

# White Paper Online Storage Migration for Minimizing Business Downtime

This document provides an overview, the points to consider, and the procedure to use the online Storage Migration function of the FUJITSU Storage ETERNUS AF series and ETERNUS DX series.



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Preface

In recent years, as the amount of data stored in storage systems has been rapidly growing, the data migration time for storage system replacements has also been increasing. This situation makes minimizing business downtime during data migrations a challenge to tackle. The FUJITSU Storage ETERNUS AF series and ETERNUS DX series provide a migration method called online Storage Migration that can significantly reduce downtime by allowing business operations to continue while data is being migrated.

This document provides the points to consider and the migration procedure when using online Storage Migration.

■ Naming Conventions

The following abbreviations are used in this document.

- FUJITSU Storage ETERNUS AF150 S3, AF250 S3, and AF650 S3 .....ETERNUS AF S3 series
- FUJITSU Storage ETERNUS AF250 S2 and AF650 S2 .....ETERNUS AF S2 series
- FUJITSU Storage ETERNUS DX S5 series and ETERNUS DX S4 series .....ETERNUS DX S5/S4 series
- FUJITSU Storage ETERNUS DX S4 series, ETERNUS DX S3 series, and ETERNUS DX S2 series .....ETERNUS DX S4/S3/S2 series
- FUJITSU Storage ETERNUS AF250/AF650 .....ETERNUS AF250/AF650
- FUJITSU Storage ETERNUS DX S3 series .....ETERNUS DX S3 series
- FUJITSU Storage ETERNUS DX200F .....ETERNUS DX200F

■ Target Storage Systems

- The supported migration source storage systems are the ETERNUS AF S2 series, the ETERNUS AF250/AF650, ETERNUS DX S4/S3/S2 series, and the ETERNUS DX200F.
- The migration destination storage systems that support online Storage Migration are the ETERNUS AF S3 series, the ETERNUS AF S2 series, and the ETERNUS DX S5/S4 series.

■ Units of Measurement

IOPS is a unit of measurement for the number of I/O operations per second.

■ Prerequisite

This document is based on the product lineup and product information as of November 2019. The procedures for Online Storage Migration are valid as of October 2016.

■ Target Readers

This document is intended for the following personnel:

- Those who are in charge of planning data migrations to replace storage systems
- Those who are considering a replacement of the existing ETERNUS AF S2 series, ETERNUS AF250/AF650, ETERNUS DX S4/S3/S2 series, or ETERNUS DX200F with the latest model
- Those who have basic knowledge of storage systems

## 1. Overview

### 1.1. Migrating Data with Storage Migration

Storage Migration is a function that migrates the data of each volume (logical drive [LU]) from the old storage system to a new storage system. In this document, the old storage system is referred to as the "source storage system" and the new storage system is referred to as the "destination storage system".

Storage Migration provides two data migration methods: offline and online. With offline, operations must be stopped in the storage systems during a data migration and with online, the storage systems can migrate data while performing operations. (Hereinafter, "Storage Migration" refers to both offline Storage Migration and online Storage Migration when their functionality is the same.)

Because Storage Migration migrates data on a per volume basis, data can be migrated even if the source storage system and the destination storage system use different HDDs and RAID configurations.

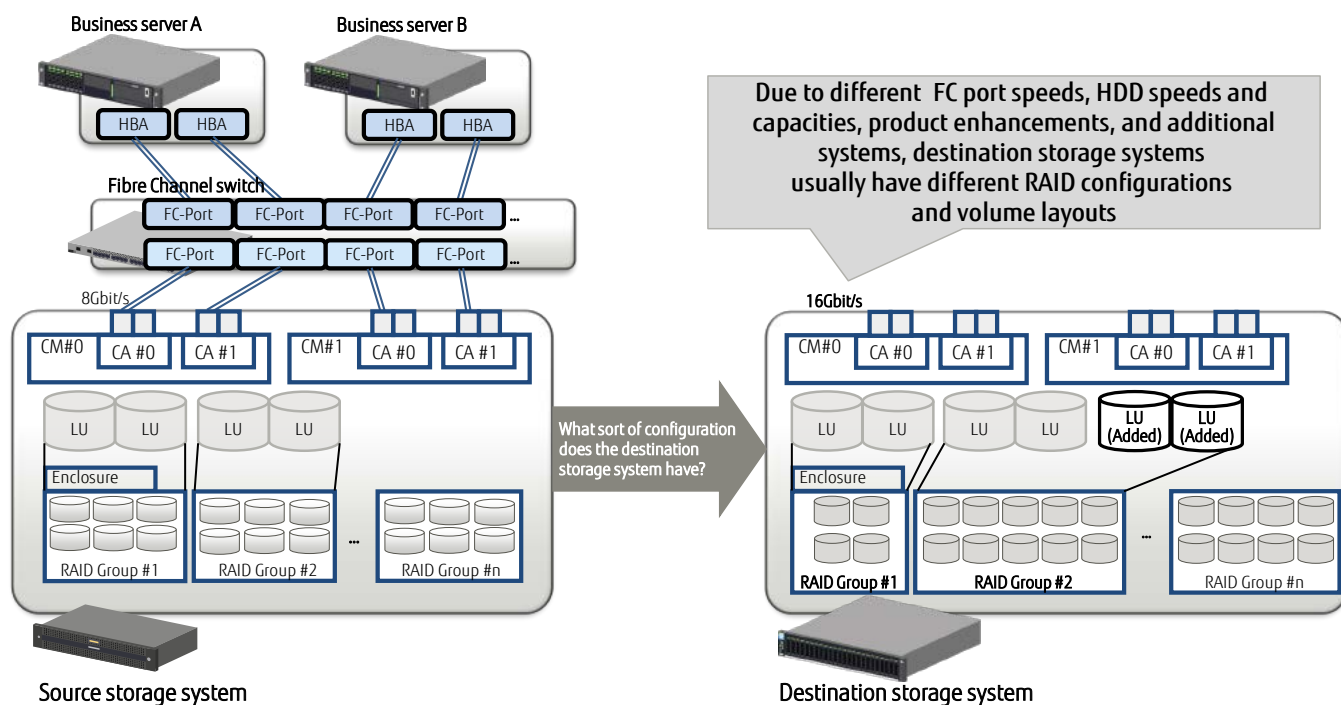


Figure 1.1-1 Different configurations in the source storage system and the destination storage system

This document provides information about the necessary configurations, the points to consider, and the procedure to use online Storage Migration, which can migrate data without stopping operations.

## 1.2. Features of Online Storage Migration

Storage Migration is a data migration function provided by the storage system. With this function, the data of each logical drive (LU) is migrated from the source storage system to the destination storage system.

The main feature of online Storage Migration is that data migrations can be performed while business operations continue.

The figure below shows business downtime using three cases: data migration via a server, with offline Storage Migration, and with online Storage Migration.

In data migrations via a server, data is migrated using a server. Business operations must be stopped during a data migration because the data must remain unchanged until the copy is completed from the source storage system to the destination storage system.

During a data migration with offline Storage Migration, the destination storage system views and copies the data in the source storage system. Because the storage system migrates the data, the migration time can be reduced. However, as is the case with migrations via a server, business operations must be stopped during a data migration to prevent the data from being changed.

Online Storage Migration allows the business server to read from and write to the destination storage system while data is being migrated from the source storage system.

Operations can be resumed immediately after the cables are switched. Therefore, downtime can be reduced significantly with online Storage Migration. However, consider the effect on performance when business operations are performed at the same time since the load caused by data migrations affect the business operations.

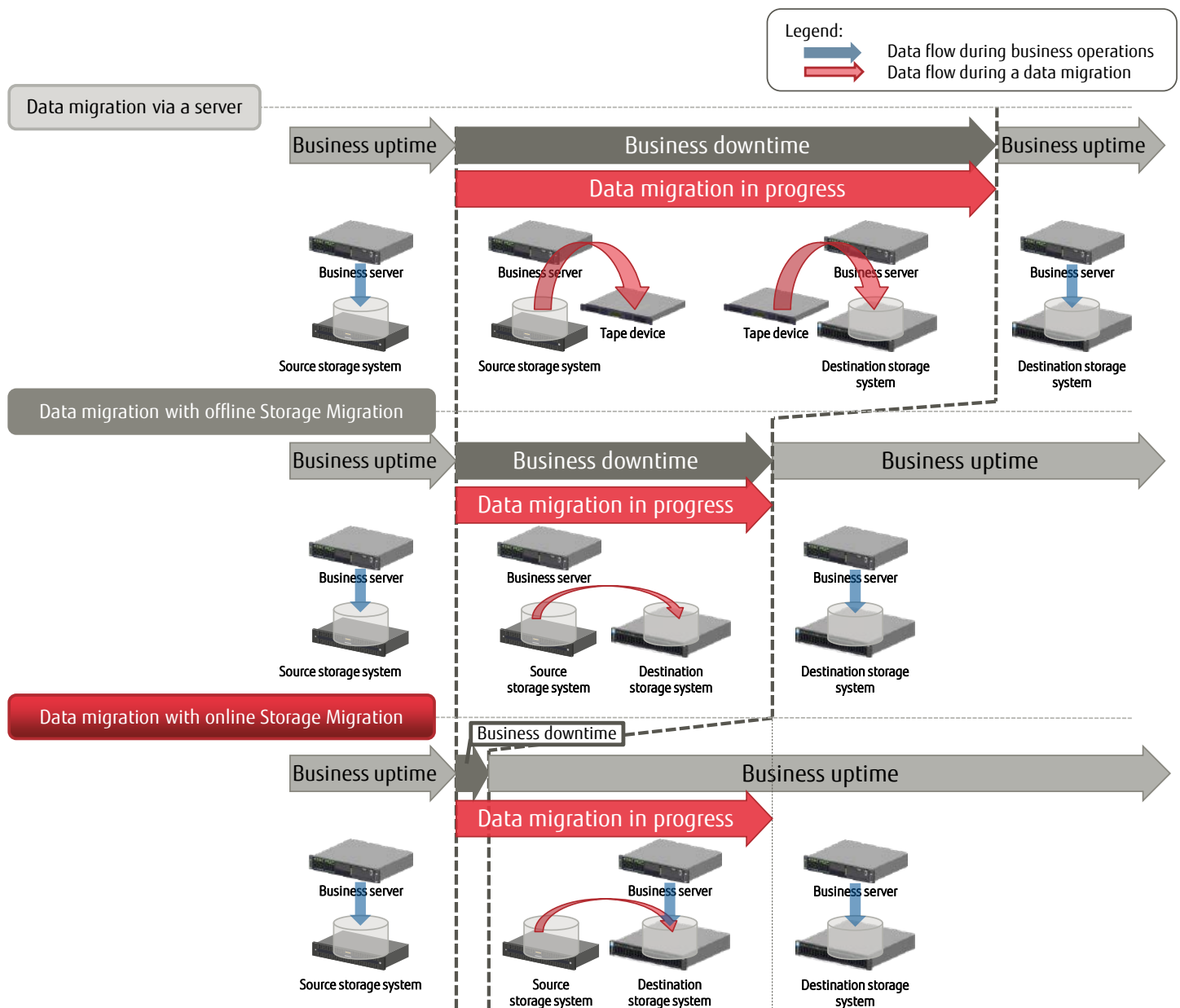


Figure 1.2-1 Comparison of business downtime during a data migration



Drives in the migration destination behave as if data has already been migrated, which enables business operations to resume immediately.

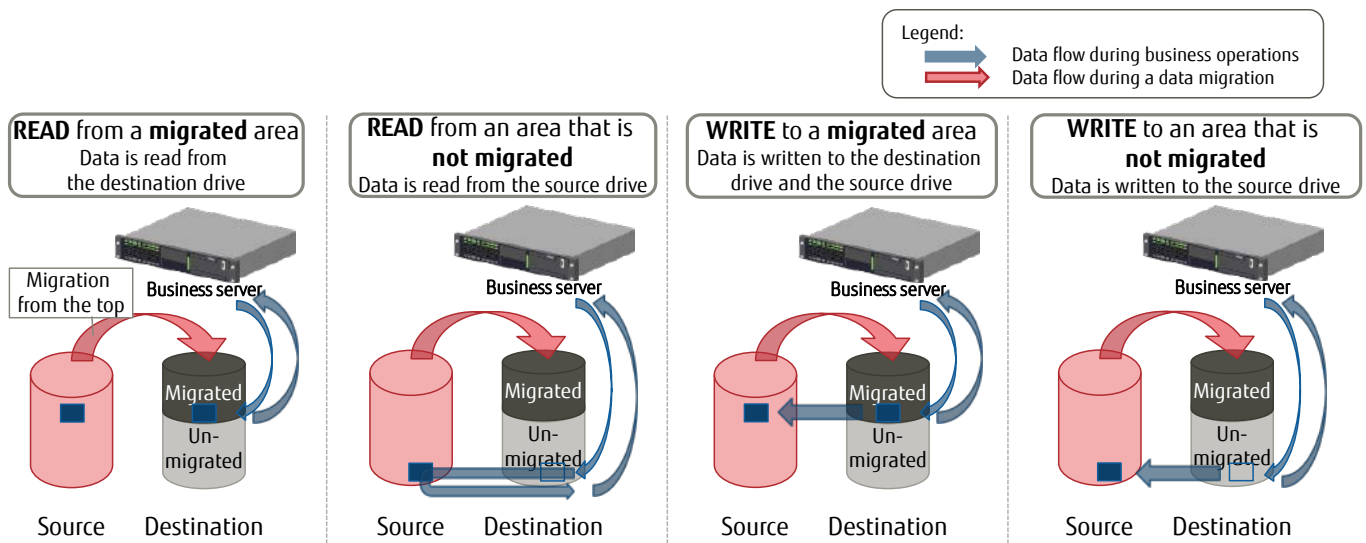


Figure 1.2-2 Business data flow during a data migration

With online Storage Migration, volume data in the source storage system is copied block by block.

Online Storage Migration is intended for migrations during business operations. The system area is excluded as a migration target because the operation of the OS after the system area is migrated cannot be guaranteed.

The following features are also available with online Storage Migration:

- Additional software or licenses are not required.
- Data can be migrated without changing the mapping configuration in the source storage system.
- Data that is written from the business server during a data migration can also be written to the source volume.
- The data migrating state continues until the connection is removed even if the actual migration process is completed.
- As the number of migration paths increases, the less the host access performance is affected. Up to eight migration paths can be set.
- Data migrations that are conducted before a storage system is powered off can be resumed after it is powered on.

### 1.3. Restrictions and Notes

This section describes the restrictions and notes for online Storage Migration.

#### Restrictions on simultaneous execution

- Online Storage Migration cannot be used simultaneously with offline Storage Migration.

#### Restrictions and notes on logical drives

- The following types of logical drive volumes can be migrated:
  - Standard volume
  - Thin Provisioning Volume (TPV) (NAS Volumes are not supported)
  - Flexible Tier Volume (FTV) (VVOLs are not supported)
  - Wide Striping Volume (WSV)
- If more than 1024 logical drives of the source storage system are connected to the business server, Storage Migration cannot migrate data from the 1025th and later logical drives.
- The same number of volumes as the source storage system must be created in the destination storage system before a data migration. Each volume must also have the same capacity as the source storage system.
- Data is migrated in units of logical drives. For example, a range of partitions cannot be specified.
- If the destination volume is a TPV or an FTV, the destination pool must have a physical capacity that is equal to or larger than the logical capacity of the migration source volumes.  
(Volumes are migrated as logical volumes and each logical volume is migrated with the entire area. Because the unused areas are also migrated, the benefits of Thin Provisioning are not available in the destination storage system.)
- During a data migration, data that is written from the business server is also written to the migration source volume. Back up the data as required before the migration.

#### Restrictions and notes on the FC ports

- Storage Migration supports only FC host interfaces for the CA ports that are used for data migrations. iSCSI, FCoE, and SAS are not supported.
- A single port in a CA board can only be used as either an FC port in the FC-Initiator mode or an FC port in the CA/RA mode.
- Different ports can coexist in the same CA board. One as an FC port in the FC-Initiator mode and the others as ports in the CA mode, the RA mode, and the CA/RA mode.
- The source volume must prevent access from the business servers during a data migration with online Storage Migration. (This can be achieved, for example, by deleting the host affinity setting or changing the switch zoning.)

#### Notes on performance

- The host access performance is reduced during a data migration with online Storage Migration.
- Disconnect the migration paths immediately after the data migration is completed. If the paths remain connected, the host access performance is reduced as much as when data is being migrated.
- The performance varies depending on the RAID level and the type of logical drive volumes that configure the RAID groups in the source storage system and the destination storage system.
- If the migration target logical drives are concentrated in a RAID group, performance bottlenecks become more frequent due to drive conflicts when Storage Migration is performed for the logical drives at the same time.

#### Notes on errors

- If all migration paths are blocked, the migration process stops abnormally. In this case, operations stop due to an access error from the host to the volume that is being migrated.



#### 1.4. Data Migration Flow during Online Storage Migration

The FC ports in the FC-Initiator mode migrate data by reading the data from the source storage systems as if the business server is reading the data.

In order to allow data access from the business server during a data migration, online Storage Migration requires FC ports for connecting with the business server in addition to FC ports in the FC-Initiator mode. (Offline Storage Migration does not require these ports because the business server is disconnected until the data migration is completed.)

The following section explains the data migration flow of online Storage Migration with a focus on the FC ports. In the examples, a single set of multipath is used as data migration paths.

The data migration time can be reduced by increasing the number of data migration paths because the path performance improves as the number of paths increases.

##### 1. [Pre-migration]

The business server is accessing data through ports in the FC-CA mode.

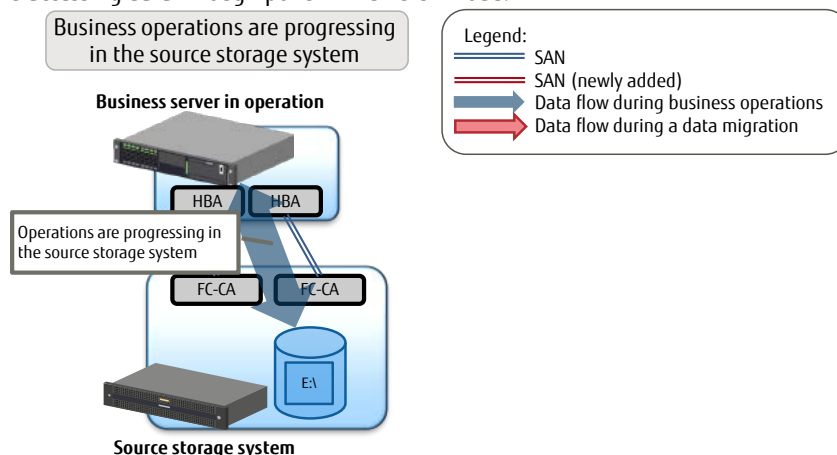


Figure 1.4-1 Business operations are progressing in the source storage system

##### 2. [Preparing for a data migration]

Stop the business server and switch the cable connections.

Stop the business server and connect it to the destination storage system. Use the FC ports in the FC-CA mode instead of the FC ports in the FC-Initiator mode for the connection.

For connections between the source storage system and the destination storage system, remove the cables from the business server and reconnect them to the FC ports in the FC-CA mode in the destination storage system.

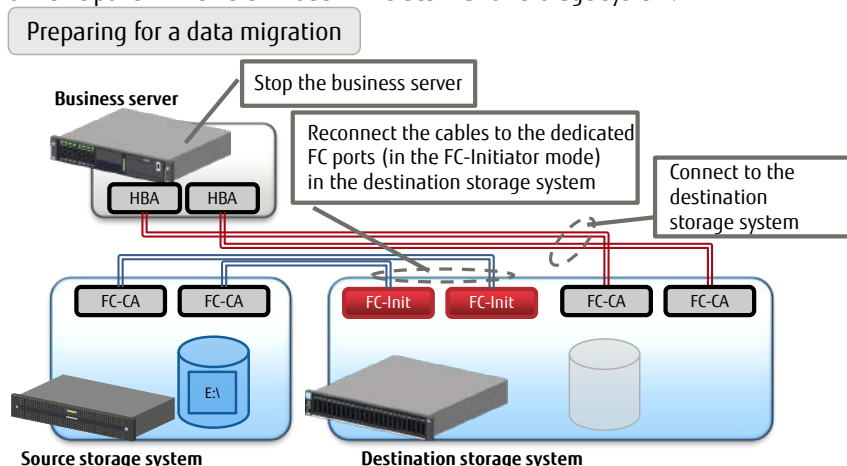


Figure 1.4-2 Preparing for a data migration

3. [Starting a data migration]  
Execute Storage Migration using ETERNUS Web GUI on the destination storage system.

**Starting a data migration**

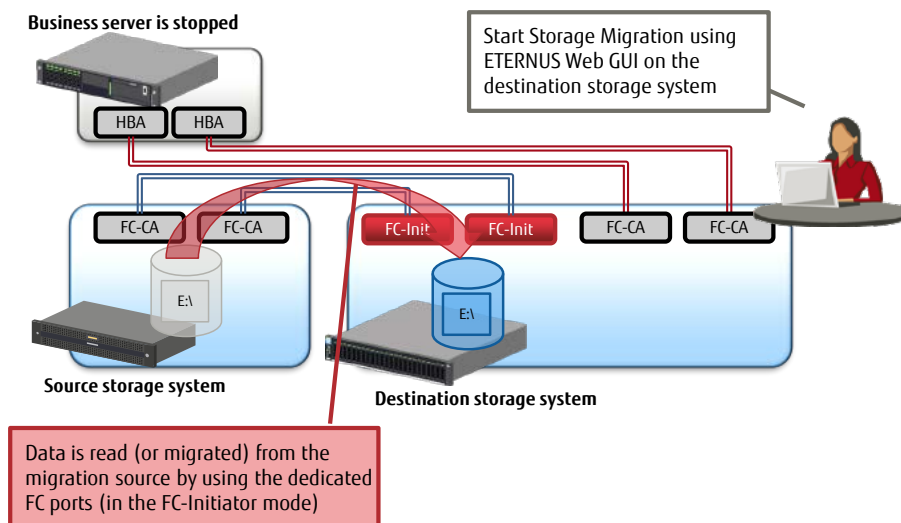


Figure 1.4-3 Starting a data migration

4. [Business operations are in progress in the destination storage system while data is being migrated]  
Resume business operations. While data is being migrated, the business server is accessing data through the FC-CA mode ports. A write process from the business server is also applied to the drive in the source storage system.

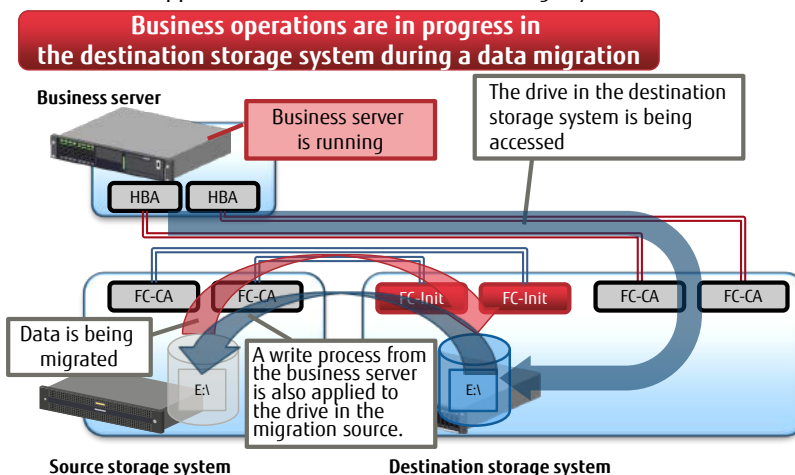


Figure 1.4-4 Business operations are in progress in the destination storage system while data is being migrated

5. [Completion of a data migration while operations are in progress in the destination storage system]  
Disconnect the FC ports in the FC-Initiator mode after the data migration. Remove the source storage system as required.

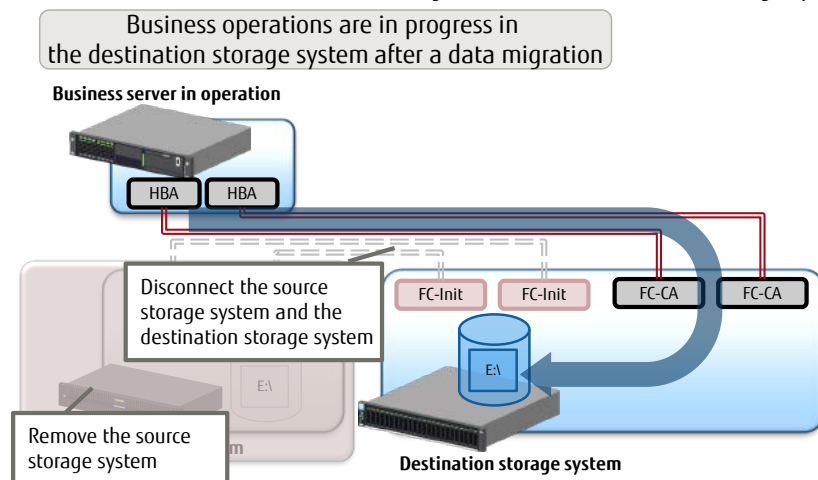


Figure 1.4-5 Completion of a data migration

6. [Post-data migration]  
After data is migrated, the FC ports in the FC-Initiator mode are no longer required. Consider reusing the FC ports for other purposes. If the FC-Initiator mode is changed to the FC-CA mode, the ports can be used for connecting with business servers.

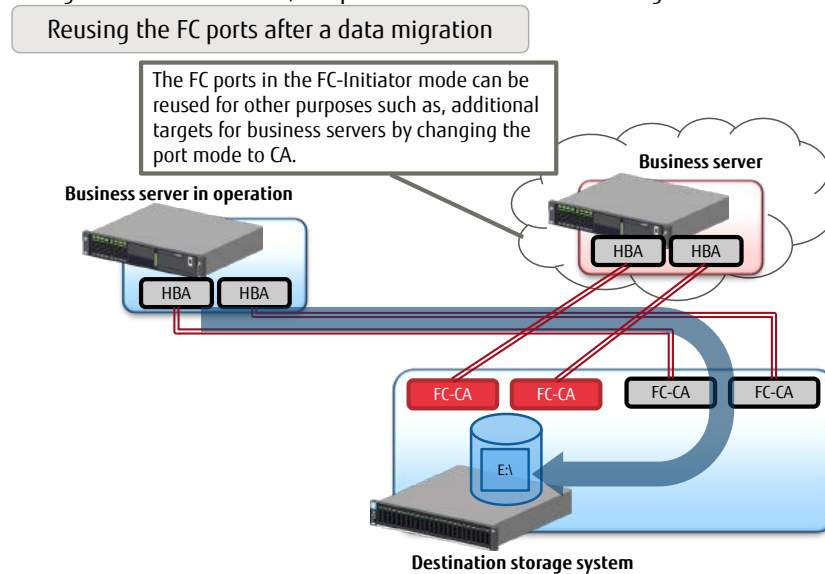


Figure 1.4-6 Reusing the FC ports after a data migration

### 1.5. Required FC Ports in Online Storage Migration

This section describes the FC ports that are used for data migrations with online Storage Migration in seven typical configurations.

Configuration	Business server	Source storage system	Destination storage system	Fibre Channel switch
(a) Migrating from a source to a destination when a single server is used	Single	Single	Single	No
(b) Migrating from a source to a destination when a single server is used (with Fibre Channel switches)	Single	Single	Single	Yes
(c) Migrating from multiple sources to a single destination when a single server is used (with Fibre Channel switches)	Single	Multiple	Single	Yes
(d) Migrating from a single source to multiple destinations when a single server is used (with Fibre Channel switches)	Single	Single	Multiple	Yes
(e) Migrating from multiple sources to a single destination when multiple servers are used (with Fibre Channel switches) and some of the business data volumes have not been migrated	Multiple (with business data volumes that have not been migrated)	Multiple	Single	Yes
(f) Migrating from a single source to multiple destinations when multiple servers are used (with Fibre Channel switches) and some of the business data volumes have been migrated	Multiple (with migrated business data volumes)	Single	Multiple	Yes
(g) Migrating from a single source to a single destination when a blade server is used	Multiple (blade server)	Single	Single	No

Table 1.5-1 Typical configuration list

### (a) Migrating from a source to a destination when a single server is used

In addition to the FC ports that are used for connecting with the business server, the destination storage system must have FC ports in the FC-Initiator mode.

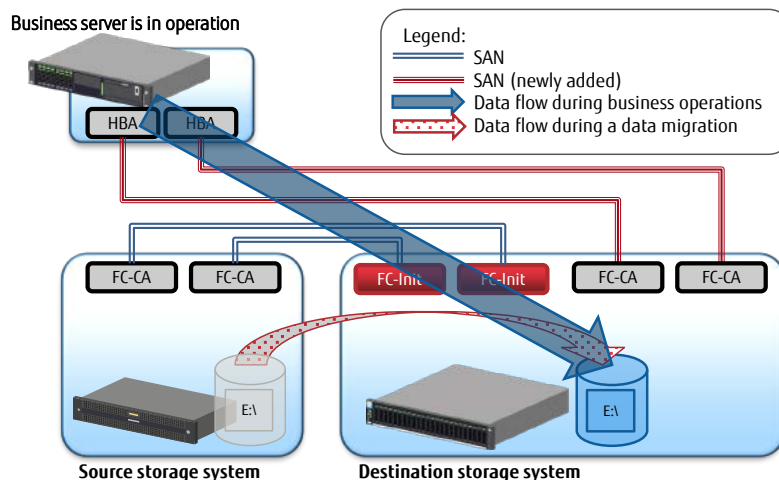


Figure 1.5-1 Migrating from a source to a destination when a single server is used

### (b) Migrating from a source to a destination when a single server is used (with Fibre Channel switches)

In addition to the FC ports that are used for connecting with the business server, the destination storage system must have FC ports in the FC-Initiator mode.

Fibre Channel switches require ports to connect with the FC ports in the FC-Initiator mode.

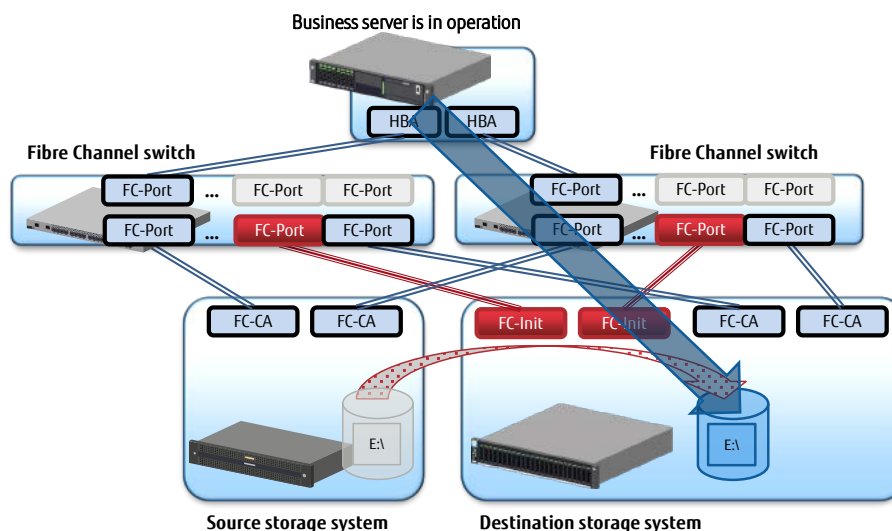


Figure 1.5-2 Migrating from a source to a destination when a single server is used (with Fibre Channel switches)

### (c) Migrating from multiple sources to a single destination when a single server is used (with Fibre Channel switches)

When data is migrated simultaneously from several source storage systems, the destination storage system must have FC ports in the FC-Initiator mode for each source storage system. Also, Fibre Channel switches must have the same number of ports as the FC ports in the FC-Initiator mode.

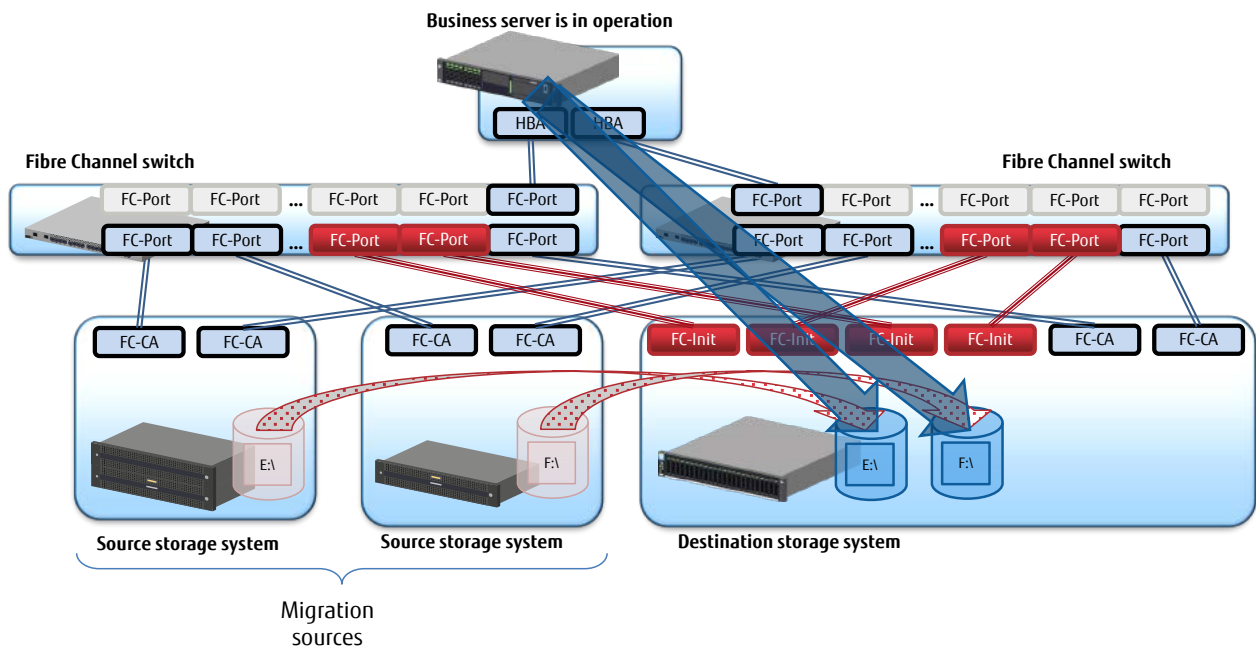


Figure 1.5-3 Migrating from multiple sources to a single destination when a single server is used (with Fibre Channel switches)

### (d) Migrating from a single source to multiple destinations when a single server is used (with Fibre Channel switches)

If data is migrated from a source storage system to multiple destination storage systems, each destination storage system must have FC ports in the FC-Initiator mode. Also, Fibre Channel switches must have the same number of ports as the FC ports in the FC-Initiator mode.

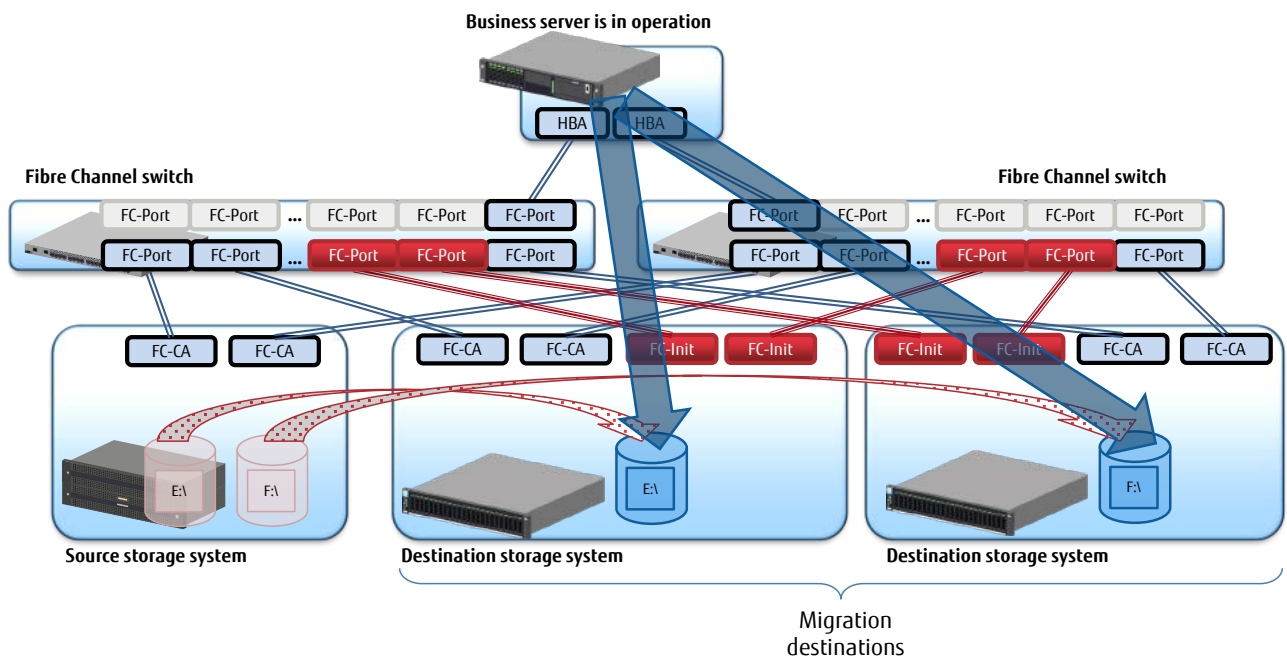


Figure 1.5-4 Migrating from a single source to multiple destinations when a single server is used (with Fibre Channel switches)



**(e) Migrating from multiple sources to a single destination when multiple servers are used (with Fibre Channel switches) and some of the business data volumes have not been migrated**

When multiple business servers are used and some of them are using source storage systems, the destination storage system must have FC ports in the FC-Initiator mode. Also, Fibre Channel switches must have the same number of ports as the FC ports in the FC-Initiator mode.

Prevent the business servers from accessing the volume that is to be migrated ("F:\") in the figure below). This can be achieved, for example, by deleting the host affinity setting in the source storage system.

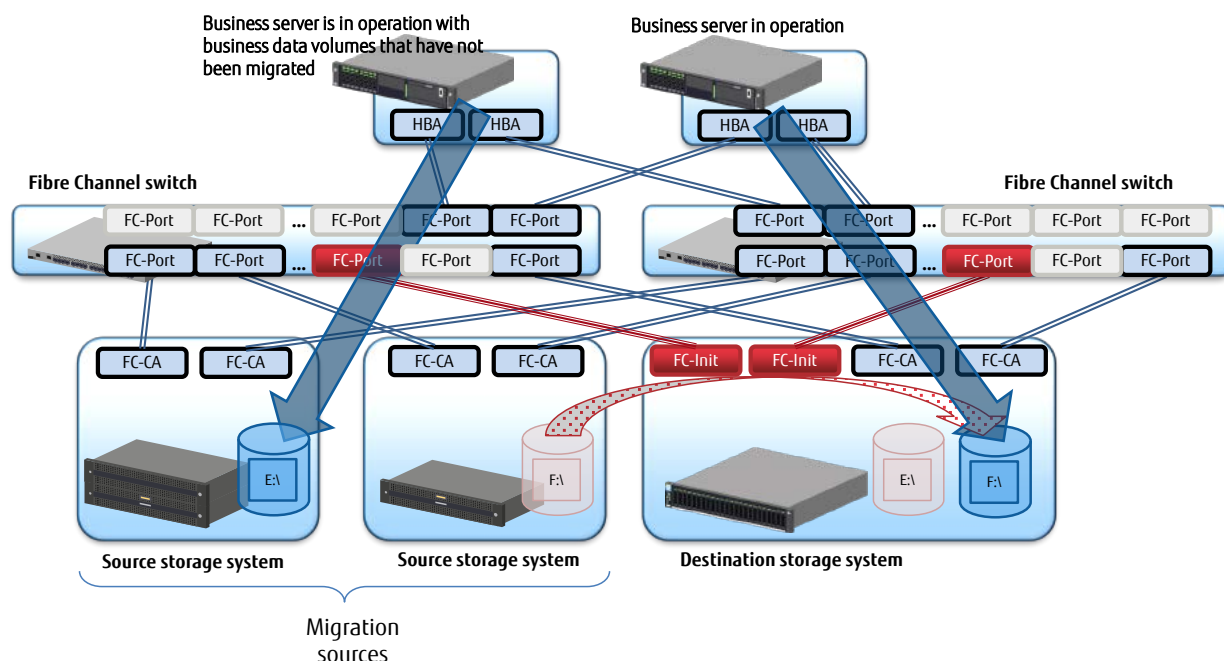


Figure 1.5-5 Migrating from multiple sources to a single destination when multiple servers are used (with Fibre Channel switches) and some of the business data volumes have not been migrated

**(f) Migrating from a single source to multiple destinations when multiple servers are used (with Fibre Channel switches) and some of the business data volumes have been migrated**

When multiple business servers are used and some of them are using destination storage systems, the destination storage systems with the migrated business data volumes do not need to have FC ports in the FC-Initiator mode.

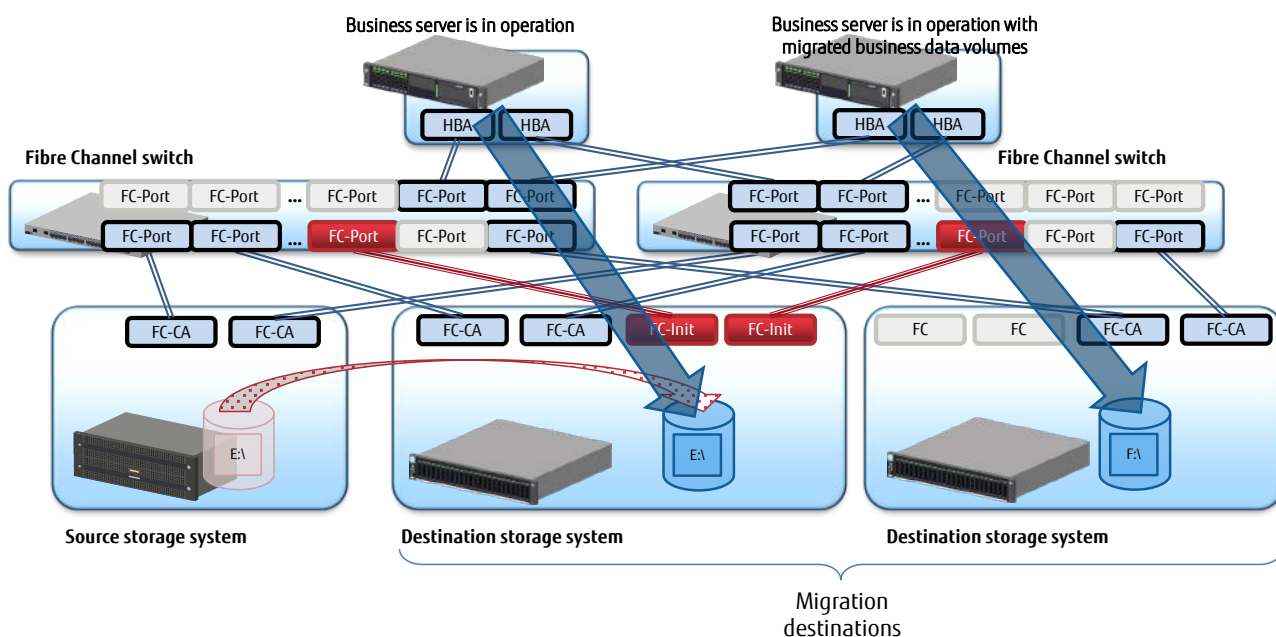


Figure 1.5-6 Migrating from a single source to multiple destinations when multiple servers are used (with Fibre Channel switches) and some of the business data volumes have been migrated

**(g) Migrating from a single source to a single destination when a blade server is used**

When multiple business servers (or a blade server) are used and some of them are using the source storage system, the destination storage system must have FC ports in the FC-Initiator mode.

Prevent the business servers from accessing the volume that is to be migrated ("E:\") in the figure below). This can be achieved, for example, by deleting the host affinity setting in the source storage system.

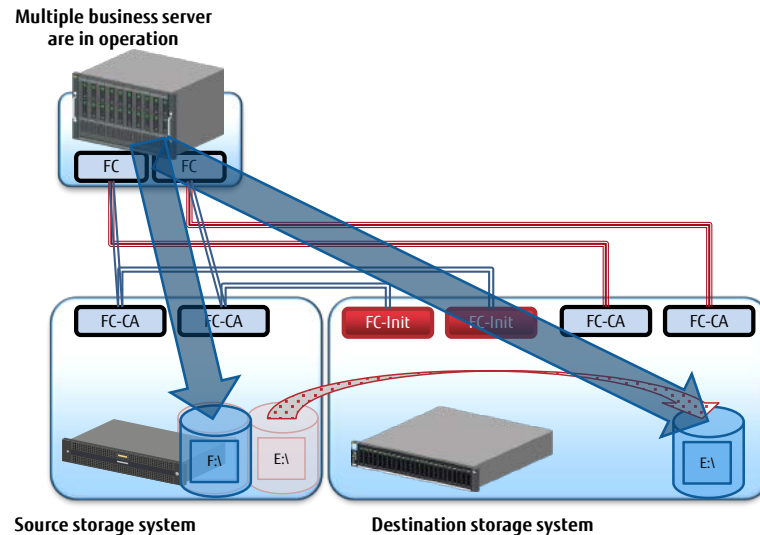


Figure 1.5-7 Migrating from a single source to a single destination when a blade server is used

## 1.6. Data Migration Steps and the Main Scope of This Document

The figure below shows the data migration workflow using online Storage Migration and the main scope of this document. This document mainly describes the preparations required for data migrations with online Storage Migration. Only storage system replacement is covered (server replacement is not included).

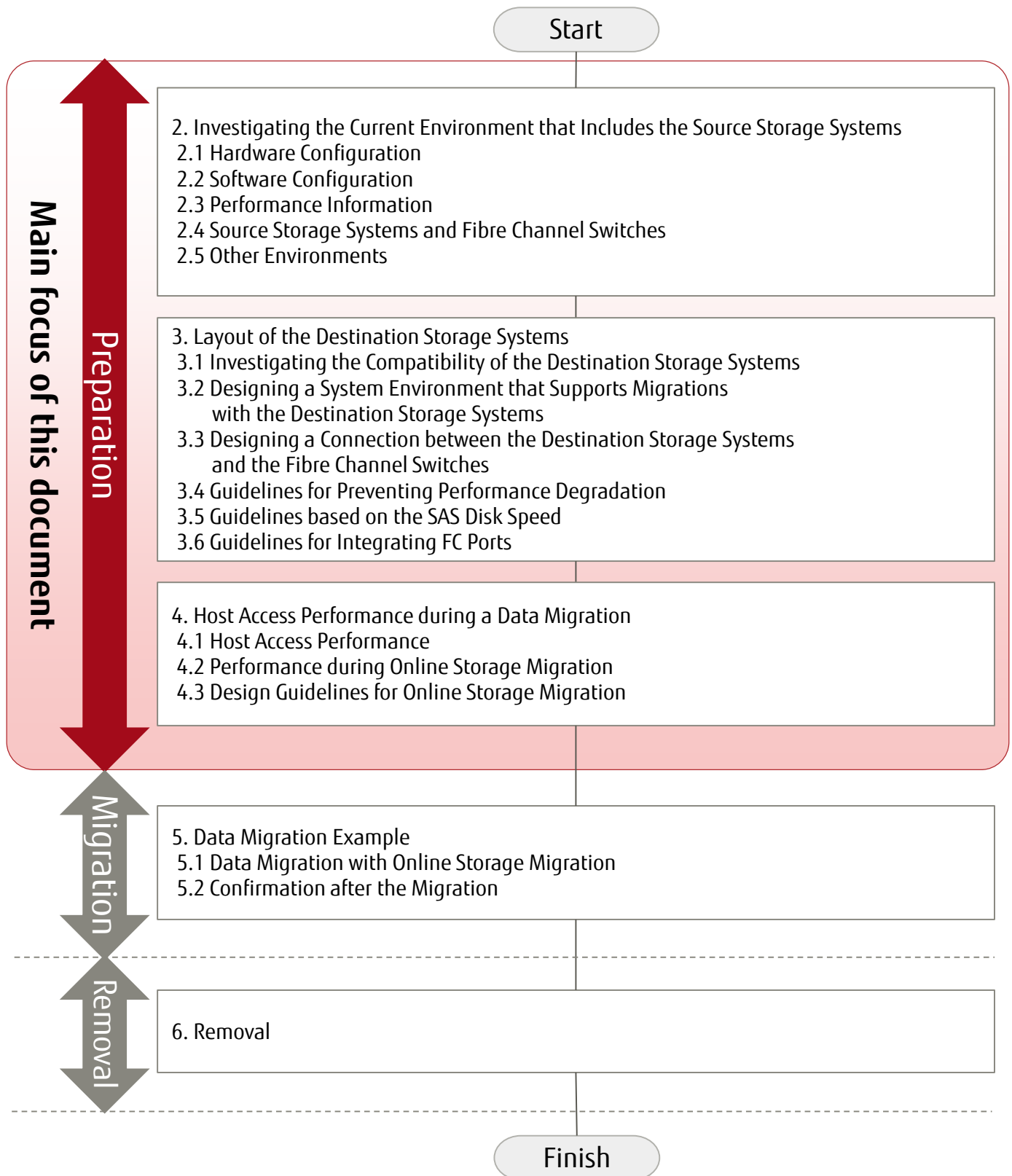


Figure 1.6-1 Data migration workflow using online Storage Migration and the main scope of this document

## 2. Investigating the Current Environment that Includes the Source Storage Systems

Collect information on the current environment that includes the source storage systems to migrate data with online Storage Migration. The collected information is used later in "3. Layout of the Destination Storage Systems" and "4. Host Access Performance during Data Migrations".

### 2.1. Hardware Configuration

Collect the current information for the following items to check the compatibility with the destination storage systems.

- The number of target servers and their corresponding product IDs
- The number of source storage systems and their corresponding product IDs
- The number of SAN devices and their corresponding product IDs
- The number of paths from each source storage system
- The connection topology between the source storage systems and the servers (direct connection or switch connection)

### 2.2. Software Configuration

Collect the current information for the following items to check whether the destination storage systems support the software that is used in the source storage systems.

- The OS and OS version installed in the business servers
- The applications and application versions that use the data to be migrated
- Multipath information (multipath driver name and the driver version)

### 2.3. Performance Information

The migration performance with online Storage Migration can be degraded due to drive conflicts between business operations. Collect the current information for the following items to determine the degree of deterioration.

- Performance information for each business operation cycle (maximum IOPS, average IOPS, throughput, and response time)
- High-load hours

### 2.4. Source Storage Systems and Fibre Channel Switches

Collect the current information for the following items. The collected information is used to assign FC ports that are required for data migrations with online Storage Migration.

- WWNs and transfer rates of the FC cards in the server
- Each source storage system's port information (location, WWN, transfer rate, Loop ID, and connection topology)

[If Fibre Channel switches are used]

- Fibre Channel switch information (switch transfer speed)
- The Fibre Channel switch's port information (locations of used ports and unused ports)
- Zoning information

### 2.5. Other Environments

#### 2.5.1. Configuration of the Migration Target Logical Drive and the Stored Data in the Source Storage Systems When Viewed from the Business Servers

Collect the current information for the following items to perform various checks after a data migration.

- Drive information (drive number, drive label (MBR/GPT), file system type (NTFS or other), and capacity)
- Partition information (partition type [primary, extended (logical)], partition number, drive letter/mount point, and capacity)
- Stored data

#### 2.5.2. Configuration of the Main Unit of the Source Storage System

Collect the current information for the following items from the source storage system. The collected information is used for designing the system environment that supports migrations with the destination storage systems.

- Firmware version
- RAID group information for the logical drive that is to be migrated (RAID level, the number of drives that configure the RAID group, drive type, and total capacity)
- Volume information for the logical drive that is to be migrated (RAID group name to which the logical drive belongs, volume name, volume type, and capacity)

## 2.6. Example Investigation

Collect the necessary information from the design sheet.

Server information

OS	Windows Server 2012 R2
HBA	PY-FC202 (Emulex LPe12002-M8)
Multi-pathing	MSDSM
Switch	-
Cluster software	-
Backup software	-
Storage	ETERNUS DX60
Topology	Direct connection

### System

Setting type	Item name				Input value		
(Large category)	(Middle category)	(Small category 1)	(Small category 2)	(Small category 3)	Select or enter the setting values within the red box.		
Basic information							
	Storage system information	Model			ETERNUS DX60		
		Product ID			ET06F21A		
		Serial number			4541203999		
		Device identification number			10304D		
		Firmware version			V10L10		
System settings							
	Storage system name settings	Name			ET60-1		
		Installation site			musashinakahara		
		Administrator (contact information)			abc@aa.bb.fujitsu.com		
		Description			for test		
	Date and time settings	Preferred NTP server	Domain name/IP address		192.168.149.254		
			Used port		MNT		
		Alternate NTP server	Domain name/IP address		192.168.149.254		
			Used port		MNT		
	Box ID setting	Box ID			00ETERNUSDXHS3ET203A#####Lbxxxxxxxx##		
	Subsystem parameters	Thin Provisioning allocation mode			TPP balancing		
		Copybackless			Enable		
	SMI-S setting	SMI-S setting			Disable		
	SED authentication key (common key) registration	SED authentication key (common key) registration			(Enter when registering)		
	Encryption mode	Encryption mode			Disable		
	Eco-mode	Enabling or disabling Eco-mode			Disable		
	Event notification setting	Notification event			Default value		
	Extreme Cache setting	Extreme Cache function/Extreme Cache Pool function			Disable		
		Extreme Cache capacity			0		
			Monitoring I/O			read	
Network management							
	Network environment settings	(Left) IPv4, (right) IPv6	MNT port	Master IP address	Master IP link local address	192.168.10.1	fe80::10:100:0:0
					Master connect IP address		2001:10::100:0:0
			Slave IP address		Slave IP link local address	192.168.10.2	fe80::10:100:2:0
					Slave connect IP address		2001:10::100:2:0
			Subnet mask	Prefix length	255.255.255.0	64	
			Gateway	Gateway	192.168.10.254	2001:10::100:3:0	
			Preferred DNS server	Preferred DNS server	192.168.10.3	2001:20::100:3:0	
			Alternate DNS server	Alternate DNS server	192.168.10.4	2001:20::100:4:0	
			Communication speed and mode		Automatic		
			Wake on LAN		Disable		
		(Left) IPv4, (right) IPv6	RMT port	Master IP address	Master IP link local address	192.168.11.1	fe80::10:100:0:0
					Master connect IP address		2001:10::100:0:0
			Slave IP address		Slave IP link local address	192.168.11.2	fe80::10:100:2:0
					Slave connect IP address		2001:10::100:2:0
			Subnet mask	Prefix length	255.255.255.0	64	
			Gateway	Gateway	192.168.11.254	2001:10::100:3:0	
			Preferred DNS server	Preferred DNS server	192.168.11.3	2001:20::100:3:0	
			Alternate DNS server	Alternate DNS server	192.168.11.4	2001:20::100:4:0	
			Communication speed and mode		Automatic		
			Wake on LAN		Disable		

Figure 2.6-1 Example investigation of an environment that includes the source storage system

### 3. Layout of the Destination Storage Systems

This chapter describes the layout of the destination storage systems.

#### 3.1. Investigating the Compatibility of the Destination Storage Systems

Check the compatibility based on the information collected in "2. Investigating the Current Environment".

- The target servers must be able to connect to the destination storage systems.  
If the servers cannot connect, consider replacing the servers.
- SAN devices such as Fibre Channel switches must support the connection with the destination storage systems.  
If the SAN devices do not support the connection, consider replacing the SAN devices.
- The OS on the business servers must support the connection with the destination storage systems.  
If the OS does not support the connection, update the OS or apply patches.
- The applications that use the data that is to be migrated must support the drives that are connected to the destination storage systems.  
If the applications do not support the connection, update the applications or apply patches.
- The multipath driver must support the connection with the destination storage systems.  
If the multipath driver does not support the connection, update the multipath driver or apply patches.

#### 3.2. Designing a System Environment that Supports Migrations with the Destination Storage Systems

Design a system environment that supports migrations with the destination storage systems according to the information collected in "2. Investigating the Current Environment".

- The WWN of the FC ports in the source storage systems is required for a Storage Migration setting file created to migrate data with online Storage Migration.
- Design the destination storage systems so that the host connection configuration (host groups, port groups, LUN groups, and hot affinity settings) in the source storage systems can be taken over.
- Design the FC ports to migrate data with online Storage Migration by referring to "1.5. Required FC Ports in Online Storage Migration".

#### 3.3. Designing a Connection between the Destination Storage Systems and the Fibre Channel Switches

Design a connection between the destination storage systems and the Fibre Channel switches according to the information collected in "2. Investigating the Current Environment".

- Set the same connection topology, Loop ID, and transfer rate in [Modify FC Port Parameters] for the destination storage systems as the source storage systems.
- Check the location of the FC ports in the destination storage systems.
- When using Fibre Channel switches, check the location of the unused FC ports in the destination storage systems.
- When using Fibre Channel switches, configure zones using the WWNs of the business server and the destination storage systems.



### 3.4. Guidelines for Preventing Performance Degradation

Performance may degrade after a data migration due to excessive integration of the drives and the RAID groups as well as a lack of coordination for the total number of volumes, the number of controllers, and the cache memory capacity. This section provides guidelines to prevent this kind of performance degradation.

- The number of RAID groups should be equal to the source storage systems (\*1).
- The total number of drives in the RAID groups should be greater than or equal to the source storage systems (\*1).  
(If there is no performance degradation, the number of drives can be reduced.)
- The cache capacity should be greater than or equal to the source storage systems (\*1).
- Do not reduce the total number of FC ports (\*1).
- The size of the allocated data should be the same as before the data migration (\*1).

(\*1) The total of the source storage systems when several source storage systems are migrated to a single destination storage system

The following example shows a layout for preventing performance degradation.

- A total of four RAID groups (#0, #1, #2, and #3) are installed in the two source storage systems.  
Therefore, create four RAID groups in the destination storage system. In addition, install at least the same number of drives as the total number of drives used by the RAID groups in the source storage systems.
- A total cache capacity of 64GB is installed in the source storage systems (16GB x 2 in ETERNUS DX440 #1 and 16GB x 2 in ETERNUS DX440 #2).  
Therefore, install 64GB of cache (32GB x 2) in the destination storage system.
- A total of eight FC ports (or four in each source storage system) are installed in the source storage systems.  
Therefore, prepare eight FC ports for the destination storage system.
- Even if each RAID group in the destination storage system has a surplus of space, use the same data layout as the source storage systems when distributing data in the RAID groups.

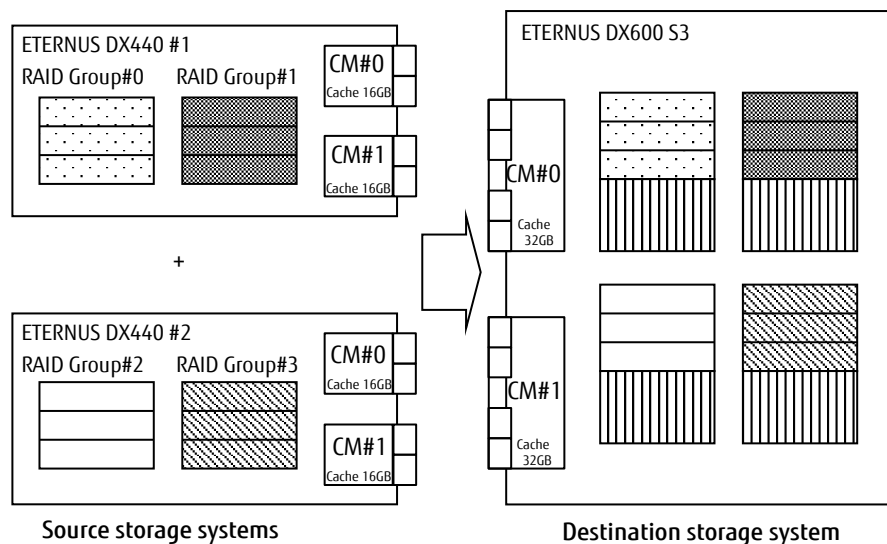


Figure 3.4-1 Example layout for preventing performance degradation

### 3.5. Guidelines based on the SAS Disk Speed

The ETERNUS DX S5/S4 series supports 2.5" SAS disks with disk speeds of 10krpm and 15krpm.

If the source storage system and the destination storage system use SAS disks with different disk speeds, this difference must be considered. The difference in the disk speeds also causes a difference in RAID group performance even if the RAID groups are configured with the same RAID level and the same number of disks. The performance of a RAID group that is configured with 10krpm SAS disks may be 70% to 80% of the performance of a RAID group that is configured with 15krpm SAS disks.

Consider the following point when migrating data from a 15krpm SAS disk to a 10krpm SAS disk:

- Increase the number of disks in each RAID group.

The guideline for increasing the number of disks in each RAID group is as follows.

The random access performance increases proportionally to the number of disks.

Therefore, if one disk is added to a 10krpm SAS disk configuration, the same performance can be achieved.

Example:

The random access performance of RAID5(4D+1P) configured with five 15krpm SAS disks is 622 IOPS.

The random access performance of RAID5(4D+1P) configured with five 10krpm SAS disks is 505 IOPS.

The following formula can calculate the required number of 10krpm SAS disks to achieve the same performance as 15krpm SAS disks.

$$622 \text{ [IOPS]} \times 5 \text{ [the number of HDDs in RAID5(4D+1P)]} \div 505 \text{ [IOPS]} \approx 6 \text{ [disks]}$$

If the number of 10krpm SAS disks is increased to six for configuring RAID5(5D+1P), the increase brings the performance close to 622 IOPS (which is the performance for RAID5(4D+1P) configured with five 15krpm SAS disks).

$$505 \text{ [IOPS]} \times 6 \text{ [the number of HDDs in RAID5(5D+1P)]} \div 5 \text{ [the number of HDDs in RAID5(4D+1P)]} = 602 \text{ IOPS}$$

However, even if the number of disks is increased, the latency is higher than 15krpm SAS disks when IOPS is low.

Example: Read response time of RAID5(4D+1P) when the IOPS is low

10krpm SAS disk: 8.0ms

15krpm SAS disk: 6.0ms

For sequential access, there is no difference in performance between 15krpm and 10krpm disks.

### 3.6. Guidelines for Integrating FC Ports

If several source storage systems are integrated when the number of FC ports in the destination storage system is less than the total number of FC ports in the source storage systems, use a host interface with a higher performance than the one in the source storage system for the FC ports in the destination storage system.

For example, when integrating two 8Gbit/s host interface ports, use 16Gbit/s FC ports.

Conduct a test in advance to make sure that the FC ports can deliver the necessary performance.

## 3.7. Investigation/Design Example

## Connectivity (Host Affinity)

Setting type	(Large category)	Host group				
Item name	(Middle category)	Name	Host response name	Host name	Connection type	Server address
(Small category 1)	(Small category 2)					
Input value	Select or enter the setting values within the red box.	hostG_0	Default	host0	FC	10:00:00:00:aa-01
		hostG_1	Default	host1	FC	10:00:00:00:bb-01

Setting type	(Large category)	Port group	
Item name	(Middle category)	Name	Member
(Small category 1)	(Small category 2)		
Input value	Select or enter the setting values within the red box.	port_0	000,000,000,000
		port_1	000,001,000,000
		port_2	000,000,000,001
		port_3	000,001,000,001

Setting type	(Large category)	LUN group								
Item name	(Middle category)	Name	Server LUN No.	Volume No.	Volume name	Type	Capacity	Unit	Capacity [MB]	Usage
(Small category 1)	(Small category 2)									
Input value	Select or enter the setting values within the red box.	lunG_0	0	0	vol00	Standard	512	GB	524,288	e-mail
		lunG_0	1	1	vol01	Standard	512	GB	524,288	e-mail
		lunG_0	2	2	vol02	Standard	256	GB	262,144	Sales department data
		lunG_0	3	3	vol03	Standard	256	GB	262,144	Sales department data
		lunG_1	0	4	vol1_00	Standard	256	GB	262,144	Accounting department data
		lunG_1	1	5	vol1_01	Standard	256	GB	262,144	Accounting department data
		lunG_1	2	6	vol1_02	Standard	256	GB	262,144	General affairs department data
		lunG_1	3	7	vol1_03	Standard	256	GB	262,144	General affairs department data

Setting type	(Large category)	Host affinity			
Item name	(Middle category)	Host group	Port group	Enabled port	LUN group
(Small category 1)	(Small category 2)	Name	Name	Member	Name
Input value	Select or enter the setting values within the red box.	hostG_0	port_0	000,000,000,000	lunG_0
		hostG_0	port_1	000,001,000,000	lunG_0
		hostG_1	port_2	000,000,000,001	lunG_1
		hostG_1	port_3	000,001,000,001	lunG_1

## Volume, RAID group, Thin Provisioning

Setting type	(Large category)	RAID group information									
Item name	(Middle category)	TPP to which the RAID group belongs	No.	RAID name	RAID level	Data+M/P	Drive type	Select drives	Controlling CM	Total capacity [MB]	Remaining capacity [MB]
(Small category 1)	(Small category 2)										
Input value	Select or enter the setting values within the red box.		0	RAID_0	RAID5+0	4+1	Online	2.5" 300GB/15krpm	Automatic	1,116,160	67,584

Setting type	(Large category)	Volume information											
Item name	(Middle category)	TPP to which the volume belongs	RAID to which the volume belongs	No.	Name	Concatenation order	Type	Allocation	Usage	Controlling CM	Volume capacity	Unit	
Input value	Select or enter the setting values within the red box.		RAID_0	0	vol00		Standard		e-mail	Automatic	512	GB	
			RAID_0	1	vol01		Standard		e-mail	Automatic	512	GB	

Figure 3.7-1 Design example of a destination storage system

## 4. Host Access Performance during a Data Migration

### 4.1. Host Access Performance

The table below shows a comparison of the host access performance.

- Each RAID group is configured with a single volume and the host access performance is compared by changing the number of RAID groups (= number of volumes) that are migrated at the same time.
- The value for host access performance (throughput and response) without data migration is assumed to be "1". The performance is compared by performing a data migration operation with online Storage Migration (based on a Read:Write ratio of 3:1 as an average system).

No. of RAID groups to migrate at the same time (= No. of volumes)	Comparison of host access performance	
	Throughput	Response
2	0.37	1.19
4	0.45	1.22
6	0.54	1.25
8	0.63	1.28
10	0.71	1.32

Random 8KB, 1.06TB (RAID5[4+1] x 1 using 10krpm disks)/volume

Table 4-1 Comparison of host access performance

### 4.2. Performance during Online Storage Migration

As the number of RAID groups that are to be migrated at the same time increases, the less the host access performance is affected. This is because the data migration maintains a certain performance level regardless of the number of RAID groups that are migrated at the same time.

### 4.3. Design Guidelines for Online Storage Migration

Based on the information collected in "2. Investigating the Current Environment that Includes the Source Storage Systems", design an online Storage Migration plan.

Estimate the host access performance during an online Storage Migration by referencing Table 4-1. Use the values in Table 4-1 only as a guideline since the host access performance varies depending on the storage system and the RAID configuration.

## 5. Data Migration Example

### 5.1. Data Migration with Online Storage Migration

This section uses the following example configuration to show a data migration procedure.

[Details of the configuration]

- Data is migrated from a migration source to a migration destination when a single server is used.
- The source storage system and the destination storage system are directly connected.
- The business server and the storage systems are connected via Fibre Channel switches.
- The migration targets are four Windows volumes (20GB each).

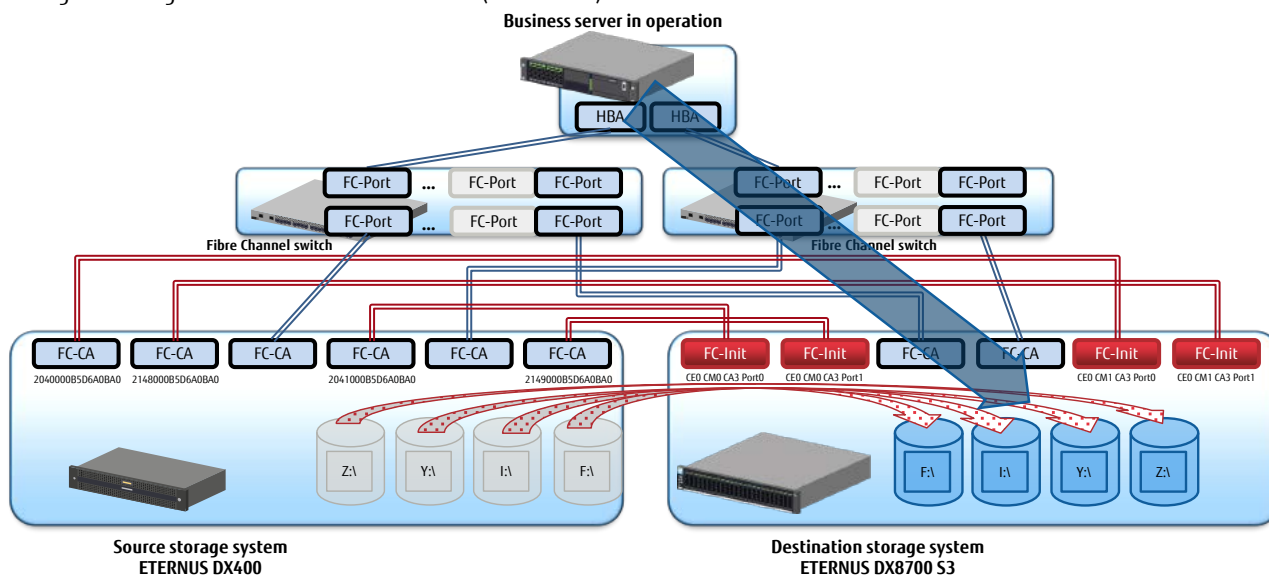


Figure 5.1-1 Example configuration for a data migration

[Data migration example]

The following section provides the data migration procedure. The start of each procedure is indicated with [Operations on the business server], [Operations on the destination storage system], or [Other operations].

#### Procedure overview

1. [Operations on the destination storage system] Create a logical drive with the same capacity (20GB) as the volume that is to be migrated.
2. [Operations on the business server] Check the logical drive of the migration source (items such as "F:\\" and "20GB") and stop operations (shut down the business server).
3. [Operations on the destination storage system] Set the CA port mode to "Initiator".
4. [Other operations] Connect the source storage system to the destination storage system using FC cables.
5. [Other operations] Create a Storage Migration setting file (StMig\_Win.txt) by entering the FC ports that are to be used for the data migration and the association between the logical drive numbers in the migration source and the migration destination.
6. [Operations on the destination storage system] Apply the Storage Migration setting file (StMig\_Win.txt) to the destination storage system and then start a data migration with Storage Migration.
7. [Other operations] Delete the volume mappings of the source storage system to the server and then create mappings to the destination storage system.
8. [Other operations] Connect the server to the destination storage system using FC cables.
9. [Operations on the business server] Start the server, confirm that the logical drive of the migration destination is the same as the logical drive of the migration source (items such as "F:\\" and "20GB"), and then resume operations.
10. [Operations on the destination storage system] Confirm that the data migration is completed in the progress screen.
11. [Operations on the destination storage system] Confirm again that the data migration is completed in the details screen of the data migration.
12. [Operations on the destination storage system] Delete the paths that are confirmed to have finished Storage Migration.

## Procedure details

1. [Operations on the destination storage system] Create a logical drive with the same capacity (20GB) as the volume that is to be migrated.

**Create Volume**

▼ Information

Please enter the parameters for volume provision a new Volume.

1MB = 1024 \* 1024bytes, 1GB = 1024MB, 1TB = 1024GB

It is recommended to select a single drive type to compose a RAID group in Wide Striping Volume.  
If Wide Striping Volume is composed of Online and Nearline mixed disks, performance may be limited.

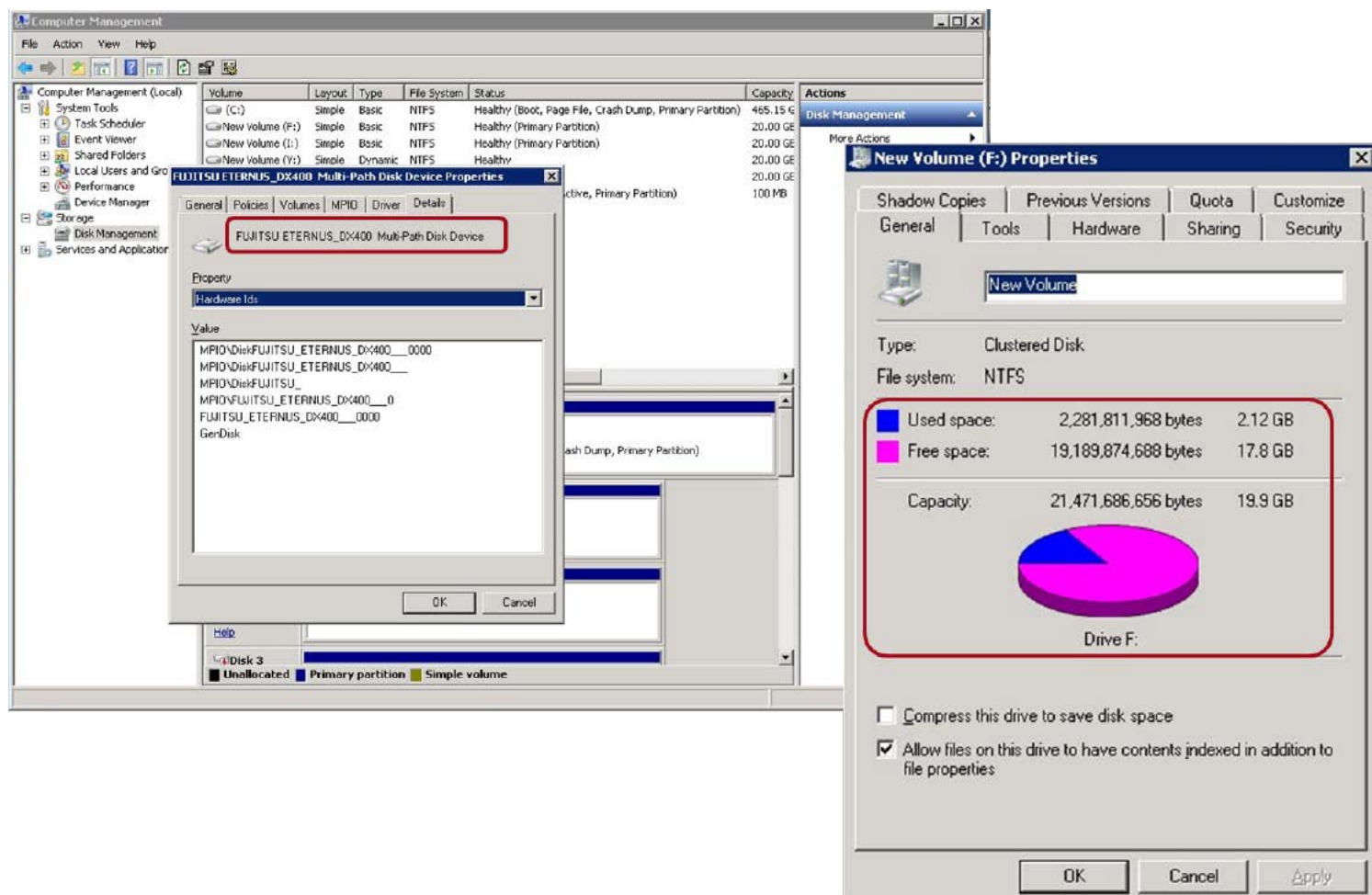
▼ New Volume

Name	vol0
Capacity	20 GB
Type	Standard Wide Striping Volume Thin Provisioning Volume Snap Data Volume Snap Data Pool Volume
Capacity of source volume (only SDV)	GB
Allocation	Thin Thick
RAID Group / TPP Selection	Automatic Manual
Data Integrity	Default T10-DIF

▼ Automatic Setting

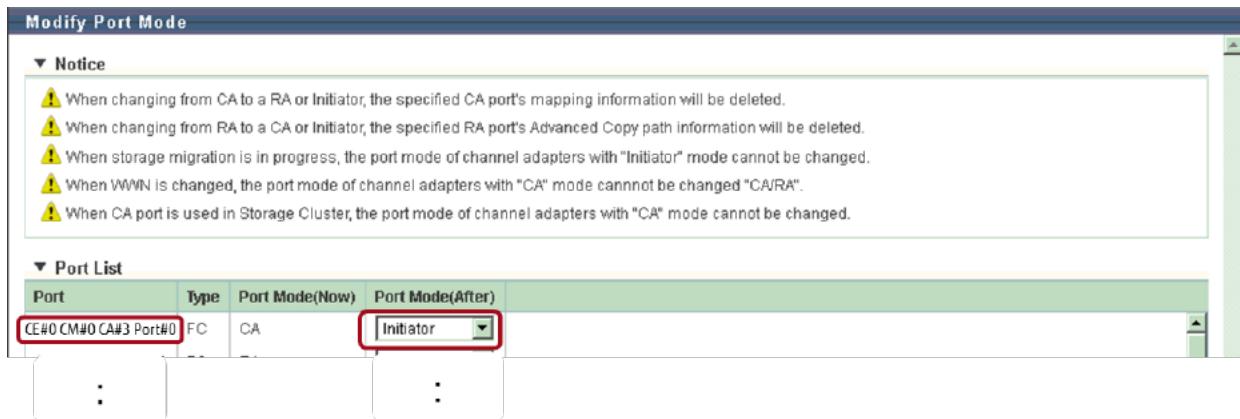
Create Cancel

2. [Operations on the business server] Check the logical drive of the migration source (items such as "F:" and "20GB") and stop operations (shut down the business server).





3. [Operations on the destination storage system] Set the CA port mode to "Initiator".



4. [Other operations] Connect the source storage system to the destination storage system using FC cables.
5. [Other operations] Create a Storage Migration setting file (StMig\_Win.txt) by entering the FC ports that are to be used for the data migration and the association between the logical drive numbers in the migration source and the migration destination.

```
#Open Storage Migration
eternus-storage-migration-0101
Type=Open
GROUP=0x0
PEMODE=M&IO
{
    PATH=CE0,CM0,CA3,P0,2041000B5D6A0BA0
    PATH=CE0,CM0,CA3,P1,2149000B5D6A0BA0
    PATH=CE0,CM1,CA3,P0,2040000B5D6A0BA0
    PATH=CE0,CM1,CA3,P1,2148000B5D6A0BA0
    VOL=0,85
    VOL=1,86
    VOL=2,87
    VOL=3,88
}
[EOF]
```

(1) Code to identify the path file format (fixed)

(2) Storage Migration type (fixed to "Open")

(3) Group identifier for the path group. Specify from 0x0 to 0xF (\*1)

(4) Storage Migration operation mode (fixed to "M&IO" for the online method)

(5) Associates the FC-Initiator mode port in the migration destination and the WWPN of the migration source.  
This example shows that the destination storage port ("CE#0 CM#0 CA#3 Port#0") is connected to the WWPN of the source storage system ("2041000B5D6A0BA0").

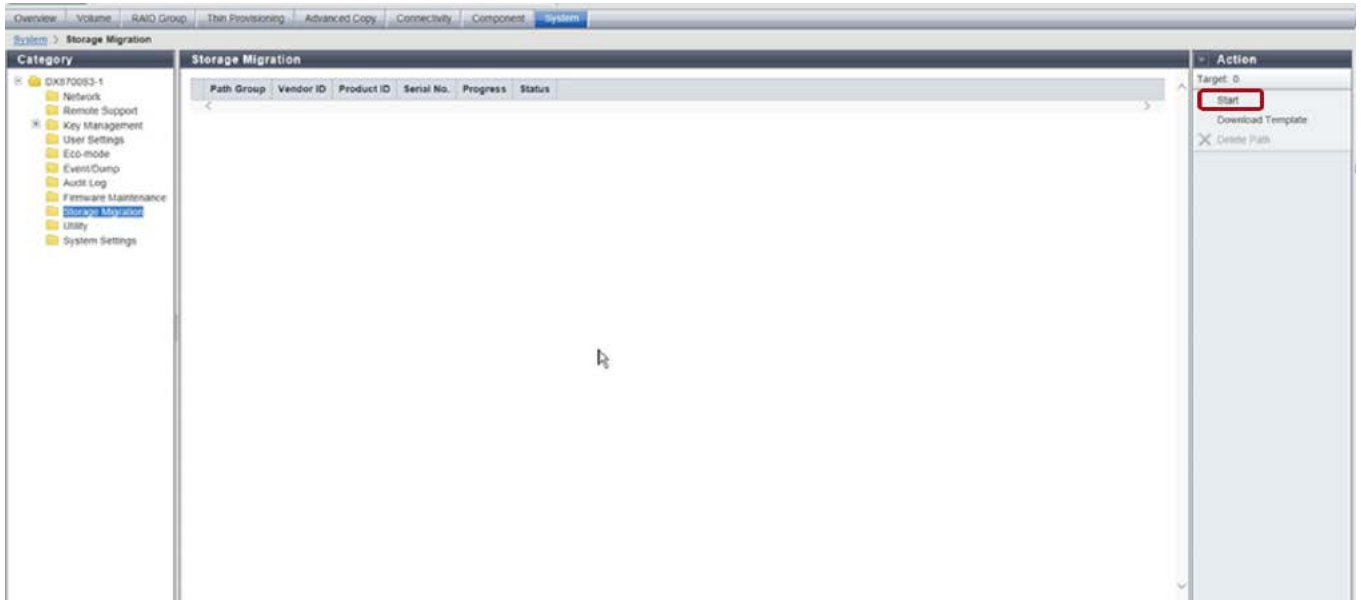
(6) Associates the logical drives numbers in the migration source and the migration destination.  
This example shows that the source storage system's logical drive number "0" is associated with the destination storage system's logical drive number "85".

(7) [EOF] (End of File) indicates the end of the path setting file

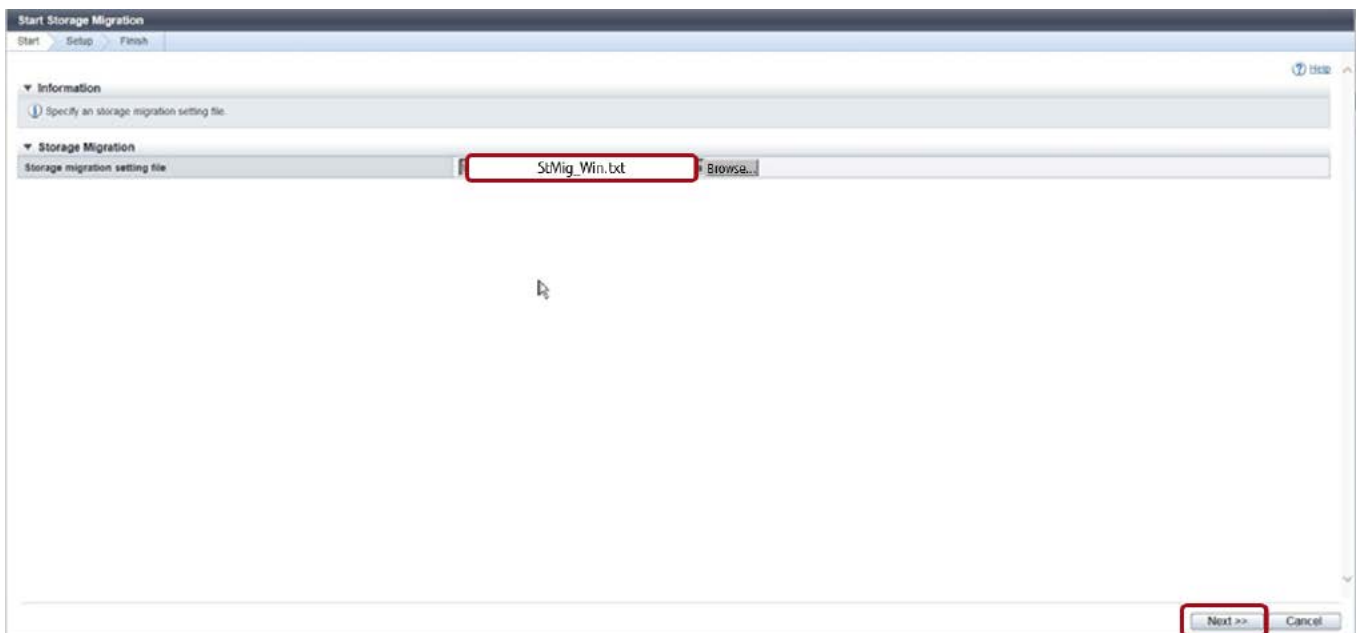
- (\*1) The group identifier for the path group associates a migration volume to a migration FC port.  
Setting multiple FC ports in a path group creates a multipath group.  
If a path group is blocked, a path failover is performed to another FC port in the path group.  
A migration source FC port must be paired with a migration destination FC port (in the Initiator mode).  
In addition, an FC port that is already set in one path group cannot be set in another.

6. [Operations on the destination storage system] Apply the Storage Migration setting file (StMig\_Win.txt) to the destination storage system and then start a data migration with Storage Migration.

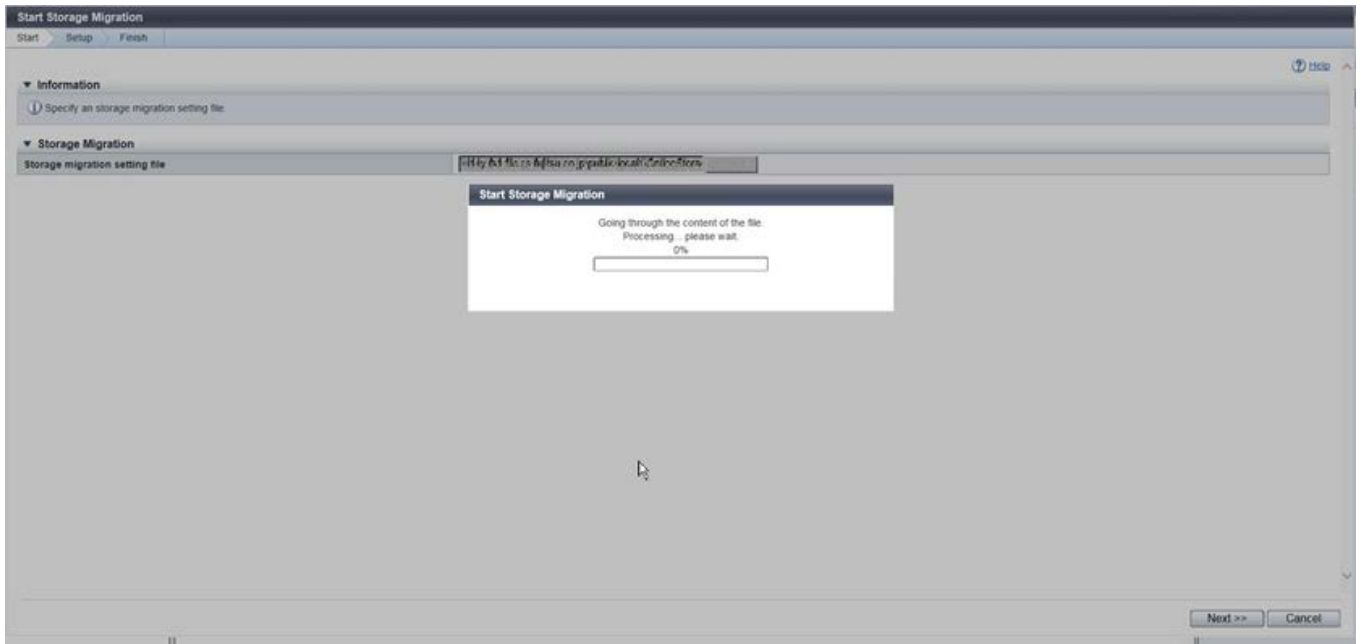
(1) Click [Start] in [Action].



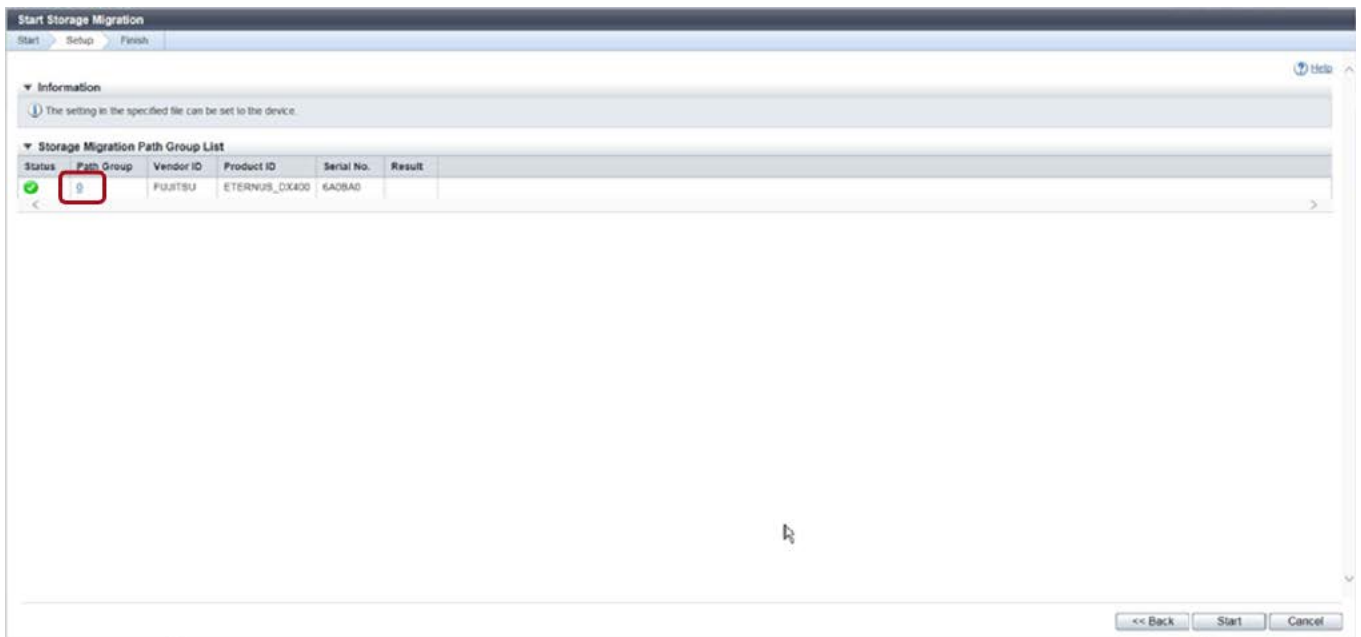
(2) Click the [Browse] button, select the Storage Migration setting file, and then click the [Next] button.



The Storage Migration setting file is processed.



(3) Click the group number under [Path Group] to check the details.



(4) Confirm the settings and then click the [Close] button.

Start Storage Migration

StartSetupFinish

▼ Storage Migration Path Information

Path Group

Vendor ID

Product ID

Serial No.

Operation Mode

0

FUJITSU

ETERNUS\_DX400

6A0B40

Migration & Host IO

▼ Migration Connection Path

Source WWN

CA Port

2041000B505A2B40

CEW CM90 CA90 Port0

2149000B505A2B40

CEW CM90 CA90 Port1

2040000B505A2B40

CEW CM91 CA90 Port0

2140000B505A2B40

CEW CM91 CA90 Port1

▼ Storage Migration Volume List

11 items

1 / 1 pages

1 page

Go

Source LUN	Source LUN (Hex)	Source LUN Status	Destination Volume No.	Destination Volume No (Hex)	Destination Volume Name	Capacity	Result
0	0x0000	Available	05	0x0055	CSM_STD000000	20.00 GB	
1	0x0001	Available	06	0x0056	CSM_STD000001	20.00 GB	
2	0x0002	Available	07	0x0057	CSM_STD000002	20.00 GB	
3	0x0003	Available	08	0x0058	CSM_STD000003	20.00 GB	

Close

(5) Click the [Start] button.

Start Storage Migration

StartSetupFinish

▼ Information

The setting in the specified file can be set to the device.

▼ Storage Migration Path Group List

Status	Path Group	Vendor ID	Product ID	Serial No.	Result
✓	0	FUJITSU	ETERNUS_DX400	6A0B40	

<< Back

Start

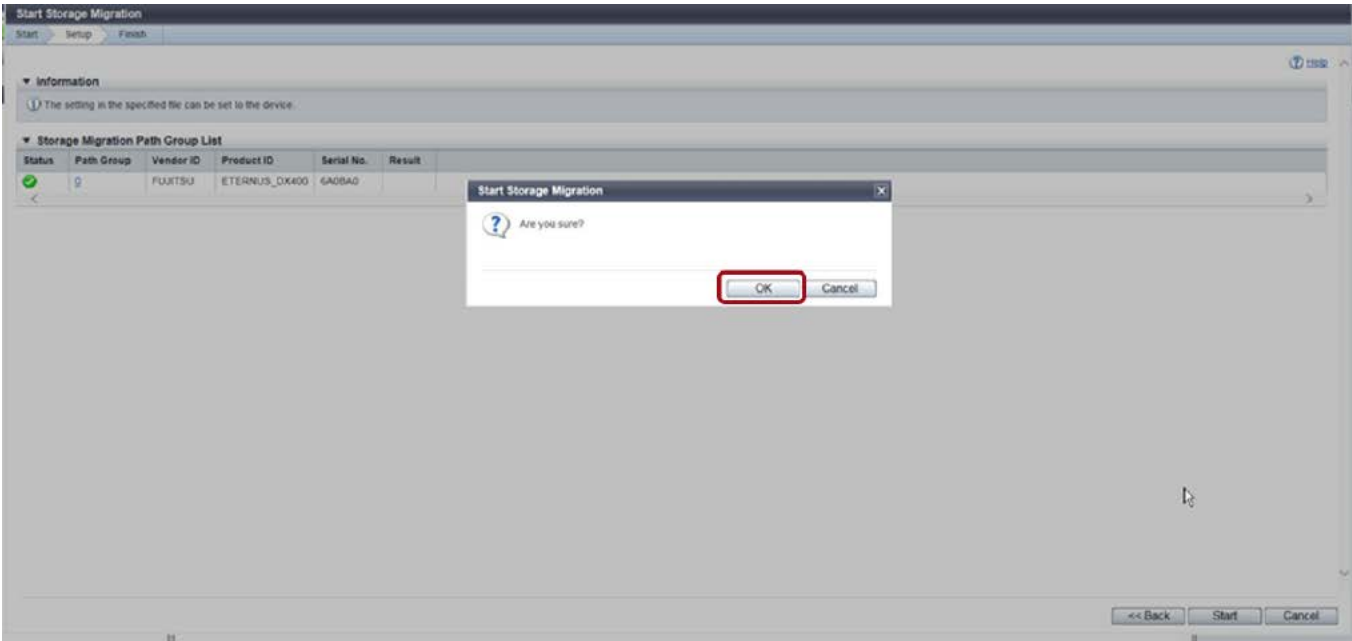
Cancel

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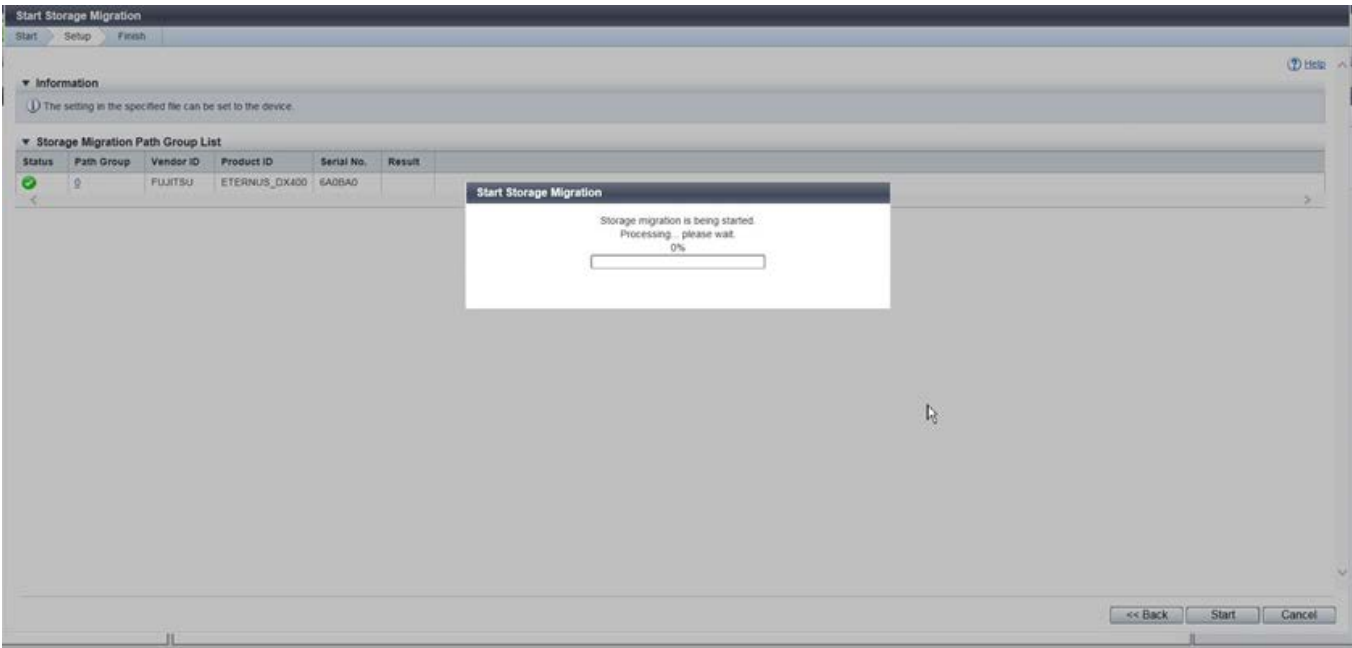
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<https://www.fujitsu.com/eternus>

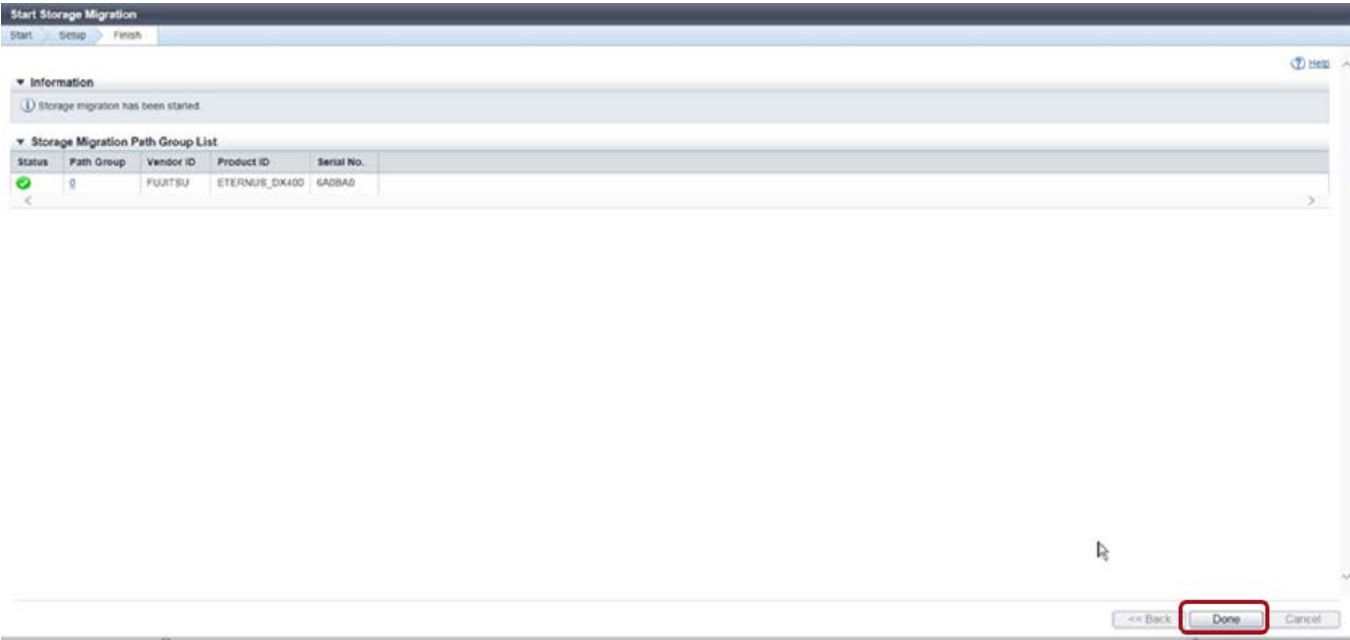
(6) Click the [OK] button.



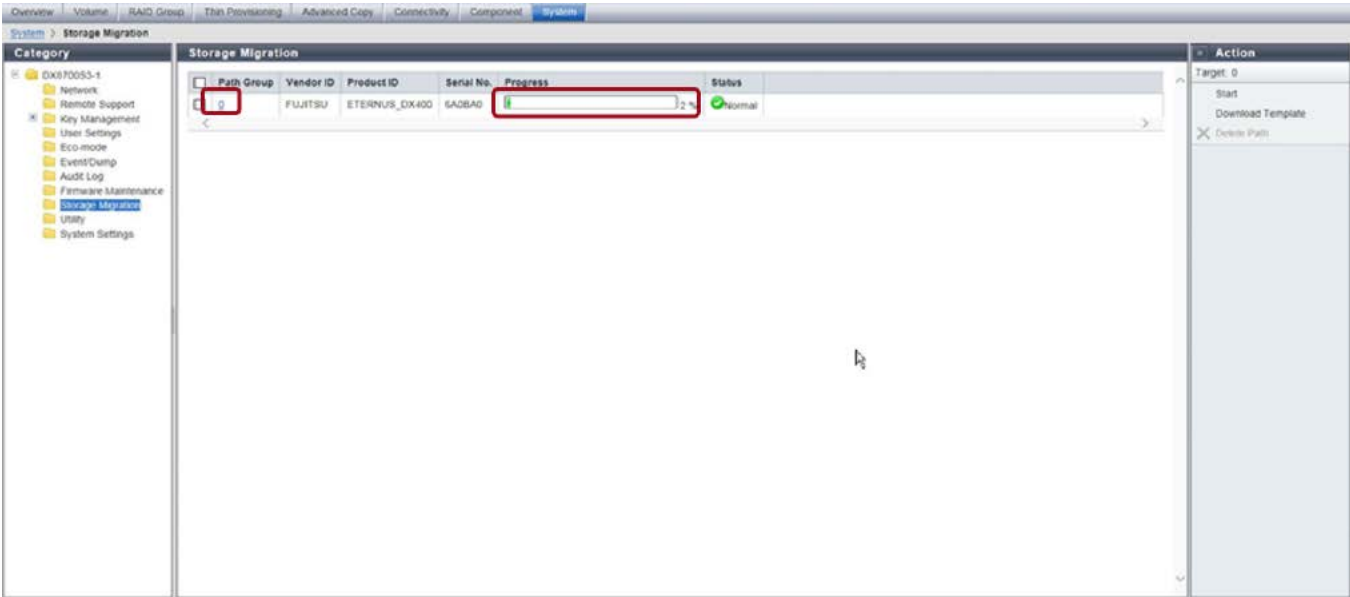
A data migration with online Storage Migration is started.



(7) After the data migration starts, click [Done] to return to the [Storage Migration] screen.

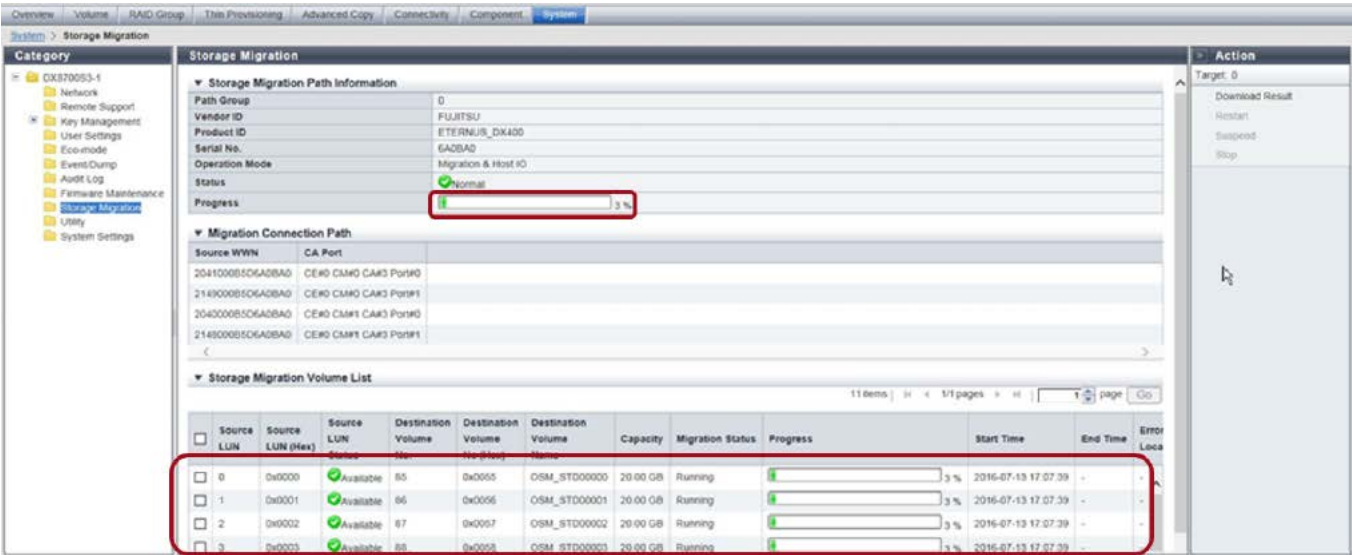


(8) Confirm that the data is being migrated using the progress bar. Click the group number under [Path Group] to check the details.



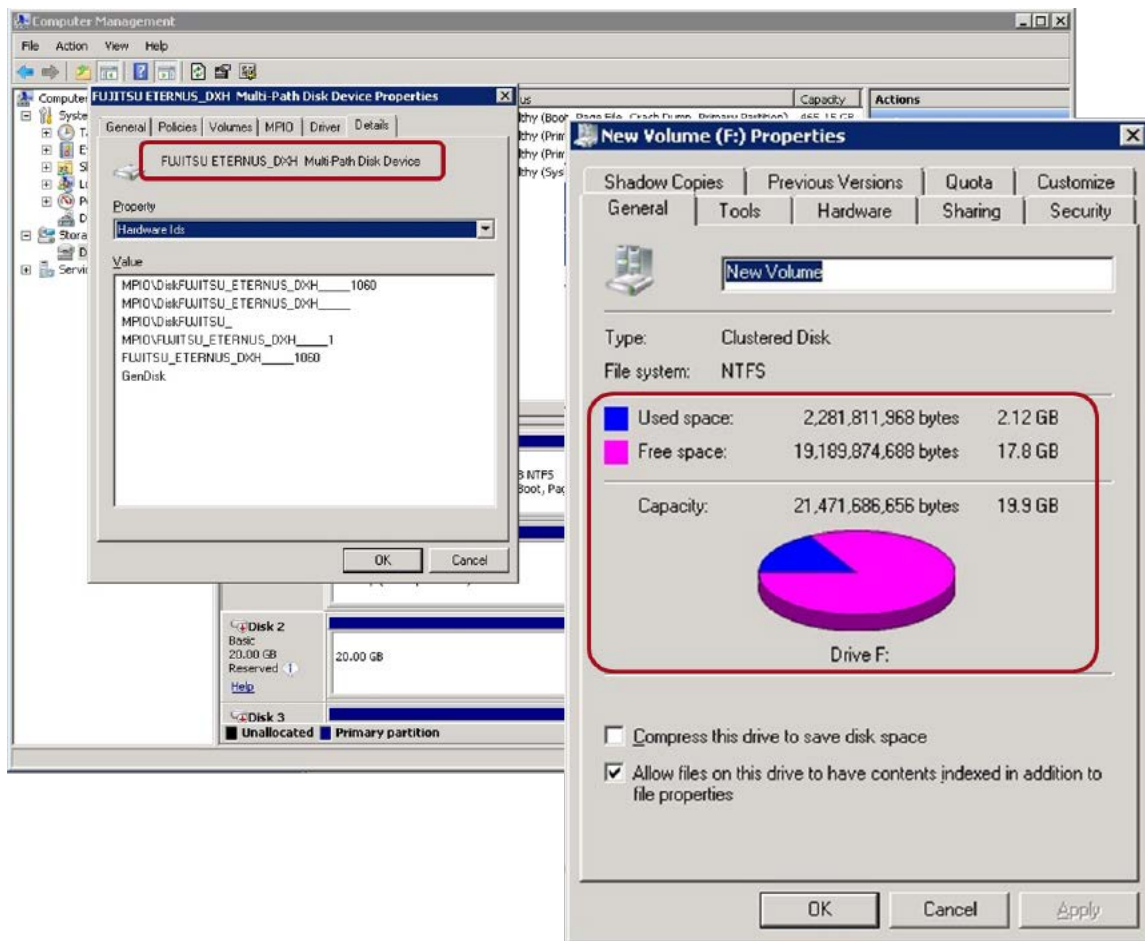


- (9) Check the detailed information of the data migration progress.

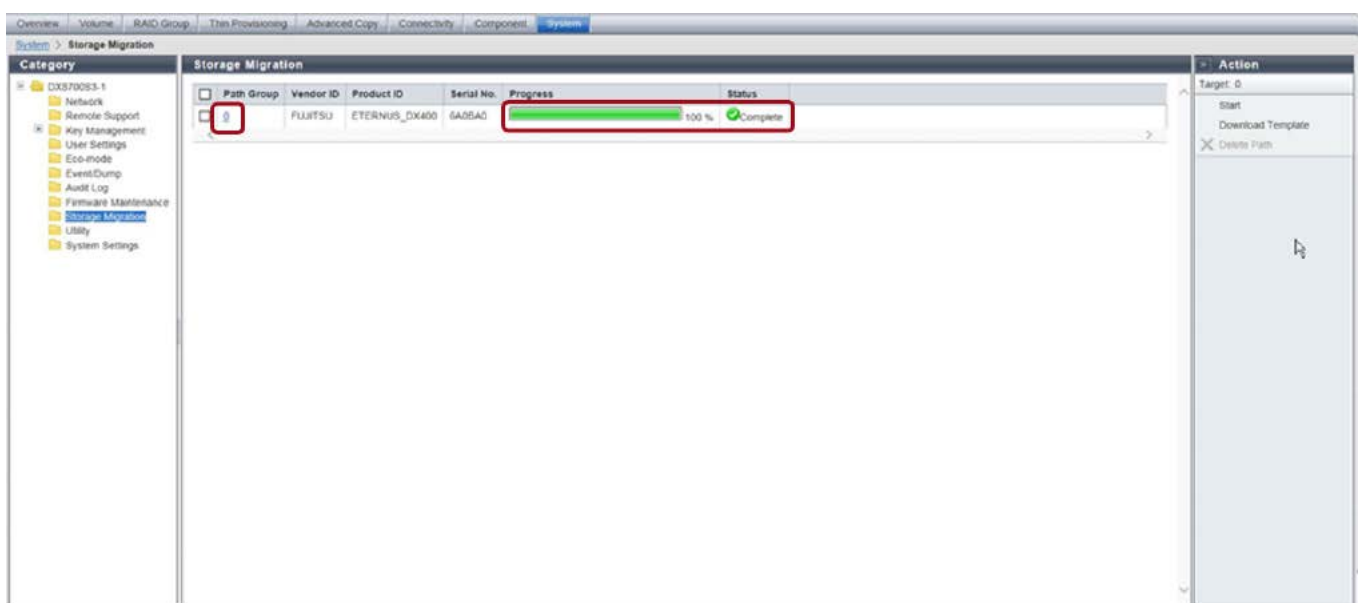


7. [Other operations] Delete the volume mappings of the source storage system to the server and then create mappings to the destination storage system.
8. [Other operations] Connect the server to the destination storage system using FC cables.

9. [Operations on the business server] Start the server, confirm that the logical drive of the migration destination is the same as the migration source's logical drive (items such as "F:" and "20GB"), and then resume operations.



10. [Operations on the destination storage system] Confirm that the data migration is completed in the progress screen. If the Progress bar is "100%" and "Complete" is displayed under [Status] for the Path Group, the data migration is completed. Then click the group number under [Path Group].



11. [Operations on the destination storage system] Confirm again that the data migration is completed in the details screen of the data migration.
- If "Complete" is displayed for [Status], the Progress bar is "100%" for the Path Group, and "Normal End" is displayed under [Migration Status] in [Storage Migration Volume List], the data migration is completed.

The screenshot shows the 'Storage Migration' details screen. The 'Status' field is marked 'Complete' with a green checkmark. The 'Progress' bar is at 100%. The 'Migration Connection Path' table shows four paths, all with 'Normal End' status. The 'Storage Migration Volume List' table shows four volumes, all with 'Normal End' status and 100% progress.

Source LUN	Source LUN (Hex)	Source LUN Status	Destination Volume No.	Destination Volume No (Hex)	Destination Volume Name	Capacity	Migration Status	Progress	Start Time	End Time
0	0x0000	Available	85	0x0055	OSM_STD00000	20.00 GB	Normal End	100 %	2016-07-13 17:07:39	2016-07-13
1	0x0001	Available	86	0x0056	OSM_STD00001	20.00 GB	Normal End	100 %	2016-07-13 17:07:39	2016-07-13
2	0x0002	Available	87	0x0057	OSM_STD00002	20.00 GB	Normal End	100 %	2016-07-13 17:07:39	2016-07-13
3	0x0003	Available	88	0x0058	OSM_STD00003	20.00 GB	Normal End	100 %	2016-07-13 17:07:39	2016-07-13

12. [Operations on the destination storage system] Delete the paths that are confirmed to have finished Storage Migration.

The screenshot shows the 'Storage Migration' list screen. The 'Delete Path' button is highlighted in the 'Action' column for the selected path group.

Path Group	Vendor ID	Product ID	Serial No.	Progress	Status	Action
0	FUJITSU	ETERNUS_DX400	6A0BAG	100 %	Complete	Delete Path

## 5.2. Confirmation after the Migration

Confirm that the data has been successfully migrated by comparing the following information with the information collected in "2. Investigating the Current Environment".

- Drive information (drive number, drive label (MBR/GPT), file system type (NTFS or other), and capacity)
- Partition information (partition type [primary, extended (logical)], partition number, drive letter/mount point, and capacity)
- Operation of migrated applications and migrated data

## 6. Removal

Disconnect the cables used for data migrations and remove the source storage systems as required.

## 7. Conclusion

Online Storage Migration is extremely useful as a means to migrate data.

This function can minimize business downtime while reducing costs by eliminating the need to prepare a dedicated facility, and obtain licenses and software for data migrations.

Since data can be migrated at high speed, online Storage Migration provides a greater advantage as the amount of migration target increases. To migrate large amounts of data, such as during a storage replacement, the ETERNUS AF S3 series, ETERNUS AF S2 series, and ETERNUS DX S5/S4 series are viable solutions.

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