

White Paper

FUJITSU Storage ETERNUS AF series and ETERNUS DX series: Reducing the Costs of Remote Data Storage

Remote data storage is costly in terms of equipment and human resource allocation. This document describes how the FUJITSU Storage ETERNUS AF series and ETERNUS DX series reduce the costs of remote data storage.



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Preface

Storing data remotely is a method for reducing the risk of data loss due to equipment failure, accidents, or disasters, such as earthquakes or fires.

One method of storing data to a remote site is the tape system. The FUJITSU Storage ETERNUS AF series and ETERNUS DX series can be used to remotely store data at a lower cost.

This document describes the remote storage of data using the FUJITSU Storage ETERNUS AF series, ETERNUS DX series, and ETERNUS SF AdvancedCopy Manager Copy Control Module.

The contents of the procedures in this document are current as of October 2017.

The product lineup and product information stated in this document are current as of November 2019.

■ Target Audience

This document targets the following:

- Those who are using storage systems or considering the use of storage systems, and are considering remote data storage or proposing such a system.
- Those with a basic knowledge of storage systems.

■ Target Models

This document applies to the following storage systems that support Remote Advanced Copy functions (refer to Terms below).

- FUJITSU Storage ETERNUS AF150 S3/AF250 S3 and AF650 S3
- FUJITSU Storage ETERNUS DX100 S5/S4, DX200 S5/S4, DX500 S5/S4, DX600 S5/S4, DX900 S5, and DX8100 S4/DX8900 S4

■ Terms

The following terms are used in this document.

- Storage system.....A storage system comprised of HDDs or flash memory.
- Tape systemA system that reads data from and writes data to magnetic tape.
(Includes systems such as tape libraries that incorporate a "robot mechanism" for transporting the cartridge tape.)
- Advanced Copy functions.....These FUJITSU Storage ETERNUS AF series and ETERNUS DX series functions transfer data and create copies at high speed within the storage system without using the server's CPU.
The following three methods are available for creating copies:
 - Mirror breaking method (Equivalent Copy: EC)
 - Background copy method (One Point Copy: OPC)
(Differential copies using this method is called QuickOPC.)
 - Copy-on-write method (SnapOPC)
- Remote Advanced Copy functions.....An expanded version of the Advanced Copy function's "mirror breaking method (Equivalent Copy: EC)" that copies between FUJITSU Storage ETERNUS AF/DX series storage systems.
 - Extended Remote Equivalent Copy
A data transfer method using Remote Equivalent Copy to connect storage systems via a network such as a WAN.
 - Remote Equivalent Copy
A data transfer method using the Remote Equivalent Copy function that, unlike Extended Remote Equivalent Copy, does not connect via a network such as a WAN.

■ Naming Conventions

The following abbreviations are used in this document.

- FUJITSU Storage ETERNUS AF series that supports the Remote Advanced Copy functions ETERNUS AF series
- FUJITSU Storage ETERNUS DX series that supports the Remote Advanced Copy functions..... ETERNUS DX series
- ETERNUS AF series and ETERNUS DX series ETERNUS AF/DX
- ETERNUS SF AdvancedCopy Manager ACM
- ETERNUS SF AdvancedCopy Manager Copy Control Module CCM

1. Methods for Storing Data Remotely

A tape system is a typical method for remotely storing data from the storage system in the operation site (hereafter, "tape backup"). For remote data storage using tape backups, the data in the storage system is backed up to tape periodically and this tape is transported to a remote site. The deployment costs and running costs of this system are low and large volumes of data can be stored for a long time.

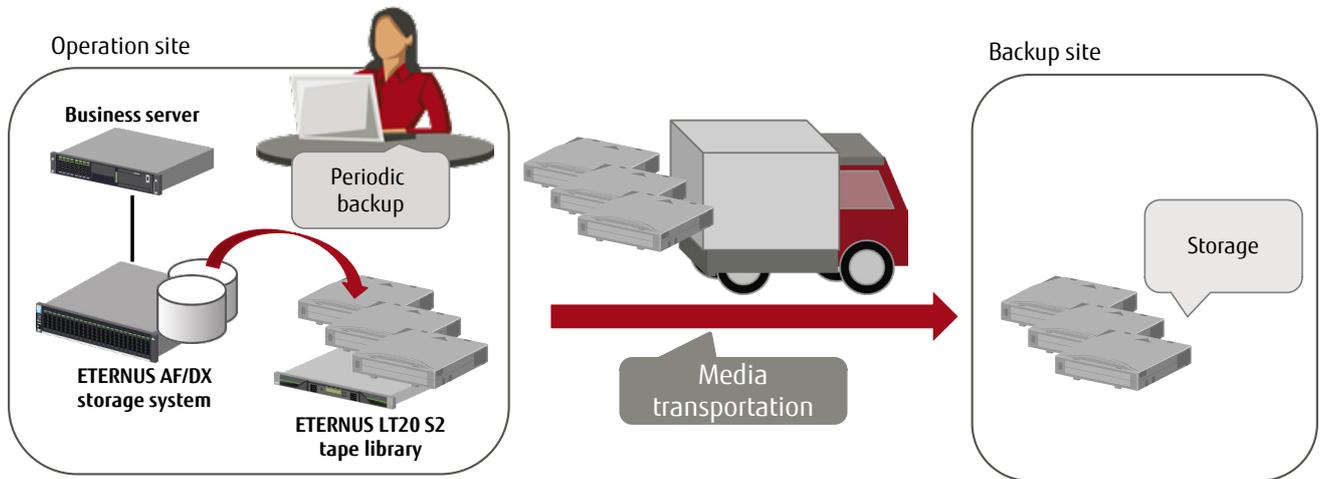


Figure 1-1 Remote data storage using tape backups

On the other hand, for the remote storage method using the ETERNUS AF/DX, the ETERNUS AF/DX storage systems are connected via a network, such as a WAN, and "Extended Remote Equivalent Copy" is used to transfer the data to the storage system in the remote site.

"Extended Remote Equivalent Copy" can be used for backups by creating snapshots or by mirroring between storage systems and can protect data from accidents or disasters. Tape transportation is not necessary and there is no need for tape libraries or periodic maintenance of the tapes. Manual work at the remote site can also be reduced.

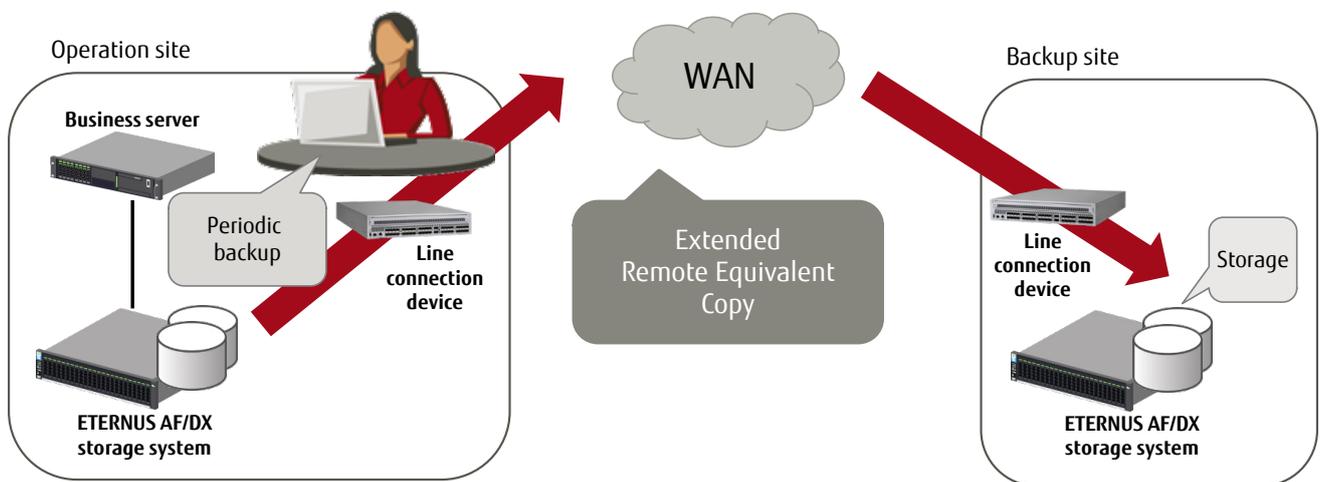


Figure 1-2 Remote data storage using ETERNUS AF/DX

2. Easy Deployment and Low-Cost Remote Copying between Storage Systems Using an iSCSI Connection

Fibre Channel (FC) and Internet Small Computer System Interface (iSCSI) are available for connecting storage systems when "Extended Remote Equivalent Copy" is performed.

FC connections transfer data at high speed and can also be used for recovery of mission critical systems after a disaster. However, WAN connections require a high-cost Fibre Channel switch to enable FC-IP tunneling connections.

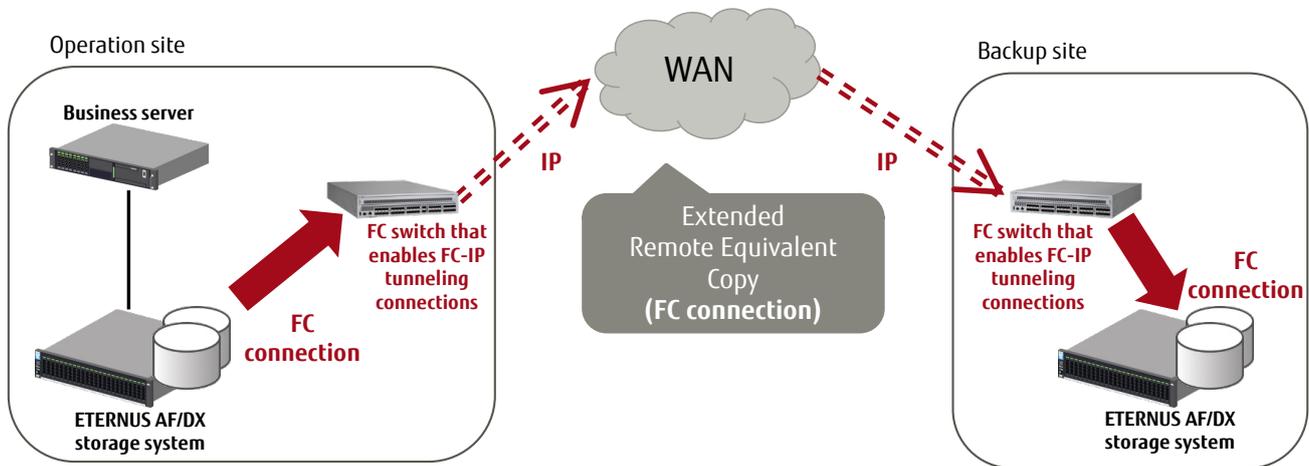


Figure 2-1 Remote data storage using an FC connection between ETERNUS AF/DX storage systems

iSCSI is a protocol standard for building a Storage Area Network (SAN) using an IP network. An iSCSI connection using this standard can be configured from low-cost devices such as Ethernet routers and network cables.

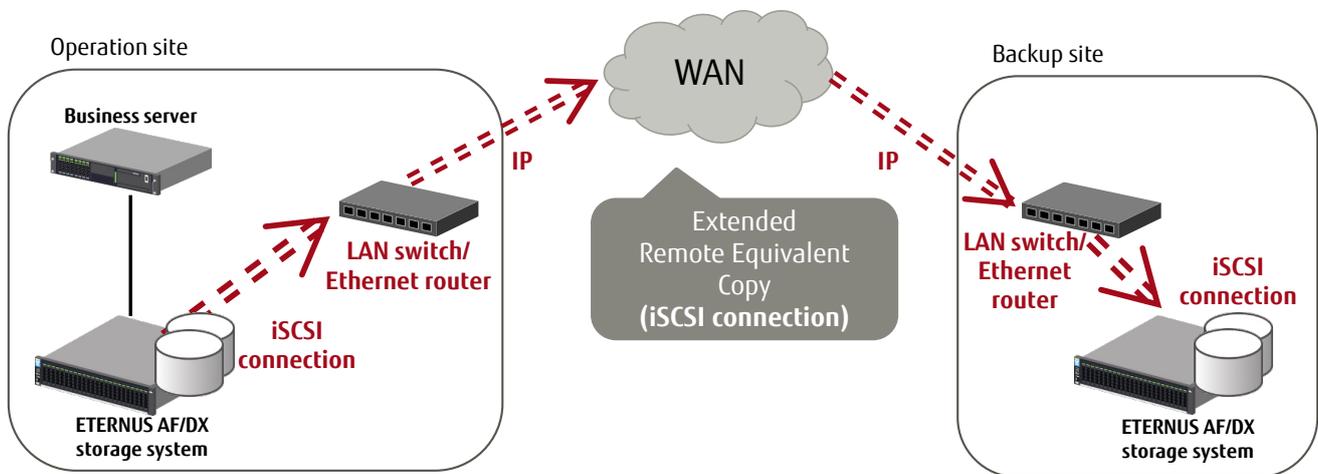


Figure 2-2 Remote data storage using an iSCSI connection between ETERNUS AF/DX storage systems

Because iSCSI connections can use low-cost network devices, such as LAN switches and Ethernet routers, installation costs are reduced. Configuring REC and operating the remote data storage are also easy.

The following chapters describe the deployment and operation procedures for remote data storage when the ETERNUS AF/DX storage systems are connected with iSCSI.

3. Example Deployment of an "Extended Remote Equivalent Copy" Environment for Remote Copying between Storage Systems Using iSCSI

This chapter describes an example deployment of an "Extended Remote Equivalent Copy" environment that uses iSCSI.

3.1. System Configuration Overview

In this configuration, the business data of the storage system in the operation site is copied to the storage system in the remote backup site via a WAN.

ETERNUS AF/DX is used as the storage systems and iSCSI is used for connecting the storage systems to the WAN.

In the following configuration example, iSCSI is used as the connection method for the business server and the ETERNUS AF/DX of the operation site.

The same network devices are used for the REC IP-SAN, which connects the ETERNUS AF/DX storage systems via the WAN; and the management LAN, which controls each device. The LAN segments are divided by a VLAN. The business IP-SAN, which is between the business server and the ETERNUS AF/DX, uses different network devices.

A CCM server is deployed in the operation site to control the Advanced Copy functions of the ETERNUS AF/DX.

ETERNUS SF AdvancedCopy Manager Copy Control Module (hereafter, "CCM") is installed in the CCM server. This tool of ETERNUS SF AdvancedCopy Manager (hereafter, "ACM") controls the Advanced Copy functions of the ETERNUS AF/DX.

CCM controls the copy operation from the ETERNUS AF/DX storage system in the operation site to the ETERNUS AF/DX storage system in the backup site via the management LAN.

The Remote Equivalent Copy function (REC) is used for copying between the storage systems.

In this configuration example, because the ETERNUS AF/DX in the backup site is managed from the operation site, the management LAN is also connected via the WAN.

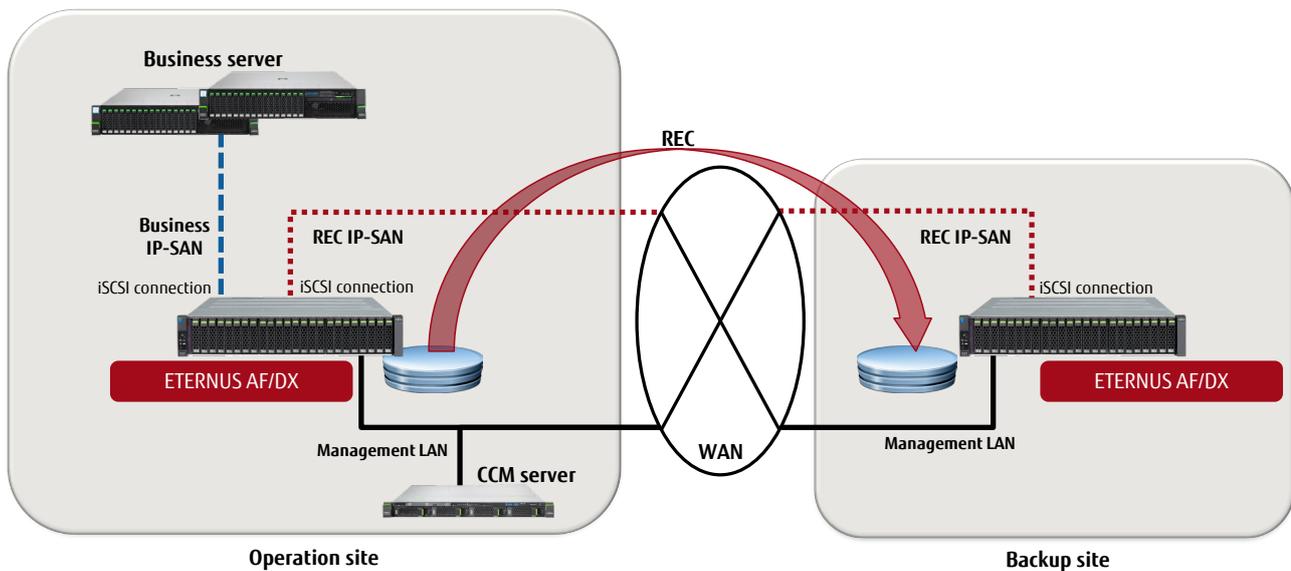


Figure 3-1 System diagram

Note that "Figure 3-1 System diagram" omits network devices such as L2 switches and terminals for managing the ETERNUS AF/DX. In addition, redundancy is used for the business IP-SAN, the REC IP-SAN, and the management LAN, but this has been simplified in the diagram.

3.2. Copy Method Overview

This section describes the method for storing one generation of the production volume that is in the operation site to the remote data storage in the backup site on a logical volume basis. The impact on business due to volume copying is reduced and complete data is stored even when problems occur in the operation site or the connection.

Differential copying (QuickOPC) is used to copy the production volume to the REC copy source volume of the ETERNUS AF/DX storage system in the operation site. Then, REC is used to copy that data to the ETERNUS AF/DX storage system in the backup site. After the REC copy is completed, differential copying (QuickOPC) is used to copy the data to the backup volume of the ETERNUS AF/DX storage system in the backup site.

Copying with QuickOPC in the storage system is completed instantaneously and does not impact the volume access of the business server. Copying the REC copy destination volume ensures that one previous generation of the entire data is stored to the backup site even if a problem occurs during REC.

All copy operations are controlled from the CCM server.

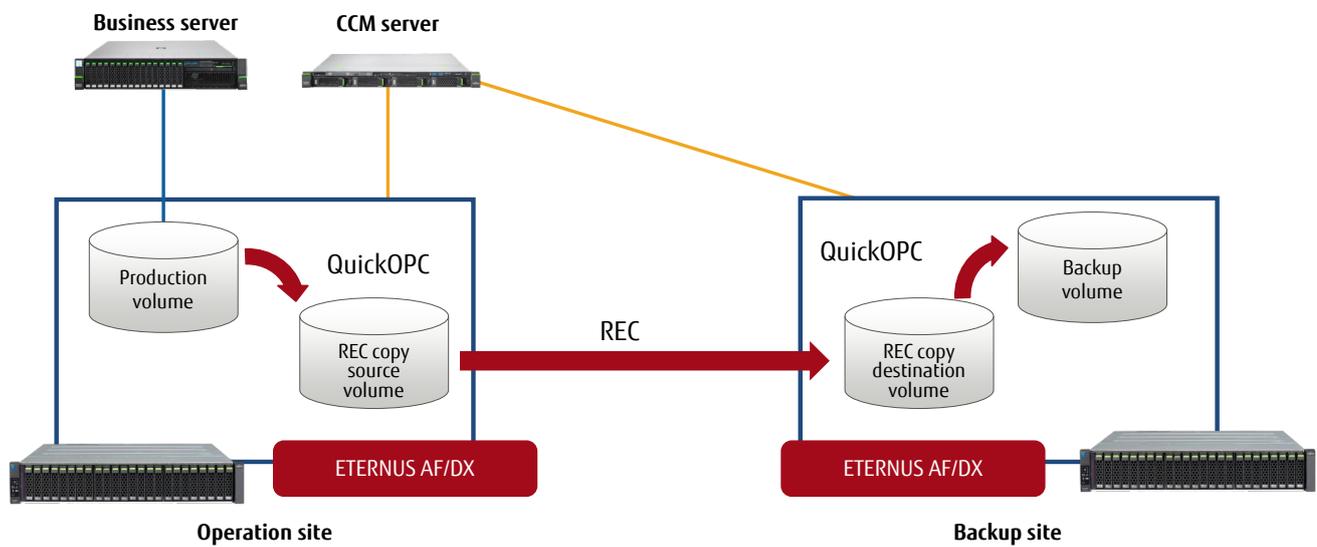


Figure 3-2 Diagram of the remote copy operation

3.3. Build Environment Workflow

Of the environments shown in the overviews of the system configuration and copy method, the following table shows the workflow for building the CCM environment and for building the Advanced Copy environment required for remote copying between storage systems.

Main Item	CCM Server Workflow	Operation Site ETERNUS Workflow	Backup Site ETERNUS Workflow		
1. Building the CCM Environment	Install CCM	Register users	Register users		
	Set the CCM operating environment				
2. Building the Advanced Copy Environment	Register a license	Set the iSCSI port	Set the iSCSI port		
				Configure the basic settings of Advanced Copy	Configure the basic settings of Advanced Copy
				Set the REC path	
3. Copy Settings	Register the ETERNUS storage system				
	Create a copy group				
	Add a copy pair				

Table 3-1 Building environment workflow

3.4. Environment Build Procedure

This section describes the build procedure for CCM and Advanced Copy using the following environment configuration as an example.

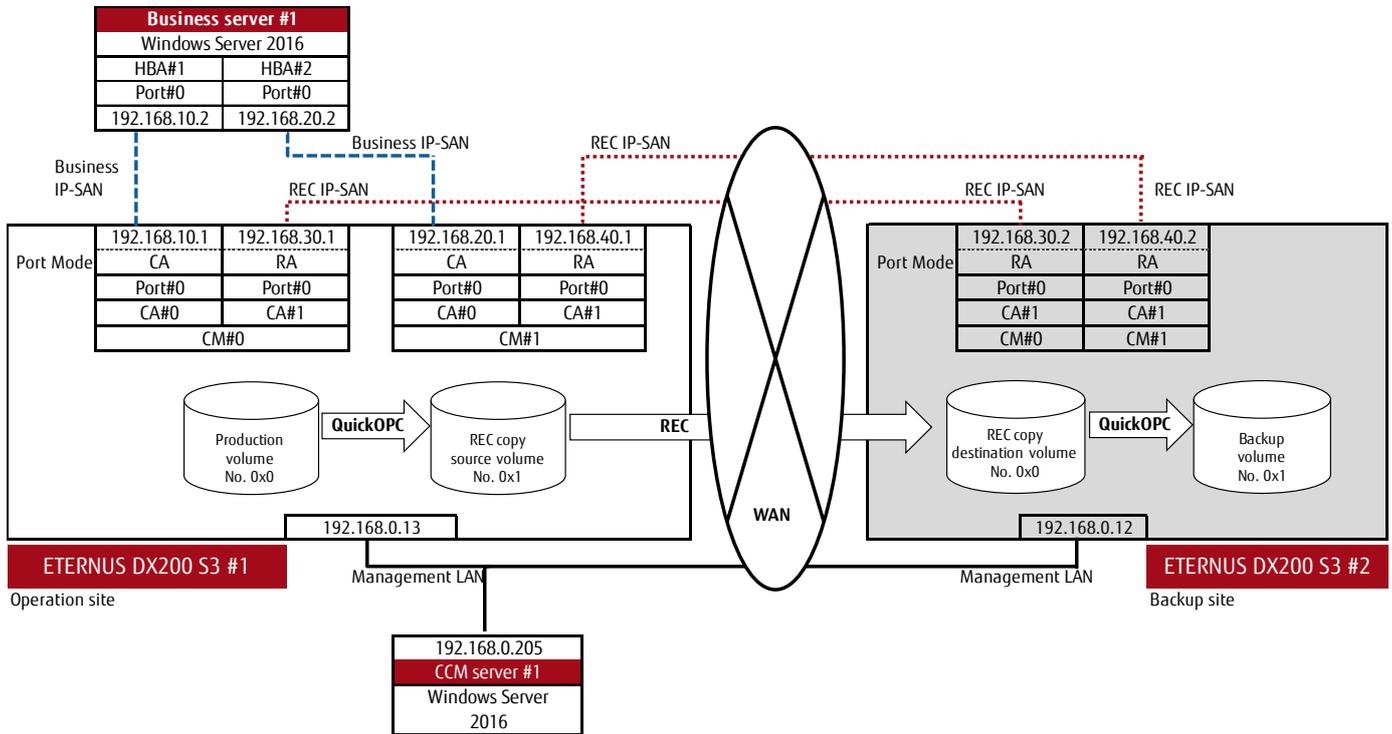


Figure 3-3 System environment configuration diagram for remote copy operations

Before building the CCM environment and the Advanced Copy environment, check that the following preparations have been made:

- The production volume of the ETERNUS AF/DX in the operation site is configured and can be used from the business server.
- The OS environment of the CCM server is configured.
The following describes the procedure for using Windows Server as the CCM server OS.
- The WAN is connected between the operation site and the backup site.
- The CCM server and ETERNUS AF/DX storage systems in the operation site and backup site are connected via the management LAN (MNT ports).
- The REC LAN to be used for the REC path between the operation site and backup site can communicate with the WAN.
- The logical volumes required for copying are created in the ETERNUS AF/DX storage systems of both the operation site and the backup site.
The following volumes are required:
 - REC copy source volume
 - REC copy destination volume
 - Backup volume
 Each volume must be created with the same capacity as the production volume of the backup target.

Note:

If a firewall is used between the CCM server and the ETERNUS AF/DX in the backup site, open the following ports in the backup site for communication with the ETERNUS AF/DX.

- 1372/tcp
- 1999/tcp
- 22/tcp
- 23/tcp
- 32002/tcp

If a firewall is used between the REC LAN of the operation site and the backup site, open the following communication port.

- 3260/tcp

3.4.1. Building the ETERNUS SF AdvancedCopy Manager Copy Control Module Environment

Perform the following to build the CCM environment.

- Install CCM.
- Register users.
- Configure the CCM operating environment.

Install CCM using the "ETERNUS SF SC/ACM/Express Media Pack (Windows 64-bit version) Manager Program 1/2" installation DVD.

Register users who will use CCM in the ETERNUS AF/DX storage systems at the operation site and the backup site as Software role accounts. For the user accounts, 1 to 32 single-byte alphanumeric characters and symbols ("!", "-", "_", ".") can be used.

In the operating environment settings of the CCM server, create CCM users and set the PATH environment variable.

Create CCM users by creating accounts with the Software role registered in the ETERNUS AF/DX.

Add the following CCM bin directory to the PATH environment variable.

<Program installation directory>\CCM\bin

3.4.2. Building the Advanced Copy Environment

Perform the following to build the Advanced Copy environment.

- Register an Advanced Copy license.
- Set the iSCSI port.
- Configure the basic settings of Advanced Copy.
- Set the REC path.
- Check the REC path connection.

To register an Advanced Copy license, register a license for ETERNUS SF AdvancedCopy Manager using the license function of ETERNUS SF. Enter the following "esflm add" command at the command prompt with the OS administrator rights on the CCM server.

```
esflm add <licenseID> <licenseKey> -i <ipAddress> -u <userName> -p <password>
```

The path of the license function command is <Program installation directory>\LM\bin.

Register the ETERNUS SF AdvancedCopy Manager license in each ETERNUS AF/DX storage system.

For <licenseID>, specify the license ID of AdvancedCopy.

The specifiable <licenseID> can be checked by entering the "esflm listid" command at the command prompt.

For <licenseKey>, specify the license key obtained from the ETERNUS SF AdvancedCopy Manager license.

For <ipAddress>, specify the IP address of the ETERNUS AF/DX MNT port in the operation site or backup site.

For <userName> and <password>, specify a user with administrator rights in the ETERNUS AF/DX and enter the password.

In the iSCSI port settings, set the port mode and IP address of the REC iSCSI port in the ETERNUS AF/DX.

The port mode of the REC iSCSI port must be set as "RA" or "CA/RA".

When using the iSCSI port only for REC, set the port mode to "RA". When using the iSCSI port for both REC and connection to the server, set to "CA/RA".

Set the iSCSI port mode from [Connectivity] - [Port Group] - [iSCSI] - [Modify Port Mode] of ETERNUS Web GUI.

Set the IP address of the iSCSI port from [Connectivity] - [Port Group] - [iSCSI] - [Modify iSCSI Port Parameters] of ETERNUS Web GUI.

After setting the IP address for the iSCSI port of the ETERNUS AF/DX in both the operation site and backup site, click [Test Connection (ping)] in [Modify iSCSI Port Parameters] to check the communication between the iSCSI ports.

Configure the basic settings for Advanced Copy in the ETERNUS AF/DX storage systems in the operation site and the backup site.

The basic settings of Advanced Copy include the following:

- EC/OPC priority setting
- Copy table size settings

For some models, the copy table size is set to OMB as the default setting at shipment. Be sure to change the copy table size.

In the copy table size settings, set the resolution of the REC copy source storage system to the same resolution as the copy destination storage system. REC cannot be executed between storage systems with different resolutions. Note that the copy table sizes do not need to be the same. If the calculated resolution for the copy source storage system and the copy destination storage system are different, set the resolution of both storage systems to the higher value. If the resolution is changed, recalculate and reset the copy table size.

For the configuration example (Section 3.1), the initial values of the ETERNUS DX200 S4 are used for the EC/OPC speed setting and the copy table size settings.

EC/OPC priority setting: "Automatic Priority"

Copy table size settings Resolution: "×16"

Table size: 128 (MB)

Table size threshold: 80%

Configure the basic settings of Advanced Copy from [Advanced Copy] - [Settings] of ETERNUS Web GUI.

For the REC path setting, set a path between the ETERNUS AF/DX storage systems.
 Export the ETERNUS AF/DX storage system information from the operation site and the backup site, and use this information to create the copy path information.
 Save the created copy path information to a file and apply the information to the ETERNUS AF/DX in the backup site.
 The following table shows the workflow of the REC path setting.

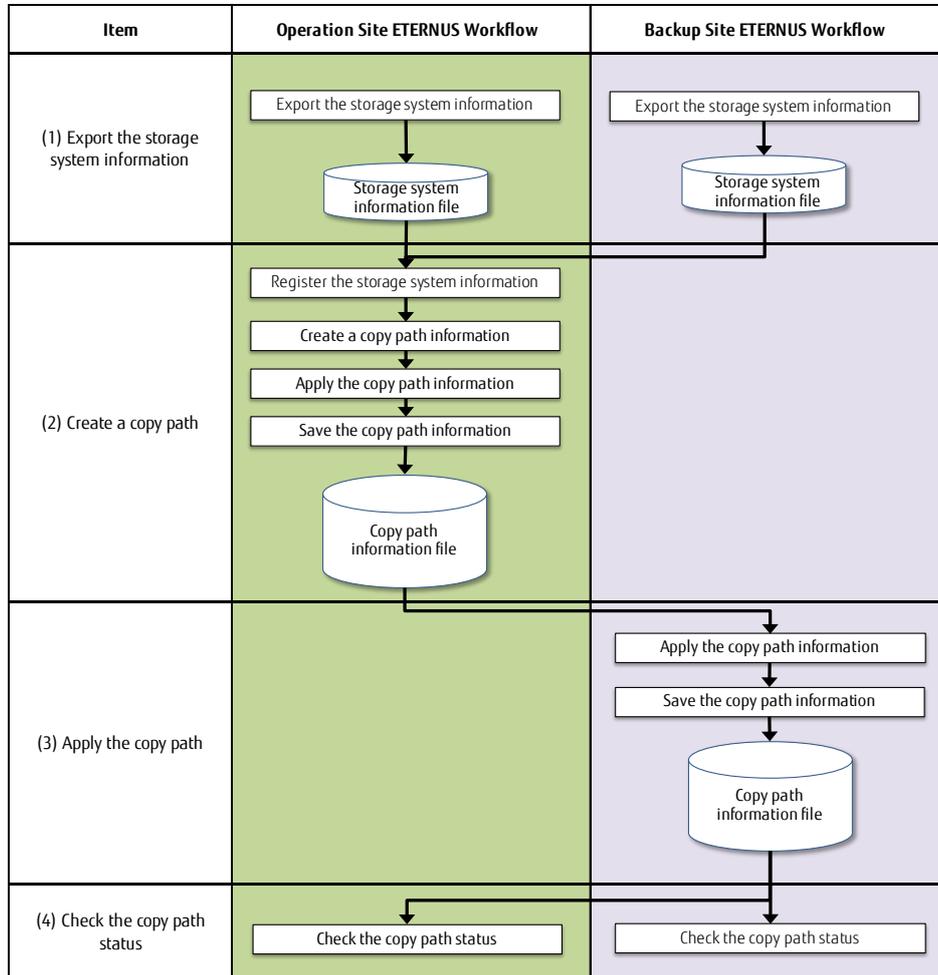


Table 3-2 Workflow of the REC path setting

- (1) Export the storage system information
Export the storage system information and save it to a file.

Click [Export Storage Info] from [Advanced Copy] - [Settings] - [Action] of ETERNUS Web GUI.

Click the [Export] button. When the export of the storage system information is completed, the screen for executing the file download is displayed.

Click the [Download] button. The downloaded file is saved to the terminal that started ETERNUS Web GUI.

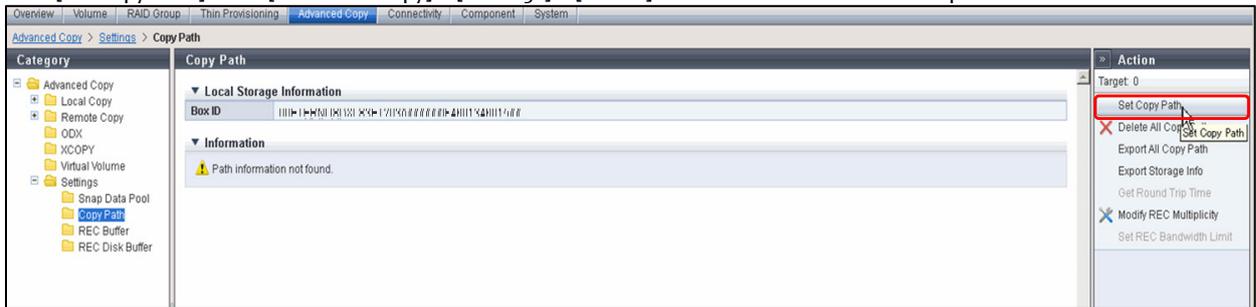
The default file name is "RecRAInfo_Serial number_YYYY-MM-DD_hh-mm-ss.bin".

Export the ETERNUS AF/DX storage system information from the operation site and the backup site.

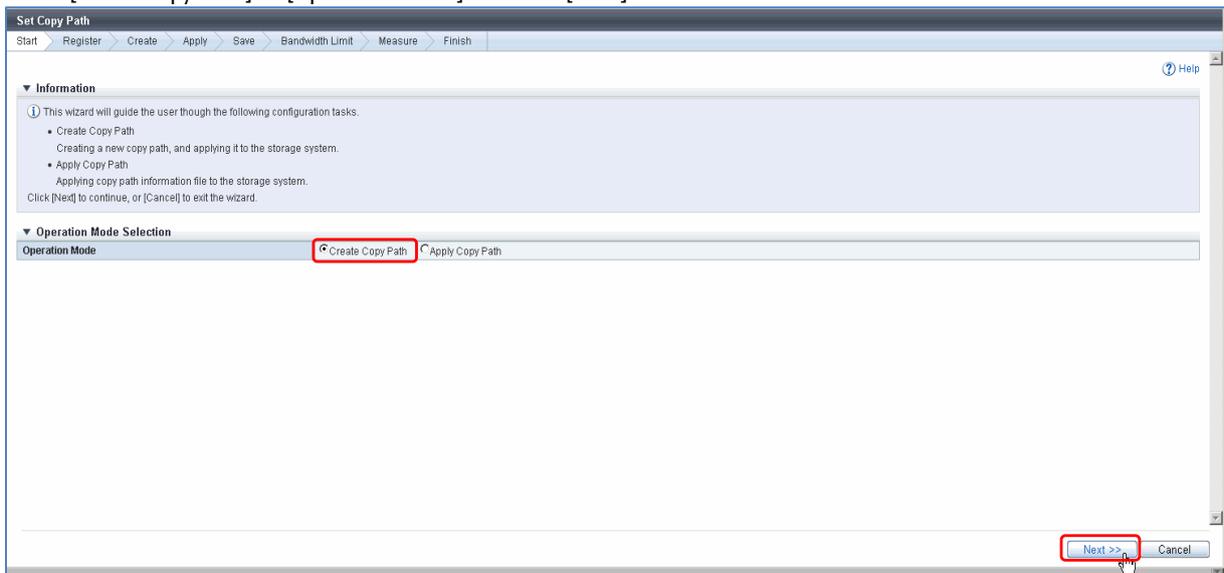
- (2) Create a copy path
Use the Wizard to set the copy path information between the storage systems, which is required for executing REC.

- a. Register the storage system information

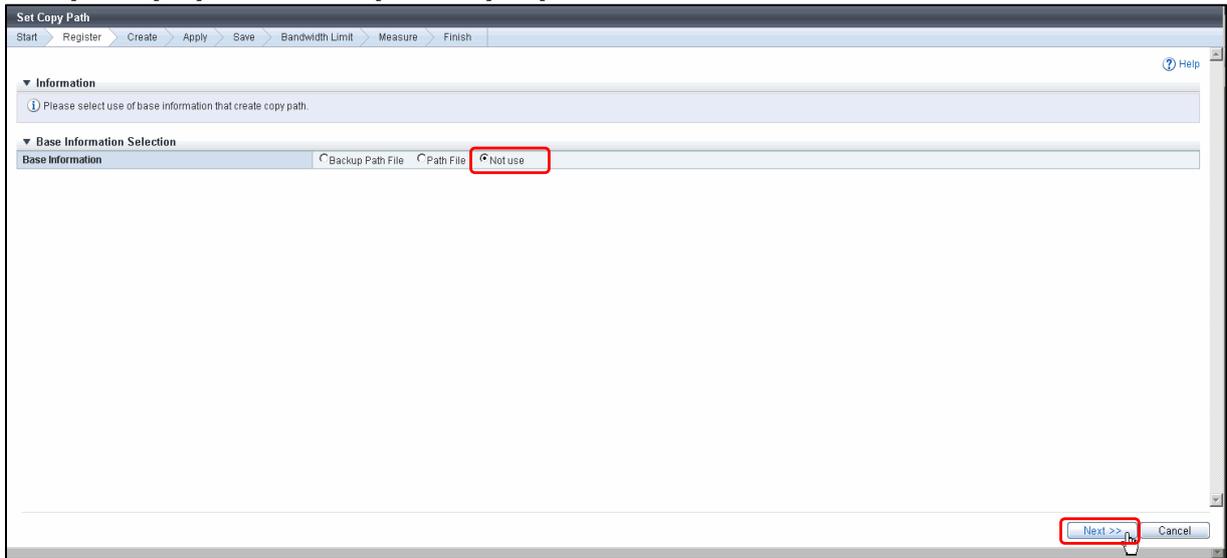
Click [Set Copy Path] from [Advanced Copy] - [Settings] - [Action] of ETERNUS Web GUI in the operation site.



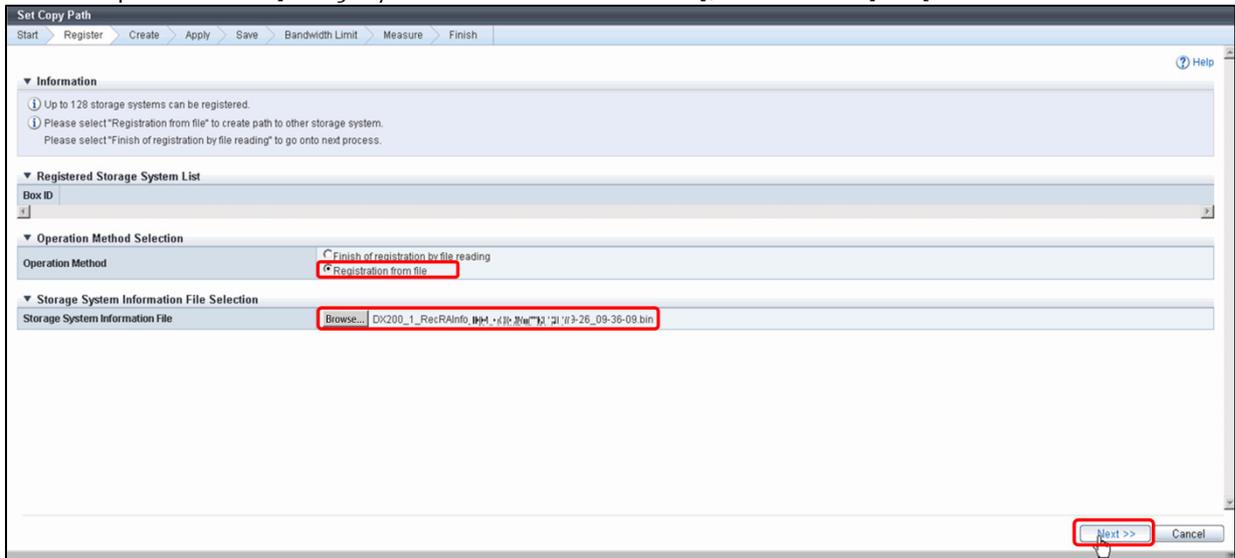
Select [Create Copy Path] in [Operation Mode] and click [Next].



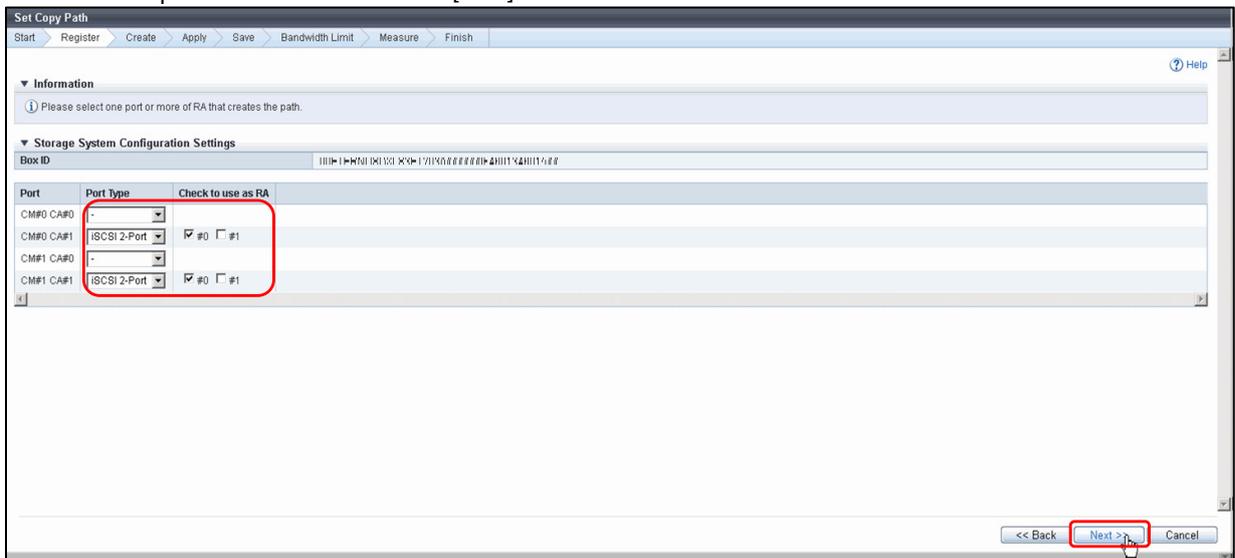
Select [Not use] in [Base Information] and click [Next].



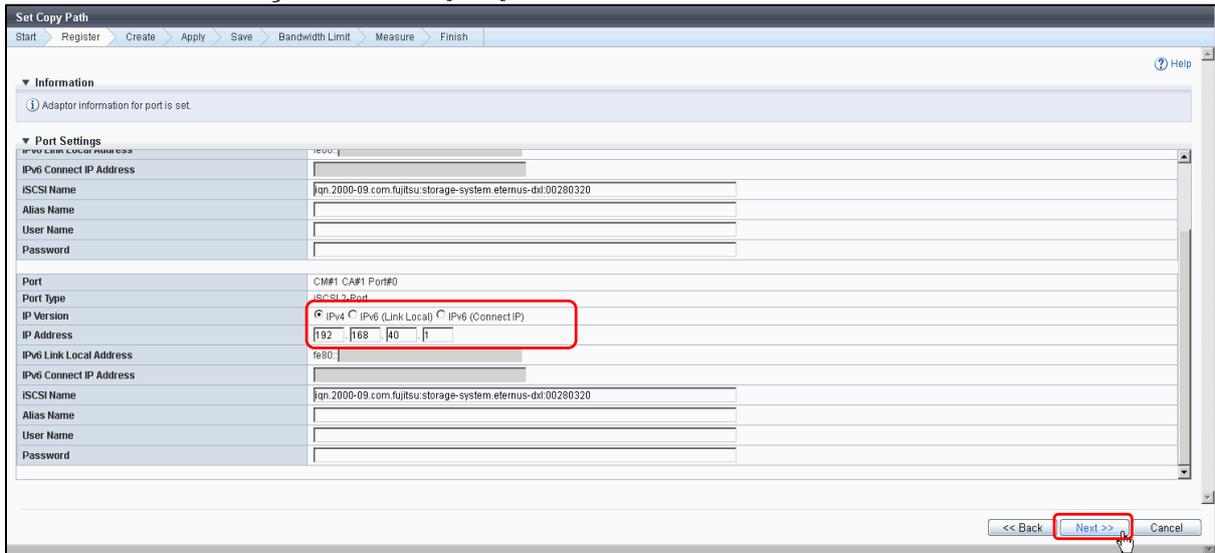
First, select the [Registration from file] radio button in [Operation Method], next select the downloaded storage system information file of the operation site in [Storage System Information File Selection], and then click [Next].



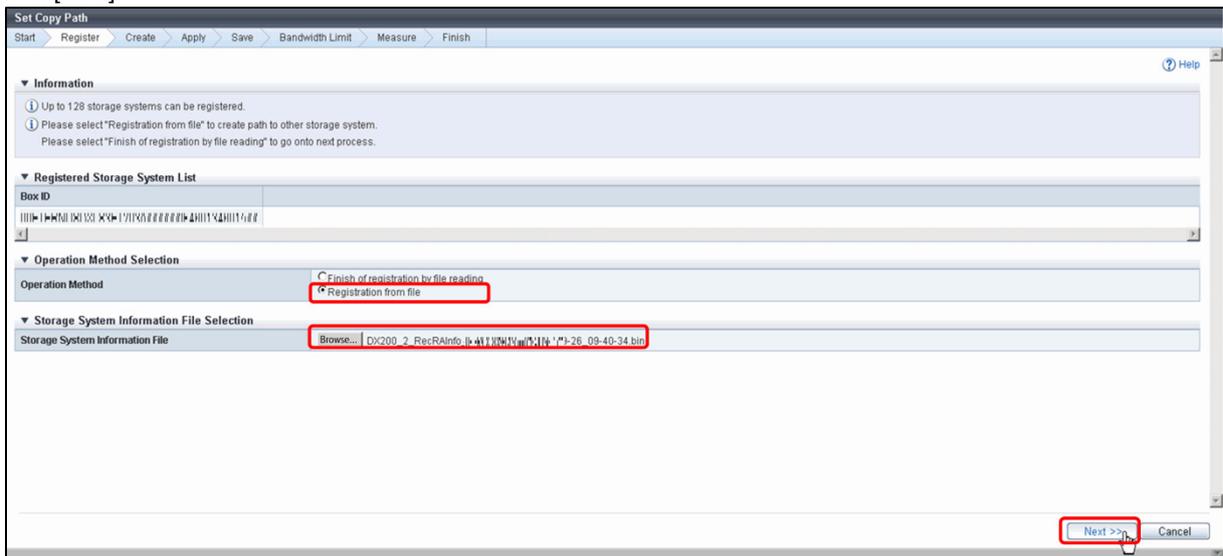
Select the iSCSI ports to use for REC and click [Next].



Check the IP address settings and then click [Next].

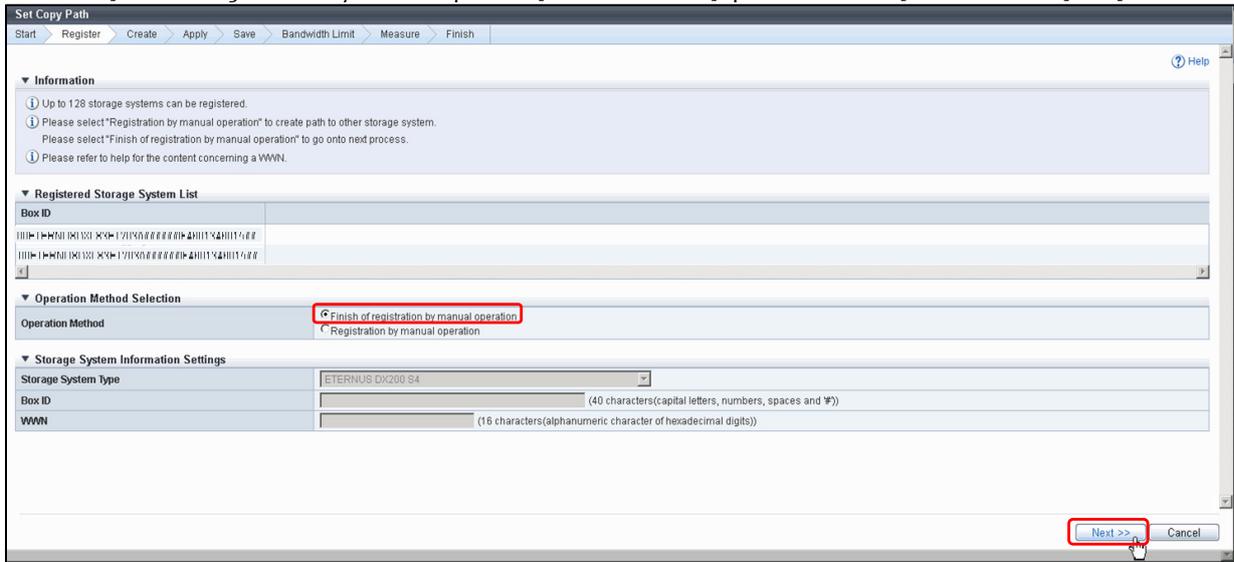


Select the downloaded storage system information file of the backup site in [Storage System Information File Selection] and then click [Next].

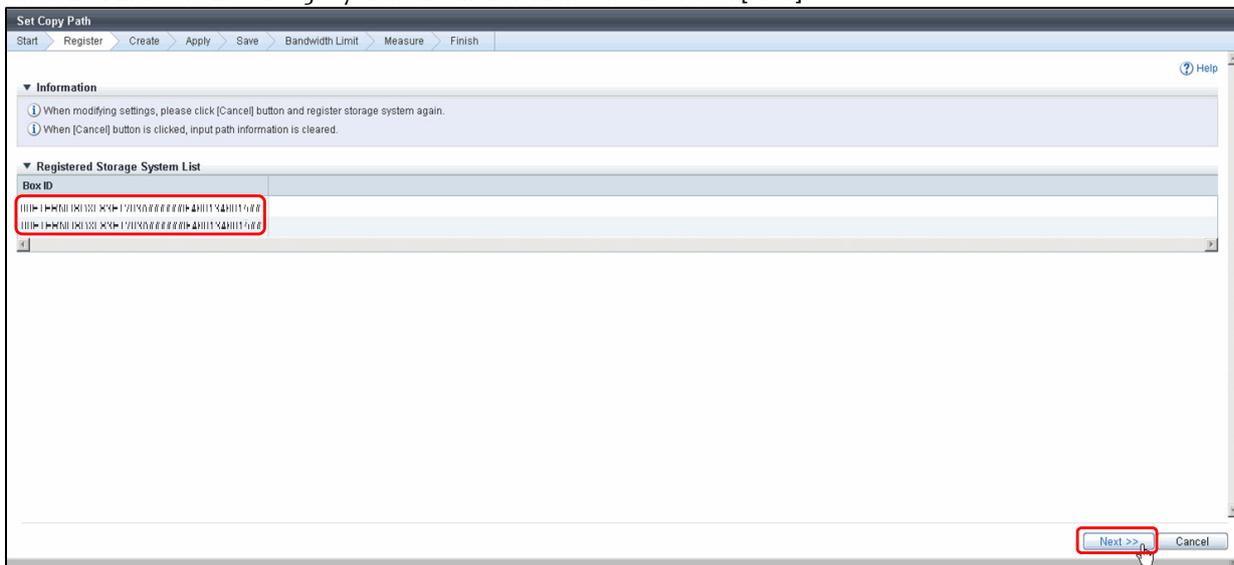


Check the port selection and the IP address setting of the REC iSCSI port for the ETERNUS AF/DX in the backup site and then click [Next].

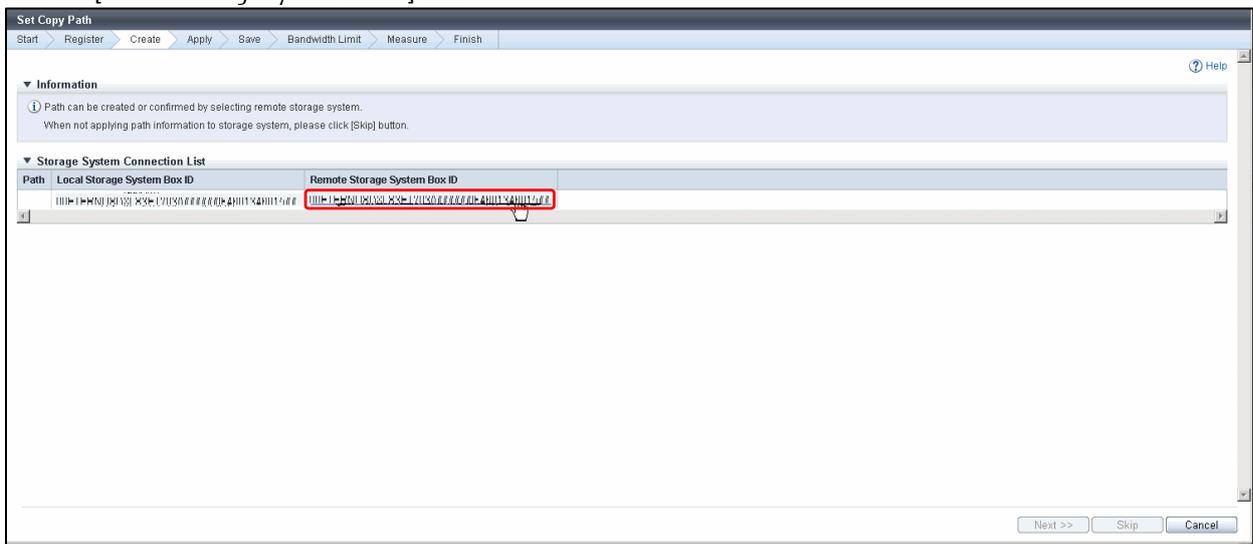
Select the [Finish of registration by manual operation] radio button in [Operation Method] and then click [Next].



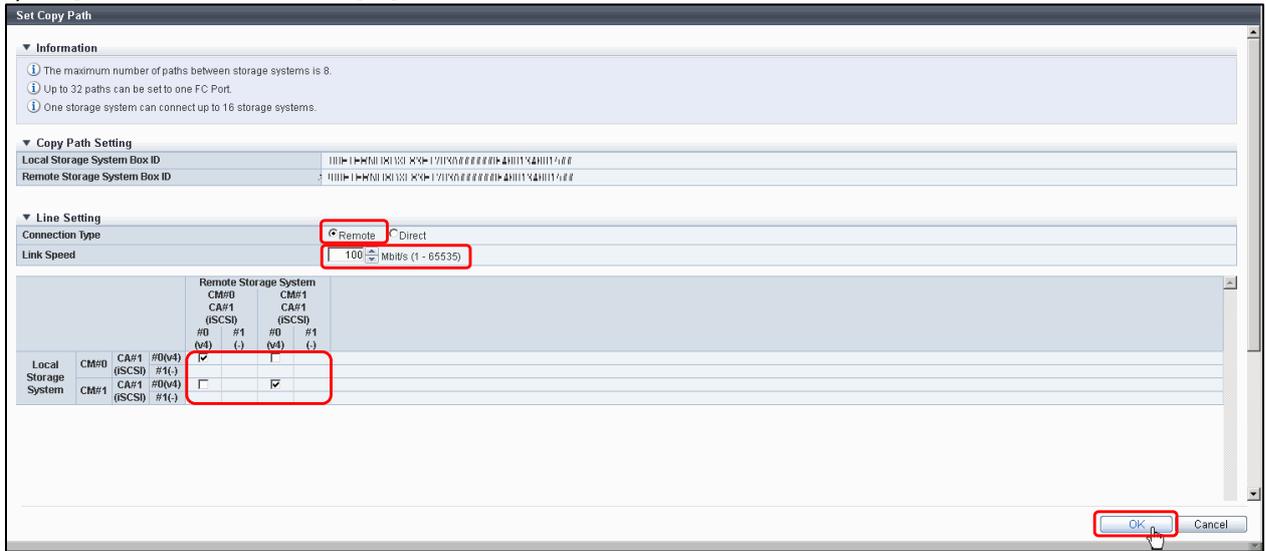
Check that there are two storage system information items and then click [Next].



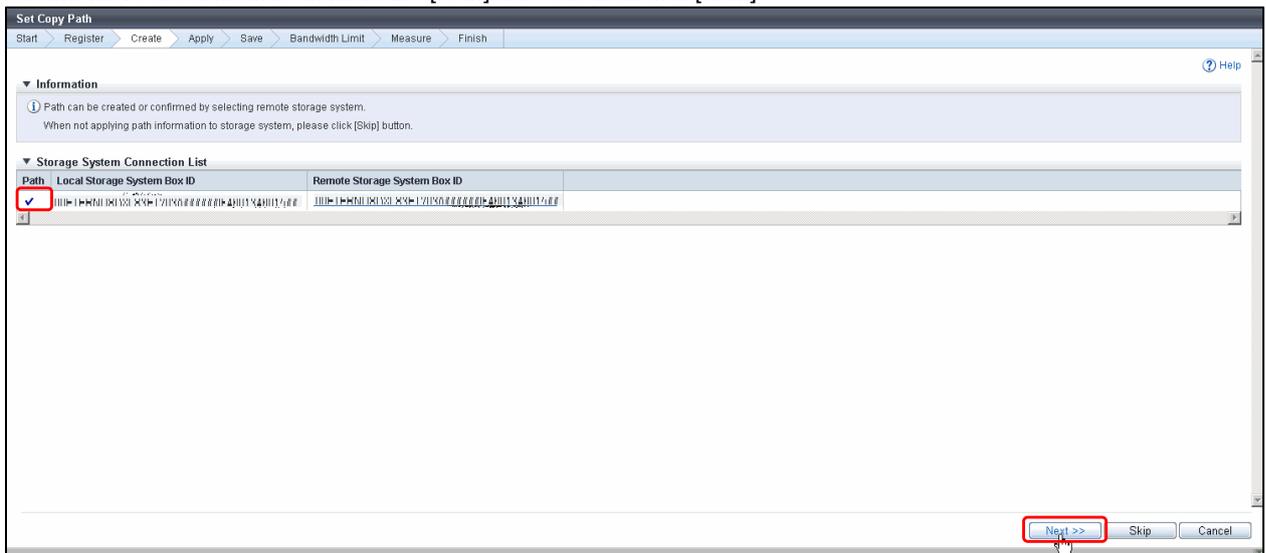
- b. Create a copy path information
Click the [Remote Storage System Box ID] link.



In [Line Setting], select [Remote] for [Connection Type] and set the value in [Link Speed]. Select the pair of ports to connect between the operation site and backup site from the [Local Storage System] and [Remote Storage System] checkboxes and then click [OK].



Confirm that a check mark is shown in the [Path] field and then click [Next].

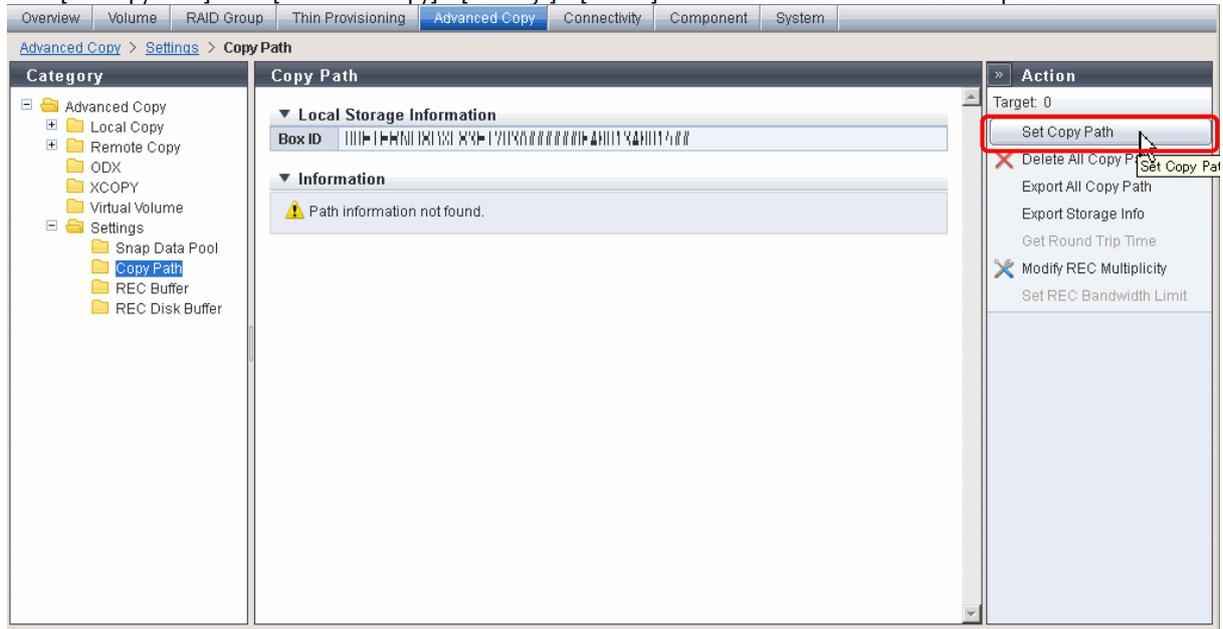


- c. Apply the copy path information
Select the checkbox for the path information to apply and click [Next].

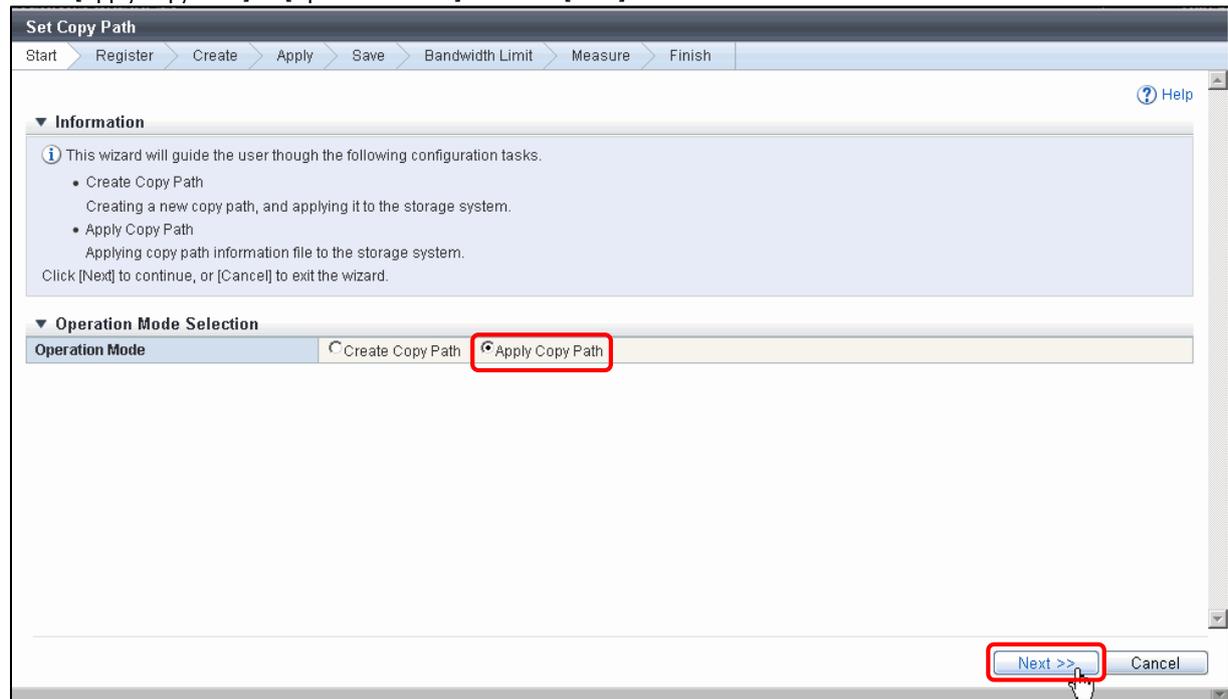
(3) Apply the copy path
Apply the copy path that was created on the ETERNUS AF/DX in the operation site to the ETERNUS AF/DX in the backup site.

a. Apply the copy path information

Click [Set Copy Path] from [Advanced Copy] - [Settings] - [Action] of ETERNUS Web GUI in the backup site.

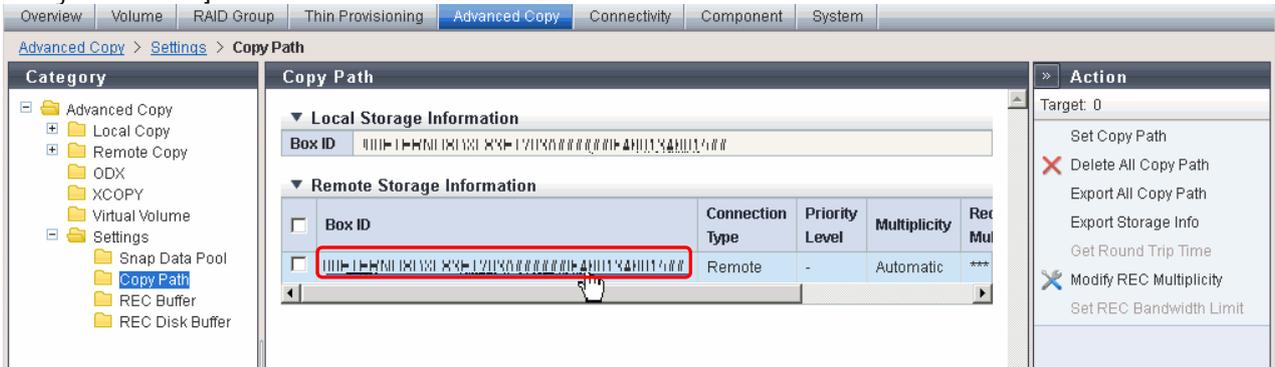


Select [Apply Copy Path] in [Operation Mode] and click [Next].

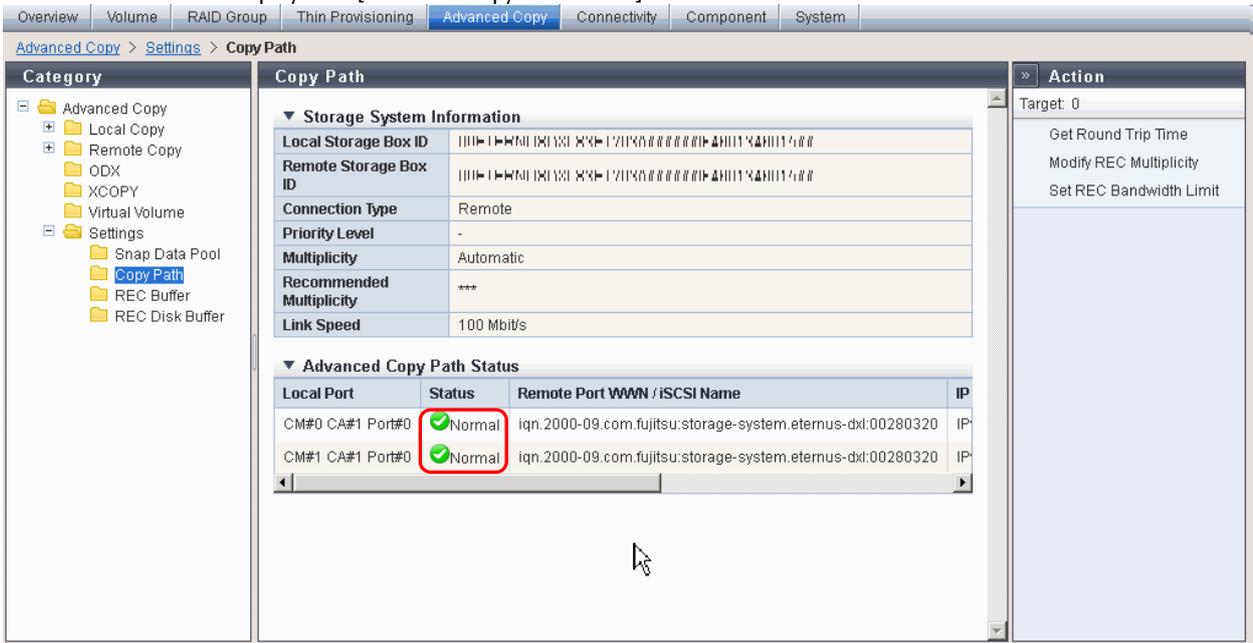


- (4) Check the REC path status
 Check that the REC path status is normal

Select [Advanced Copy] - [Settings] - [Copy Path] of ETERNUS Web GUI in the operation site and then click the [Box ID] link in [Remote Storage Information].



Check that "Normal" is displayed in [Advanced Copy Path Status].



Check [Advanced Copy Path Status] of ETERNUS Web GUI in the backup site.
 Check that "Normal" is displayed in [Advanced Copy Path Status].

3.4.3. Copy Settings

Perform the following procedure on the CCM server to execute a copy of the volumes created in the operation site and the backup site with CCM.

1. Register the ETERNUS AF/DX storage systems.
2. Create a copy group.
3. Add a copy pair.

This section uses the following environment configuration as an example.

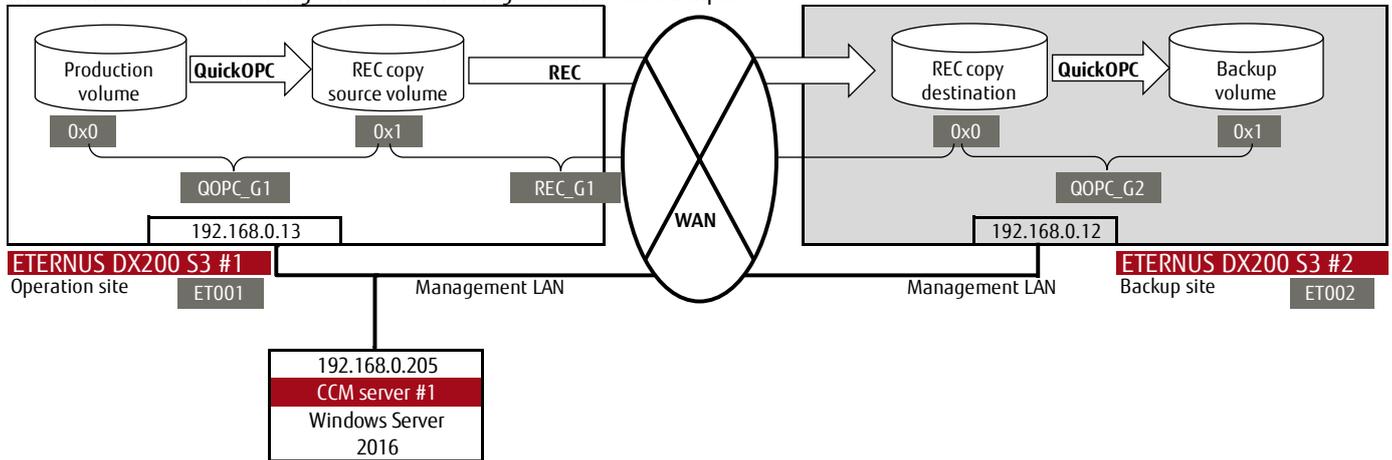


Figure 3-4 Environment configuration for copy settings

The values shown in white characters in "Figure 3-4 Environment configuration for copy settings" are used when executing the CCM commands. The meaning of each value is explained as follows.

ET001 and ET002 are arbitrary names (hereafter, "ETERNUS name") that indicate the names of the operation site and backup site storage systems. This value is defined when registering the ETERNUS AF/DX. ETERNUS names are required when executing the CCM commands.

QOPC_G1, REC_G1, and QOPC_G2 are arbitrary names that indicate groups of copy pairs consisting of logical volumes of the copy source and the copy destination. This value is defined and specified, and the Advanced Copy type is specified when a copy group is created. The copy group is required because when CCM uses the Advanced Copy functions, they are executed on a copy group basis.

QOPC_G1 is the group that executes QuickOPC at the operation site.

REC_G1 is the group that executes REC from the operation site to the backup site.

QOPC_G2 is the group that executes QuickOPC at the backup site.

0x0 and 0x1 are the logical volume numbers for the copy source and copy destination. These values are used when a copy pair is added to the created copy group. The copy pair is a string that defines the logical volumes of the copy source and copy destination. The following format is used.

ET001/0x1:ET002/0x0

(1) (2) (3) (4)

- (1) ETERNUS name of the copy source
- (2) Logical volume number of the copy source (hexadecimal starting with "0x")
- (3) ETERNUS name of the copy destination
- (4) Logical volume number of the copy destination (hexadecimal starting with "0x")

1. Register the ETERNUS AF/DX storage systems

Register the ETERNUS AF/DX by executing the "acarray add" command.

Register the ETERNUS AF/DX in the operation site

Specify ET001 for the ETERNUS name, "192.168.0.13" for the IP address, "softadmin000" and "pass000" for the user name and password of the account with the Software role registered in "3.4.1. Building the ETERNUS SF AdvancedCopy Manager Copy Control Module Environment", and "-lan" for the copy control type to indicate a LAN connection.

```
c:\ETERNUS_SF\CCM\bin>acarray add -a ET001 -ip 192.168.0.13 -user esfadmin -password esfadmin -lan
Successful completion.
```

Register the ETERNUS AF/DX in the backup site

Specify ET002 for the ETERNUS name, "192.168.0.12" for the IP address, and set the other values with the same values as above.

```
c:\ETERNUS_SF\CCM\bin>acarray add -a ET002 -ip 192.168.0.12 -user esfadmin -password esfadmin -lan
Successful completion.
```

2. Create a copy group

Create a copy group by executing the "acgroup create" command.

Create a QuickOPC group (QOPC_G1) for the operation site

Set the copy group name to QOPC_G1 and the copy type to QuickOPC in ET001.

```
c:\ETERNUS_SF\CCM\bin>acgroup create -g QOPC_G1 -type QuickOPC -a ET001
Successful completion.
```

Create a QuickOPC group (QOPC_G2) for the backup site

Set the copy group name to QOPC_G2 and the copy type to QuickOPC in ET002.

```
c:\ETERNUS_SF\CCM\bin>acgroup create -g QOPC_G2 -type QuickOPC -a ET002
Successful completion.
```

Create a REC group (REC_G1) from the operation site to the backup site

Set the copy group name to REC_G1, the copy type to REC in ET001, and the REC copy destination to ET002.

```
c:\ETERNUS_SF\CCM\bin>acgroup create -g REC_G1 -type REC -a ET001 -remote ET002
Successful completion.
```

3. Add a copy pair

Add a copy pair by executing the "acpair add" command.

Add a copy pair to the QuickOPC group (QOPC_G1) of the operation site using copy source logical volume number 0x0 and copy destination logical volume number 0x1.

```
c:\ETERNUS_SF\CCM\bin>acpair add -g QOPC_G1 -p ET001/0x0:ET001/0x1
Successful completion.
```

Add a copy pair to the QuickOPC group (QOPC_G2) of the backup site using copy source logical volume number 0x0 and copy destination logical volume number 0x1.

```
c:\ETERNUS_SF\CCM\bin>acpair add -g QOPC_G2 -p ET002/0x0:ET002/0x1
Successful completion.
```

Add a copy pair to the REC group (REC_G1) using copy source logical volume number 0x1 for ET001 and copy destination logical volume number 0x0 for ET002.

```
c:\ETERNUS_SF\CCM\bin>acpair add -g REC_G1 -p ET001/0x1:ET002/0x0
Successful completion.
```

4. Procedure for Remote Copy Operations

This section describes the operation procedure for the copy method shown in "3.2. Copy Method Overview".

4.1. Overview of the Operation Procedure

The copy commands for copying within the storage system in the operation site (QuickOPC), copying between storage systems at different sites (REC), and copying within the storage system in the backup site (QuickOPC) are performed from the CCM server each time a backup operation is performed.

The entire volume is copied for the initial backup, but only a differential copy is performed for subsequent backups.

The copy commands for the initial backup are shown below according to the backup state.

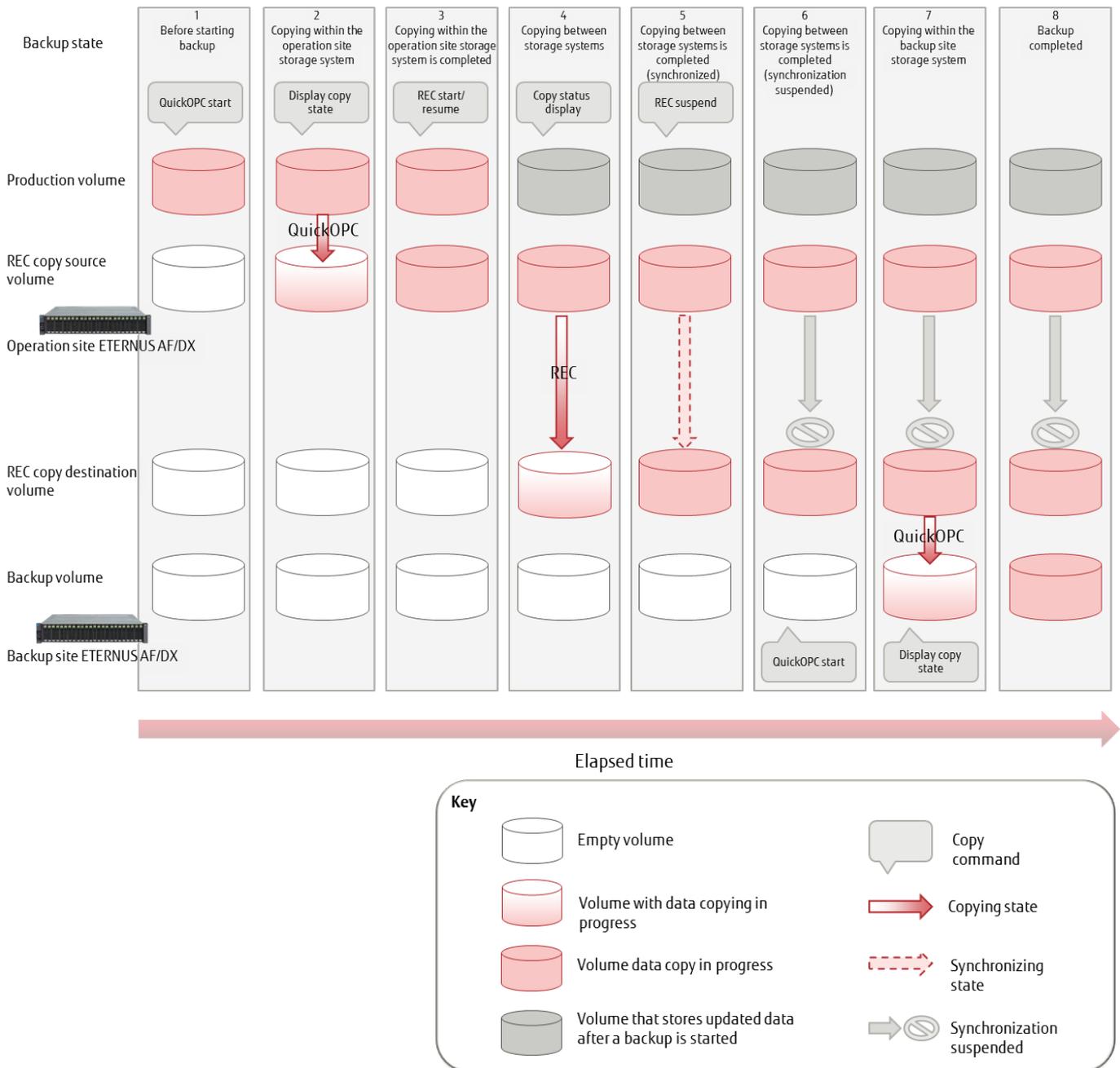


Figure 4-1 Overview of procedure for remote copy operations

The backup state and the copy commands shown in "Figure 4-1 Overview of procedure for remote copy operations" are described below. The copy commands differ between the first and subsequent backups.

1. Initial state
The state before starting a backup.
With the ETERNUS AF/DX in the operation site, start a copy (QuickOPC start) from the production volume to the REC copy source volume.
The entire volume is copied for the initial backup.
Differential data is copied for subsequent backups.
2. Copying within the operation site storage system
The state where copying from the production volume to the REC copy source volume has started.
Check the copy state by executing the copy state display command.
The copy operation is instantaneously completed.
3. Copying within the operation site storage system is completed
The state after the production volume is copied to the REC copy source volume.
The ETERNUS AF/DX in the operation site starts the copy operation between the storage systems (REC start/resume).
REC start is executed for the initial backup.
REC resume is executed for subsequent backups.
4. Copying between storage systems
The state where a copy operation between the storage systems is running.
Check the copy state by executing the copy state display command.
When the copy operation between the storage systems is completed, the REC copy source volume and REC copy destination volume are synchronized.
5. Copying between storage systems is completed (synchronized)
The state where the copy operation between the storage systems is completed.
Suspension of the synchronization (REC suspend) between the storage systems is performed to copy the REC copy destination volume in the backup site.
6. Copying between storage systems is completed (suspended)
The state where synchronization between the REC copy source volume and the REC copy destination volume is suspended.
A copy operation (QuickOPC start) to the backup volume for the ETERNUS AF/DX in the backup site is started.
The entire volume is copied for the initial backup.
Differential data is copied for subsequent backups.
7. Copying within the backup site storage system
The state where a copy operation from the REC copy destination volume to the backup volume is started.
Check the copy state by executing the copy state display command.
The copy operation is instantaneously completed.
8. Copying within the backup site storage system is completed
The state where the copy operation from the REC copy destination volume to the backup volume is completed.

4. Check the REC state. Execute the "acec query" command (display copy state).

```
c:\ETERNUS_SF\CCM\bin>acec query -g REC_G1

Copy Group Name      : REC_G1
Copy Group Type      : REC
Disk Array Name      : ET001 (00ETERNUSDXXXXXXXXXXXXXXXXAA0000000000##)
Remote Disk Array Name : ET002 (00ETERNUSDXXXXXXXXXXXXXXXXBB0000000000##)

Source    <=> Target    SID(RSID) EC Status      Copy Phase Copied Block Rcv  Split Xfer
-----
ET001/0x1 ==> ET002/0x0 0x4(0x3)  "EC Executing" "Copying"          0 auto auto  sync
```

REC is executing synchronization.

5. Check the REC equivalency state and then suspend REC.

Check the REC state. Execute the "acec query" command (display copy state).

```
c:\ETERNUS_SF\CCM\bin>acec query -g REC_G1

Copy Group Name      : REC_G1
Copy Group Type      : REC
Disk Array Name      : ET001 (00ETERNUSDXXXXXXXXXXXXXXXXAA0000000000##)
Remote Disk Array Name : ET002 (00ETERNUSDXXXXXXXXXXXXXXXXBB0000000000##)

Source    <=> Target    SID(RSID) EC Status      Copy Phase Copied Block Rcv  Split Xfer
-----
ET001/0x1 ==> ET002/0x0 0x4(0x3)  "EC Executing" "Paired"          209715200 auto auto  sync
```

REC equivalency is maintained. REC can now be suspended.

Suspend REC. Execute the "acec suspend" command (copy suspend command).

```
c:\ETERNUS_SF\CCM\bin>acec suspend -g REC_G1

ET001/0x1:ET002/0x0
# DATE : 2017/09/27 16:04:13 - << EC Suspended >>

Succeeded : 1
Failed    : 0
```

The REC suspend command has succeeded.

4.2.2. The Second and Subsequent Copies

1. Execute QuickOPC from the operation site. Execute the "acopc start" command (copy start command) with the "-diff" option.

```
c:\ETERNUS_SF\CCM\bin>acopc start -g QOPC_G1 -diff

ET001/0x0:ET001/0x1
# DATE : 2017/09/27 16:19:01 - << Differential OPC Started >>
#
From:BoxID=3030455445524e555344585a5a5a5a5a5a5a5a232323232341413030303030303030302323/
Olu=0/Adr_high=0/Adr_low=0/size_high=0/size_low=0
#
To :BoxID=3030455445524e555344585a5a5a5a5a5a5a5a232323232341413030303030303030302323/
Olu=1/Adr_high=0/Adr_low=0

Succeeded : 1
Failed      : 0
```

QuickOPC has started correctly.
Starting a differential backup from the production volume to the REC copy source volume has succeeded.

2. Check the QuickOPC state in the operation site. Execute the "acopc query" command (display copy state).

```
c:\ETERNUS_SF\CCM\bin>acopc query -g QOPC_G1

Copy Group Name : QOPC_G1
Copy Group Type : QuickOPC
Disk Array Name : ET001 (00ETERNUSDXZZZZZZZZ#####AA0000000000##)

Source    <=> Target    SID OPC Status    Copy Phase Copied Block
-----
ET001/0x0 ==> ET001/0x1 0x1 "OPC Executing" "Tracking"    209715200
```

The QuickOPC copy has been completed.

3. Check the REC suspend state and then resume REC.

Check the REC state. Execute the "acec query" command (display copy state).

```
c:\ETERNUS_SF\CCM\bin>acec query -g REC_G1

Copy Group Name      : REC_G1
Copy Group Type      : REC
Disk Array Name      : ET001 (00ETERNUSDXZZZZZZZZ#####AA0000000000##)
Remote Disk Array Name : ET002 (00ETERNUSDXZZZZZZZZ#####BB0000000000##)

Source    <=> Target    SID(RSID) EC Status    Copy Phase Copied Block Rcv  Split Xfer
-----
ET001/0x1 ==> ET002/0x0 0x4(0x3)  "EC Suspend" "Paired"    190840832 auto auto  sync
```

REC is suspended.

Resume REC from the operation site to the backup site. Execute the "acec resume" command (copy resume command).

```
c:\ETERNUS_SF\CCM\bin>acec resume -g REC_G1

ET001/0x1:ET002/0x0
# DATE : 2017/09/27 16:27:38 - << EC Resumed >>

Succeeded : 1
Failed      : 0
```

The REC resume command has succeeded.
Synchronization from the REC copy source volume to the REC copy destination volume has started.

4. Check the REC state. Execute the "acec query" command (display copy state).

```
c:\ETERNUS_SF\CCM\bin>acec query -g REC_G1

Copy Group Name      : REC_G1
Copy Group Type      : REC
Disk Array Name      : ET001 (00ETERNUSDXXXXXXXXXXXXXXXXAA0000000000##)
Remote Disk Array Name : ET002 (00ETERNUSDXXXXXXXXXXXXXXXXBB0000000000##)

Source    <=> Target    SID(RSID) EC Status      Copy Phase Copied Block Rcv  Split Xfer
-----
ET001/0x1 ==> ET002/0x0 0x4(0x3)  "EC Executing" "Copying"      200278016 auto auto  sync
```

REC is executing synchronization.

5. Check the REC equivalency state and then suspend REC.

Check the REC state. Execute the "acec query" command (display copy state).

```
c:\ETERNUS_SF\CCM\bin>acec query -g REC_G1

Copy Group Name      : REC_G1
Copy Group Type      : REC
Disk Array Name      : ET001 (00ETERNUSDXXXXXXXXXXXXXXXXAA0000000000##)
Remote Disk Array Name : ET002 (00ETERNUSDXXXXXXXXXXXXXXXXBB0000000000##)

Source    <=> Target    SID(RSID) EC Status      Copy Phase Copied Block Rcv  Split Xfer
-----
ET001/0x1 ==> ET002/0x0 0x4(0x3)  "EC Executing" "Paired"      209715200 auto auto  sync
```

REC equivalency is maintained. REC can now be suspended.

Suspend REC. Execute the "acec suspend" command (copy suspend command).

```
c:\ETERNUS_SF\CCM\bin>acec suspend -g REC_G1

ET001/0x1:ET002/0x0
# DATE : 2017/09/27 16:30:30 - << EC Suspended >>

Succeeded : 1
Failed    : 0
```

The REC suspend command has succeeded.

6. Check the REC suspend state and execute QuickOPC from the backup site.

Check the REC state. Execute the "acec query" command (display copy state).

```
c:\ETERNUS_SF\CCM\bin>acec query -g REC_G1

Copy Group Name      : REC_G1
Copy Group Type      : REC
Disk Array Name      : ET001 (00ETERNUSDXXXXXXXXXXXXXXXXAA0000000000##)
Remote Disk Array Name : ET002 (00ETERNUSDXXXXXXXXXXXXXXXXBB0000000000##)

Source    <=> Target    SID(RSID) EC Status      Copy Phase Copied Block Rcv  Split Xfer
-----
ET001/0x1 ==> ET002/0x0 0x4(0x3)  "EC Suspended" "Paired"      209715200 auto auto  sync
```

REC is suspended. A backup can be executed in the backup site.

Execute QuickOPC from the backup site. Execute the "acopc start" command (copy start command) with the "-diff" option.

```
c:\ETERNUS_SF\CCM\bin>acopc start -g QOPC_G2 -diff

ET002/0x0:ET002/0x1
# DATE : 2017/09/27 16:34:40 - << Differential OPC Started >>
#
From:BoxID=3030455445524e555344585a5a5a5a5a5a5a5a5a5a232323232342423030303030303030302323/
Olu=0/Adr_high=0/Adr_low=0/size_high=0/size_low=0
#
To :BoxID=3030455445524e555344585a5a5a5a5a5a5a5a5a5a232323232342423030303030303030302323/
Olu=1/Adr_high=0/Adr_low=0

Succeeded : 1
Failed : 0
```

QuickOPC has started correctly.
Starting a differential backup from the REC copy destination volume to the backup volume has succeeded.

Check the QuickOPC state in the backup site. Execute the "acopc query" command (display copy state).

```
c:\ETERNUS_SF\CCM\bin>acopc query -g QOPC_G2

Copy Group Name : QOPC_G2
Copy Group Type : QuickOPC
Disk Array Name : ET002 (00ETERNUSDXXXXXXXXX#####BB0000000000##)

Source    <=> Target    SID OPC Status    Copy Phase Copied Block
-----
ET002/0x0 ==> ET002/0x1 0x4 "OPC Executing" "Tracking"    209715200
```

The QuickOPC copy has been completed.
The backup from the REC copy destination volume to the backup volume is completed.

5. Conclusions

A reduction of the installation costs can be achieved with network devices such as Ethernet routers by using iSCSI as the connection method between ETERNUS AF/DX storage systems via the WAN.

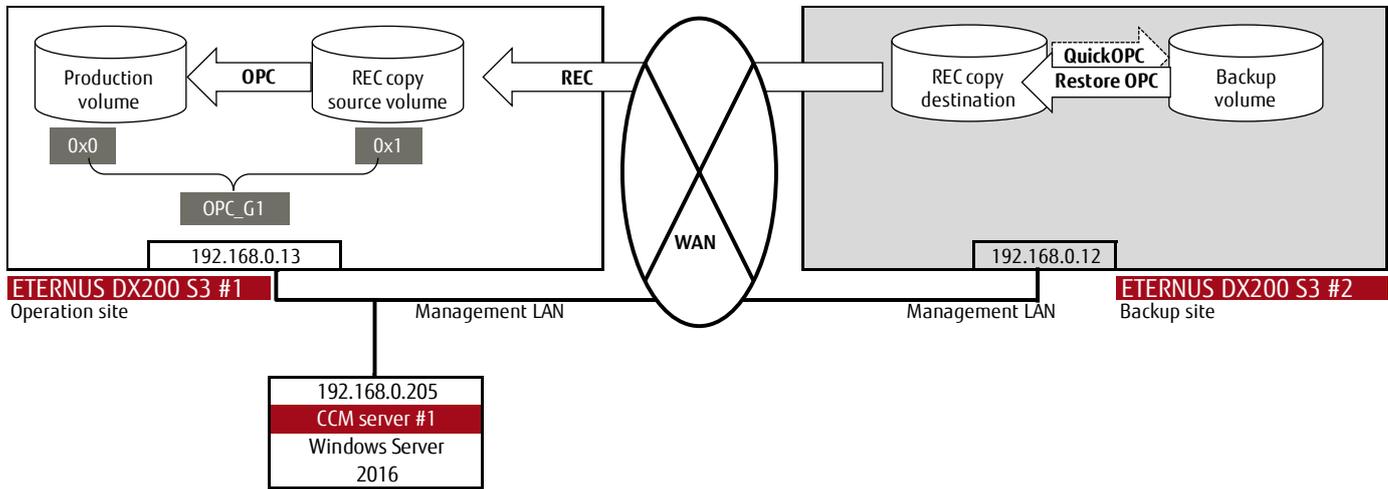
For easy operation of remote data storage, CCM can be used.

ETERNUS AF/DX and iSCSI connection is a winning combination for copying data between storage systems and for protecting your data from failures and disasters.

Appendix: Restore Procedure for Remote Copy Operations

"4. Procedure for Remote Copy Operations" describes the procedure to remotely copy the production volume data to the backup site. This section describes the procedure for restoring the data stored in the backup site by remotely copying to the production volume.

It is assumed that your environment is set as described in "3.4.3. Copy Settings", that a QuickOPC operation is not being performed from the operation site production volume to the REC copy source volume, and a REC is not being performed from the REC copy source volume to the REC copy destination volume.



Appendix Figure-1 Diagram of volume configuration for remote copy operation (restore)

Create the following copy group and add a copy path to execute OPC in the operation site.

Create the OPC group (OPC_G1) in the operation site
Set the copy group name OPC_G1 with the copy type set as OPC in ET001.

```
c:\ETERNUS_SF\CCM\bin>acgroup create -g OPC_G1 -type OPC -a ET001
Successful completion.
```

Add a copy pair to the OPC group (OPC_G1) of the operation site using copy source logical volume number 0x1 and copy destination logical volume number 0x0.

```
c:\ETERNUS_SF\CCM\bin>acpair add -g OPC_G1 -p ET001/0x1:ET001/0x0
Successful completion.
```

Perform the following procedure.

1. Restore QuickOPC in the backup site. Execute the "acopc start" command with the "-r" option.

```
c:\ETERNUS_SF\CCM\bin>acopc start -g QOPC_G2 -r

ET002/0x0:ET002/0x1
# DATE : 2017/09/27 18:15:15 - << OPC Started >>
#
From:BoxID=3030455445524e555344585a5a5a5a5a5a5a5a5a5a232323232342423030303030303030302323/
Olu=1/Adr_high=0/Adr_low=0/size_high=0/size_low=0
#
To :BoxID=3030455445524e555344585a5a5a5a5a5a5a5a5a5a232323232342423030303030303030302323/
Olu=0/Adr_high=0/Adr_low=0

Succeeded : 1
Failed      : 0
```

The restore OPC start command has succeeded.

Check the restore OPC state in the backup site. Execute the "acopc query" command (display copy state) with the "-r" option.

```
c:\ETERNUS_SF\CCM\bin>acopc query -g QOPC_G2 -r

Copy Group Name : QOPC_G2
Copy Group Type : QuickOPC
Disk Array Name : ET002 (00ETERNUSDXZZZZZZZZ#####BB0000000000##)

Source    <=> Target    SID OPC Status    Copy Phase Copied Block
-----
ET002/0x0 <== ET002/0x1 0x5 "OPC Executing" "Copying"    209715200
```

Restore OPC is executing.

2. Execute REC from the backup site to the operation site. Execute the "acec start" command (copy start command) with the "-r" option.

```
c:\ETERNUS_SF\CCM\bin>acec start -g REC_G1 -r -transfer sync

ET001/0x1:ET002/0x0
# DATE : 2017/09/27 18:18:01 - << EC Started >>
#
From:BoxID=3030455445524e555344585a5a5a5a5a5a5a5a5a5a232323232342423030303030303030302323/
Olu=0/Adr_high=0/Adr_low=0/size_high=0/size_low=0
#
To :BoxID=3030455445524e555344585a5a5a5a5a5a5a5a5a5a232323232341413030303030303030302323/
Olu=1/Adr_high=0/Adr_low=0

Succeeded : 1
Failed      : 0
```

REC has started correctly.

Synchronization from the REC copy destination volume to the REC copy source volume has started.

3. Start a restore operation in the operation site (OPC from the REC copy source volume to the production volume).

When REC maintains equivalency, REC can be suspended.

Check the REC state. Execute the "acec query" command (display copy state) with the "-r" option.

```
c:\ETERNUS_SF\CCM\bin>acec query -g REC_G1 -r

Copy Group Name      : REC_G1
Copy Group Type      : REC
Disk Array Name      : ET001 (00ETERNUSDXXXXXXXXXXXXXXXXAA0000000000##)
Remote Disk Array Name : ET002 (00ETERNUSDXXXXXXXXXXXXXXXXBB0000000000##)

Source  <=> Target  SID(RSID) EC Status      Copy Phase Copied Block Rcv  Split Xfer
-----
ET001/0x1 <== ET002/0x0 0x6(0x6)  "EC Executing" "Paired"      209715200 auto auto  sync
```

REC equivalency is maintained. REC can now be suspended.

Suspend REC. Execute the "acec suspend" command (copy suspend command) with the "-r" option.

(After REC is suspended, a restore operation can be executed in the operation site.)

```
c:\ETERNUS_SF\CCM\bin>acec suspend -g REC_G1 -r

ET001/0x1:ET002/0x0
# DATE : 2017/09/27 18:26:31 - << EC Suspended >>

Succeeded : 1
Failed    : 0
```

The REC suspend command has succeeded.

Check the REC state. Execute the "acec query" command (display copy state) with the "-r" option.

```
c:\ETERNUS_SF\CCM\bin>acec query -g REC_G1 -r & echo %time%

Copy Group Name      : REC_G1
Copy Group Type      : REC
Disk Array Name      : ET001 (00ETERNUSDXXXXXXXXXXXXXXXXAA0000000000##)
Remote Disk Array Name : ET002 (00ETERNUSDXXXXXXXXXXXXXXXXBB0000000000##)

Source  <=> Target  SID(RSID) EC Status      Copy Phase Copied Block Rcv  Split Xfer
-----
ET001/0x1 <== ET002/0x0 0x6(0x6)  "EC Suspend" "Paired"      209715200 auto auto  sync
```

REC is suspended. A restore operation can be executed in the operation site.

Execute a restore operation in the operation site (OPC from the REC copy source volume to the production volume).
Execute the "acopc start" command (copy start command).

```
c:\ETERNUS_SF\CCM\bin>acopc start -g OPC_G1

ET001/0x1:ET001/0x0
# DATE : 2017/09/27 18:27:25 - << OPC Started >>
#
From:BoxID=3030455445524e555344585a5a5a5a5a5a5a5a5a5a232323232341413030303030303030302323/
Olu=1/Adr_high=0/Adr_low=0/size_high=0/size_low=0
#
To :BoxID=3030455445524e555344585a5a5a5a5a5a5a5a5a5a232323232341413030303030303030302323/
Olu=0/Adr_high=0/Adr_low=0

Succeeded : 1
Failed : 0
```

OPC has started correctly.
Starting a restore operation from the REC copy source volume to the production volume has succeeded.

Check if the restore operation is completed (OPC from the REC copy source volume to the production volume).

```
c:\ETERNUS_SF\CCM\bin>acopc query -g OPC_G1

Copy Group Name : OPC_G1
Copy Group Type : OPC
Disk Array Name : ET001 (00ETERNUSDXLS3ET203A#####IF4601346015##)

Source      <=> Target      SID OPC Status      Copy Phase Copied Block
-----
ET001/0x1 N/A ET001/0x0 N/A "OPC action not startup" "Not set"      N/A
```

OPC is completed.
The restore operation from the REC copy source volume to the production volume is completed.