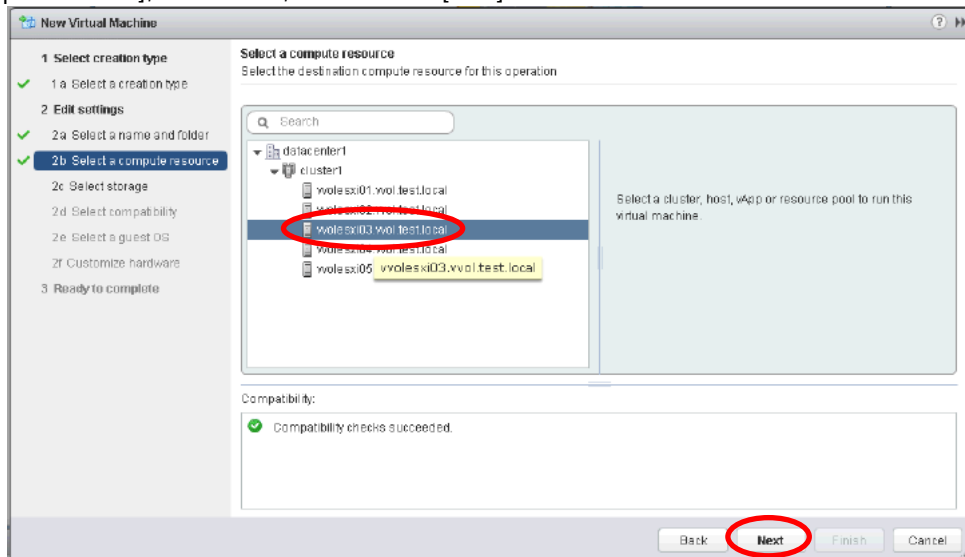


Figure-82 Select a compute resource

5. In [Select storage], select the values shown in the following table, and then click [Next].

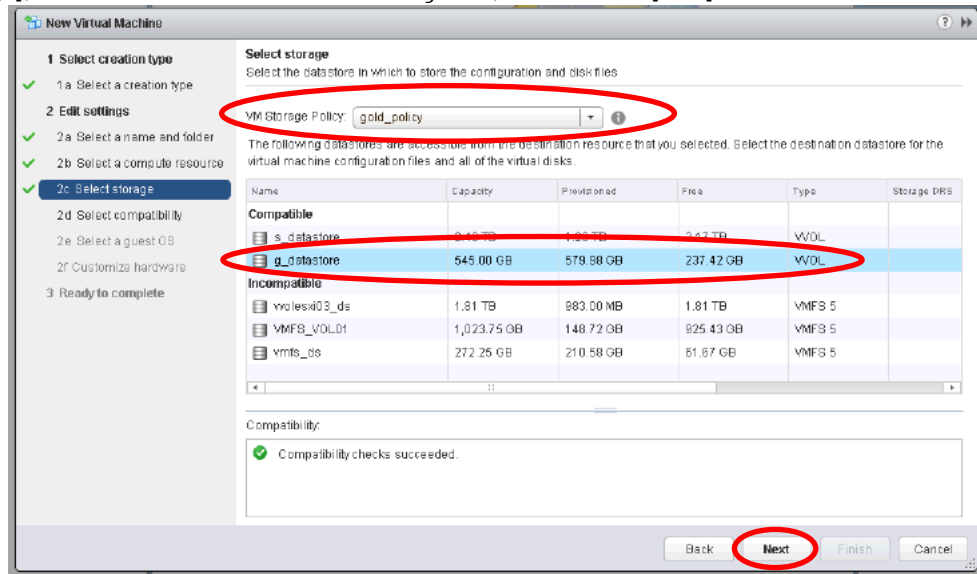


Figure-83 Select storage

Item	Information
VM Storage Policy	gold_policy
Datastore	g_datastore

Table-39 Values for the "Select storage" setting

6. In [Select compatibility], click [Next].

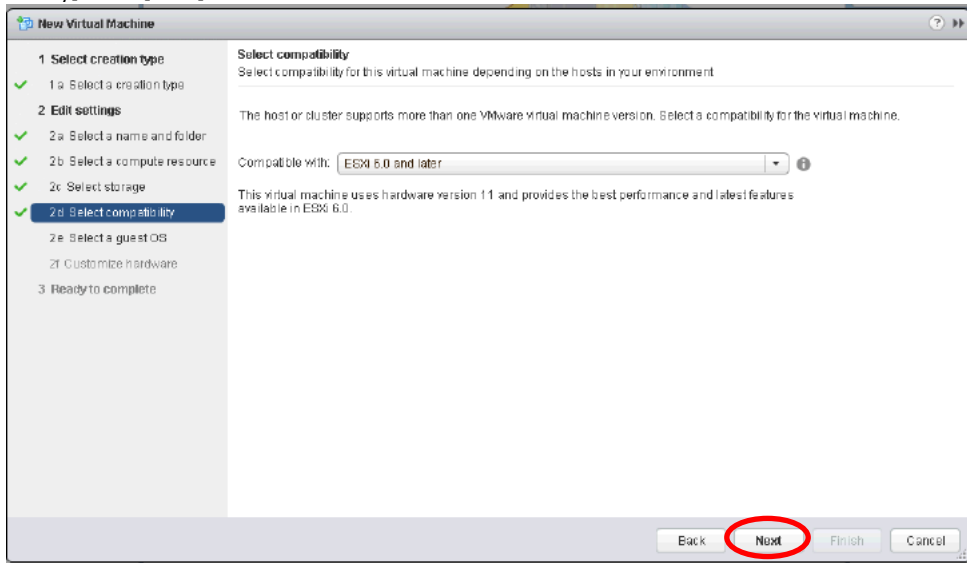


Figure-84 Select compatibility

7. In [Select a guest OS], enter the items shown in the following table, and then click [Next].

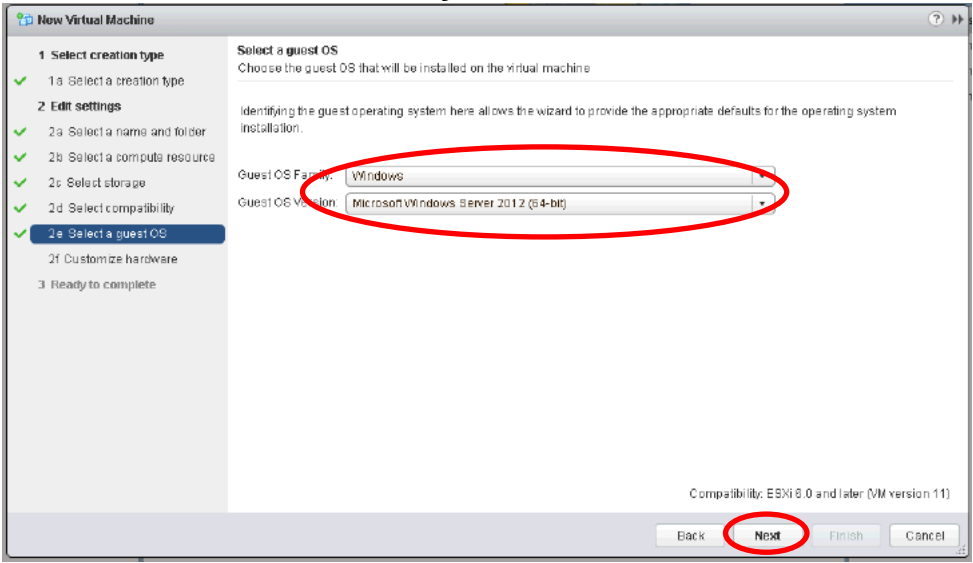


Figure-85 Select a guest OS

Item	Information
Guest OS Family	Windows
Guest OS Version	Microsoft Windows Server 2012 (64-bit)

Table-40 Values for the "Select a guest OS" setting

8. In [Customize hardware], enter the items shown in the following table, and then click [Next].

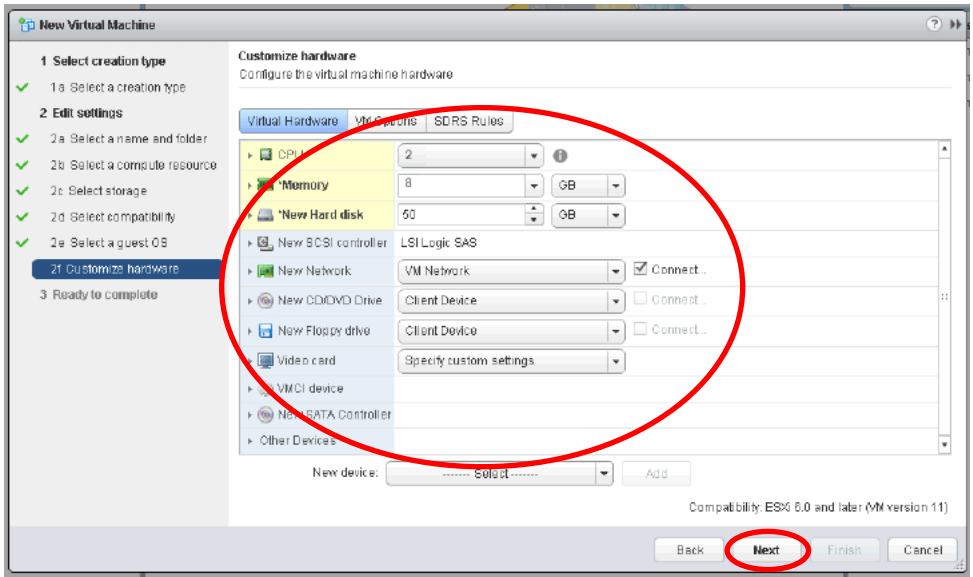


Figure-86 Customize hardware

Item	Information
CPU	2
Memory	8GB
New Hard disk	50GB

Table-41 Values for the "Customize hardware" setting

9. In [Ready to complete], click [Finish].
When a virtual machine is powered on, it is automatically registered to the ETERNUS SF system.

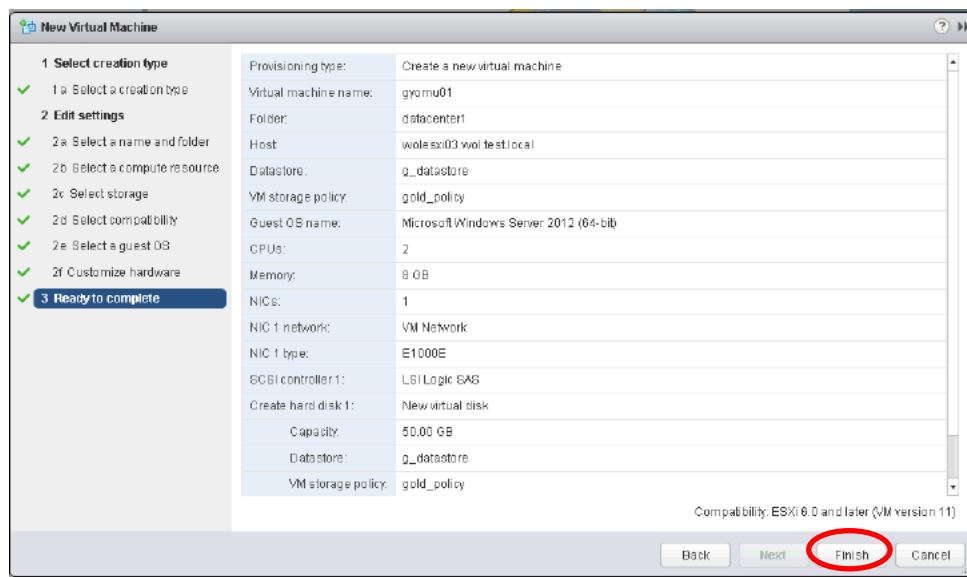


Figure-87 Ready to complete

10. Install and set up Windows Server 2012 R2.
Create new virtual machines or clone the created virtual machine to prepare the required number of virtual machines.

Checklist

Confirm the following item.

- On vSphere Web Client, clicking [VMs and Templates] in [Home] displays the created virtual machines.

2.3 Operational Procedure

2.3.1 Virtual Machine Backup/Restore Procedure

■ Backing up snapshots/clones

1. On the virtual machine, create a file for confirming that a backup/restore has been successfully executed.

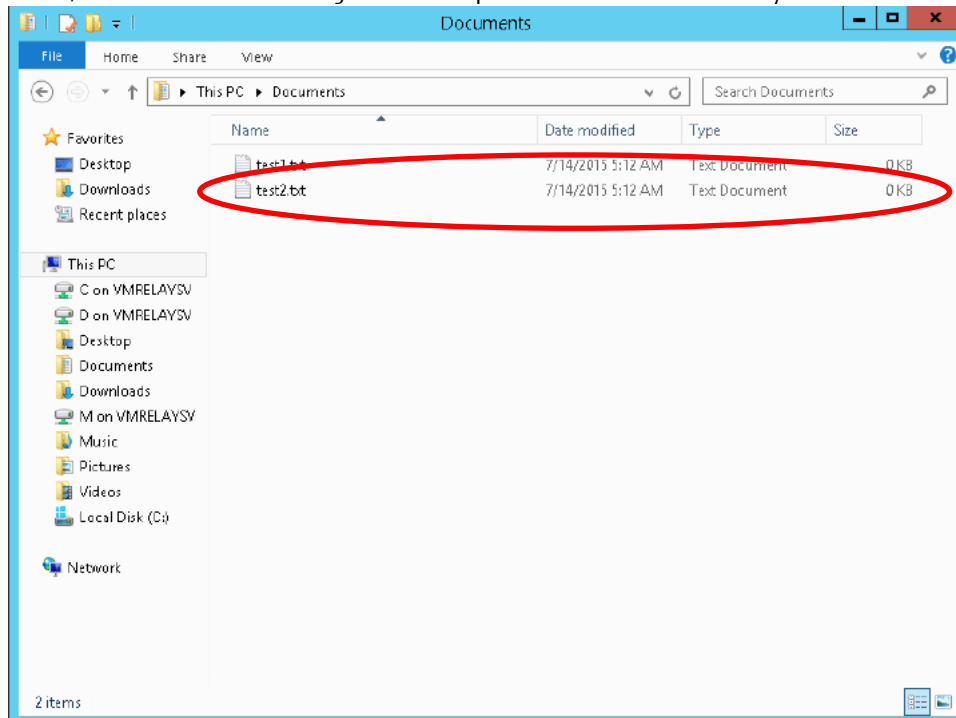


Figure-88 Creating a file for confirmation

2. In the global navigation tab, click [Storage].
On the Category pane, click [VVOL Management].

- On the Category pane, click [VVOL Backup Management].

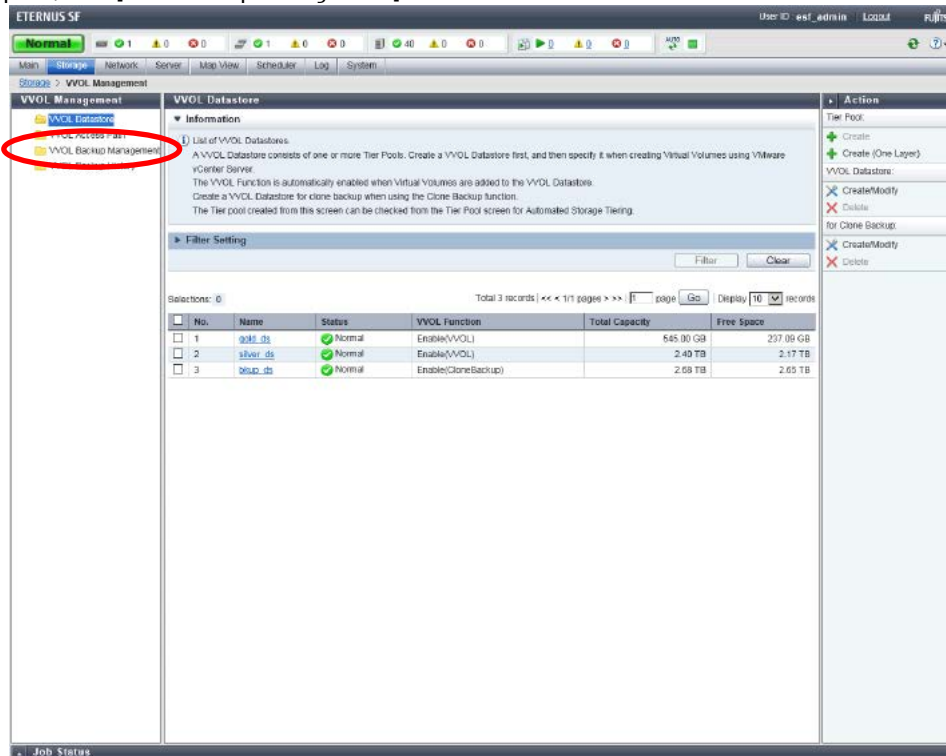


Figure-89 VVOL Management

- On the Main pane, select a virtual machine to back up.
On the Action pane, click [Execute] under [Manual Execution].

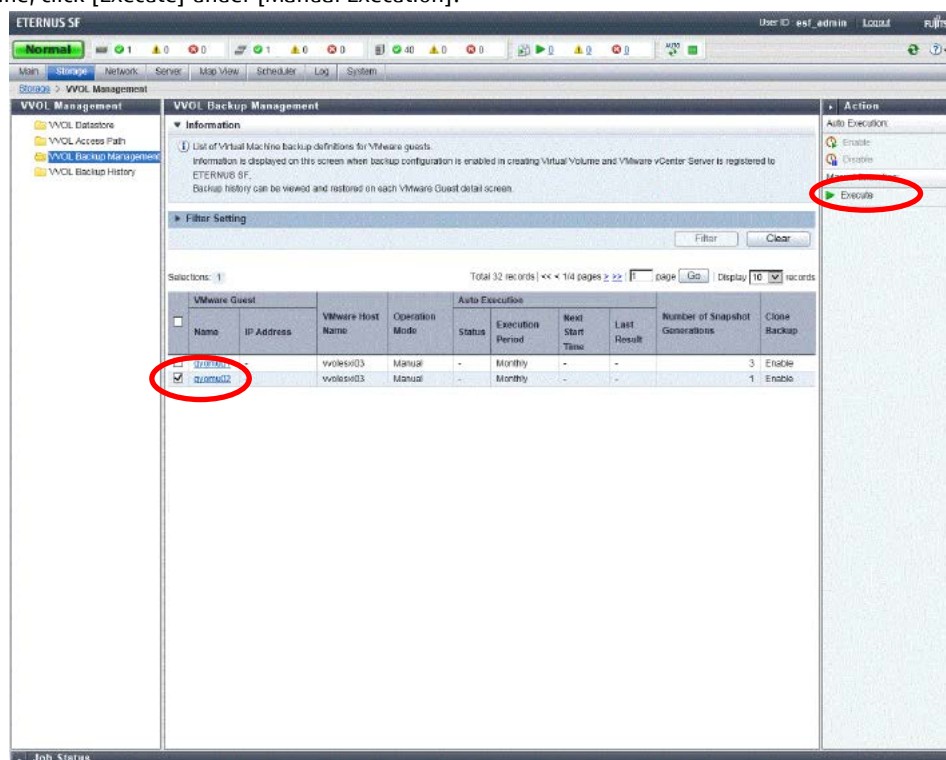


Figure-90 VVOL Backup Management

- The warning dialog box is displayed. Confirm that the backup operation will not cause a problem, and then click [OK].

6. A message is displayed to inform that the process has been accepted. Click the [Done] button.

Points

Check the Job Status pane and make sure that the result changes to [Success] before proceeding to the next procedure. For details on how to use the Job Status pane, refer to "2.2.1.2 Checking the Common Processes of the ETERNUS SF Web Console Operations".

Checklist

Confirm the following items.

- On the Main pane of the [VVOL Backup History] screen, the snapshot backup history list displays the snapshot backups.
- On the Main pane of the [VVOL Backup History] screen, clicking the [Clone Backup History] tab displays the clone backups in the clone backup history list.

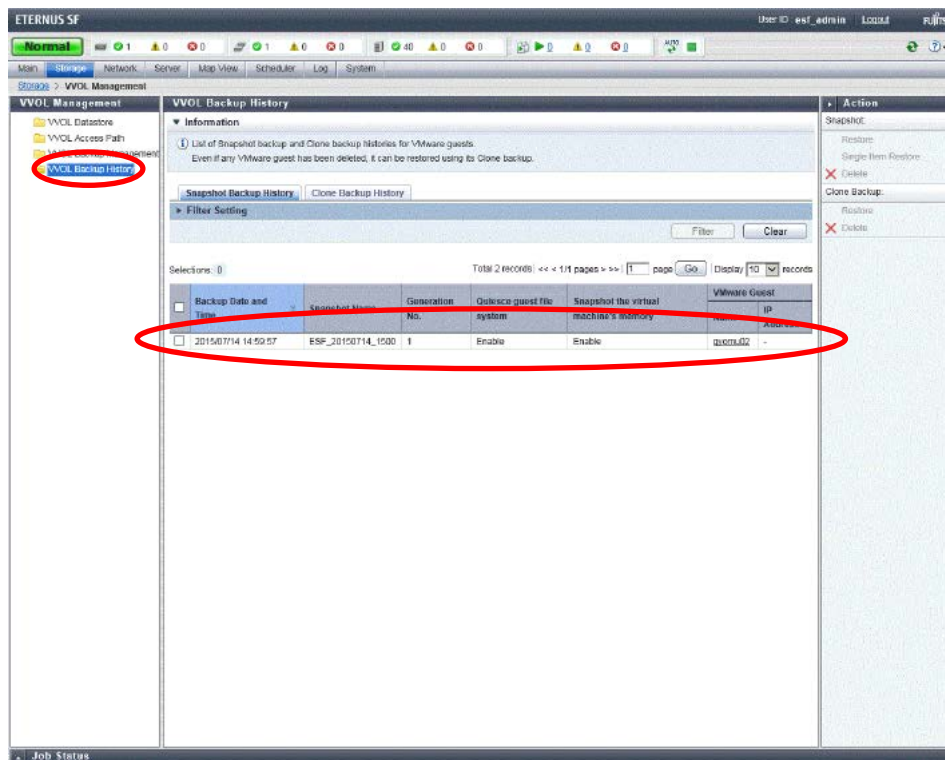


Figure-91 Snapshot Backup History

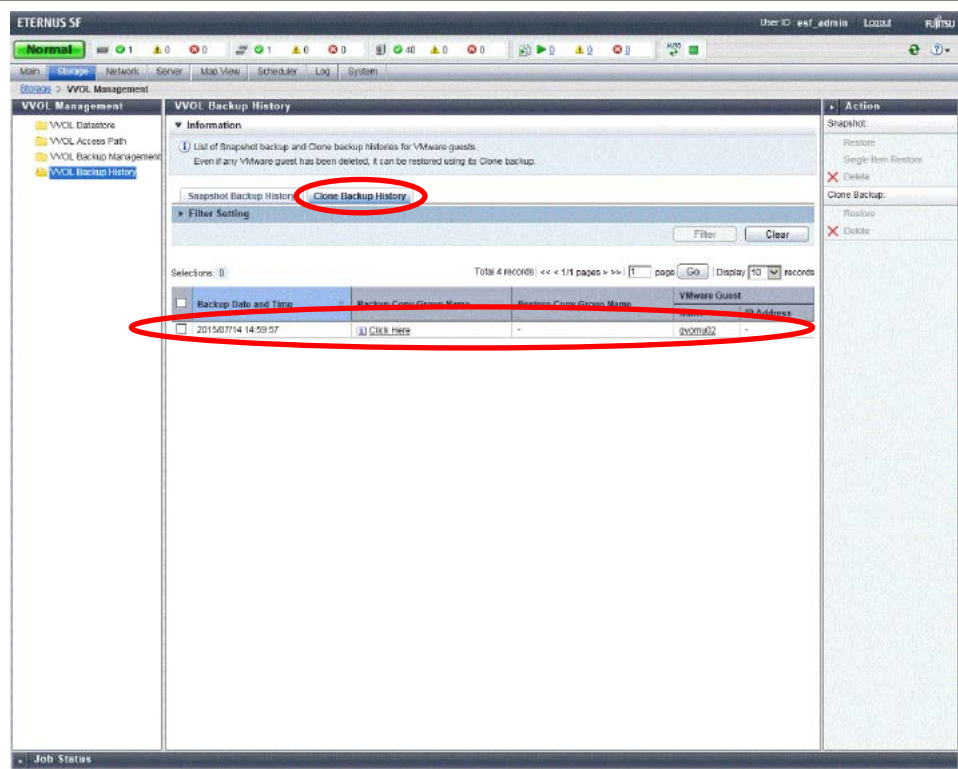


Figure-92 Clone Backup History

■ Restoring snapshots

1. On the virtual machine, delete the file created for confirmation in Step 1 of the "Backing Up Snapshots/Clones" procedure.

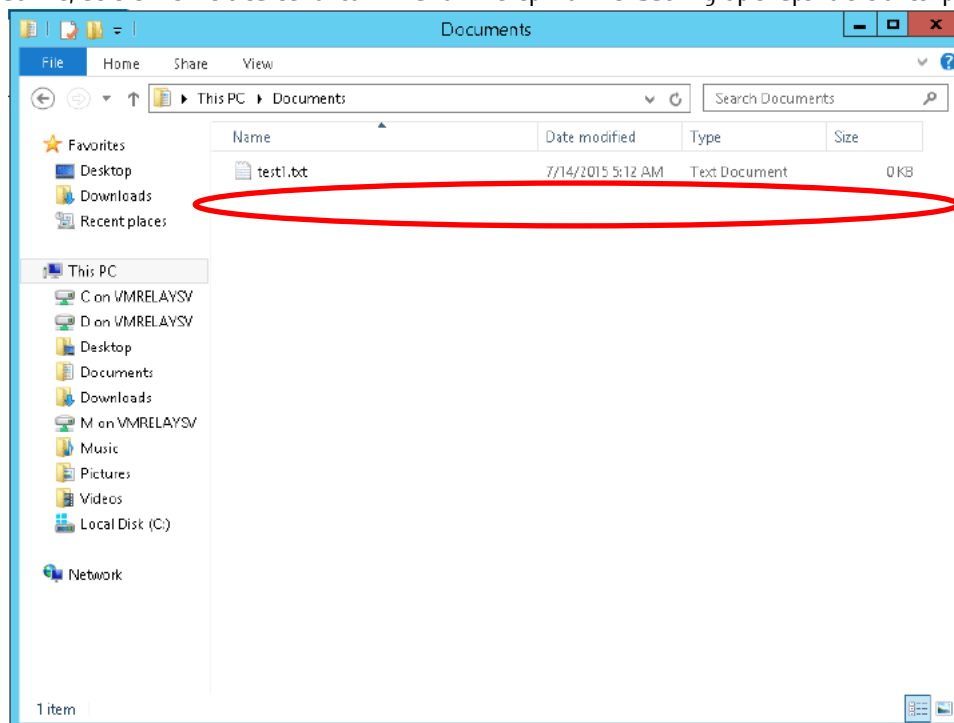


Figure-93 Deleting the file for confirmation

2. In the global navigation tab, click [Storage].
On the Category pane, click [VVOL Management]. This changes the items of the Category pane to items related to VVOL management.
3. On the Category pane, click [VVOL Backup Management].
Select a snapshot backup to restore, and then click [Restore] under [Snapshot] on the Action pane.

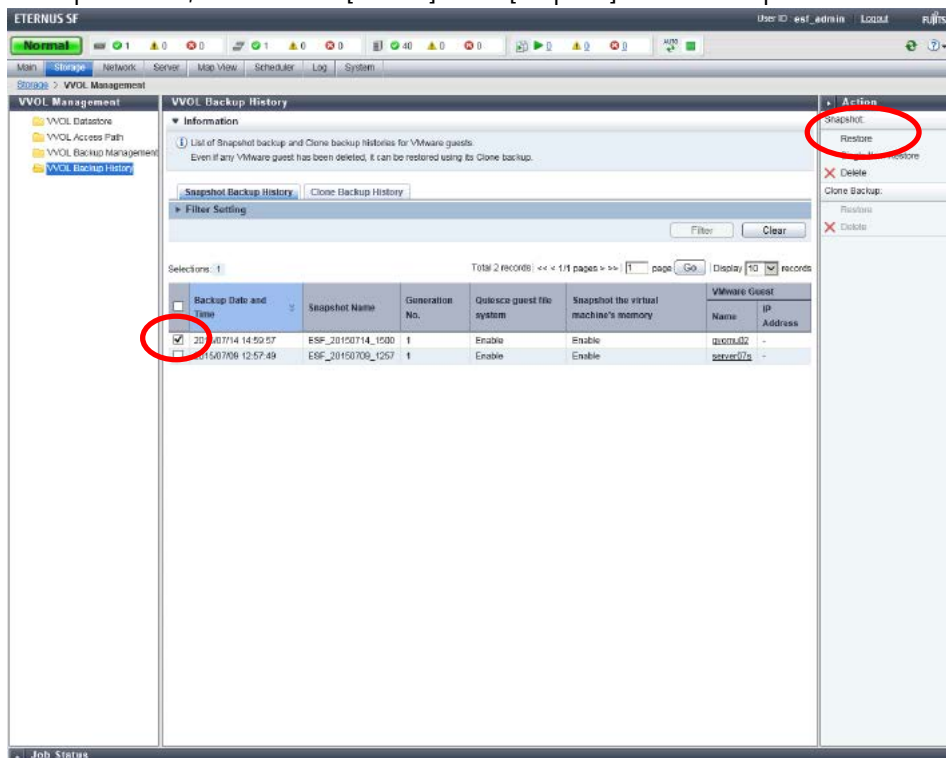


Figure-94 Snapshot Backup History

4. The warning dialog box is displayed. Confirm that the backup operation will not cause a problem, and then click [OK].

5. A message is displayed to inform that the process has been accepted. Click the [Done] button.

Points

Check the Job Status pane and make sure that the result changes to [Success] before proceeding to the next step.
For details on how to use the Job Status pane, refer to "2.2.1.2 Checking the Common Processes of the ETERNUS SF Web Console Operations".

6. Power on the restored virtual machine, and then check that the file for confirmation that was deleted on the virtual machine is restored.

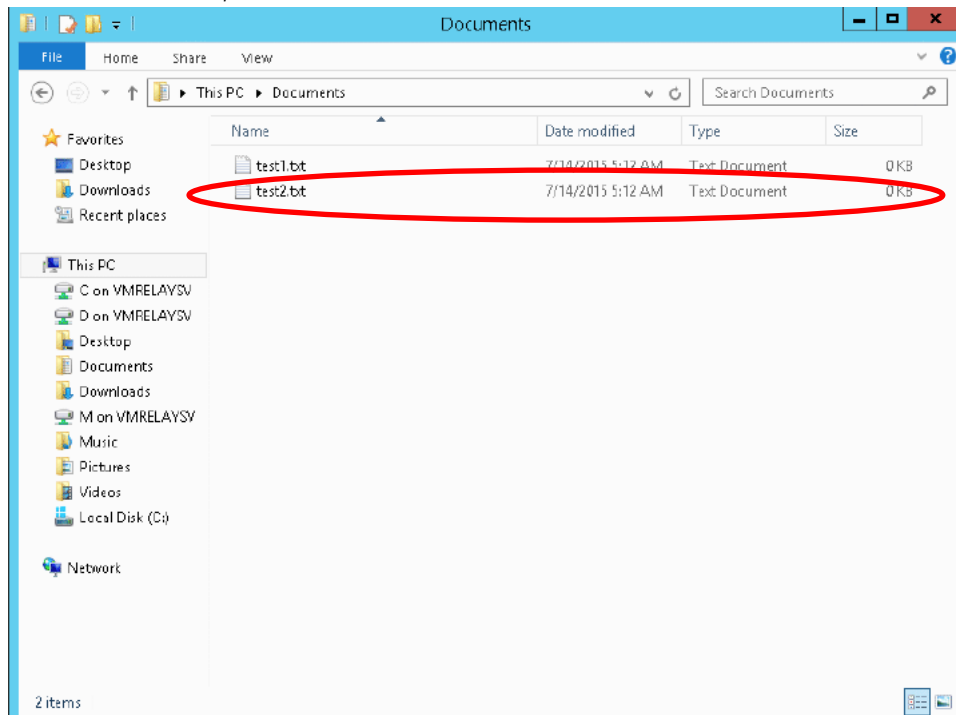


Figure-95 Restoring the file for confirmation

■ Restoring clone backups

1. On the virtual machine, delete the file created for confirmation in Step 1 of the "Backing Up Snapshots/Clones" procedure.

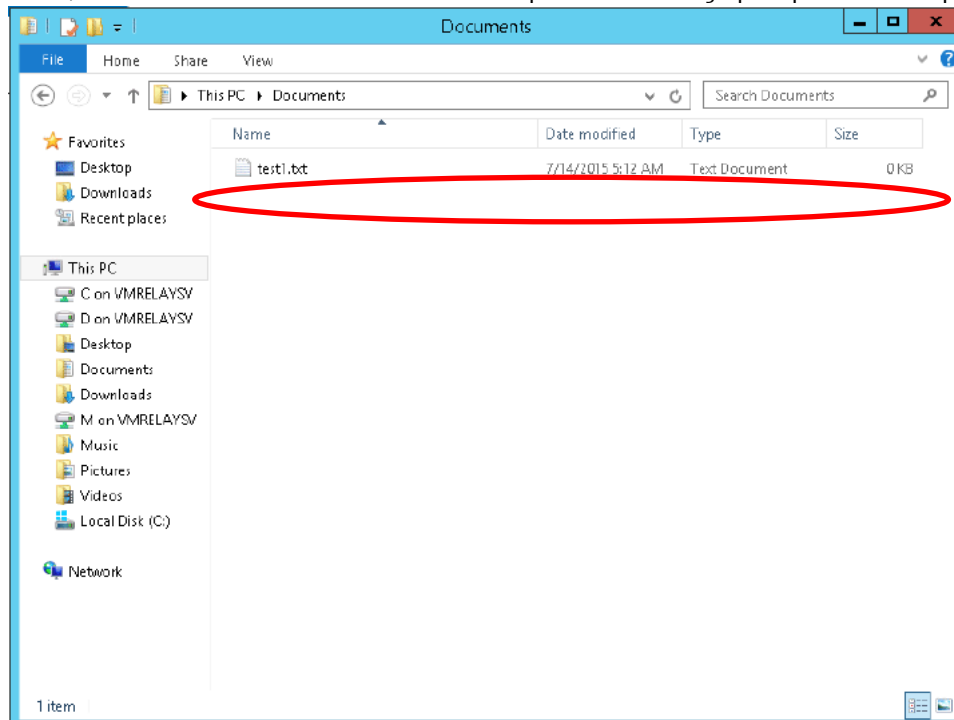


Figure-96 Deleting the file for confirmation

2. Shut down the virtual machine and then on vCenter Web Client, make sure that the virtual machine to be restored is powered off.
3. In the global navigation tab, click [Storage]. Then, on the Category pane, click [VVOL Management].
4. On the Category pane, click [VVOL Backup History]. Then, on the Main pane, click the [Clone Backup History] tab.

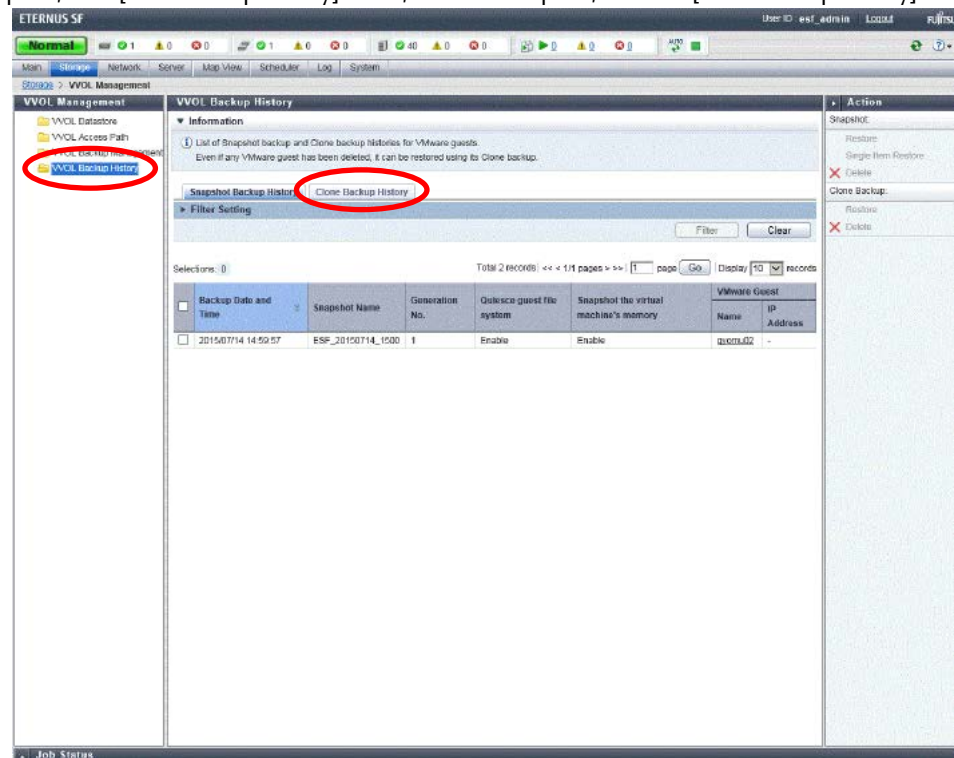


Figure-97 VVOL Backup History

5. In [Clone Backup History], select a clone backup to restore.
Then, on the Action pane, click [Restore] under [Clone Backup].

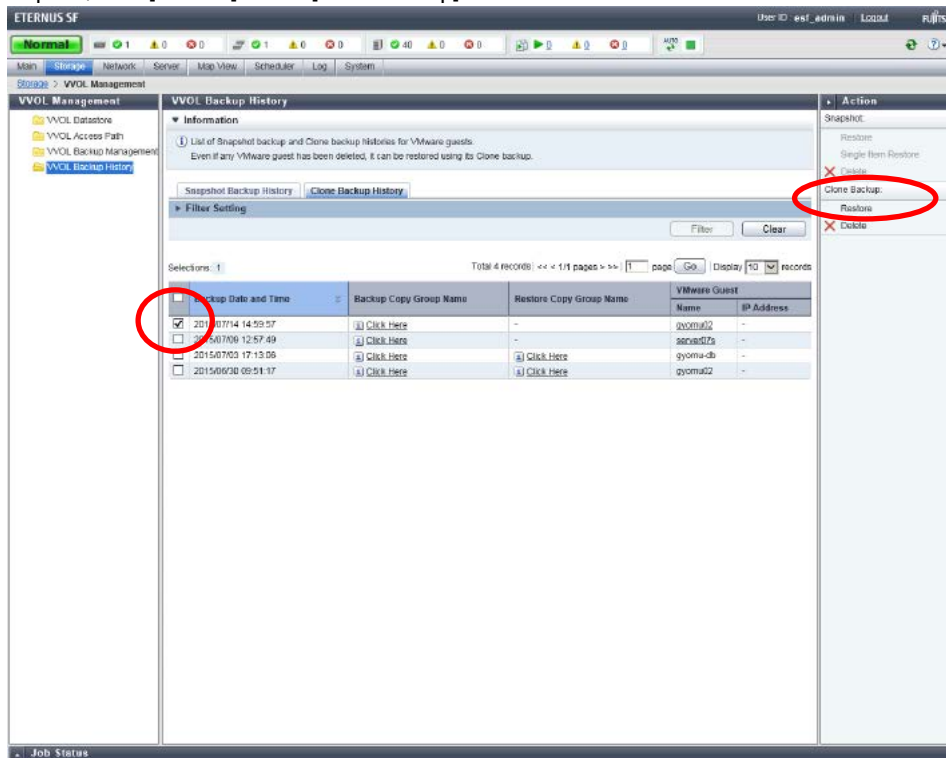


Figure-98 Clone Backup History

6. Enter the VMware guest name for the restore destination, and then click the [Restore] button.

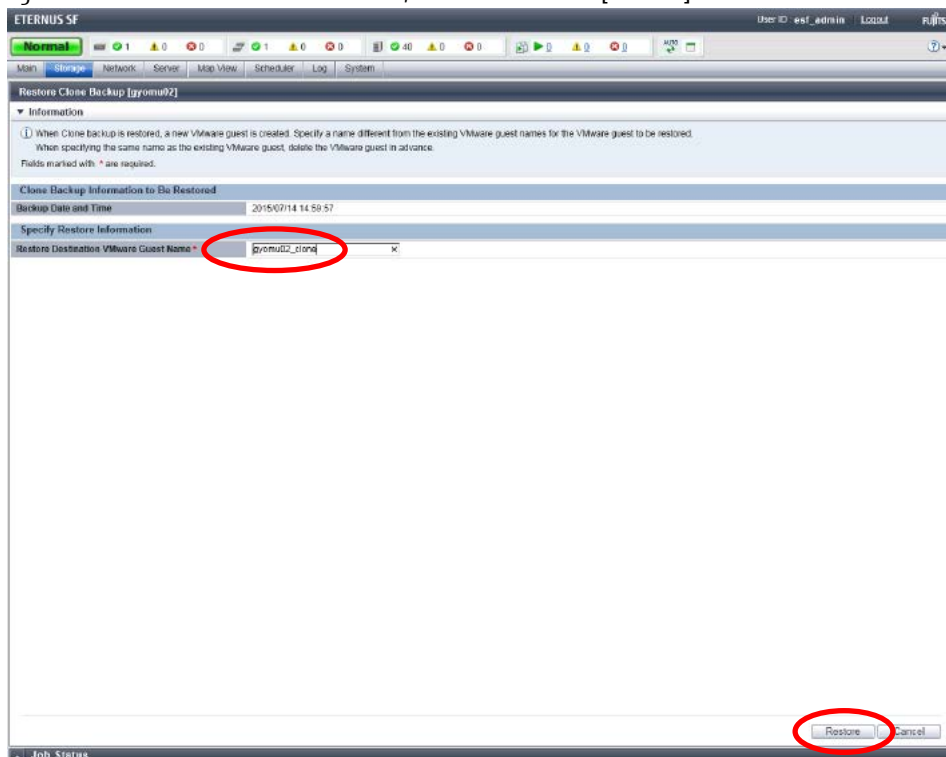


Figure-99 Restore Clone Backup

7. A message is displayed to inform that the process has been accepted. Click the [Done] button.

Points

Check the Job Status pane and make sure that the result changes to [Success] before proceeding to the next step.
For details on how to use the Job Status pane, refer to "2.2.1.2 Checking the Common Processes of the ETERNUS SF Web Console Operations".

8. On vCenter Web Client, check the restored virtual machine.

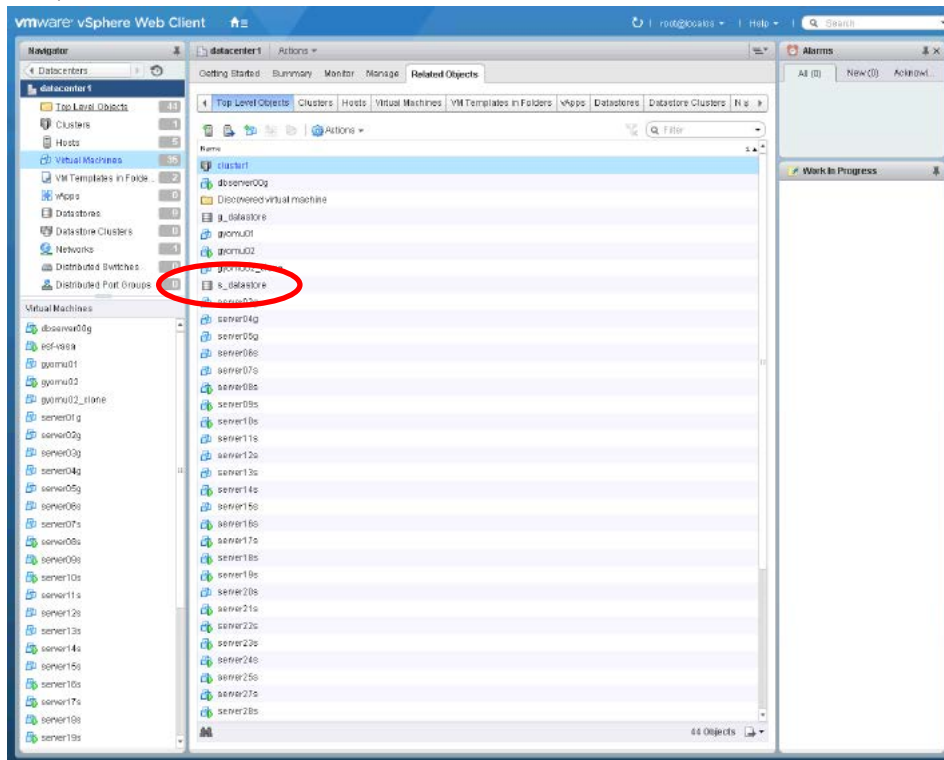


Figure-100 Checking the restored virtual machine

9. Power on the restored virtual machine, and then check that the file for confirmation that was deleted on the virtual machine is restored.

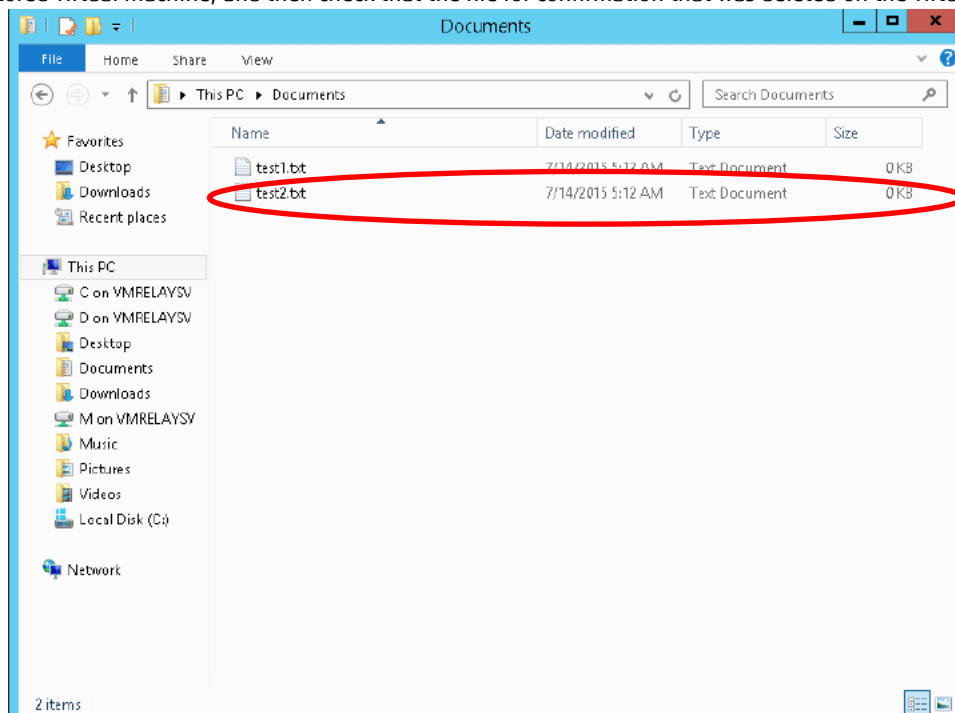


Figure-101 Restoring the file for confirmation

- *1 For a virtual machine that was restored from a clone backup, the following actions may be required depending on the OS:
 - Microsoft Windows : Depending on the version, "Status: 0xc000000e (or 0xc0000225)" may be displayed on the virtual machine console of vSphere Web Client, and the virtual machine may not start up.
 - Linux OS : For cloned virtual machines, a new MAC address is assigned to the network adapter. Because the MAC address and the OS setting is different, the network becomes unavailable. Modify the network settings according to the OS version before using the network.

For details on how to solve the above problems, refer to the VMware Knowledge Base and the OS's manual.

- *2 After the file is restored, delete any unnecessary virtual machines.

■ Restoring a single item

1. On the virtual machine, delete the file created for confirmation in Step 1 of the "Backing Up Snapshots/Clones" procedure.

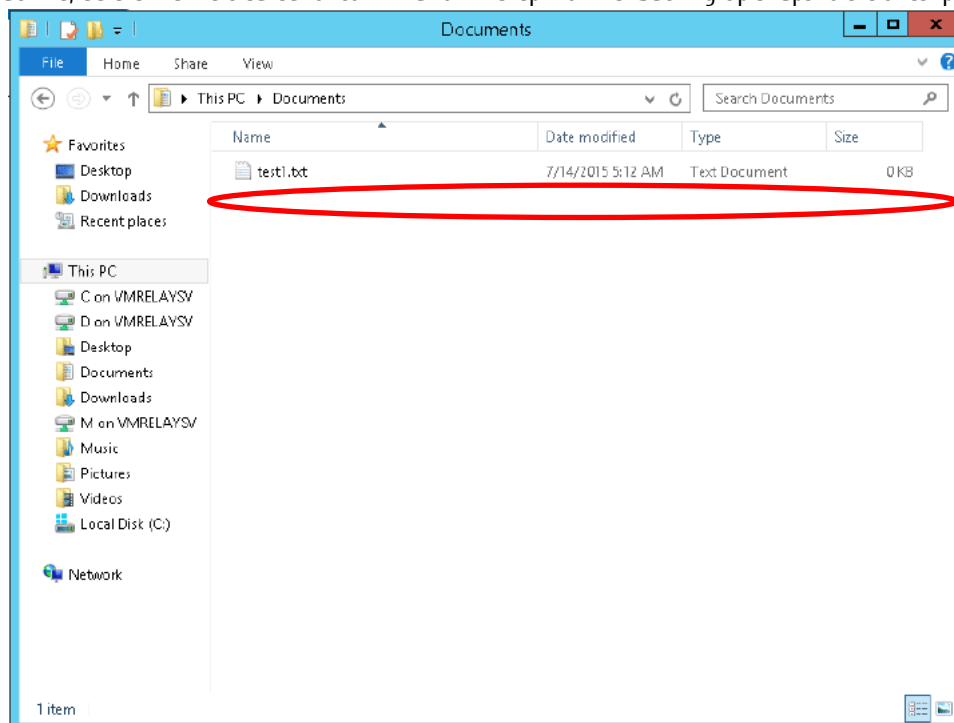


Figure-102 Deleting the file for confirmation

2. In the global navigation tab, click [Storage].
On the Category pane, click [VVOL Management].
3. On the Category pane, click [VVOL Backup Management].
Select a snapshot backup to restore, and then click [Single Item Restore] under [Snapshot] on the Action pane.

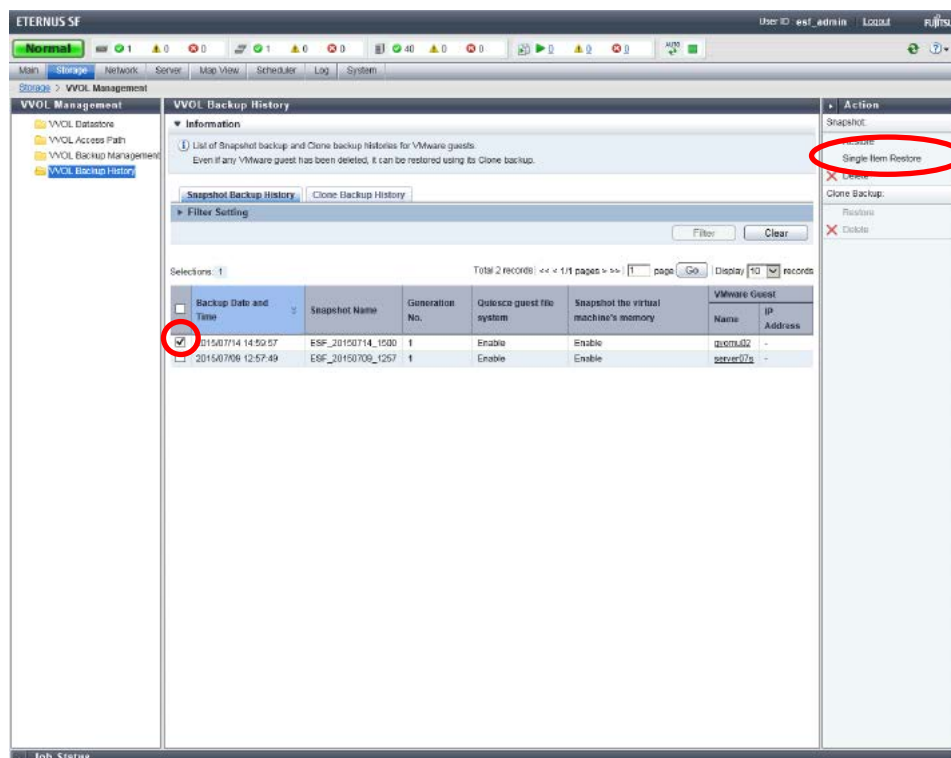


Figure-103 Snapshot Backup History

4. Set [Allocation duration of temporary volume] to 24 and in the VMDK file list, select the VMDK file to restore. Then, click the [Restore] button.

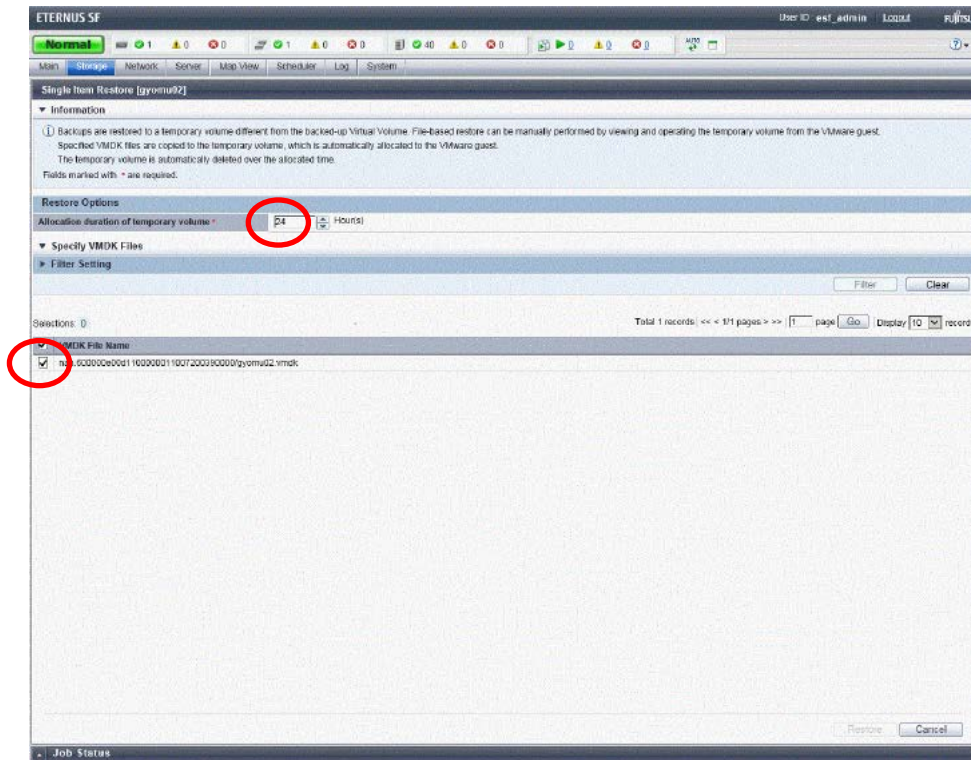


Figure-104 Restore

5. A message is displayed to inform that the process has been accepted. Click the [Done] button.

Points

Check the Job Status pane and make sure that the result changes to [Success] before proceeding to the next step.

6. In the virtual machine, right-click [Start], and then click [Computer Management].

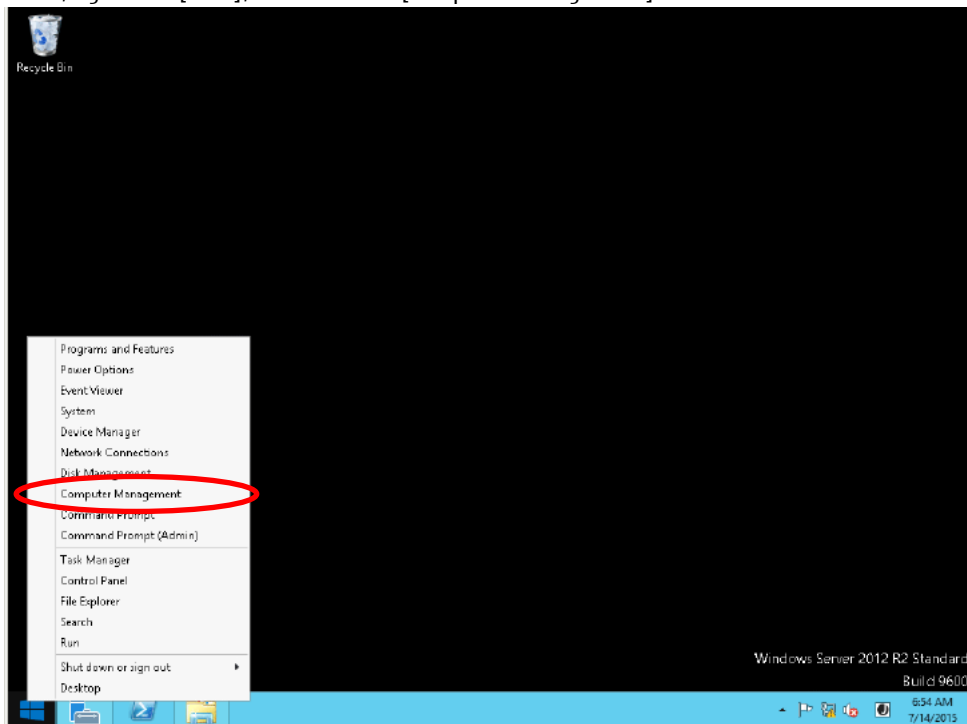


Figure-105 Desktop

7. In the tree pane, right-click [Disk Management], and then click [Rescan Disks] in the menu.

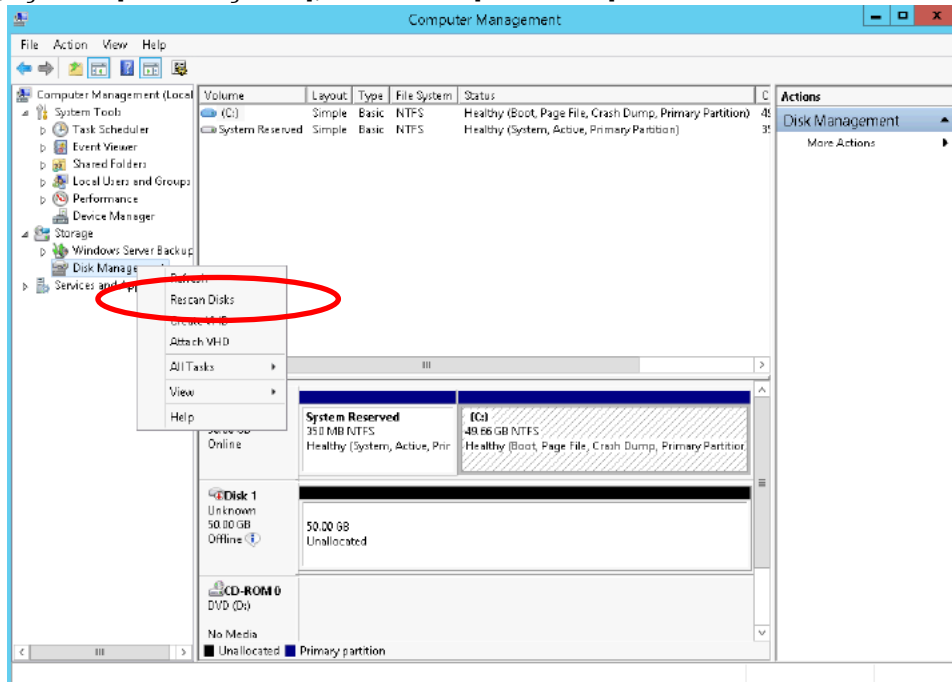


Figure-106 Computer Management

8. On the Menu List pane, right-click [Disk 1], and then click [Online] in the menu.
This mounts the temporary volume that was assigned on ETERNUS SF Web Console.

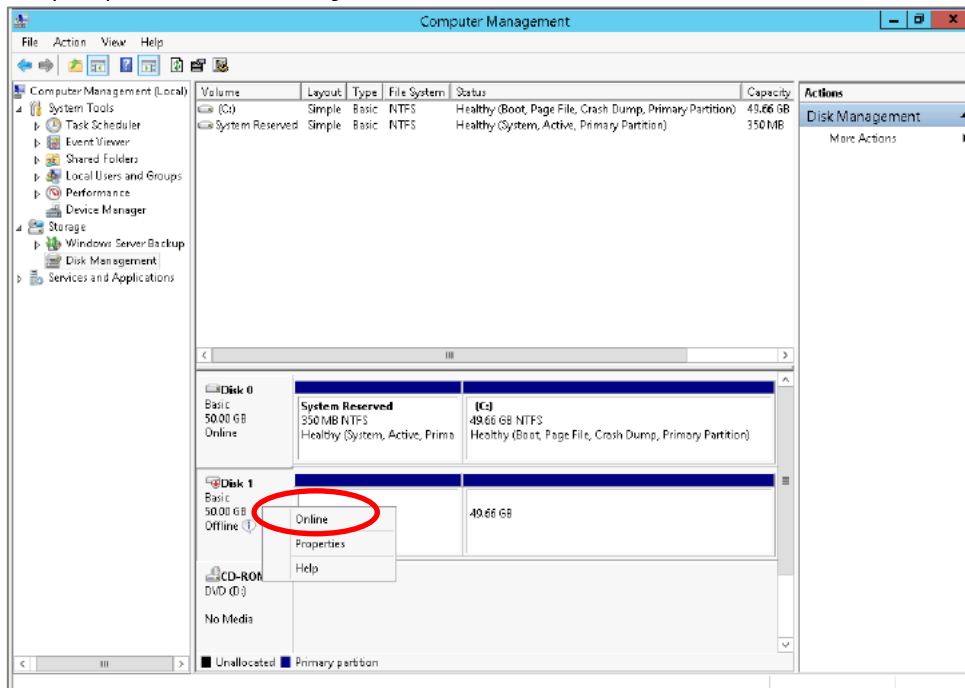


Figure-107 Mounting the temporary volume

9. Check the mounted temporary volume in Explorer.

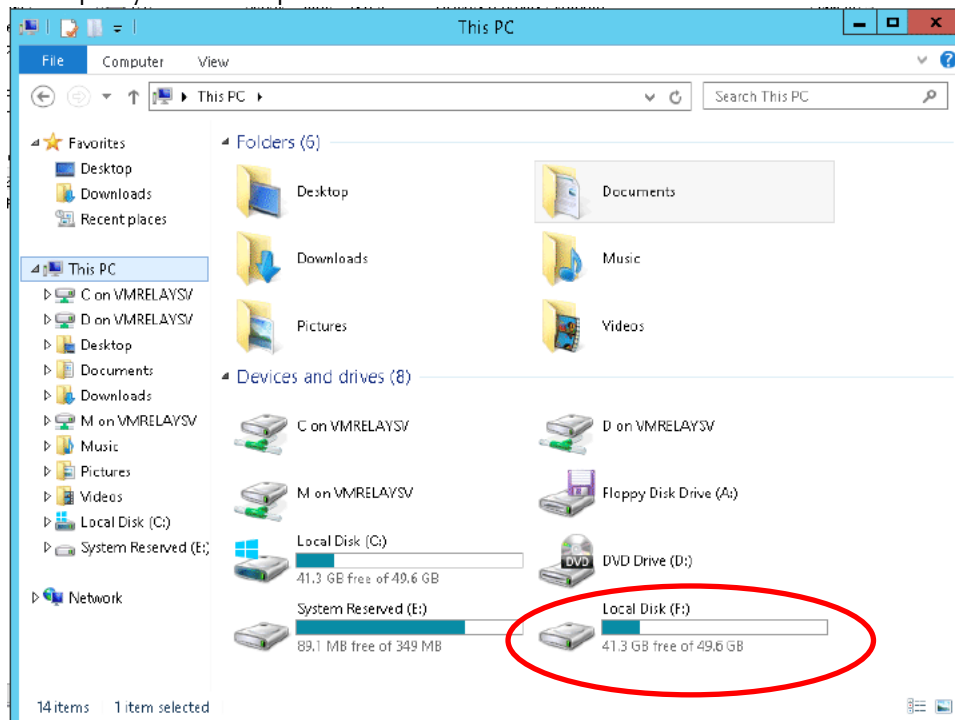


Figure-108 Checking the temporary volume

10. Copy the file from the temporary volume to the restore destination.

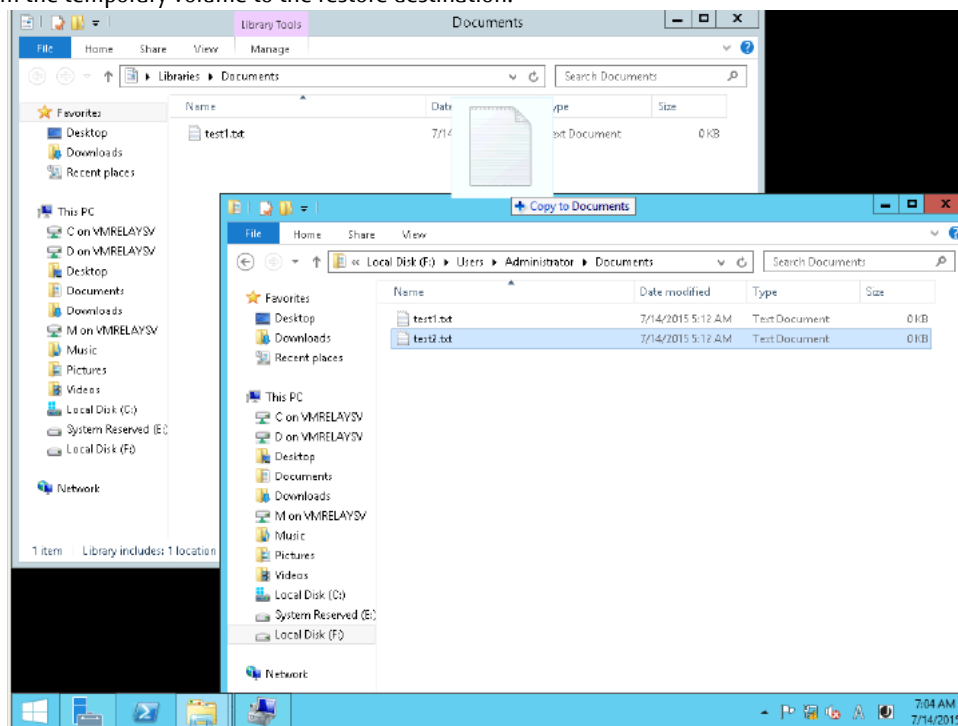


Figure-109 Copying the file

11. Check that the restore is successfully completed.

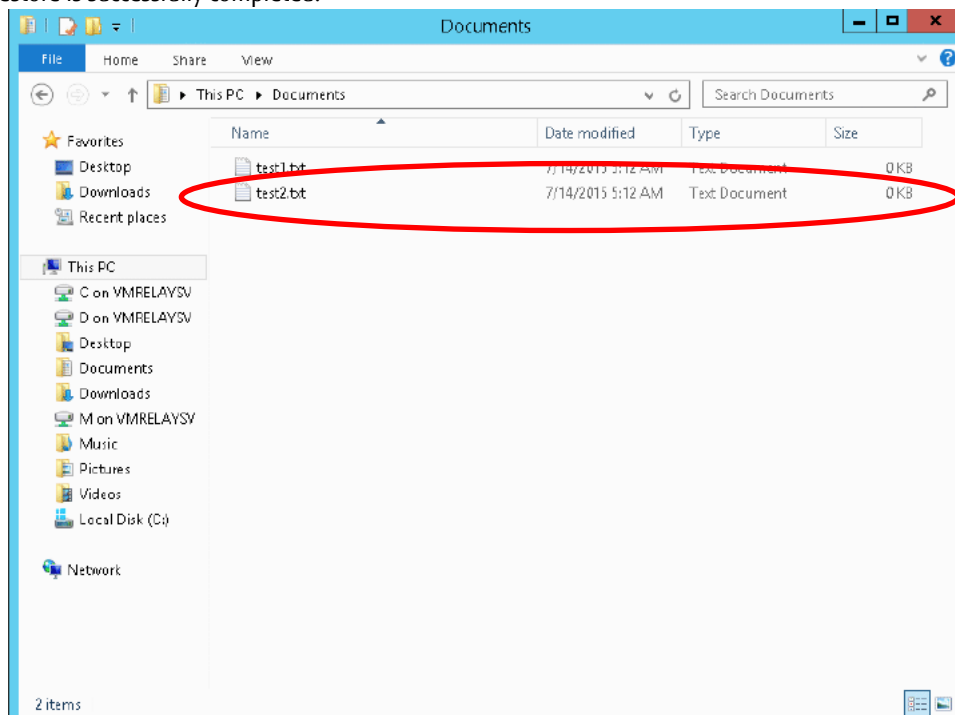


Figure-110 Checking the restored file

12. Repeat Steps 7 and 8 to display the [Disk Management] screen.
 Right-click [Disk 1] and then in the menu, click [Offline].
 This unmounts the temporary volume that was assigned on ETERNUS SF Web Console.

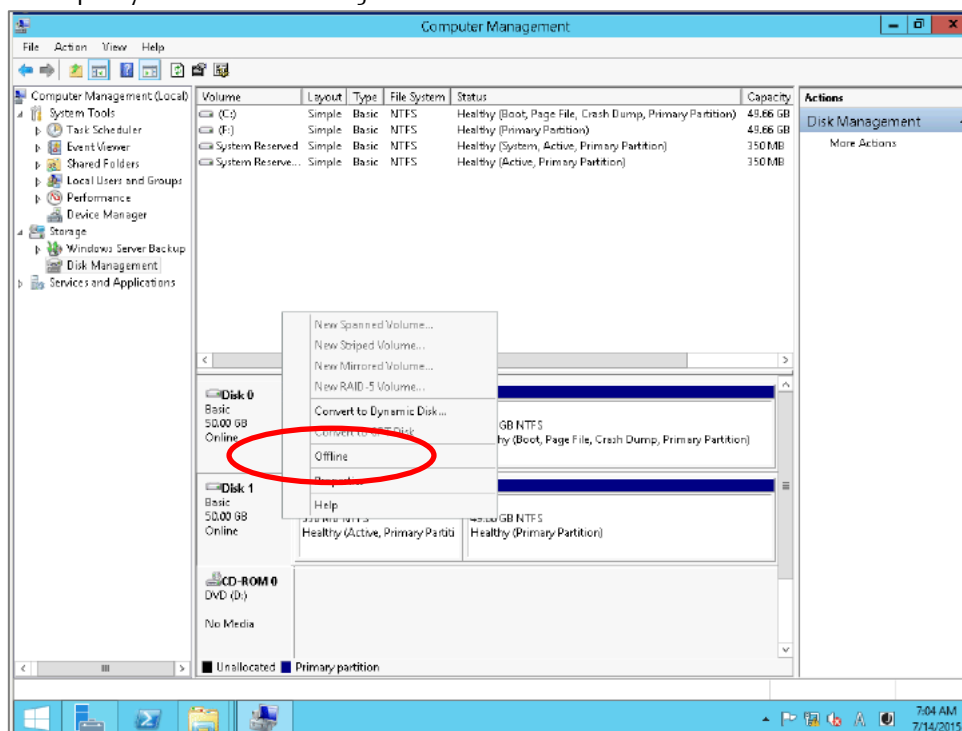


Figure-111 Unmounting the temporary volume

13. Delete the temporary volume.
In the global navigation tab, click [Scheduler].
On the Main pane, select a task. Then, on the Action pane, click [Execute immediately] under [Operation].

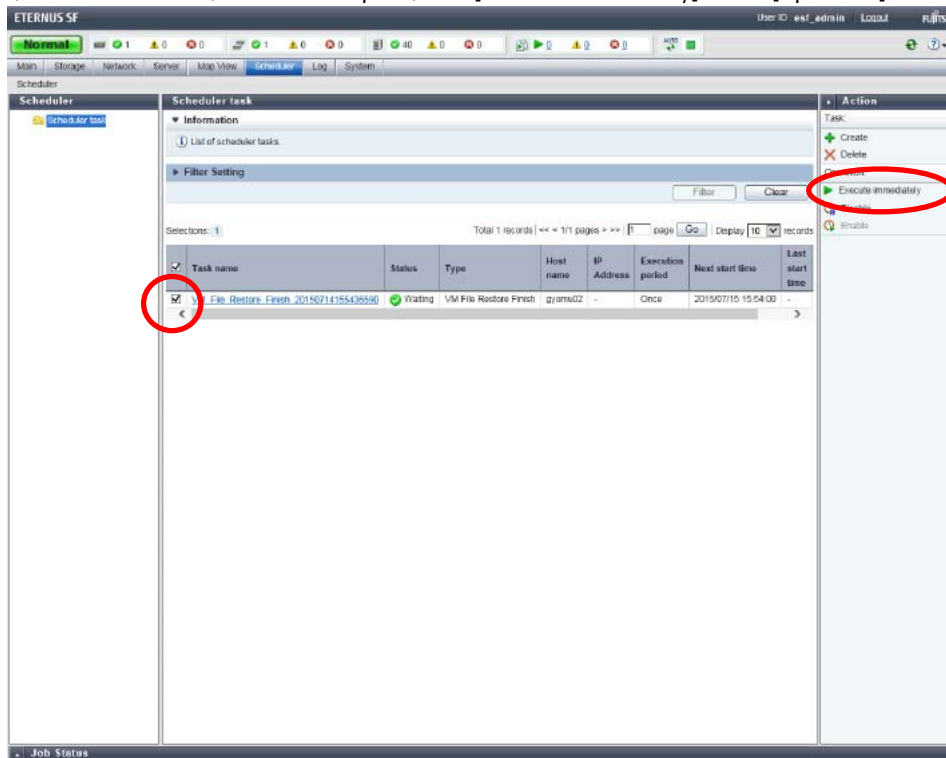


Figure-112 Scheduler task

14. Check the operation to be executed, and then click the [Execute] button.
15. In the message notifying the immediate execution of the scheduler task, click the [Done] button.

Points

Check the Job Status pane and make sure that the result changes to [Success] before proceeding to the next procedure. For details on how to use the Job Status pane, refer to "2.2.1.2 Checking the Common Processes of the ETERNUS SF Web Console Operations".

Checklist

- Confirm the following items.
- On the Main pane of the [Scheduler] screen, no scheduler tasks are displayed.
 - The temporary volume is unmounted.

3 Verification of the VVOL Reference Architecture

A test was performed for environments configured using this reference architecture to determine whether the environments were able to support the load and the operation of the various functions that are expected in actual operations.

In VVOL environments, operations to create clones and snapshots of virtual machines are offloaded to the storage system.

The difference between the conventional VMFS datastore process and the VVOL datastore process was tested by offloading operations to the VVOL environment storage system.

- Tested items
- Load while creating virtual machine clones
 - Performance while using snapshots

3.1 Confirming the Normal Operation of the 30 Virtual Machines

30 virtual machines were tested under expected loads from the following business systems and all the virtual machines were confirmed to operate normally in this configuration.

No.	Storage/VVOL		Server vCPU	Assumed application
	GOLD	SILVER		
1	2		2 vCPUs	File server
2	2		2 vCPUs	Document server
3	1		2 vCPUs	Audit trail server
4		2	2 vCPUs	External connection server
5		1	2 vCPUs	Job execution server
6		8	2 vCPUs	FEP server
7		4	2 vCPUs	Web server
8		8	2 vCPUs	AP server
9	2		4 vCPUs	Database (OLTP mainly performing reference work)

3.2 Confirming the Operation of VMware vSphere 6.0

VMware vSphere 6.0 was confirmed to operate without any problems in this configuration by checking the following items.

- Storage vMotion operations between VVOL and VMFS

Migrating virtual machines between different datastores formats, VVOL (volume) datastore and VMFS (file system) datastore, was tested. The following operations were tested and confirmed that Storage vMotion was executable between a VVOL datastore and a VMFS datastore.

- Powered-off virtual machines: Cold migration from a VVOL datastore to a VMFS datastore*
- Cold migration from a VMFS datastore to a VVOL datastore*
- Powered-on virtual machines: Storage vMotion from a VVOL datastore to a VMFS datastore*
- Storage vMotion from a VMFS datastore to a VVOL datastore*

* A "Datastore does not match current VM policy" message is displayed while migration is performed.

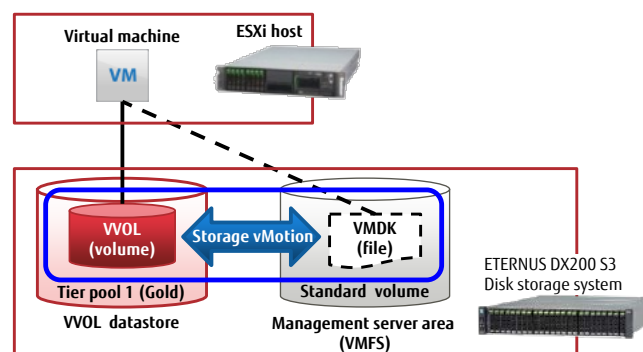


Figure-113 Confirmation of Storage vMotion

- Failover for the operation management server due to vSphere HA

The availability of vSphere HA was tested for situations where an operation management server and a business server were installed on the same ESXi host.

An operation management server is necessary for virtual machine operations that use VVOLs. This is why an operation management server was placed on the VMFS.

These virtual machines were tested to determine whether they were started in different ESXi hosts when a failover was performed for the ESXi host that has business servers that use VVOLs and an operation management server that uses the VMFS.

The following items were tested and confirmed that vSphere HA was valid even in VVOL environments.

- Whether a different ESXi host can start these virtual machines after a failover is performed for an ESXi host that runs a business server
- Whether a different ESXi host can start these virtual machines after an error was deliberately generated in an ESXi host that runs the operation management server, the vCenter server, and a business server

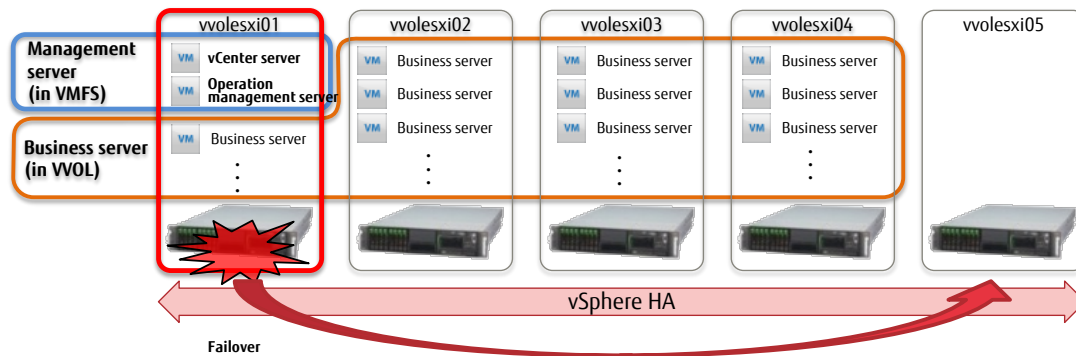


Figure-114 vSphere HA for the operation management server

3.3 Load during the Creation of Virtual Machine Clones

The load on the storage system from creating virtual machine clones on a VVOL datastore and from creating virtual machine clones on a VMFS datastore were tested.

Conditions for the measurement

- Multiple virtual machine clones are created by a single ESXi host
- The clone source is a virtual machine
- The clone source and clone destination virtual machines are placed in a datastore (gold)
- For a VMFS datastore, a standard volume created in the Flexible Tier Pool (one layer) is used to match the configuration of a VVOL datastore (gold)

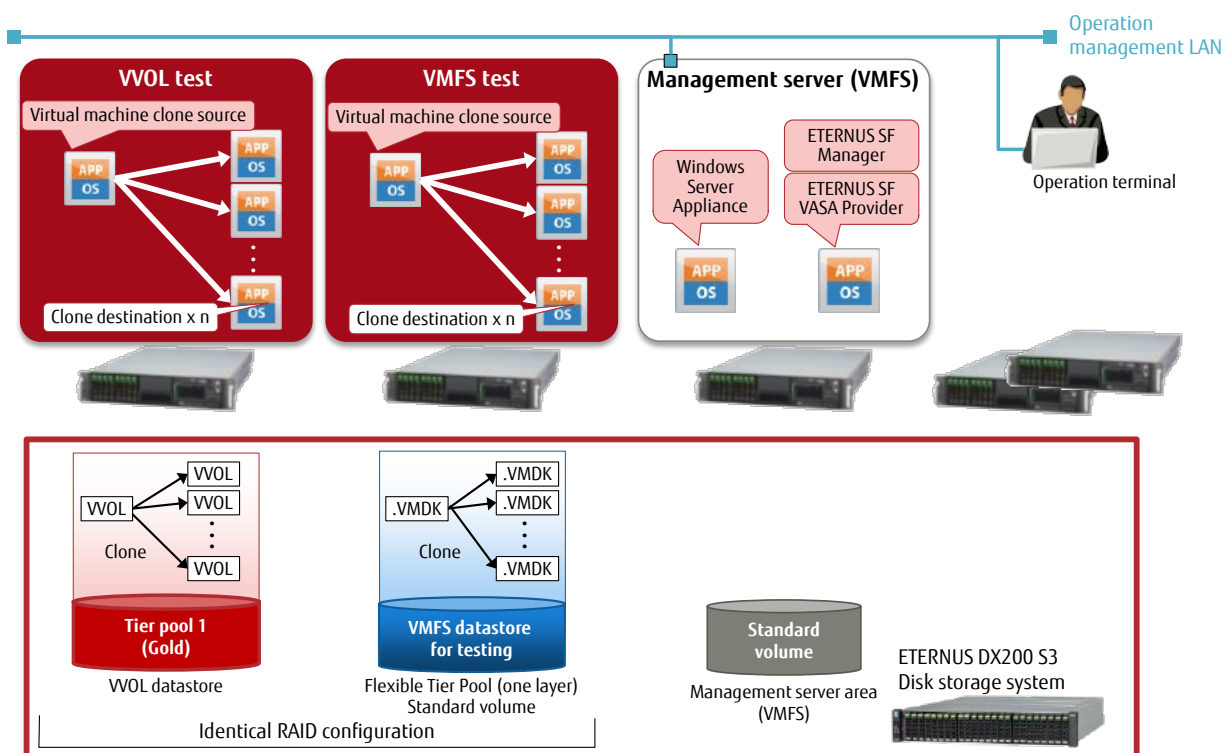


Figure-115 Test configuration for creating clones

The following graph shows the load (or the CPU usage of the entire storage system) in the ETERNUS DX200 S3's controller module (CM) that was measured when one virtual machine clone was created and when three, five, or more than five virtual machine clones were created at the same time from vCenter Server.

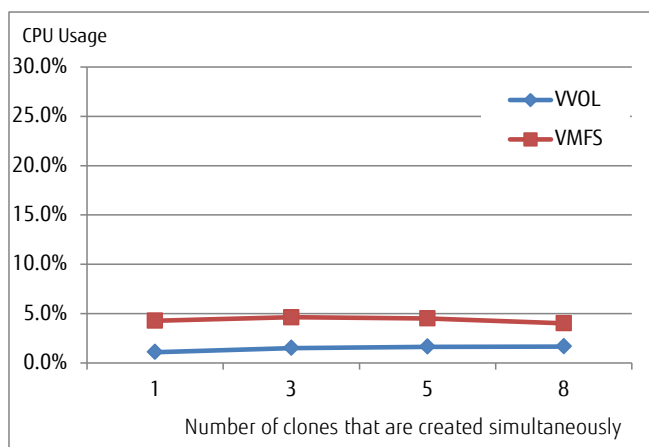


Figure-116 CM load rate during the creation of clones

For both VVOL and VMFS, the CM load was low even if multiple virtual machine clones were created at the same time. In addition, increasing the number of virtual machines to be cloned at the same time did not dramatically change the load on the storage system.

3.4 Snapshot Comparison

I/O performance was compared between VVOL and VMFS datastores when multiple snapshots for a single virtual machine were created. The following graphs show changes in access performance from the virtual machine to the storage system as the number of snapshots to be created increases.

Conditions for the measurement

- Same configuration as "Figure-115 Test configuration for creating clones"
- Multiple snapshots for a single virtual machine are created
- Snapshots are stored in the same datastore as the virtual machine
- IOPS values are measured with random accesses of 50% Read and 50% Write on the virtual machine

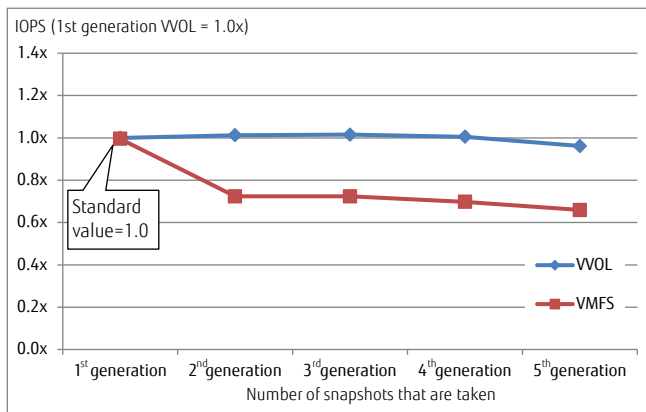


Figure-117 Number of snapshots and the write performance

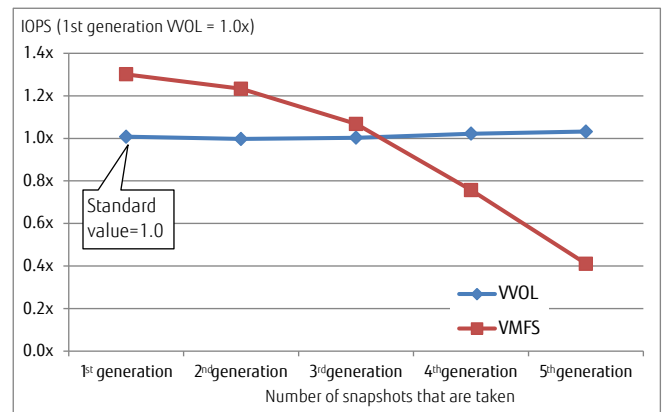


Figure-118 Number of snapshots and the read performance

"Figure-117 Number of snapshots and the write performance" and "Figure-118 Number of snapshots and the read performance" use the IOPS value of the first VVOL snapshot generation as the standard value (1.0x).

For VMFS, the read performance tends to decrease as the number of snapshots increases, and for the fourth and later generations, the performance is lower than that of VVOL.

On the other hand, for VVOL, an increase in the number of snapshots does not affect the write/read performance.

This is because with VVOLs, snapshots differences are managed on the ETERNUS AF/DX side.

By managing snapshots differently from VMware vSphere, regardless of an increase in the number of snapshots, snapshot backup operations are performed without a reduction in performance.

3.5 Conclusion

This reference architecture configuration was confirmed usable by the tests shown above.

4 Notes

1. Tier pools and volumes that can be used in the ETERNUS AF/DX

- The following table shows the number of Tier pools that can be registered in each storage system model.

Storage system	Maximum number of Tier pools	Maximum number of sub-pools	Maximum pool capacity
ETERNUS AF150 S3	24	24	4PB
ETERNUS AF250 S3	24	132	6PB
ETERNUS AF650 S3	64	256	24PB
ETERNUS DX100 S5	30	72	4PB
ETERNUS DX200 S5	30	132	6PB
ETERNUS DX500 S5	60	256	16PB
ETERNUS DX600 S5	64	256	24PB
ETERNUS DX900 S5	64	256	128PB
ETERNUS AF250 S2	24	24	2,048TB
ETERNUS AF650 S2	96	96	8,192TB
ETERNUS DX100 S4	30	72	2,048TB
ETERNUS DX200 S4	30	132	2,048TB
ETERNUS DX500 S4	60	256	3,072TB
ETERNUS DX600 S4	64	256	8,192TB
ETERNUS DX8900 S4	64	256	128PB

Table-42 Maximum numbers of Tier pools in a storage system

- The following table shows the number of volumes that can be created in each storage system model.

Storage system	Maximum number of volumes in the storage system	Number of available volumes ^{*1}	Recommended number of volumes for VVOLs ^{*1}
ETERNUS AF150 S3, AF250 S3/S2	3,072	3,033	2,729
ETERNUS AF650 S3/S2	12,288	12,217	10,995
ETERNUS DX100 S5/S4	4,096	4,057	3,651
ETERNUS DX200 S5/S4	8,192	8,153	7,337
ETERNUS DX500 S5/S4	16,384	16,313	14,681
ETERNUS DX600 S5/S4			
ETERNUS DX900 S5			
ETERNUS DX8900 S4 ^{*2}	65,535	65,464	58,917

^{*1} Values when pools are configured with six RAID groups.

^{*2} For details on the support range and operation environment, contact your Fujitsu sales representative.

Table-43 Maximum numbers of volumes that can be created in a storage system

2. VMware vCenter Server Appliance

- By default, the password for a Single Sign On user is valid for 90 days.
Change the default password policy according to the operational requirements.

Password policy setting item	Default value
Maximum lifetime	Password must be changed every 90 days
Restrict reuse	Users cannot reuse any previous 5 passwords
Maximum length	20 characters
Minimum length	8 characters
Character requirements	At least 2 alphabetic characters
	At least 1 special characters
	At least 1 uppercase characters
	At least 1 lowercase characters
	At least 1 numeric characters
	Identical adjacent characters:3

Table-44 Password policy for VMware vCenter Server Appliance

- The clocks of each component of VMware ESXi Server must be synchronized.
For SSL communications between unsynchronized servers, SSL certificates that require time synchronization are recognized as disabled and services in VMware may fail to start.

3. ETERNUS SF Storage Cruiser

- The Thin Provisioning function in the ETERNUS AF/DX must be enabled to use VVOLs.
Automated Storage Tiering must also be enabled with ETERNUS SF Manager.
(One layer Tier pool of Automated Storage Tiering becomes available for ETERNUS SF Storage Cruiser.)

For more details, refer to "3.3 Activation of Automated Storage Tiering" in "FUJITSU Storage ETERNUS SF Storage Cruiser V16.4 Operation Guide for Optimization Function".

- In vSphere HA configurations, when a VVOL datastore is mounted on vCenter Server, management volumes are automatically created in the VVOL datastore of the ETERNUS AF/DX.
When deleting a VVOL datastore from ETERNUS SF Web Console, the management volumes in vSphere HA must be deleted.
In order to delete the management volumes of vSphere HA, unmount the VVOL datastore from vCenter Server, and then execute the following ETERNUS SF Manager command.

```
storageadm volume delete -ipaddr [IP address of the ETERNUS AF/DX] -volume [volume number]
```

5 Reference

1. Product information
 - Fujitsu's ETERNUS AF series
<https://www.fujitsu.com/global/products/computing/storage/all-flash-arrays/>
 - Fujitsu's ETERNUS DX series
<https://www.fujitsu.com/global/products/computing/storage/disk/>
 - Storage Foundation Software : FUJITSU Storage ETERNUS SF
<https://www.fujitsu.com/global/products/computing/storage/software/eternus-sf/>
2. Software to download
 - ETERNUS VASA Provider 2.x
3. Related manuals
 - FUJITSU Storage ETERNUS (*Model name) Hybrid Storage Systems Configuration Guide (Basic)
 - FUJITSU Storage ETERNUS (*Model name) All-Flash Arrays Configuration Guide (Basic)
 - FUJITSU Storage ETERNUS AF S3 series All-Flash Arrays, ETERNUS DX S5 series, ETERNUS DX8100 S4/DX8900 S4 Hybrid Storage Systems Configuration Guide (Web GUI)
 - FUJITSU Storage ETERNUS AF, ETERNUS DX Configuration Guide -Server Connection- (iSCSI) for VMware® ESX
 - FUJITSU Storage ETERNUS SF Express V16.x / Storage Cruiser V16.x / AdvancedCopy Manager V16. x Installation and Setup Guide
FUJITSU Storage ETERNUS SF Express V16.x / Storage Cruiser V16.x / AdvancedCopy Manager V16.x Web Console Guide
FUJITSU Storage ETERNUS SF Express V16 / Storage Cruiser V16 / AdvancedCopy Manager V16 Troubleshooting Guide
 - FUJITSU Storage ETERNUS SF Storage Cruiser V16.x Operation Guide
FUJITSU Storage ETERNUS SF Storage Cruiser V16.x Operation Guide for VMware vSphere Virtual Volumes
FUJITSU Storage ETERNUS SF Storage Cruiser V16.x Operation Guide for Optimization Function
 - ETERNUS VASA Provider 2.x User's Guide

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