EXPRESSCLUSTER X 6.0 for Linux
Installation and Configuration Guide

Release 4

NEC Corporation

Oct 02, 2026

TABLE OF CONTENTS:

1 Preface **1**
- 1.1 Who Should Use This Guide . . . 1
- 1.2 How This Guide is Organized . . . 2
- 1.3 EXPRESSCLUSTER X Documentation Set . . . 3
- 1.4 Conventions . . . 4
- 1.5 Contacting NEC . . . 6

2 Determining a system configuration **7**
- 2.1 Steps from configuring a cluster system to installing EXPRESSCLUSTER . . . 8
- 2.2 What is EXPRESSCLUSTER? . . . 9
- 2.3 Planning system configuration . . . 11
- 2.4 Checking system requirements for each EXPRESSCLUSTER module . . . 20
- 2.5 Example of EXPRESSCLUSTER (main module) hardware configuration . . . 21
- 2.6 Verifying system requirements for the Cluster WebUI . . . 22
- 2.7 Determining a hardware configuration . . . 23
- 2.8 Settings after configuring hardware . . . 24

3 Configuring a cluster system **35**
- 3.1 Configuring a cluster system . . . 36
- 3.2 Determining a cluster topology . . . 38
- 3.3 Determining applications to be duplicated . . . 49
- 3.4 Planning a cluster configuration . . . 53
- 3.5 Understanding group resources . . . 54
- 3.6 Understanding monitor resources . . . 55
- 3.7 Understanding heartbeat resources . . . 56
- 3.8 Understanding network partition resolution resources . . . 60

4 Installing EXPRESSCLUSTER **63**
- 4.1 Steps from Installing EXPRESSCLUSTER to creating a cluster . . . 64
- 4.2 Setting up the EXPRESSCLUSTER Server . . . 65

5 Registering the license **73**
- 5.1 Registering the CPU license . . . 74
- 5.2 Registering the VM node license . . . 77
- 5.3 Registering the node license . . . 80
- 5.4 Registering the fixed term license . . . 83

6 Creating the cluster configuration data **85**
- 6.1 Creating the cluster configuration data . . . 86
- 6.2 Starting up the Cluster WebUI . . . 87
- 6.3 Checking the values to be configured in the cluster environment with two nodes . . . 89

6.4 Creating the configuration data of a 2-node cluster . . . 104
6.5 Checking the values to be configured in the cluster environment with three nodes . . . 116
6.6 Creating the configuration data of a 3-node cluster . . . 123
6.7 Checking the values to be configured in the cluster environment with three nodes (hybrid type) . . . 136
6.8 Creating the configuration data of a 3-node cluster (hybrid type) . . . 141
6.9 Saving the cluster configuration data . . . 153
6.10 Check the cluster configuration data . . . 154
6.11 Creating a cluster . . . 157

7 Verifying a cluster system 159
7.1 Verifying operations using the Cluster WebUI . . . 160
7.2 Verifying operation by using commands . . . 162

8 Verifying operation 163
8.1 Operation tests . . . 164
8.2 Backup procedures . . . 169
8.3 Restoration procedures . . . 171

9 Preparing to operate a cluster system 175
9.1 Operating the cluster system . . . 176
9.2 Suspending EXPRESSCLUSTER . . . 178
9.3 Modifying the cluster configuration data . . . 179
9.4 Introducing Integrated Cluster WebUI . . . 181

10 Upgrading EXPRESSCLUSTER 183
10.1 How to upgrade EXPRESSCLUSTER . . . 184

11 Uninstalling and reinstalling EXPRESSCLUSTER 187
11.1 Uninstallation . . . 188
11.2 Reinstallation . . . 190

12 Troubleshooting 193
12.1 Error messages when installing the EXPRESSCLUSTER Server . . . 193
12.2 Error messages when uninstalling the EXPRESSCLUSTER Server . . . 194
12.3 Licensing . . . 195

13 Glossary 197

14 Legal Notice 201
14.1 Disclaimer . . . 201
14.2 Trademark Information . . . 202

15 Revision History 203

CHAPTER

ONE

PREFACE

1.1 Who Should Use This Guide

The *Installation and Configuration Guide* is intended for system engineers and administrators who want to build, operate, and maintain a cluster system. Instructions for designing, installing, and configuring a cluster system with EXPRESSCLUSTER are covered in this guide.

1.2 How This Guide is Organized

- 2. *Determining a system configuration*: Provides instructions for how to verify system requirements and determine the system configuration.
- 3. *Configuring a cluster system*: Helps you understand how to configure a cluster system.
- 4. *Installing EXPRESSCLUSTER*: Provides instructions for how to install EXPRESSCLUSTER.
- 5. *Registering the license*: Provides instructions for how to register the license.
- 6. *Creating the cluster configuration data*: Provides instructions for how to create the cluster configuration data with the Cluster WebUI.
- 7. *Verifying a cluster system*: Verify if the cluster system that you have configured operates successfully.
- 8. *Verifying operation*: Run the pseudo-failure test and adjust the parameters.
- 9. *Preparing to operate a cluster system*: Provides information on what you need to consider before actually start operating EXPRESSCLUSTER.
- 10. *Upgrading EXPRESSCLUSTER*: Provides instructions for how to upgrade EXPRESSCLUSTER.
- 11. *Uninstalling and reinstalling EXPRESSCLUSTER*: Provides instructions for how to uninstall and reinstall EXPRESSCLUSTER.
- 12. *Troubleshooting*: Provides information on installation- and setup-related problems and their solutions.
- 13. *Glossary*: Provides explanations of EXPRESSCLUSTER terms.

1.3 EXPRESSCLUSTER X Documentation Set

The EXPRESSCLUSTER X manuals consist of the following five guides. The title and purpose of each guide is described below:

EXPRESSCLUSTER X Getting Started Guide

This guide is intended for all users. The guide covers topics such as product overview, system requirements, and known problems.

EXPRESSCLUSTER X Installation and Configuration Guide

This guide is intended for system engineers and administrators who want to build, operate, and maintain a cluster system. Instructions for designing, installing, and configuring a cluster system with EXPRESSCLUSTER are covered in this guide.

EXPRESSCLUSTER X Reference Guide

This guide is intended for system administrators. The guide covers topics such as how to operate EXPRESSCLUSTER, function of each module and troubleshooting. The guide is supplement to the Installation and Configuration Guide.

EXPRESSCLUSTER X Maintenance Guide

This guide is intended for administrators and for system administrators who want to operate and maintain EXPRESSCLUSTER-based cluster systems. The guide describes maintenance-related topics for EXPRESSCLUSTER.

EXPRESSCLUSTER X Hardware Feature Guide

This guide is intended for administrators and for system engineers who want to build EXPRESSCLUSTER-based cluster systems. The guide describes features to work with specific hardware, serving as a supplement to the Installation and Configuration Guide.

1.4 Conventions

In this guide, **Note**, **Important**, **See also** are used as follows:

Note: Used when the information given is important, but not related to the data loss and damage to the system and machine.

Important: Used when the information given is necessary to avoid the data loss and damage to the system and machine.

See also:

Used to describe the location of the information given at the reference destination.

The following conventions are used in this guide.

Convention	Usage	Example
Bold	Indicates graphical objects, such as fields, list boxes, menu selections, buttons, labels, icons, etc.	In **User Name**, type your name. On the **File** menu, click **Open Database**.
Angled bracket within the command line	Indicates that the value specified inside of the angled bracket can be omitted.	clpstat -s[-h host_name]
#	Prompt to indicate that a Linux user has logged on as root user.	# clpcl -s -a
Monospace	Indicates path names, commands, system output (message, prompt, etc.), directory, file names, functions and parameters.	`/Linux/6.0/en/server/`
bold	Indicates the value that a user actually enters from a command line.	Enter the following: # clpcl -s -a
italic	Indicates that users should replace italicized part with values that they are actually working with.	`rpm -i expresscls-<version_number>-<release_number>.x86_64.rpm`

In the figures of this guide, this icon represents EXPRESSCLUSTER.

This document uses KB, MB, GB, and TB as units of data size. Each unit represents 1,024 times the size of the next smaller unit (e.g., 1 KB = 1,024 bytes; 1 MB = 1,024 KB; 1 GB = 1,024 MB).

1.5 Contacting NEC

For the latest product information, visit our website below:

https://www.nec.com/global/prod/expresscluster/

CHAPTER

TWO

DETERMINING A SYSTEM CONFIGURATION

This chapter provides instructions for determining the cluster system configuration that uses EXPRESSCLUSTER.

This chapter covers:

- 2.1. *Steps from configuring a cluster system to installing EXPRESSCLUSTER*
- 2.2. *What is EXPRESSCLUSTER?*
- 2.3. *Planning system configuration*
- 2.4. *Checking system requirements for each EXPRESSCLUSTER module*
- 2.5. *Example of EXPRESSCLUSTER (main module) hardware configuration*
- 2.6. *Verifying system requirements for the Cluster WebUI*
- 2.7. *Determining a hardware configuration*
- 2.8. *Settings after configuring hardware*

2.1 Steps from configuring a cluster system to installing EXPRESSCLUSTER

Before you set up a cluster system that uses EXPRESSCLUSTER, you should carefully plan the cluster system with due consideration for factors such as hardware requirements, software to be used, and the way the system is used. When you have built the cluster, check to see if the cluster system is successfully set up before you start its operation.

This guide explains how to create a cluster system with EXPRESSCLUSTER through step-by-step instructions. Read each chapter by actually executing the procedures to install the cluster system. Following is the steps to take from designing the cluster system to operating EXPRESSCLUSTER:

The following is the procedure for configuring a cluster system to run an operation test:

Prepare for installing EXPRESSCLUSTER. Determine the hardware configuration and the setting information of a cluster system to be constructed.

Step 1 "2. *Determining a system configuration*"

Step 2 "3. *Configuring a cluster system*"

Install EXPRESSCLUSTER to server machines, create a configuration data file on the Cluster WebUI by using the setting information created **in Steps 1 and** 2 , and construct a cluster. After that, verify that a cluster system operates normally.

Step 3 "4. *Installing EXPRESSCLUSTER*"

Step 4 "5. *Registering the license*"

Step 5 "6. *Creating the cluster configuration data*"

Step 6 "7. *Verifying a cluster system*"

Perform an evaluation required before starting the EXPRESSCLUSTER operation. Test the operations of a constructed cluster system, and then check what should be checked before starting the EXPRESSCLUSTER operation. On the last part of this section, how to uninstall and reinstall EXPRESSCLUSTER is described.

Step 7 "8. *Verifying operation*"

Step 8 "9. *Preparing to operate a cluster system*"

Step 9 "10. *Upgrading EXPRESSCLUSTER*"

Step 10 "11. *Uninstalling and reinstalling EXPRESSCLUSTER*"

See also:

Refer to the *Reference Guide* as you need when operating EXPRESSCLUSTER by following the procedures introduced in this guide. See the Getting Started Guide for installation requirements.

2.2 What is EXPRESSCLUSTER?

EXPRESSCLUSTER is software that enhances availability and expandability of systems by a redundant (clustered) system configuration. The application services running on the active server are automatically taken over to the standby server when an error occurs on the active server.

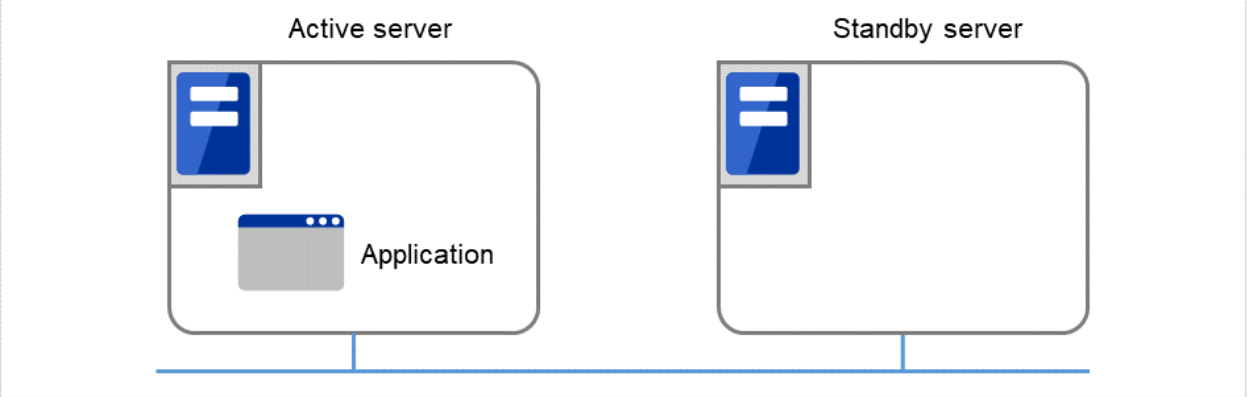


Fig. 2.1: Cluster system (in normal operation)

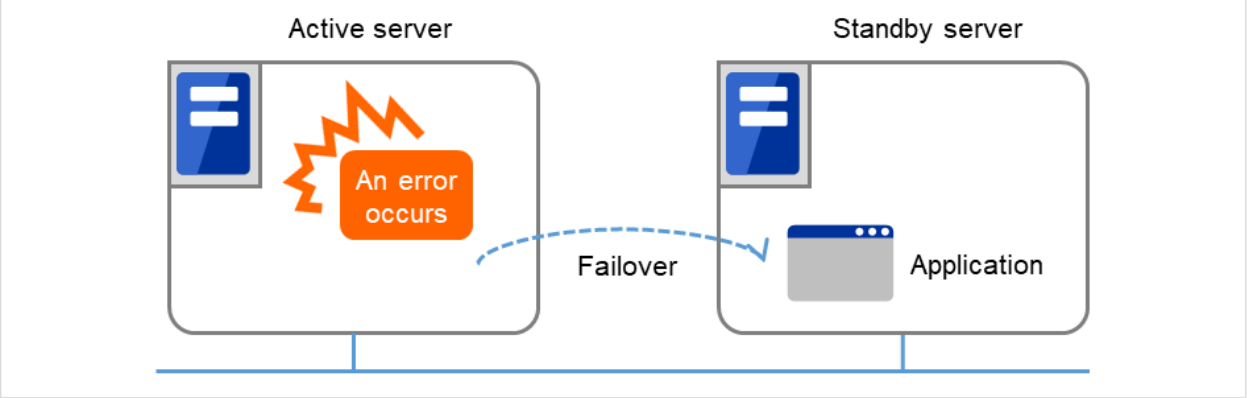


Fig. 2.2: Cluster system (when an error occurs)

The following can be achieved by installing a cluster system that uses EXPRESSCLUSTER.

- High availability
  The down time is minimized by automatically failing over the applications and services to a "healthy" server when one of the servers which configure a cluster stops.
- High expandability
  An expandable database platform can be provided by supporting a parallel database up to 32 servers.

See also:

For details on EXPRESSCLUSTER, refer to "What is a cluster system?" and "Using EXPRESSCLUSTER" in the Getting Started Guide.

2.2.1 EXPRESSCLUSTER modules

EXPRESSCLUSTER consists of following two modules:

a) EXPRESSCLUSTER Server
The main module of EXPRESSCLUSTER and has all high availability functions of the server. Install this module on each server constituting the cluster.

b) Cluster WebUI
This is a tool to create the configuration data of EXPRESSCLUSTER and to manage EXPRESSCLUSTER operations. It is distinguished from the EXPRESSCLUSTER Server because the Cluster WebUI is operated through a Web browser on the management PC.

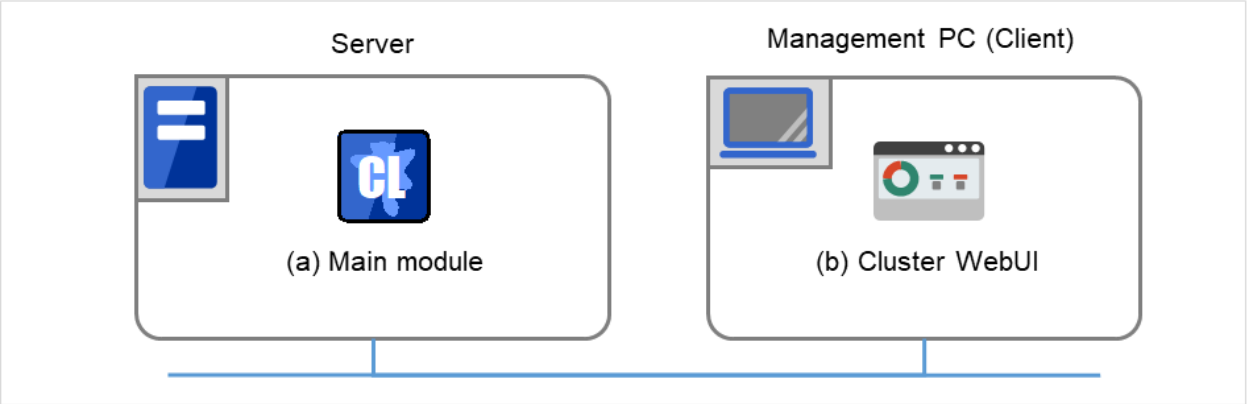


Fig. 2.3: Software configuration

2.3 Planning system configuration

You need to determine an appropriate hardware configuration to install a cluster system that uses EXPRESSCLUSTER. The configuration examples of EXPRESSCLUSTER are shown below.

See also:

For latest information on system requirements, refer to the Getting Started Guide.

2.3.1 Shared disk type and data mirror type

There are two types of system configurations: shared disk type and data mirror type, which has a subset, hybrid type.

- Shared disk type
  When the shared disk type configuration is used, application data is stored on a shared disk that is physically connected to servers, by which access to the same data after failover is ensured.
  You can make settings that block the rest of the server from accessing the shared disk when one server is using a specific space of the shared disk.
  The shared disk type is used in a system such as a database server where a large volume of data is written because performance in writing data does decrease.
- Data mirror type
  When the data mirror type configuration is used, application data is always mirrored between disks of two servers, by which access to the same data after failover is ensured.
  When data is written on the active server, writing the data is considered as being completed after the data is written on the standby server simultaneously.
  Performance in writing decreases because data is written on the standby server. However, cost of system can be reduced because no external disk such as a shared disk is necessary, and the cluster can be achieved only by disks on servers.
- Hybrid type
  This configuration is a combination of the shared disk type and the mirror disk type. By mirroring the data on the shared disk, the data is placed in the third server, which prevents the shared disk being a single point of failure. This method is a subset of the data mirror type.
  Data writing performance, operational topology and precautions of the mirror disk type apply to the hybrid type.

The following show configuration examples of the shared disk type, the mirror disk type and the hybrid type. Use these examples to design and set up your system.

2.3.2 Example 1: configuration using a shared disk with two nodes

The most commonly used system configuration:

- Different models can be used for servers.
- Use LAN cables for interconnection. (A dedicated HUB can be used for connection as in the case with the 4-nodes configuration)

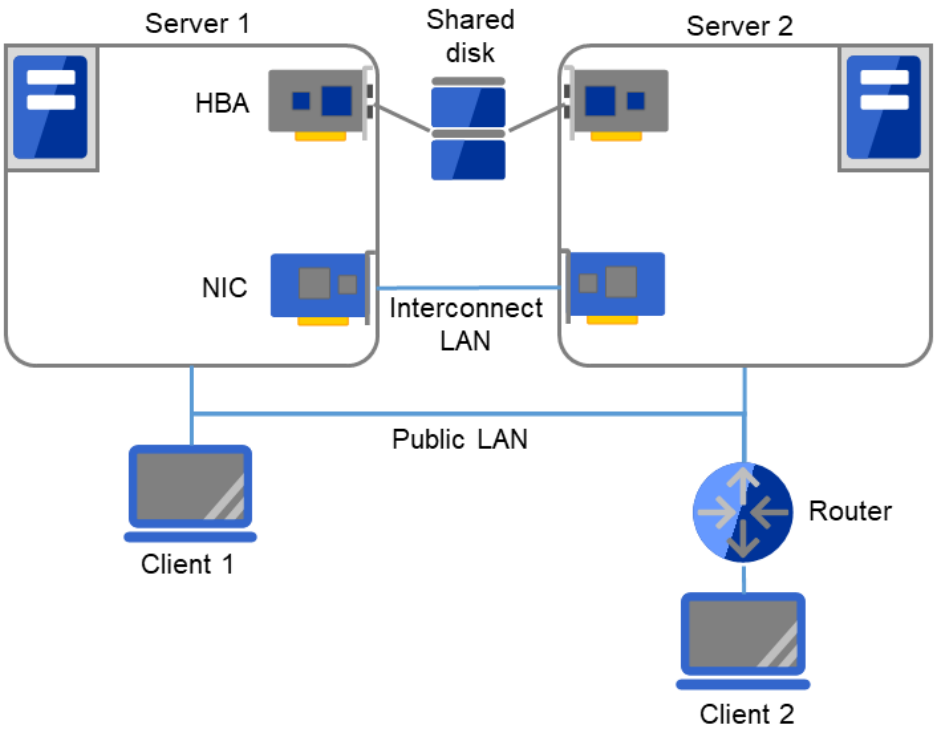


Fig. 2.4: Example of a configuration using a shared disk with two nodes

Client 1, which exists on the same LAN as that of the cluster servers, can access them through a floating IP address. Client 2, which exists on a remote LAN, can also access the cluster servers through a floating IP address. Using floating IP addresses does not require the router to be configured for them.

2.3.3 Example 2: configuration using mirror disks with two nodes

- Different models can be used for servers. However, servers should have the same architecture.
- Use LAN cables for interconnection. Use cross cables for the interconnection between the mirror disks (mirror disk connect). Do not connect a HUB.

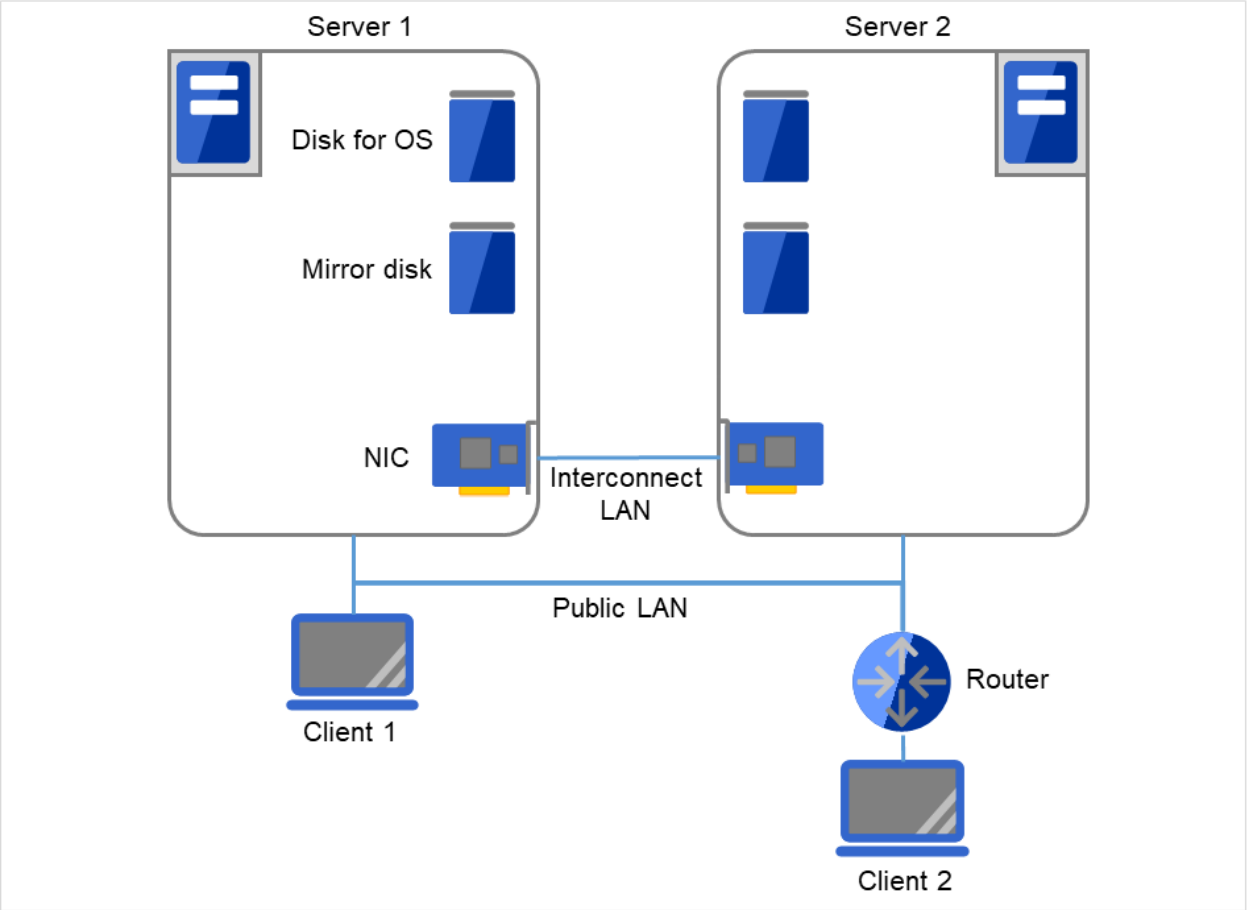


Fig. 2.5: Example of a configuration using mirror disks with two nodes

Client 1, which exists on the same LAN as that of the cluster servers, can access them through a floating IP address. Client 2, which exists on a remote LAN, can also access the cluster servers through a floating IP address. Using floating IP addresses does not require the router to be configured for them.

2.3.4 Example 3: configuration using mirror disks with two nodes and one LAN

- Different models can be used for servers, but the servers must have the same architecture.

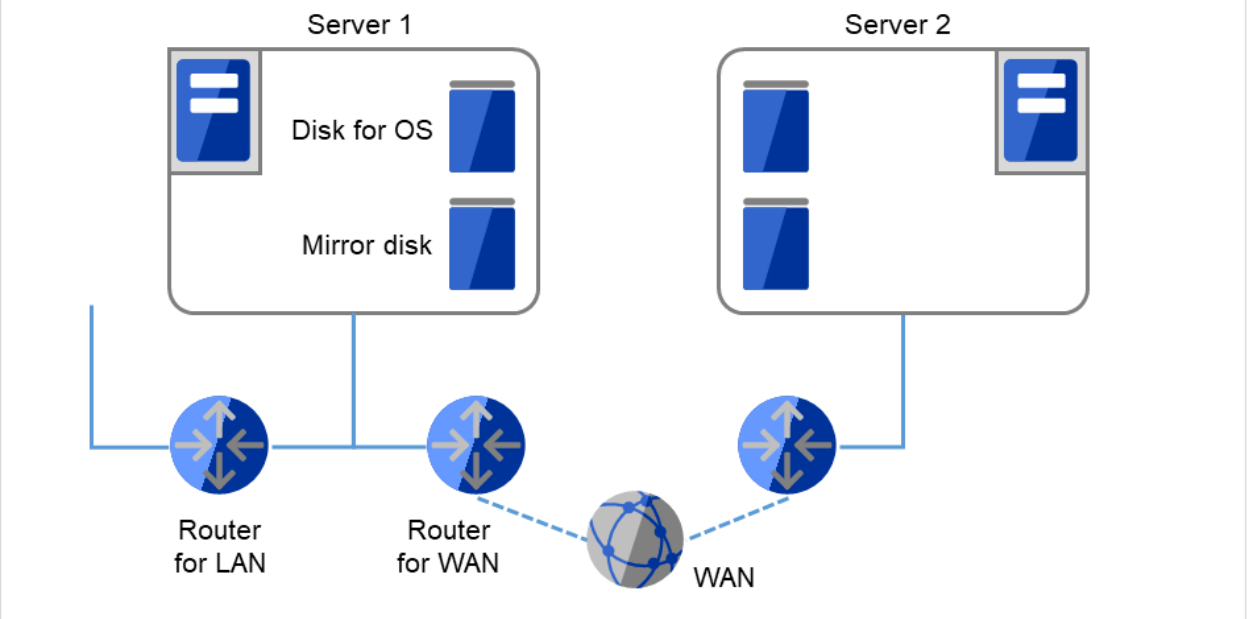


Fig. 2.6: Example of a configuration using mirror disks with two nodes and one LAN

WAN and LAN routers are to be monitored for the Ping NP resolution method. The WAN throughput must be enough to update data in an operation. EXPRESSCLUSTER does not support boosting line speed.

2.3.5 Example 4: configuration using mirror partitions on the disks for OS with two nodes

- As shown below, a mirroring partition can be created on the disk used for the OS.

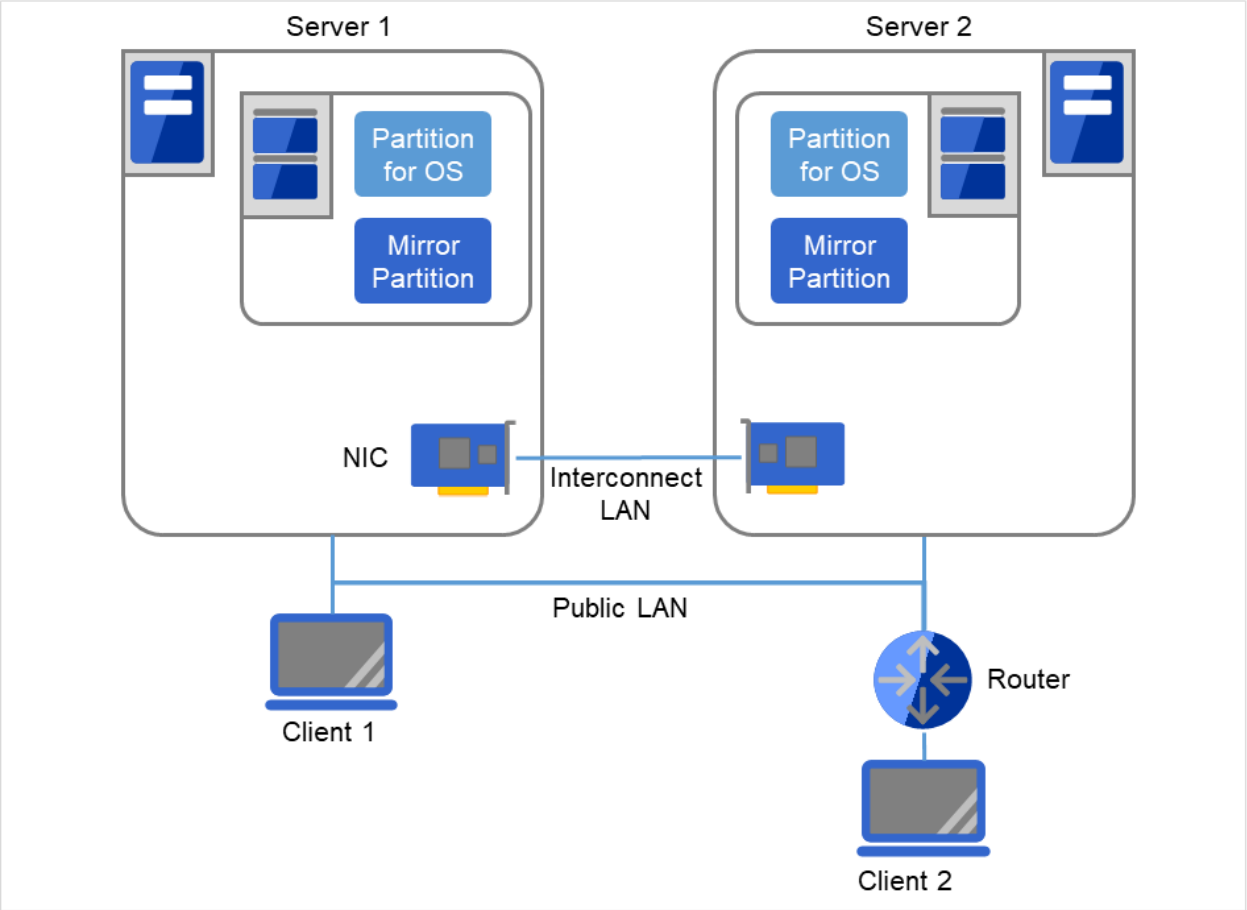


Fig. 2.7: Example of a configuration using mirror partitions on the disks for OSs with two nodes

Client 1, which exists on the same LAN as that of the cluster servers, can access them through a floating IP address. Client 2, which exists on a remote LAN, can also access the cluster servers through a floating IP address. Using floating IP addresses does not require the router to be configured for them.

See also:

For mirror partition settings, refer to "Group resource details" in the Reference Guide.

2.3.6 Example 5: configuration with three nodes

- For three nodes configuration, prepare two mirror disks on a standby server where mirror resources are integrated (in the figure below, server3).
- Install a dedicated HUB for LAN used for interconnect and mirror disk connection.
- For the HUB, use the high-speed HUB.

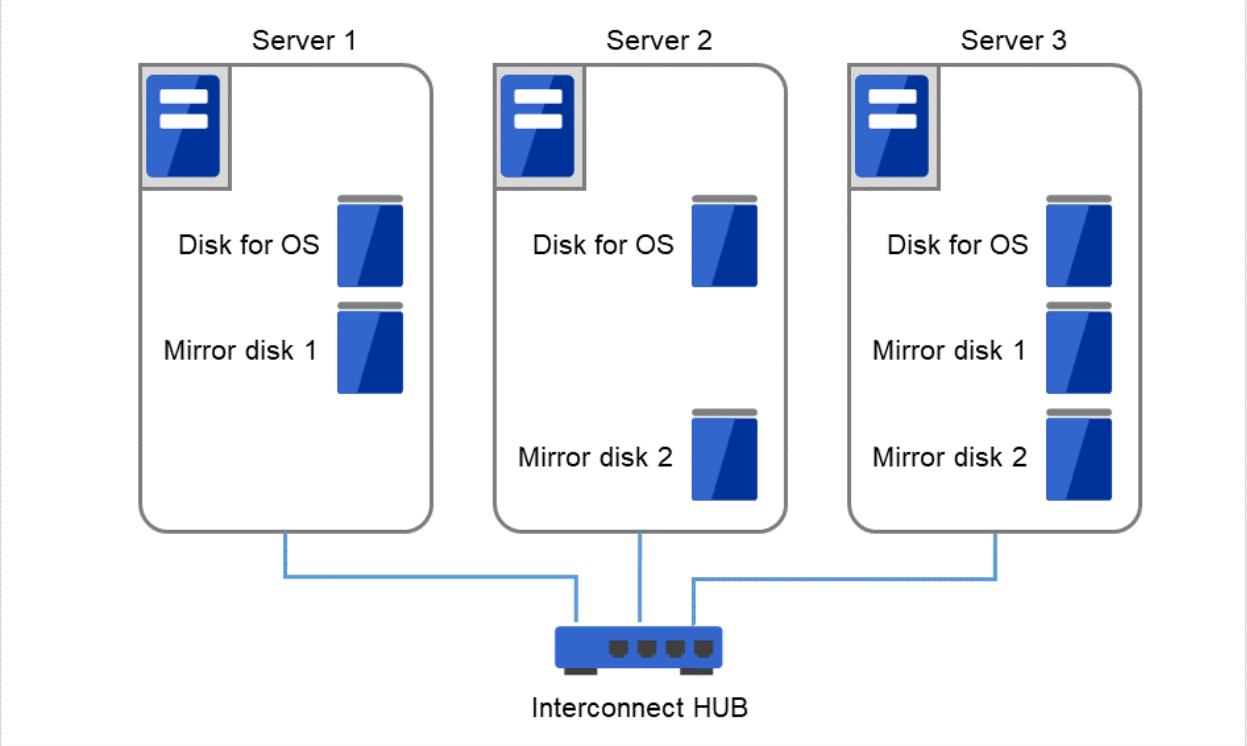


Fig. 2.8: Example of a configuration with three nodes

Interconnect LAN cables are connected to the interconnect hub, which is not connected to any other server or client.

2.3.7 Example 6: configuration with four nodes

- As is the case with two nodes, connect a shared disk.
- Install a dedicated HUB for interconnect.

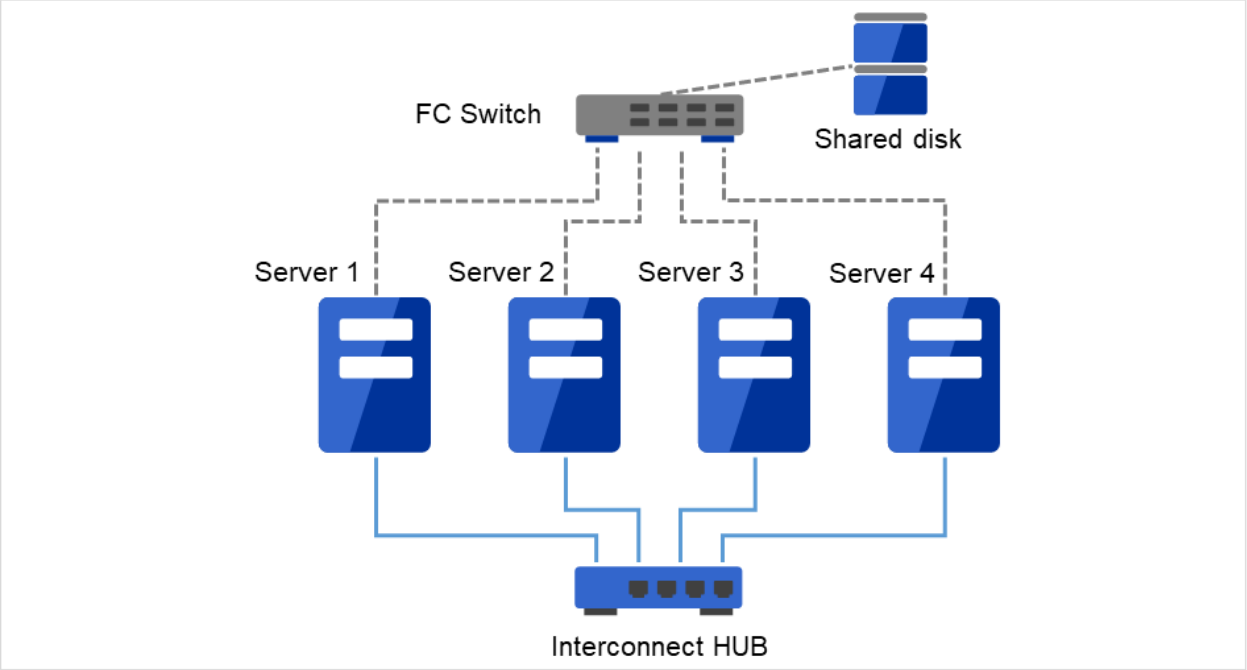


Fig. 2.9: Example of a configuration with four nodes

Interconnect LAN cables are connected to the interconnect hub, which is not connected to any other server or client.

2.3.8 Example 7: Configuration of hybrid type with three nodes

This is a configuration with three nodes, which consists of two nodes connected to the shared disk and one node with the disk to be mirrored.

- Different models can be used for servers but the servers must be configured in the same architecture.
- Install a dedicated HUB for interconnection and LAN of mirror disk connect.
- For the HUB, use a fast HUB.

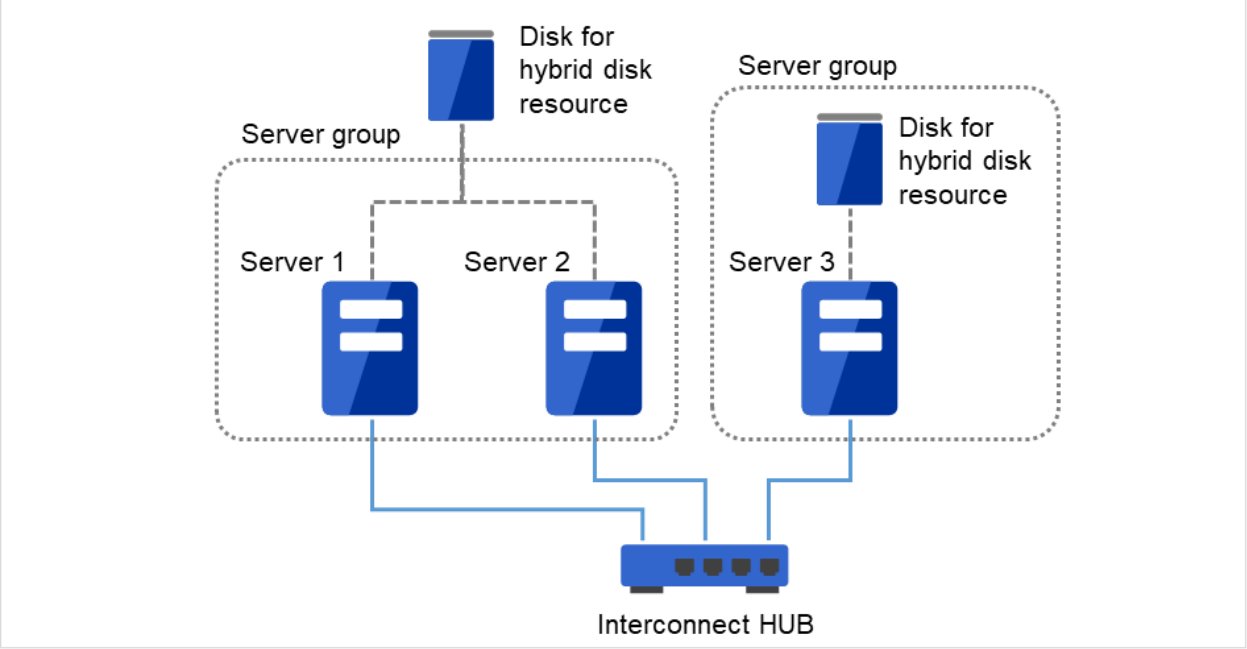


Fig. 2.10: Example of a configuration of the hybrid type with three nodes

Interconnect LAN cables are connected to the interconnect hub, which is not connected to any other server or client.

2.3.9 Example 8: Configuration for using BMC-related functions with two nodes

This is an example of 2-node cluster configuration for using the BMC linkage functions, such as the forced stop function of a physical machine.

- When using BMC-related functions, connect the interconnect LAN and BMC management LAN via a dedicated HUB.
- Use as fast a HUB as is available.

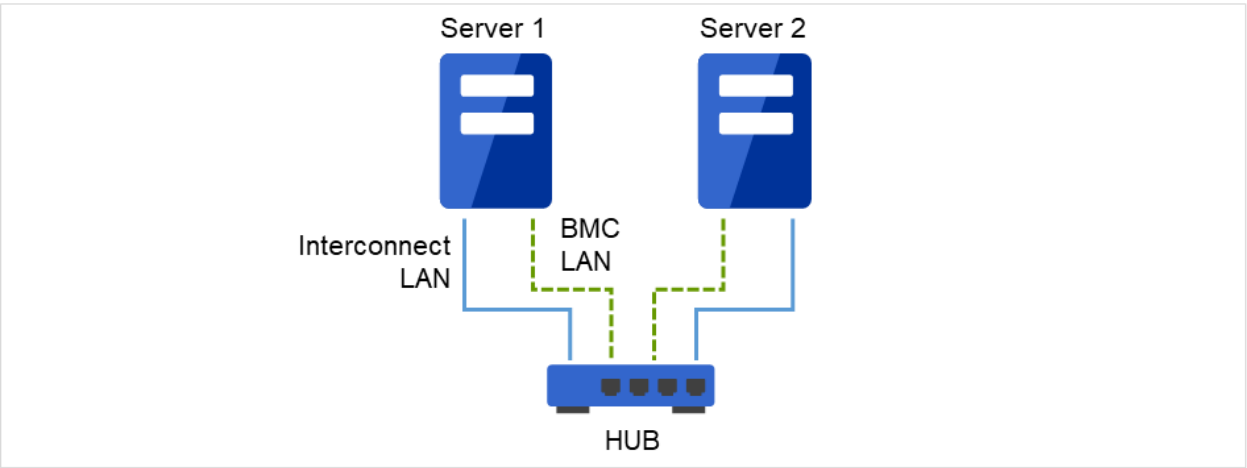


Fig. 2.11: Example of a configuration for using BMC-related functions with two nodes

Interconnect LAN and BMC LAN cables are connected to the hub, which is not connected to any other server or client.

2.4 Checking system requirements for each EXPRESSCLUSTER module

EXPRESSCLUSTER X consists of two modules: EXPRESSCLUSTER Server (main module) and Cluster WebUI. Check configuration and operation requirements of each machine where these modules will be used. For details about the operating environments, see "Installation requirements for EXPRESSCLUSTER" in the Getting Started Guide.

2.5 Example of EXPRESSCLUSTER (main module) hardware configuration

The EXPRESSCLUSTER Server is a core component of EXPRESSCLUSTER. Install it on each server that constitutes a cluster. Cluster WebUI is included in the EXPRESSCLUSTER Server and it is automatically installed once the EXPRESSCLUSTER Server is installed.

2.5.1 General requirements

Following is the recommended specification for the EXPRESSCLUSTER Server:

- Ethernet port: 2 or more ports
- Shared disk (For disk resource and/or hybrid disk resource)
- Disk for mirroring or free partition (For mirror disk resource or hybrid disk resource)
- DVD-ROM drive (required when the installation DVD-ROM is used)

See also:

For information on system requirements for supported hardware and OS, refer to the Getting Started Guide.

2.6 Verifying system requirements for the Cluster WebUI

To monitor a cluster system that uses EXPRESSCLUSTER, use Cluster WebUI, which accesses from a management PC via a Web browser. Therefore, a management PC should be able to make access to the cluster via network. The management PC can be Linux or Windows.

For information of the latest system requirements of the Cluster WebUI (supported operating systems and browsers, required memory and disk size) see the Getting Started Guide.

2.7 Determining a hardware configuration

Determine a hardware configuration considering an application to be duplicated on a cluster system and how a cluster system is configured. Read "3. *Configuring a cluster system*" before you determine a hardware configuration.

2.8 Settings after configuring hardware

After you have determined the hardware configuration and installed the hardware, do the following:

- 2.8.1. *Shared disk settings for disk resource (Required for disk resource)*
- 2.8.2. *Shared disk settings for Hybrid disk resource (Required for Replicator DR)*
- 2.8.3. *Partition settings for Hybrid disk resource (Required for the Replicator DR)*
- 2.8.4. *Partition settings for Mirror disk resource (when using Replicator)*
- 2.8.5. *Adjustment of time for EXPRESSCLUSTER services to start up (Required)*
- 2.8.6. *Verification of the network settings (Required)*
- 2.8.7. *Verification of the firewall settings (Required)*
- 2.8.8. *Server clock synchronization (Required)*
- 2.8.9. *Setup of OpenSSL (Optional)*
- 2.8.10. *SELinux settings (Required)*

2.8.1 Shared disk settings for disk resource (Required for disk resource)

Set up the shared disk by following the steps below. For using hybrid disk resource (for Replicator DR), refer to "2.8.2. *Shared disk settings for Hybrid disk resource (Required for Replicator DR)*".

Note: When you continue using the data on the shared disk (in the cases such as reinstalling the server), do not create partitions or a file system. If you create partitions or a file system, data on the shared disks will be deleted.

1-a. Allocate a partition for disk heartbeat resource.

Allocate a partition on a shared disk to be used as a disk heartbeat resource in EXPRESSCLUSTER. Create a partition on one of the servers in the cluster that uses the shared disk. Use the fdisk command to set 83 (Linux) for the partition ID.

Note: Typically, only one partition is used for heartbeat resources. However, in addition to the LUN used for heartbeat, you should create another partition used for the disk heartbeat resources in each disk as a spare dummy partition. This is because heartbeat needs to be done in other LUN when the file system gets corrupted and the device name is changed by disk error or other errors. Use the same partition number for partitions for disk heartbeat in all the LUNs.

Note: A disk heartbeat partition should be 10 MB (10*1024*1024 bytes) or larger. It is not necessary to construct any file system for disk heartbeat partitions.

1-b. Allocate a partition for disk resource.

Create partitions to be used for disk resources on the shared disk. Use a server in the cluster that uses the shared disk to create the partition. Run the fdisk command to set 83 (Linux) for the partition ID.

2. Create a file system.

Configure a file system for a partition for the disk resource on a shared disk. Run the mkfs command on a server in the cluster that uses the shared disks as you usually do in Linux.

Note: It is not necessary to construct the file system for a partition for the disk heartbeat resource.

Note: The EXPRESSCLUSTER controls the file systems on shared disks. Do not enter the file systems on the shared disks into /etc/fstab in the operating system. (If the entry to is required /etc/fstab, please use the noauto option is not used ignore option.)

- The disk resource basically does not depend on file systems, problems may occur depending on the specification of the fsck of the file system.
- It is recommended to use a file system that is capable of journaling to avoid system failure.
- Following is the currently supported file systems:
  - ext3
  - ext4
  - xfs

3. Create a mount point.

Create a directory to mount the partition for disk resource.
Create this directory on all servers in the cluster that use disk resource.

2.8.2 Shared disk settings for Hybrid disk resource (Required for Replicator DR)

Configure the shared disk for hybrid disk resource by following the steps below. For information on settings for general disk resource, see "2.8.1. *Shared disk settings for disk resource (Required for disk resource)*".
To use a disk other than a shared disk (such as internal disk of the server or a non-shared external disk) as a hybrid disk resource, see "2.8.3. *Partition settings for Hybrid disk resource (Required for the Replicator DR)*".

Note: When you continue using the data on the shared disk (in the cases such as reinstalling the server), do not create partitions or a file system. If you create partitions or a file system, data on the shared disks will be deleted.

---

1. Allocate a cluster partition.
   Allocate a partition to be used by the mirror driver. The mirror driver and mirror agent use this partition to monitor the status of hybrid disk.
   Create a partition from one server in the cluster that uses shared disk. Use the fdisk command to set 83 (Linux) for the partition ID.

   Note: A cluster partition should be 1024 MB or larger. (The size will be actually larger than 1024 MB even if you specify exactly 1024 MB because of the disk geometry difference. This will cause no problem.) You do not need to create a file system on this partition.

   ---

2. Initialize the cluster partition. (Required only when you continue using a shared disk that was used as EXPRESSCLUSTER mirror disk or hybrid disk.)

- Initialization is required because the old data on the cluster partition remains even if allocation of the partition is performed.
- If you continue to use a disk that was once used as an EXPRESSCLUSTER mirror disk or hybrid disk, make sure to initialize it.
- Run the following command from one server in the cluster that uses shared disk:

  ```
  dd if=/dev/zero of=<Name of the partition device to be used as cluster␣
  ↪partition>
  ```

Note: Running the dd command initializes the specified data partition. Before you run the dd command make sure to check the partition device name.

Note: The following message is displayed when you run the **dd** command. This is not an error.

```
dd: writing to [Partition_device_name_used_as_a_cluster_partition]: No space left␣
↪on device
```

---

3. Allocate a partition for hybrid disk resource.

   Allocate a partition to be used by the hybrid disk resource on the shared disk. Create the partition from one server in the cluster that uses the shared disk.

   Use the fdisk command to set 83 (Linux) for the partition ID.

4. Create a file system.

   It is necessary to create a file system on the partition for hybrid disk resource.

   - Run the mkfs command on a server in the cluster that uses the shared disks.
   - The hybrid disk resource basically does not depend on file systems, problems may occur depending on the specification of the fsck of the file system.
   - It is recommended to use file systems which have journal function for fault tolerance improvement of the system.
   - File systems of which the operation is verified so far are as follows:
     - ext3
     - ext4
     - xfs

- It is also possible to directly access the partition without creating a file system.

Note: The file systems on the hybrid disk resource are controlled by EXPRESSCLUSTER. Do not entry hybrid disk resource or partitions for the hybrid disk resource in /etc/fstab of OS. (Do not enter them into /etc/fstab, even if the ignore option is specified.)

Note: When problems occur because of forgetting creating file system, execute the following steps:

(1) Stop cluster when the cluster is running.
For the Cluster WebUI, select **Service** -> **Stop Cluster**.
For the commands, use clpcl -t -a command.

(2) Stop mirror agent when mirror agent is running.

For the Cluster WebUI, select **Service** -> **Stop Mirror Agent**.
For the commands, run service clusterpro_md stop on each server.

(3) Lift access control to the hybrid disk partition.
use the clproset command.
(Example: clproset -w -d <*partition-device*>)

(4) Create file systems
use the mkfs or other commands.
(Example: mkfs -t ext4 <*partition-device*>)

(5) Reboot the system.

5. Allocate a partition for disk heartbeat resource.

   Allocate a partition on the shared disk to be used as a disk heartbeat resource exclusively by EXPRESSCLUSTER. Create the partition from one of the servers in the cluster that uses the shared disk. Use the fdisk command to set 83 (Linux) for the partition ID.

   Note: Typically, only one partition is used for heartbeat resources. However, in addition to the LUN used for heartbeat, you should create another partition used for the disk heartbeat resources in each disk as a spare dummy partition. This is because heartbeat needs to be done in other LUN when the file system gets corrupted and the device name is changed by disk error or other errors. Use the same partition numbers for partitions for disk heartbeat in all the LUNs.

   Note: A disk heartbeat partition should be 10 MB (10*1024*1024 bytes) or larger. It is not necessary to configure a file system for disk heartbeat partitions.

6. Create a mount point.
   Create a directory to mount the partition for hybrid disk resource.
   Create this directory on servers that use hybrid disk resource and connecting to the shared disk.
   If a file system is not used for the partition for hybrid disk resources, a mount point does not need to be created.

2.8.3 Partition settings for Hybrid disk resource (Required for the Replicator DR)

Follow the steps below to configure the partitions when a non-shared disk (such as internal disk of the server or a non-shared external disk) is used as a hybrid disk resource.

For settings in a general mirror configuration (when Replicator is used), see "2.8.4. *Partition settings for Mirror disk resource (when using Replicator)*".

When a shared disk is used as a hybrid disk resource, refer to "2.8.2. *Shared disk settings for Hybrid disk resource (Required for Replicator DR)*".

Note: When you continue using an existing partition (in the cases such as clustering a single server) or reinstalling server, do not allocate a partition for a hybrid disk resource or create a file system. The data on the partition gets deleted

if you allocate a partition for hybrid disk resources or create a file system.

1. Allocate a cluster partition for hybrid disk resource.
   Allocate a partition to be used by the mirror driver. The mirror driver and mirror agent use this partition to monitor the status of hybrid disk resource. Create a partition in every server in the cluster that uses hybrid disk resource. Use the fdisk command to set 83 (Linux) for the partition ID.

   Note: A cluster partition for hybrid disk resource should be 1024 MB or larger. (The size will be actually larger than 1024 MB even if you specify exactly 1024 MB because of the disk geometry difference. This will cause no problem.) You do not need to create a file system on this partition.

2. Initialize the cluster partition. (Required only when you continue using a disk that is used as disk that was used as EXPRESSCLUSTER mirror disk or hybrid disk.)
   - Initialization is required because the old data on partitions survive even if allocation of partitions is performed.
   - If you continue to use a disk that was once used as an EXPRESSCLUSTER mirror disk or hybrid disk, make sure to initialize it.
   - Run the following command:

   ```
   dd if=/dev/zero of=<Partition device name to be used as cluster partition>
   ```

   Note: Running the dd command initializes the specified partition. Before you run the dd command make sure to check the partition device name.

   Note: The following message is displayed when you run the **dd** command. This is not an error.

   ```
   dd: writing to <Partition_device_name_used_as_a_cluster_partition>: No space␣
   ↪left on device
   ```

3. Allocate a partition for hybrid disk resource.
   Create a partition to be used for hybrid disk resource. Create the partition in every server in the cluster that use hybrid resource. Run the fdisk command to set 83 (Linux) for the partition ID.
4. Create a file system.
   It is necessary to create a file system on the partition for hybrid disk resource.
   - The hybrid disk resource basically does not depend on file systems, problems may occur depending on the specification of the fsck of the file system.
   - It is recommended to use file systems which have journal function for fault tolerance improvement of the system.
   - Following is the currently supported file systems:
     - ext3
     - ext4
     - xfs
   - It is also possible to directly access the partition without creating a file system.

Note: The EXPRESSCLUSTER controls the file systems on hybrid disk resource. Do not enter the hybrid disk resource or partition for hybrid disk resource into /etc/fstab in the operating system. (Do not enter them into /etc/fstab, even if the ignore option is specified.)

Note: When problems occur because of forgetting creating file system, execute the following steps:

(1) Stop cluster when the cluster is running.
For the Cluster WebUI, select **Service -> Stop Cluster**.
For the commands, use clpcl -t -a command.

(2) Stop mirror agent when mirror agent is running.
For the Cluster WebUI, select **Service -> Stop Mirror Agent**.
For the commands, run service clusterpro_md stop on each server.

(3) Lift access control to the hybrid disk partition.
use the clproset command.
(Example: clproset -w -d <*partition_device*>)

(4) Create file systems
use the mkfs or other commands.
(Example: mkfs -t ext4 <*partition_device*>)

(5) Reboot the system.

5. Create a mount point.
   Create a directory to mount the partition for hybrid disk resource.
   - If a file system is not used for the partition for hybrid disk resources, a mount point does not need to be created.

2.8.4 Partition settings for Mirror disk resource (when using Replicator)

Set up partitions for mirror disk resource by following the steps below. For using hybrid disk resource (for Replicator DR), refer to "2.8.3. *Partition settings for Hybrid disk resource (Required for the Replicator DR)*".

Note: When you continue using an existing partition (in the cases such as clustering a single server) or reinstalling server, do not allocate a partition for mirror resources. If you create the partition for mirror resources, data on the existing partition will be deleted.

1. Allocate a cluster partition.
   Allocate a partition to be used by the mirror driver. The mirror driver and mirror agent use this partition to monitor the status of mirror disk resource. Create a partition in every server in the cluster that uses mirror disk resource. Use the fdisk command to set 83 (Linux) for the partition ID.

   Note: A cluster partition should be 1024 MB or larger. (The size will be actually larger than 1024 MB even if you specify exactly 1024 MB because of the disk geometry difference. This will cause no problem.) You do not need to create a file system on this partition.

2. Initialize the cluster partition. (Required only when you continue using a disk that is used as disk that was used as EXPRESSCLUSTER mirror disk or hybrid disk.)

- Initialization is required because the old data on the cluster partition remains even if allocation of partitions is performed.
- If you continue to use a disk that was once used as an EXPRESSCLUSTER mirror disk or hybrid disk, make sure to initialize it.
- Run the following command:

```
dd if=/dev/zero of=<The name of the partition device to be used as cluster␣
↪partition>
```

Note: Running the dd command initializes the specified partition. Before you run the dd command make sure to check the partition device name.

Note: The following message is displayed when you run the **dd** command. This is not an error.

```
dd: writing to <Partition_device_name_used_as_a_cluster_partition>: No space␣
↪left on device
```

---

3. Allocate a partition for mirror disk resource

   Create a partition to be used for mirror disk resource. Create a partition in every server in the cluster that use mirror resource. Run the fdisk command to set 83 (Linux) for the partition ID.

4. Create a file system.

   Creation of a file system for the partition used for mirror resource depends on the **Execute initial mkfs** setting.

   - If **Execute initial mkfs** is selected when creating the cluster configuration data using the Cluster WebUI, EXPRESSCLUSTER will automatically create a file system.

     Note that the existing data on the partition will be lost.
   - If **Execute initial mkfs** is not selected when creating the cluster configuration data using the Cluster WebUI, EXPRESSCLUSTER will not create a file system.

     Because this option causes the existing file system on the partition to be used, it is necessary to create a file system in advance.

   In addition, note the following about the partition for mirror resource:

   - The mirror resource basically does not depend on file systems, problems may occur depending on the specification of the fsck of the file system.
   - It is recommended to use a file system capable of journaling to avoid system failures.
   - The file systems currently supported are:
     - ext3
     - ext4
     - xfs
   - It is also possible to directly access the partition without creating a file system.

Note:

Do not select **Execute initial mkfs** when you use the data has been saved on the partition.

If you select it, the data will be removed.

Note: The EXPRESSCLUSTER controls the file systems on the mirror resource. Do not enter the mirror resource or a partition for the mirror resource into the operating system /etc/fstab directory. (Do not enter them into /etc/fstab, even if the ignore option is specified.)

5. Create a mount point.
   Create a directory to mount the partition for mirror resource.
   Create this directory on all servers in the cluster that use mirror resource.

If a file system is not used for the partition for mirror resources, a mount point does not need to be created.

2.8.5 Adjustment of time for EXPRESSCLUSTER services to start up (Required)

Configure the time from turning on each server of the cluster system to starting up the EXPRESSCLUSTER services, longer than the following two:

- The time from power-on of the shared disk to the point they become available.
- Heartbeat timeout time (90 seconds by default)

Adjustment of the startup time is necessary due to the following reasons:

- The cluster system is started by powering on the shared disk and servers, but starting the shared disk is not completed before EXPRESSCLUSTER is started up (i.e., the startup of EXPRESSCLUSTER is completed without the shared disk recognized). This leads to a failure in the activation of disk resources.
- If a server reboots (i.e., the EXPRESSCLUSTER services start) within the heartbeat timeout time, the other server assumes that the heartbeat continues. This results in a failure in a failover by the server restart.

Therefore, after measuring the above two time periods, adjust the startup time in either of the following ways:

- Specify **Service Startup Delay Time**. (See "Reference Guide" -> "Parameter details" -> "Cluster properties" -> "Timeout tab".)
- Adjust the OS startup time in accordance with the OS boot loader settings.

  Example 1: Adjust the OS startup time in Red Hat Enterprise Linux 9 or later

  - When GRUB2 is used as the OS boot loader

    1. Edit /etc/default/grub.
       Specify GRUB_TIMEOUT=<startup_time> (in seconds).

       Example: Startup time: 90 seconds

       ```
       GRUB_TIMEOUT=90
       ```

    2. Only if you are using Red Hat Enterprise Linux 9.1 or higher, set as follows so that the boot loader menu can be displayed by default:

       ```
       # grub2-editenv - unset menu_auto_hide
       ```

    3. Run the command to make the changes of the setting effective.

       ```
       # grub2-mkconfig -o /boot/grub2/grub.cfg
       ```

Example 2: Adjust the OS startup time in Red Hat Enterprise Linux 8

- When GRUB2 is used as the OS boot loader

1. Edit /etc/default/grub.
   Specify GRUB_TIMEOUT=<startup_time> (in seconds).

   Example: Startup time: 90 seconds

```
GRUB_TIMEOUT=90
```

2. Run the command to make the changes of the setting effective.

* For the BIOS base server

```
# grub2-mkconfig -o /boot/grub2/grub.cfg
```

* For the UEFI base server

```
# grub2-mkconfig -o /boot/efi/EFI/redhat/grub.cfg
```

If you are using forced stop resources, please refer to "Reference Guide" - "Forced stop resource details" - "Notes on settings of forced stop resource".

2.8.6 Verification of the network settings (Required)

On all servers in the cluster, verify the status of the following networks using the ifconfig or ping command. Verify if network devices (eth0, eth1, eth2, etc) are assigned to appropriate roles, such as public LAN and interconnect-dedicated LAN.

- Public LAN (used for communication with all the other machines)
- LAN dedicated to interconnect (used for communication between EXPRESSCLUSTER Servers)
- Host name

Note: It is not necessary to specify the IP addresses of floating IP resources or virtual IP resources used in the cluster in the operating system.

2.8.7 Verification of the firewall settings (Required)

EXPRESSCLUSTER uses several port numbers for communication between the modules. For details about the port numbers to be used, see "Before installing EXPRESSCLUSTER" of "Notes and Restrictions"in the "Getting Started Guide".

2.8.8 Server clock synchronization (Required)

It is recommended to regularly synchronize the clocks of all the servers in the cluster. Make the settings that synchronize server clocks through protocol such as ntp on a daily basis.

Note: If the clock in each server is not synchronized, it may take time to analyze the problem when an error occurs.

2.8.9 Setup of OpenSSL (Optional)

Encrypted communication using OpenSSL can be performed for the following functions:

- Cluster WebUI
- Witness heartbeat
- HTTP network partition resolution resource
- Mail reporting

To use OpenSSL for Cluster WebUI, prepare a certificate file and a private key file.

The prepared files will be used for configuring the settings in the config mode of Cluster WebUI: the "Encryption tab" of "Cluster properties" in "Parameter details" in the "EXPRESSCLUSTER X Reference Guide".

2.8.10 SELinux settings (Required)

Disable or enable SELinux.
To use EXPRESSCLUSTER with SELinux enabled: Immediately after installing EXPRESSCLUSTER, execute the clpselctrl.sh command.
To enable SELinux after installing EXPRESSCLUSTER: Before enabling SELinux, execute the clpselctrl.sh command.
For more information on the procedure, see "4.2.3. *Setting for SELinux*".

Note: The clpselctrl.sh command requires the semanage command and the restorecon command. If these two commands are not installed, install them beforehand.

```
dnf -y install policycoreutils-python-utils
```

Note: For more information on the clpselctrl.sh command, see "Reference Guide" -> "EXPRESSCLUSTER command reference" -> "Setting for SELinux (clpselctrl.sh command)".

Note: To check if SELinux is enabled or disabled, use the getenforce command.

```
getenforce
```

One of the following words appears, each of which means:

- Enforcing : Enabled (SELinux security policy is enforced.)

- Permissive : SELinux prints warnings instead of enforcing.
- Disabled : Disabled (No SELinux policy is loaded.)

CHAPTER

THREE

CONFIGURING A CLUSTER SYSTEM

This chapter provides information on applications to be duplicated, cluster topology, and explanation on cluster configuration data that are required to configure a cluster system.

This chapter covers:

- 3.1. *Configuring a cluster system*
- 3.2. *Determining a cluster topology*
- 3.3. *Determining applications to be duplicated*
- 3.4. *Planning a cluster configuration*
- 3.5. *Understanding group resources*
- 3.6. *Understanding monitor resources*
- 3.7. *Understanding heartbeat resources*
- 3.8. *Understanding network partition resolution resources*

3.1 Configuring a cluster system

This chapter provides information necessary to configure a cluster system, including the following topics:

1. Determining a cluster system topology
2. Determining applications to be duplicated
3. Creating the cluster configuration data

In this guide, explanations are given using a 2-node and uni-directional standby cluster environment as an example.

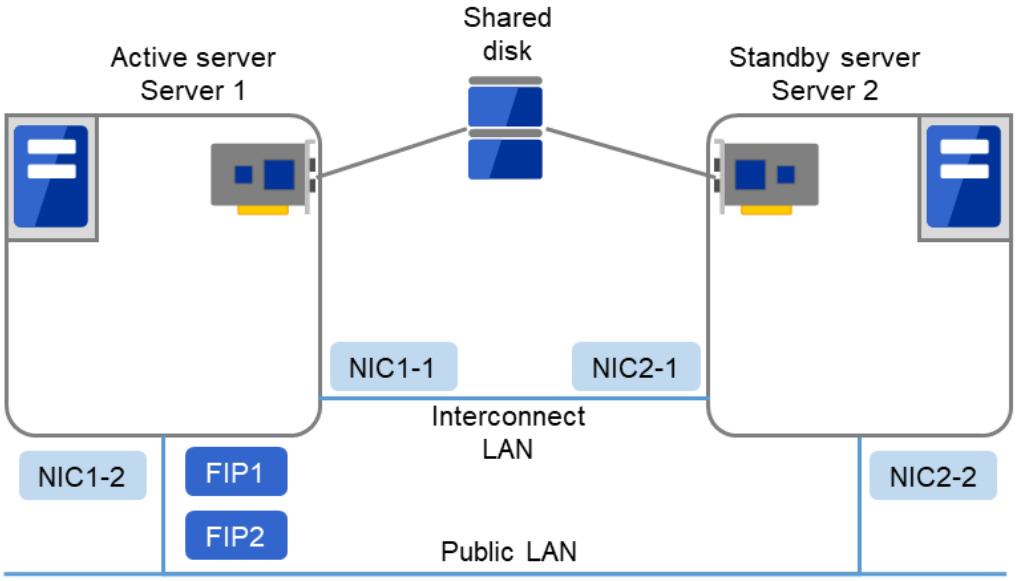


Fig. 3.1: Example of a 2-node and uni-directional standby cluster environment

FIP1	10.0.0.11 (to be accessed by Cluster WebUI clients)
FIP2	10.0.0.12 (to be accessed by operation clients)
NIC1-1	192.168.0.1
NIC1-2	10.0.0.1
NIC2-1	192.168.0.2
NIC2-2	10.0.0.2

- Shared disk

Device name of the disk heartbeat	/dev/disk/by-id/scsi-222850001557d9443-part1
Shared disk device	/dev/disk/by-id/scsi-222850001557d9443-part2
Mount point	/mnt/sd1

continues on next page

Table 3.2 – continued from previous page

File system	ext4
Device name of the disk monitor	/dev/disk/by-id/scsi-222850001557d9443-part2

3.2 Determining a cluster topology

EXPRESSCLUSTER supports multiple cluster topologies. There are uni-directional standby cluster system that considers one server as an active server and other as standby server, and multi-directional standby cluster system in which both servers act as active and standby servers for different operations.

- Uni-directional standby cluster system
  In this operation, only one application runs on an entire cluster system. There is no performance deterioration even when a failover occurs. However, resources in a standby server will be wasted.

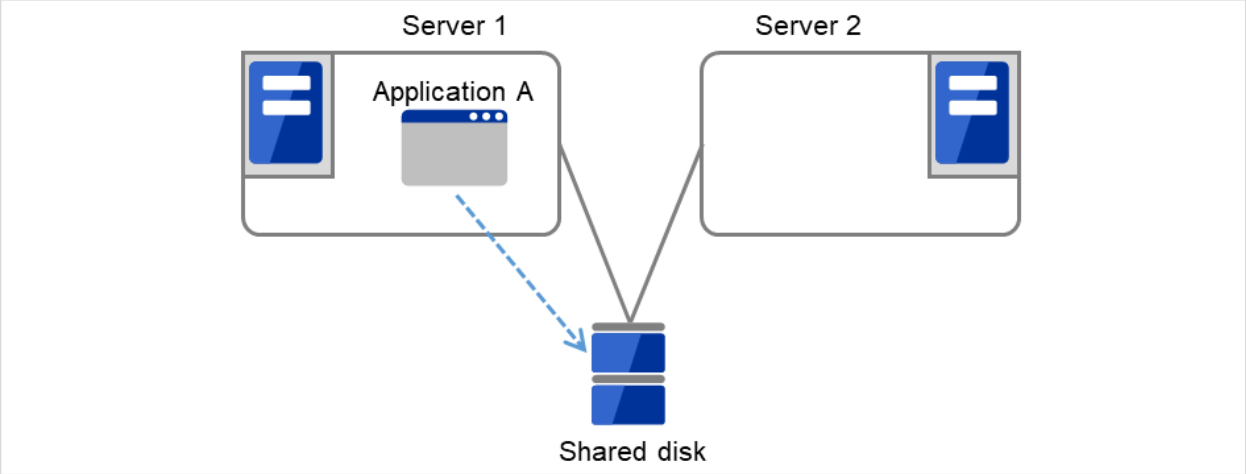


Fig. 3.2: Uni-directional standby cluster system

- Multi-directional standby cluster system with the same application
  In this operation, the same applications run simultaneously on a cluster system. Applications used in this system must support multi-directional standby operations.

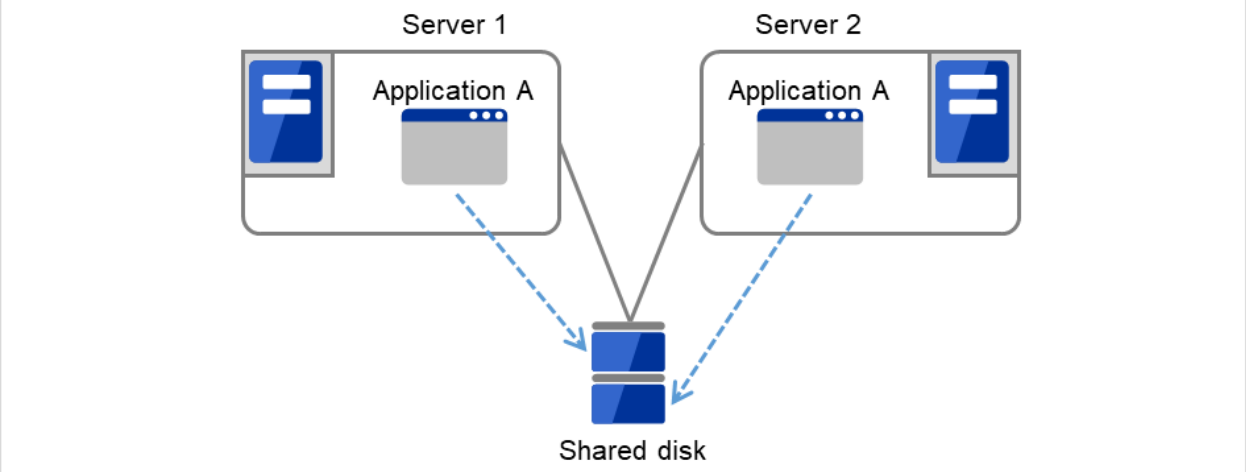


Fig. 3.3: Multi-directional standby cluster system with the same application

- Multi-directional standby cluster system with different applications

In this operation, different applications run on different servers and standby each other. Resources will not be wasted during normal operation; however, two applications run on one server after failing over and system performance deteriorates.

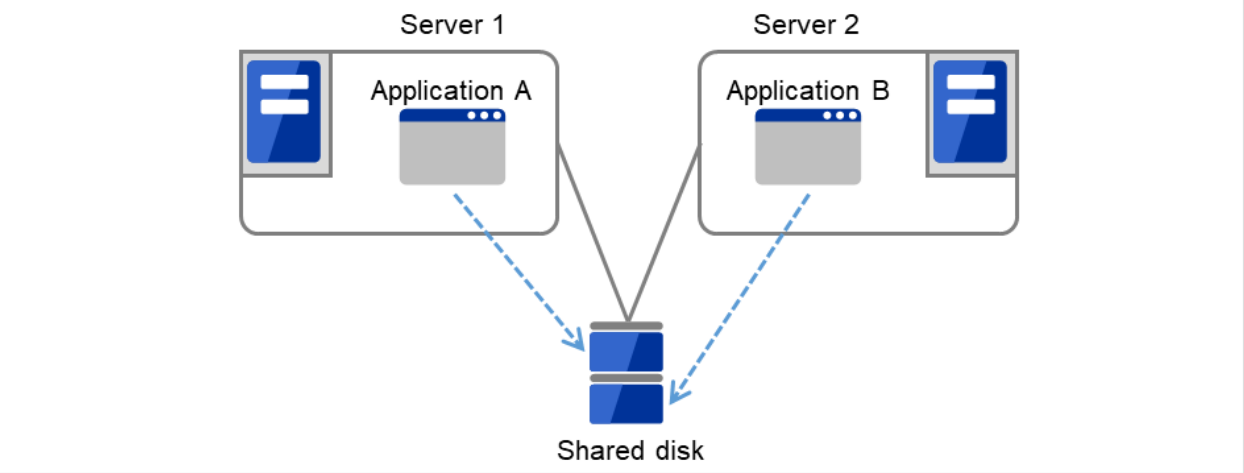


Fig. 3.4: Multi-directional standby cluster system with different applications

3.2.1 Failover in uni-directional standby cluster

On a uni-directional standby cluster system, the number of groups for an operation service is limited to one as described in the diagrams below:

When a shared disk is used

1. Server 1 runs Application A. Application A can be run on only one server in the same cluster.

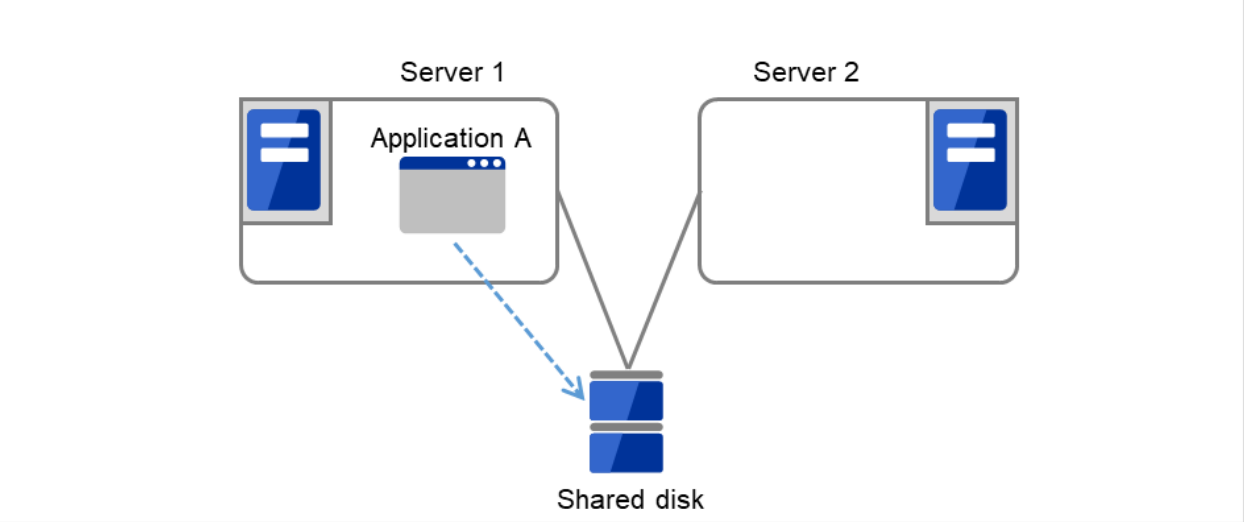


Fig. 3.5: Uni-directional standby cluster with a shared disk (1): in normal operation

2. Server 1 crashes due to some error.

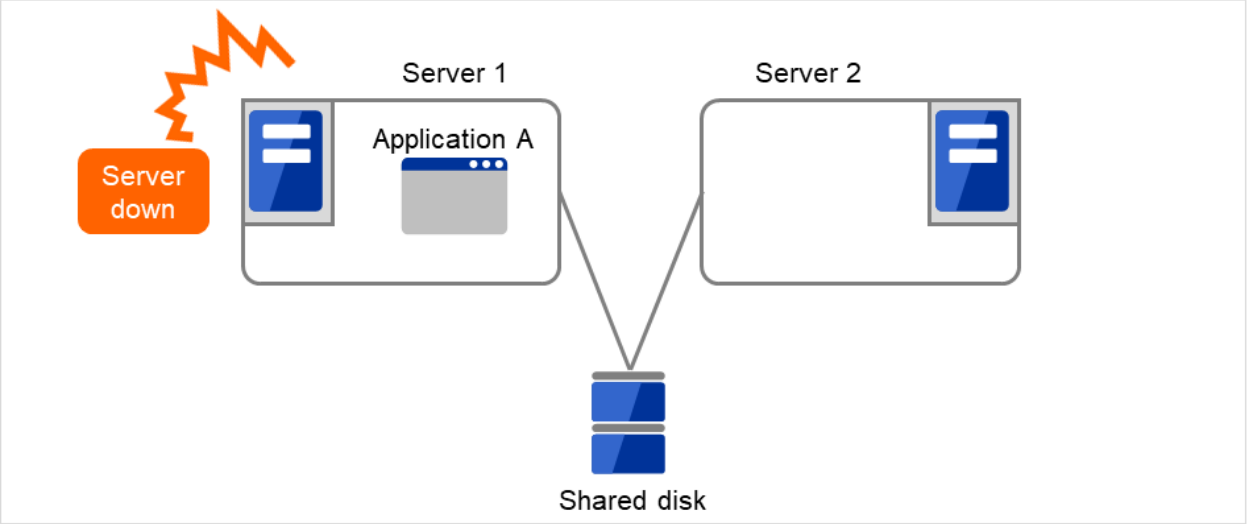


Fig. 3.6: Uni-directional standby cluster with a shared disk (2): when the server crashes

3. The application is failed over from Server 1 to Server 2.

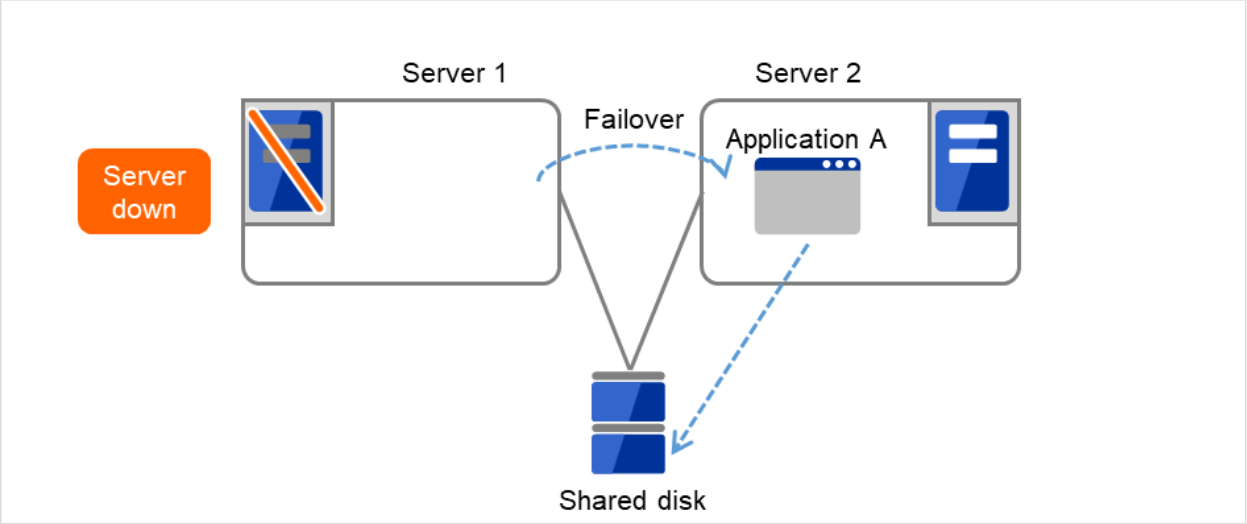


Fig. 3.7: Uni-directional standby cluster with a shared disk (3): during a failover

4. After Server 1 is restored, a group transfer can be made for Application A to be returned from Server 2 to Server 1.

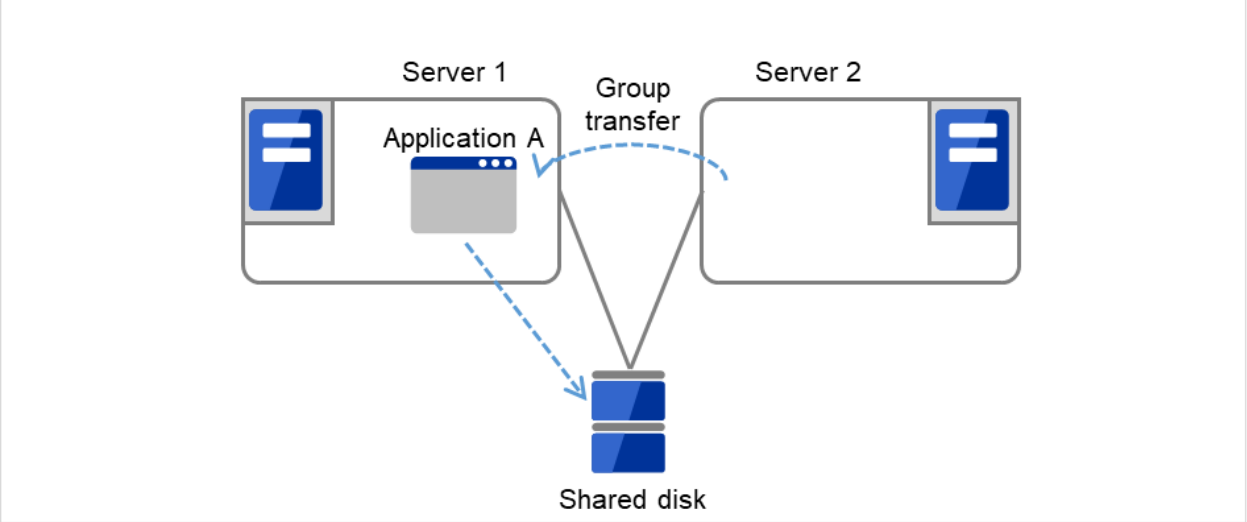


Fig. 3.8: Uni-directional standby cluster with a shared disk (4): after the server is restored

When mirror disks are used

1. Server 1 runs Application A. Application A can be run on only one server in the same cluster.

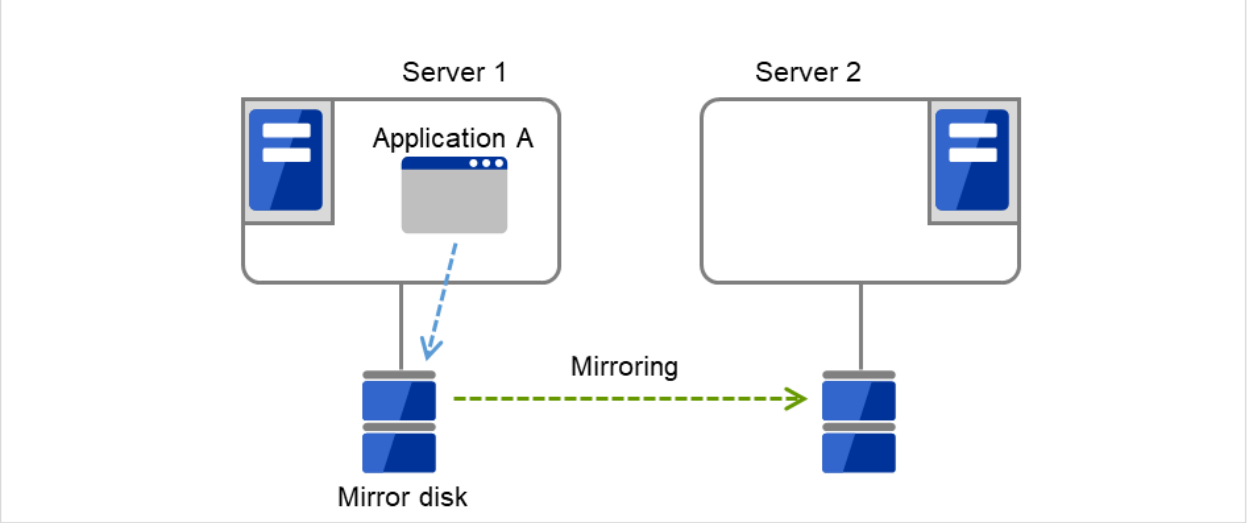


Fig. 3.9: Uni-directional standby cluster with mirror disks (1): in normal operation

2. Server 1 crashes due to some error.

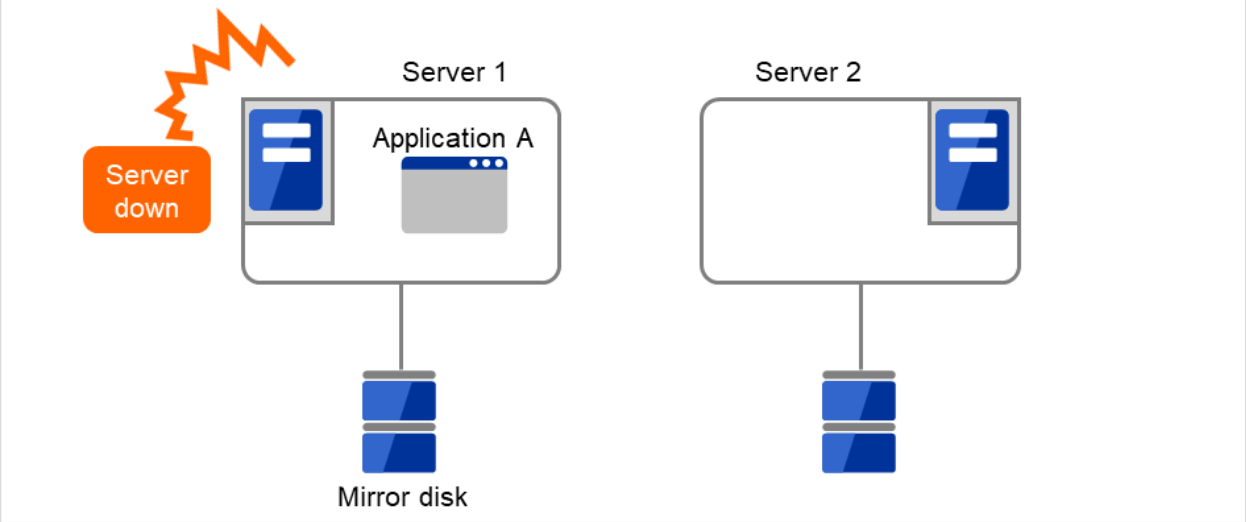


Fig. 3.10: Uni-directional standby cluster with mirror disks (2): when the server crashes

3. The application is failed over from Server 1 to Server 2.

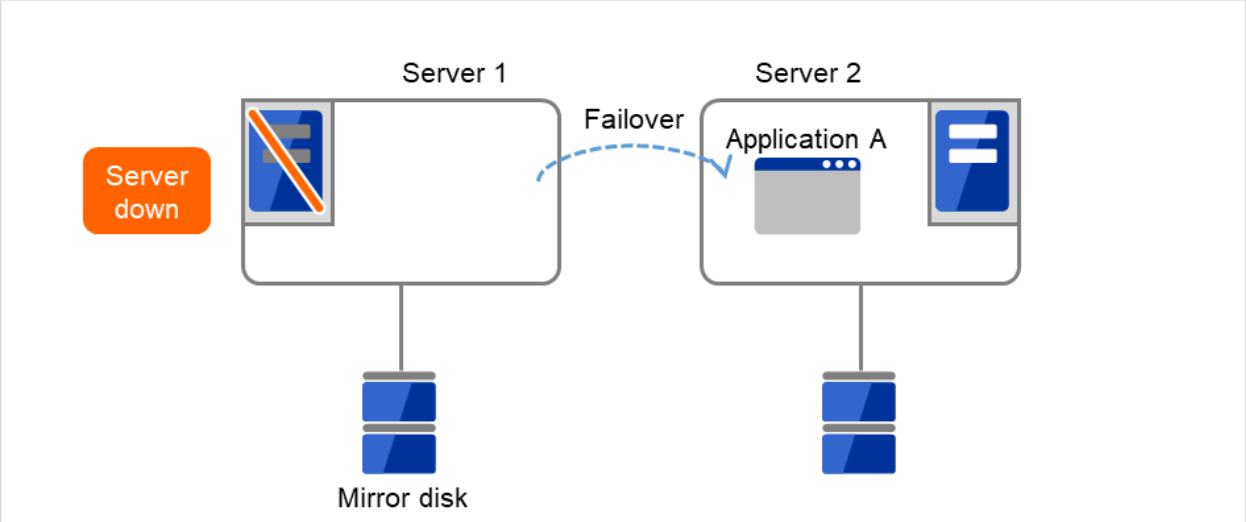


Fig. 3.11: Uni-directional standby cluster with mirror disks (3): during a failover

4. To resume the application, data is recovered from Server 2's mirror disk.

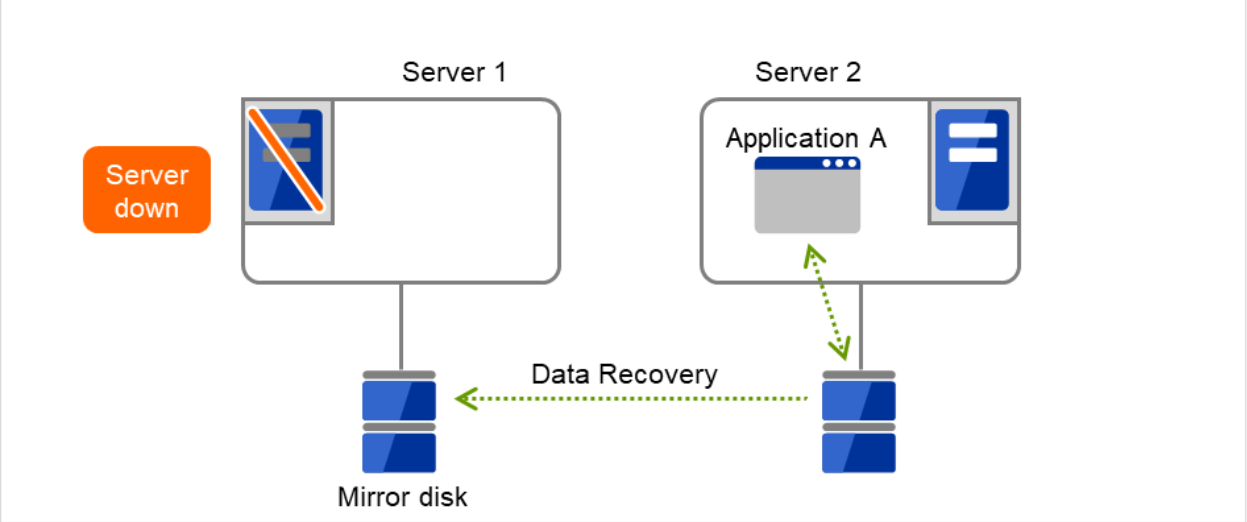


Fig. 3.12: Uni-directional standby cluster with mirror disks (4): during data recovery

5. After Server 1 is restored, a group transfer can be made for Application A to be returned from Server 2 to Server 1.

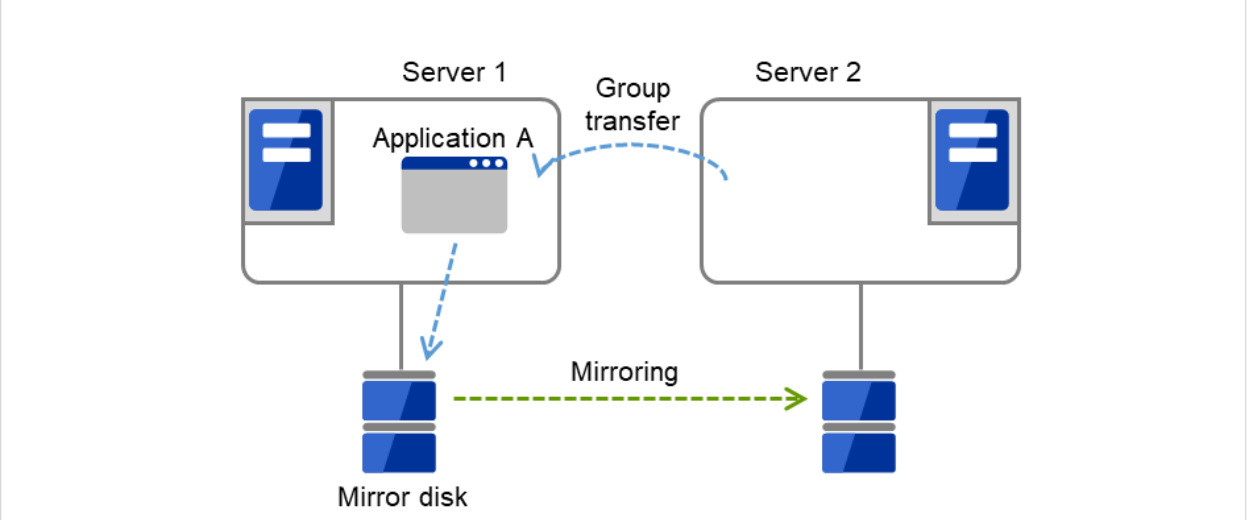


Fig. 3.13: Uni-directional standby cluster with mirror disks (5): After the server is restored

3.2.2 Failover in multi-directional standby cluster

On a multi-directional standby cluster system, an application can simultaneously run on multiple servers. However, an active server gets heavily loaded when a failover occurs as described in the diagram below:

When a shared disk is used

1. Server 1 runs Application A while Server 2 runs Application B.

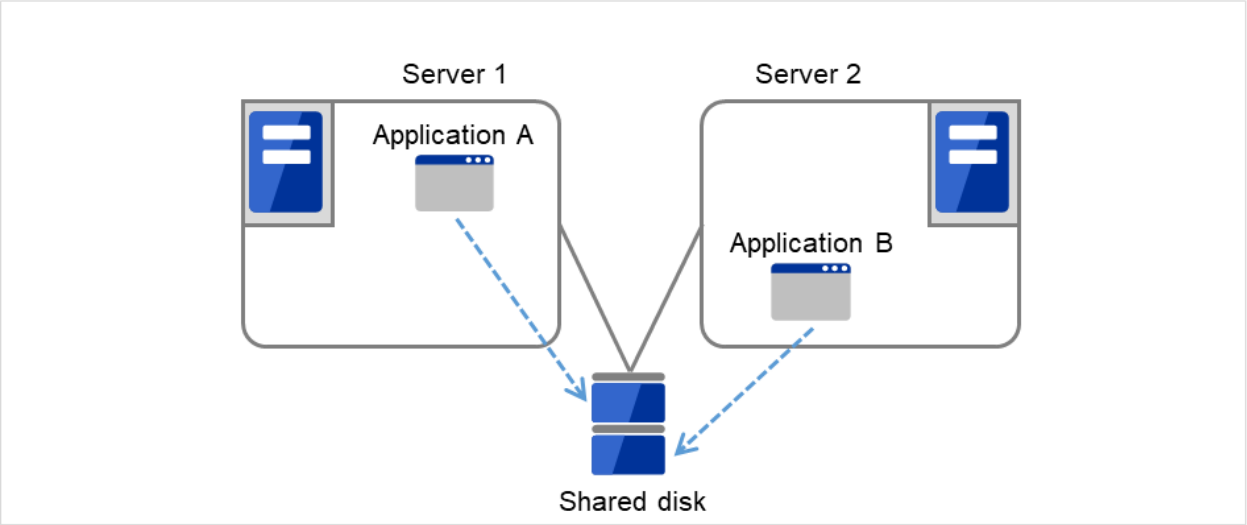


Fig. 3.14: Multi-directional standby cluster with a shared disk (1): in normal operation

2. Server 1 crashes due to some error.

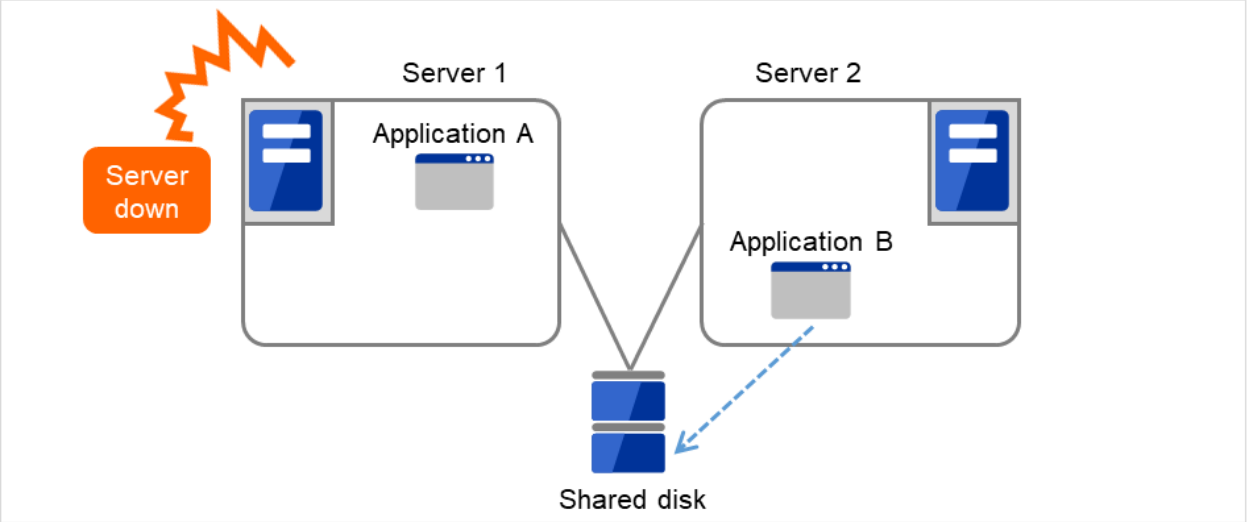


Fig. 3.15: Multi-directional standby cluster with a shared disk (2): when the server crashes

3. Application A is failed over from Server 1 to Server 2.

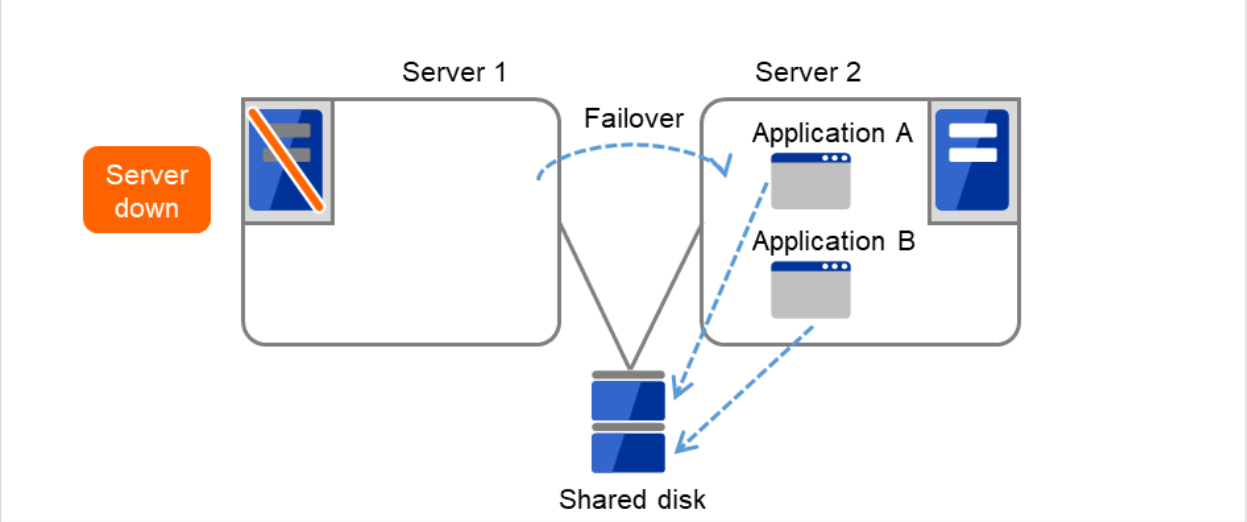


Fig. 3.16: Multi-directional standby cluster with a shared disk (3): during a failover

4. After Server 1 is restored, a group transfer can be made for Application A to be returned from Server 2 to Server 1.

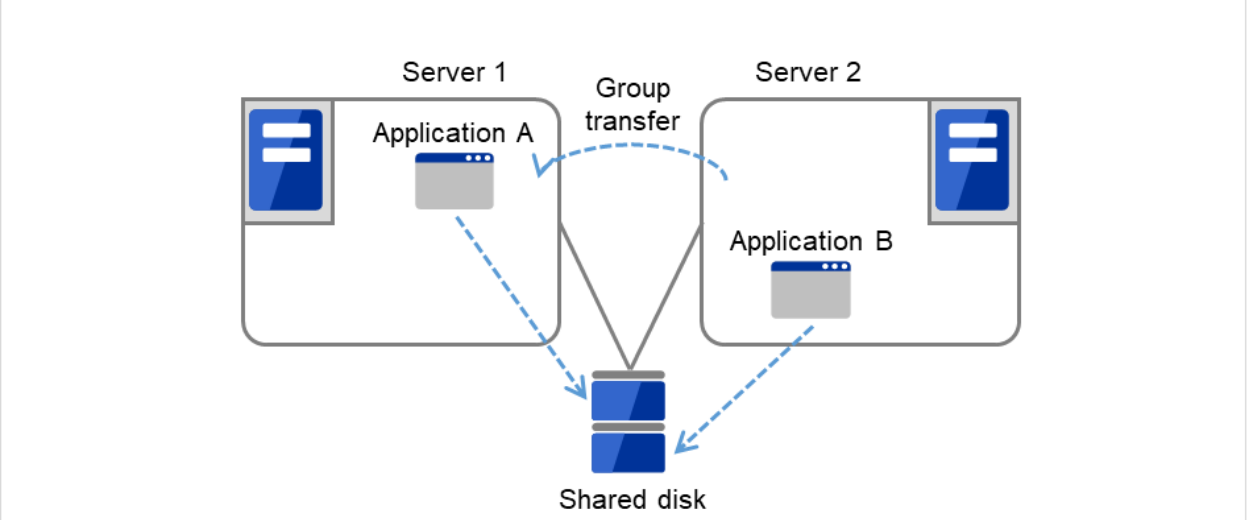


Fig. 3.17: Multi-directional standby cluster with a shared disk (4): after the server is restored

When mirror disks are used

1. Server 1 runs Application A while Server 2 runs Application B.

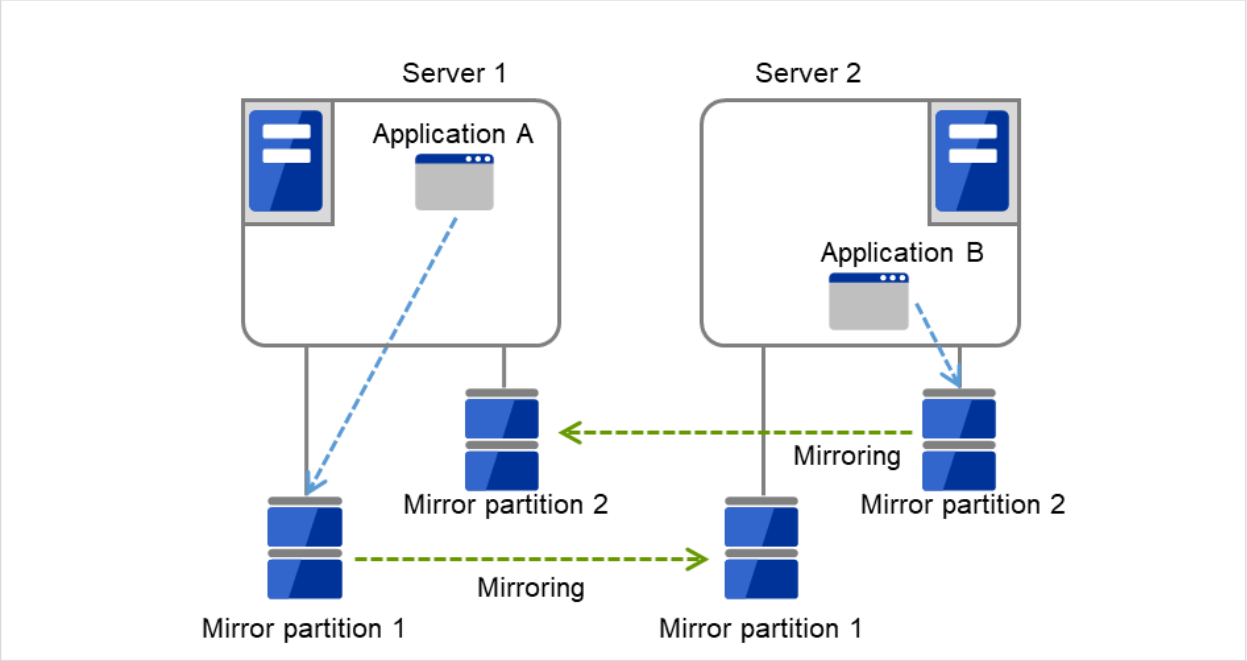


Fig. 3.18: Multi-directional standby cluster with mirror disks (1): in normal operation

2. Server 1 crashes due to some error.

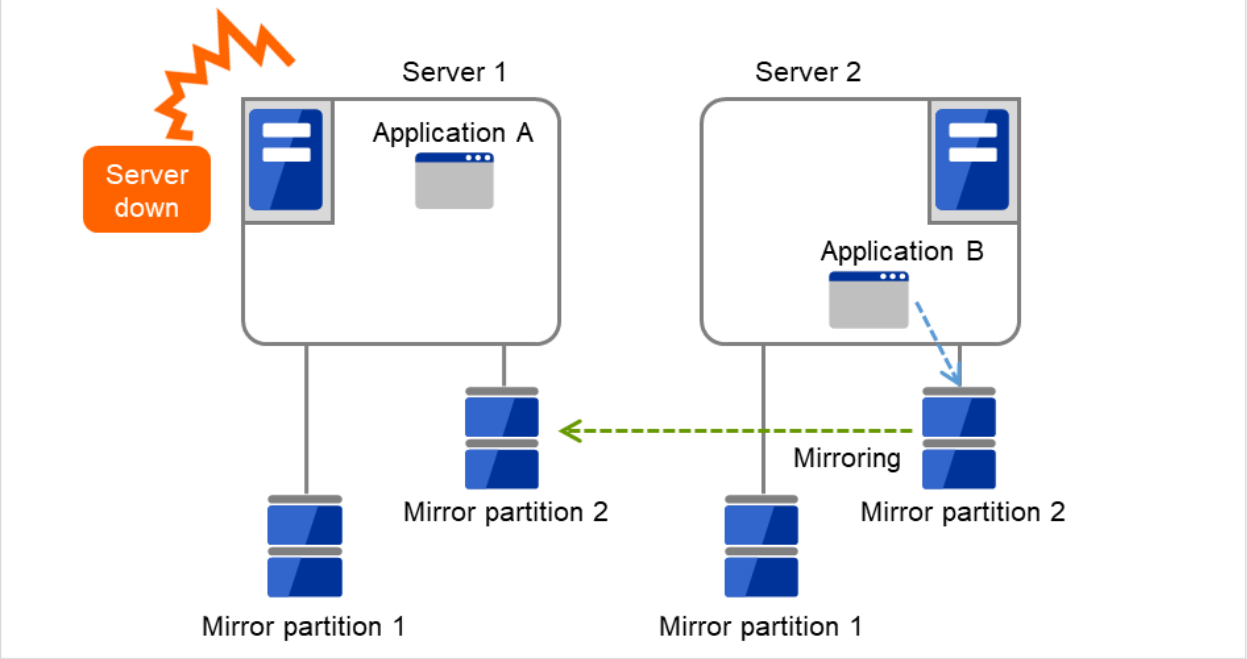


Fig. 3.19: Multi-directional standby cluster with mirror disks (2): when the server crashes

3. Application A is failed over from Server 1 to Server 2.

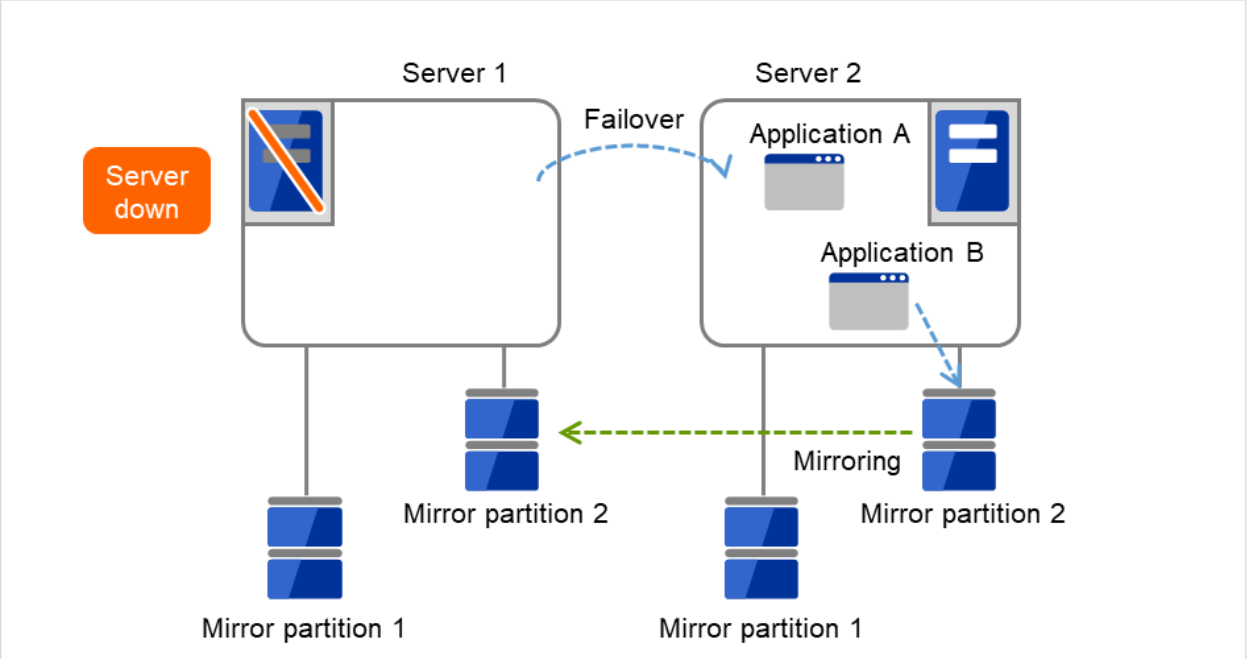


Fig. 3.20: Multi-directional standby cluster with mirror disks (3): during a failover

4. To resume Application A, data is recovered from Server 2's Mirror partition 1.

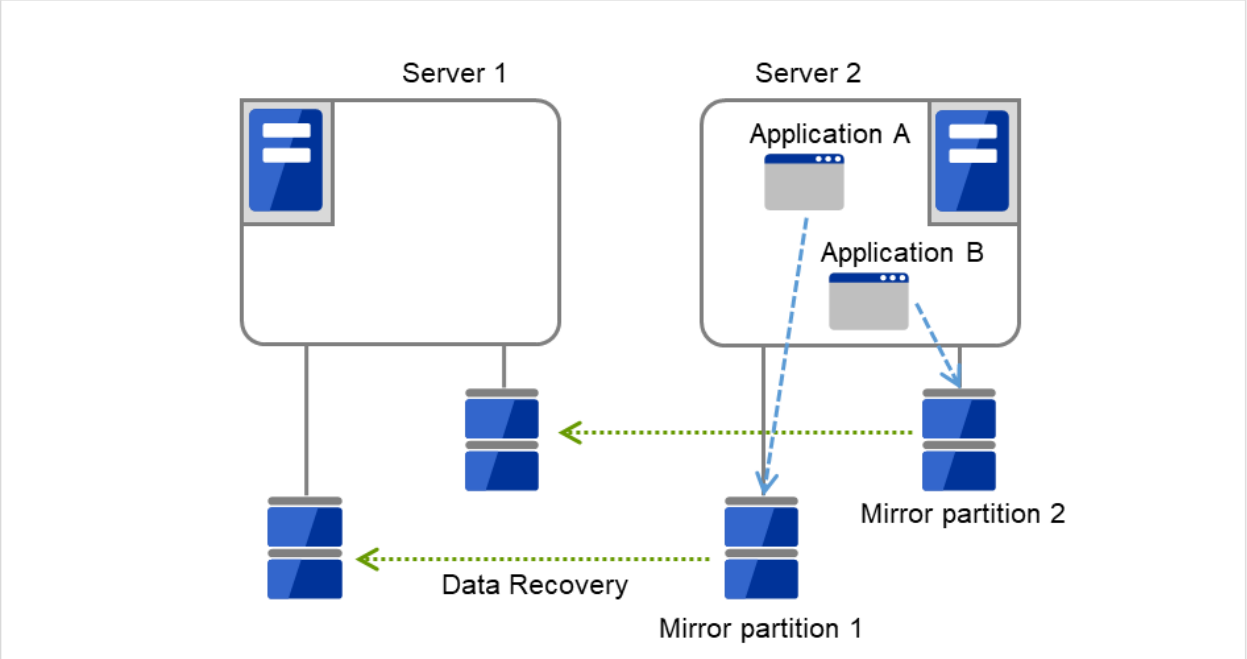


Fig. 3.21: Multi-directional standby cluster with mirror disks (4): during data recovery

5. After Server 1 is restored, a group transfer can be made for Application A to be returned from Server 2 to Server 1.

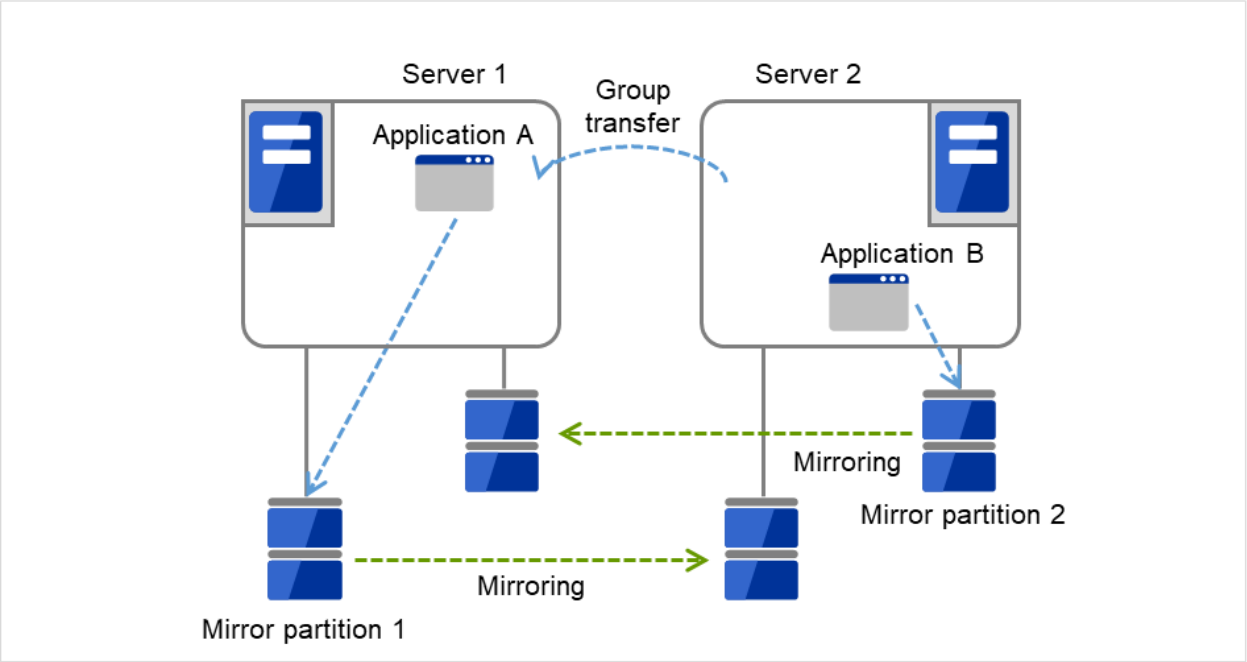


Fig. 3.22: Multi-directional standby cluster with mirror disks (5): after the server is restored

3.3 Determining applications to be duplicated

When you determine applications to be duplicated, study candidate applications considering the points described below to see whether they should be clustered in your EXPRESSCLUSTER cluster system.

3.3.1 Configuration relevant to the notes

What you need to consider differs depending on which standby cluster system is selected for an application. Following is the notes for each cluster system. The numbers correspond to the numbers of "3.3.2. *Server applications*" (1 through 5):

- Note for uni-directional standby [Active-Standby]: 1, 2, 3, and 5
- Note for multi-directional standby [Active-Active]: 1, 2, 3, 4, and 5
- Note for co-existing behaviors: 5
  (Applications co-exist and run. The cluster system does not fail over the applications.)

3.3.2 Server applications

Note 1: Data recovery after an error

If an application was updating a file when an error has occurred, the file update may not be completed when the standby server accesses to that file after the failover.

The same problem can happen on a non-clustered server (single server) if it goes down and then is rebooted. In principle, applications should be ready to handle this kind of errors. A cluster system should allow recovery from this kind of errors without human interventions (from a script).

EXPRESSCLUSTER executes fsck if the file system on a shared disk or mirror disk requires fsck.

Note 2: Application termination

When EXPRESSCLUSTER stops or transfers (performs online failback of) a group for application, it unmounts the file system used by the application group. Therefore, you have to issue an exit command for applications so that they stop accessing files on a shared disk or mirror disk.

Typically, you give an exit command to applications in their stop scripts; however, you have to pay attention if an exit command completes asynchronously with termination of the application.

Note 3: Location to store the data

EXPRESSCLUSTER can pass the following types of data between servers:

- Data on shared disk or mirror disks
  Application data should be divided into the data to be shared among servers and the data specific to the server, and these two types of data should be saved separately.

Data type	Example	Where to store
Data to be shared among servers	User data, etc.	On shared disk or mirror disks
Data specific to a server	Programs, configuration data	On server's local disks

Note 4: Multiple application service groups

For multi-directional standby operation, you have to assume (in case of degeneration due to a failure) that multiple application groups are run by the same application on a server.

Applications should have capabilities to take over the passed resources by one of the following methods described in the diagram below. A single server is responsible for running multiple application groups. The same is true for mirror disks:

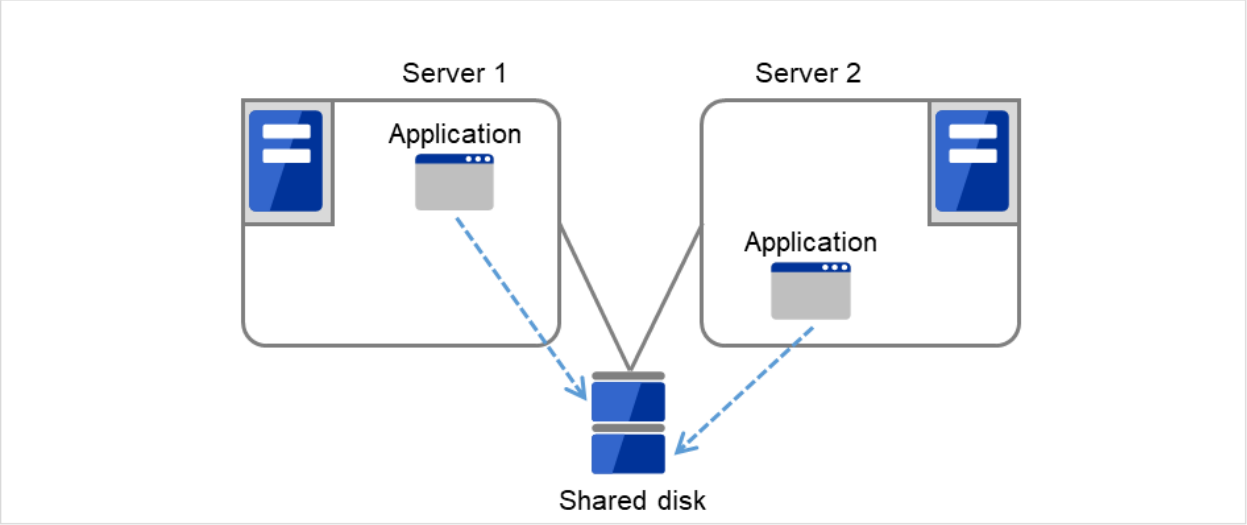


Fig. 3.23: Application running normally on each server in a multi-directional standby cluster

- **Starting up multiple instances**
  This method invokes a new process. More than one application should co-exist and run.

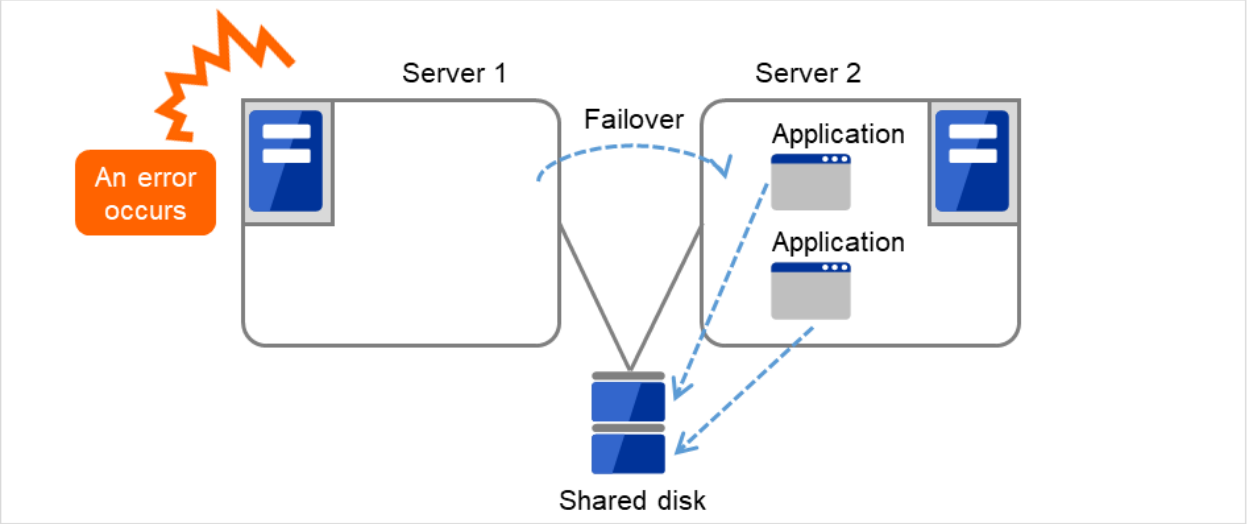


Fig. 3.24: Starting up multiple instances

- **Restarting the application**
  This method stops the application which was originally running. Added resources become available by restarting it.

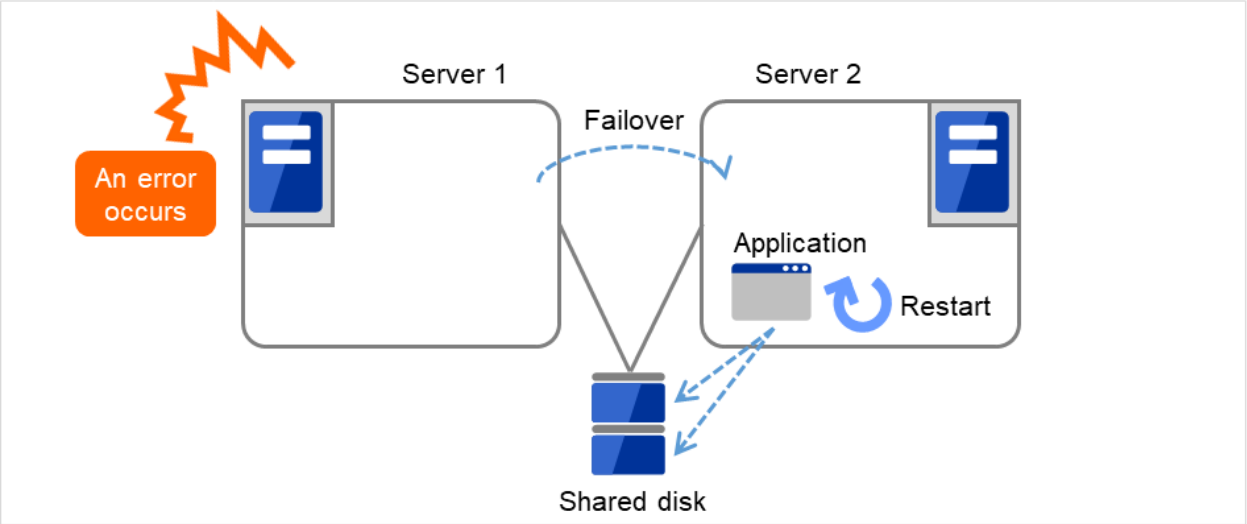


Fig. 3.25: Restarting the application

- **Adding dynamically**
  This method adds resources in running applications automatically or by instructions from script.

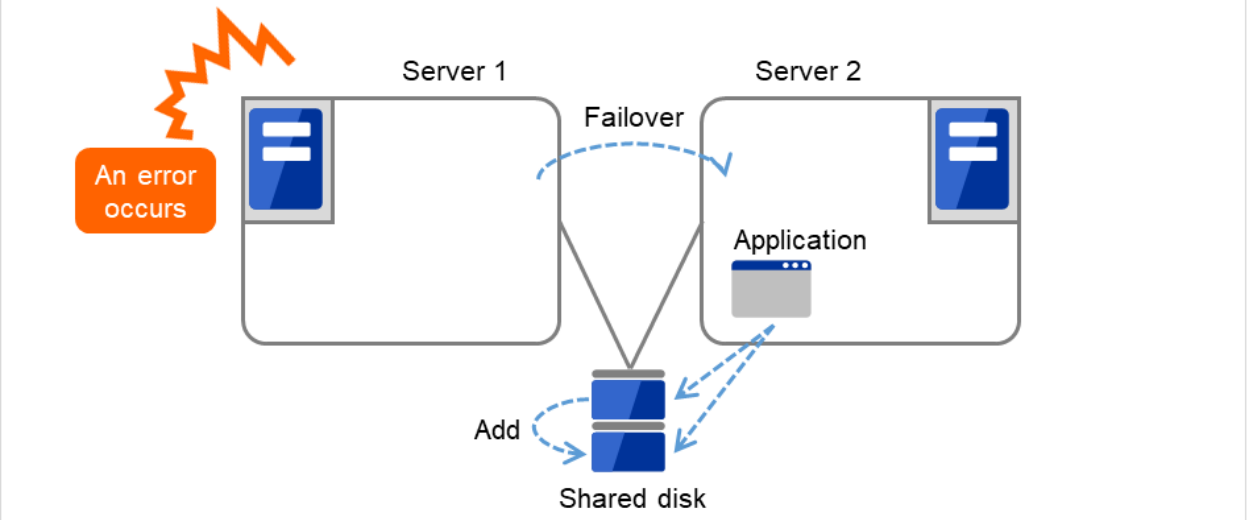


Fig. 3.26: Adding resources dynamically

Note 5: Mutual interference and compatibility with applications

Sometimes mutual interference between applications and EXPRESSCLUSTER functions or the operating system functions required to use EXPRESSCLUSTER functions prevents applications or EXPRESSCLUSTER from working properly.

- Access control of switching partitions and mirror partitions
  Inactive disk resources are not writable.
  Inactive mirror disk resources or hybrid disk resources are inaccessible.

Applications cannot access an inactive disk, mirror disk resource or hybrid disk resources (i.e. disk to which applications have no access right).

Generally, you can assume when an application that is started up by cluster script is started, the disk resource, mirror disk resource or hybrid disk resource to which it should access is already accessible.

- Multi-home environment and transfer of IP addresses
  In a cluster system, a server usually has multiple IP addresses, and an IP address (such as floating IP address) moves between servers.
- Access to shared disks or mirror disks from applications
  The stopping of application groups is not notified to co-existing applications. Therefore, if such an application is accessing a disk resource, mirror disk resource, or hybrid disk resource used by an application group at the time when the application group stops, unmount will fail.

Some applications like those responsible for system monitoring service periodically access all disk partitions. To use such applications in your cluster environment, they need a function that allows you to specify monitoring partitions.

3.3.3 Solution to the problems relevant to the notes

Problems	Solution	Note to refer
When an error occurs while updating a data file, the application does not work properly on the standby server.	Modify the program	Note 1: Data recovery after an error
The application keeps accessing a disk or file system for a certain period of time even after it is stopped.	Execute the sleep command during stop script execution.	Note 2: Application termination
The same application cannot be started more than once on one server.	In multi-directional operation, reboot the application at failover and pass the shared data.	Note 3: Location to store the data

3.3.4 How to determine a cluster topology

Carefully read this chapter and determine the cluster topology that suits your needs:

- When to start which application
- Actions that are required at startup and failover
- Data to be placed in disk resources, mirror disk resources or hybrid disk resources.

3.4 Planning a cluster configuration

A group is a set of resources required to perform an independent operation service in a cluster system. Failover takes place by the unit of group. A group has its group name, group resources, and attributes.

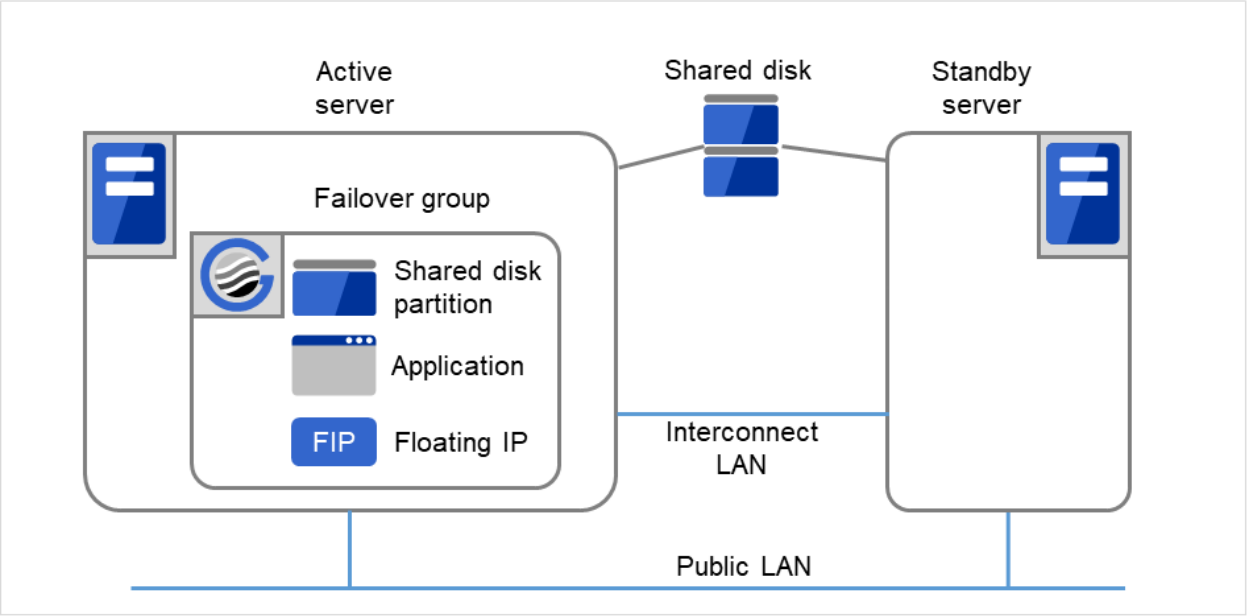


Fig. 3.27: Failover group and group resources

Resources in each group are handled by the unit of the group. If a failover occurs in group1 that has Disk resource1 and Floating IP resource1, a failover of Disk resource1 and a failover of Floating IP resource1 are concurrent (failover of disk resource 1 never takes place without that of Floating IP resource1). Likewise, Disk resources1 is never contained in other groups, such as group2.

3.5 Understanding group resources

For a failover to occur in a cluster system, a group that works as a unit of failover must be created. A group consists of group resources. In order to create an optimal cluster, you must understand what group resources to be added to the group you create, and have a clear vision of your operation.

See also:

For details on each resource, refer to the "Reference Guide".

3.6 Understanding monitor resources

Monitor resources monitor specified targets. If an error is detected in a target, a monitor resource restarts and/or fails over the group resources.
There are two types of timing for monitor resource monitoring: always monitor and monitor while activated.

Always monitors:
Monitoring is performed from when the cluster is started up until it is shut down.

Monitors while activated:
Monitoring is performed from when a group is activated until it is deactivated.

See also:

For the details of each resource, see "Monitor resource details" in the "Reference Guide".

3.7 Understanding heartbeat resources

Servers in a cluster system monitor if other servers in the cluster are active. For this, heartbeat resources are used. Following is the heartbeat device types:

1. LAN heartbeat/kernel mode LAN heartbeat (primary interconnect)

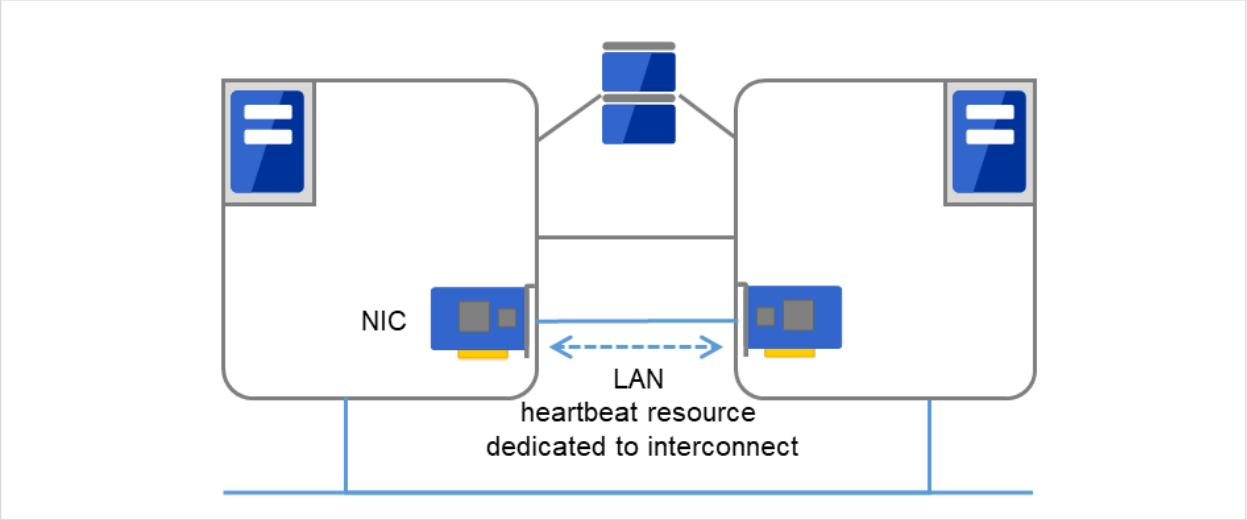


Fig. 3.28: LAN heartbeat/kernel mode LAN heartbeat (primary interconnect)

2. LAN heartbeat/kernel mode LAN heartbeat (secondary interconnect)

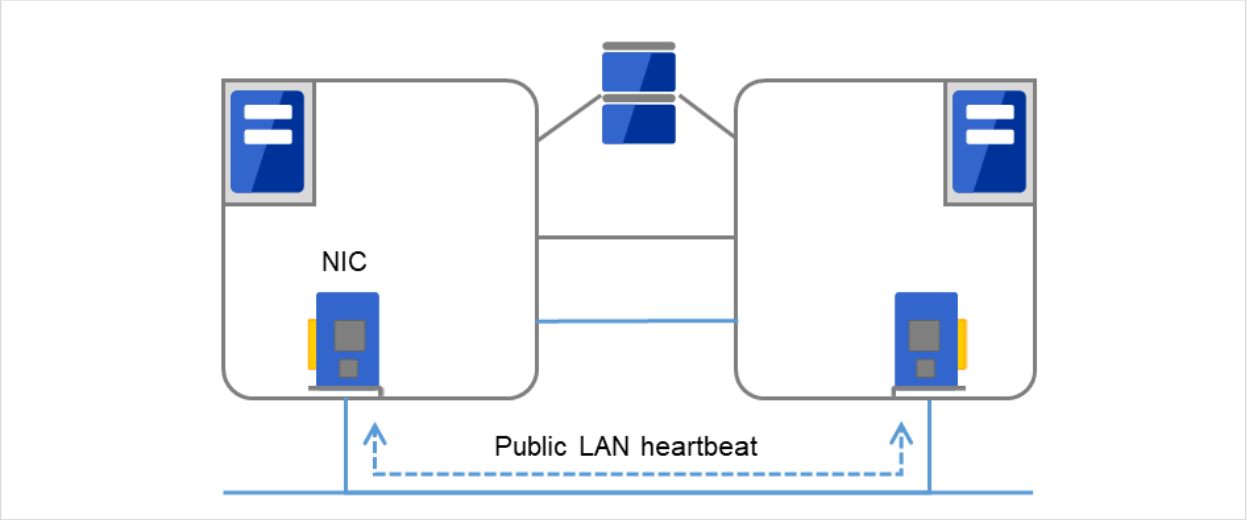


Fig. 3.29: LAN heartbeat/kernel mode LAN heartbeat (secondary interconnect)

3. Disk heartbeat

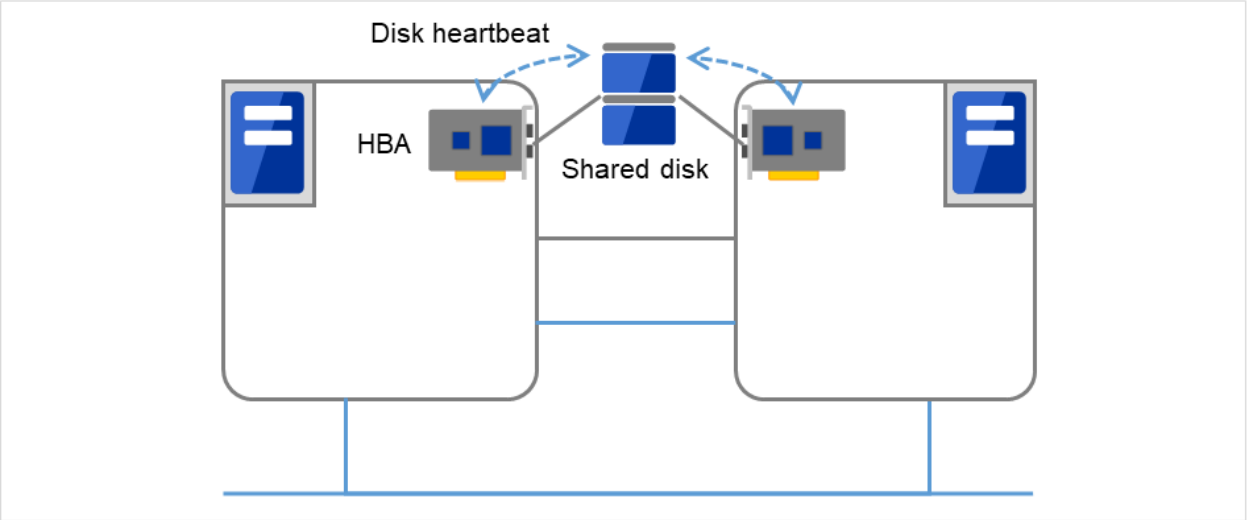


Fig. 3.30: Disk heartbeat

4. Witness heartbeat

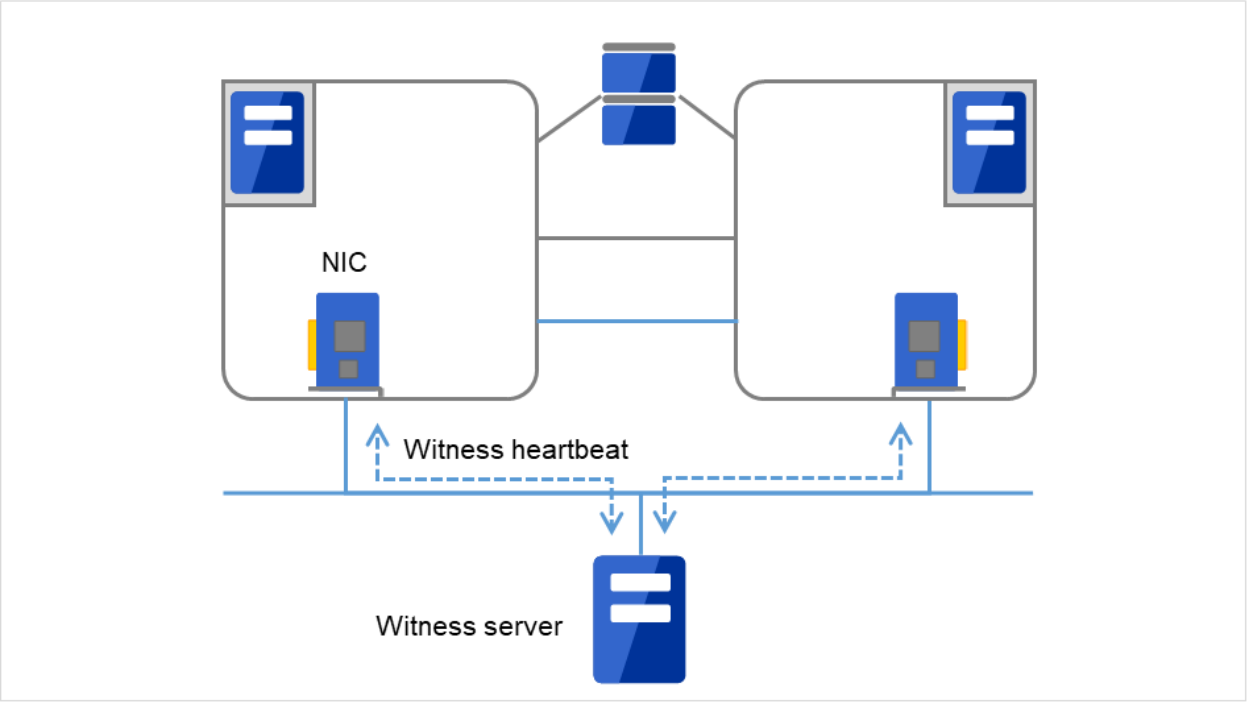


Fig. 3.31: Witness heartbeat

5. Object storage heartbeat

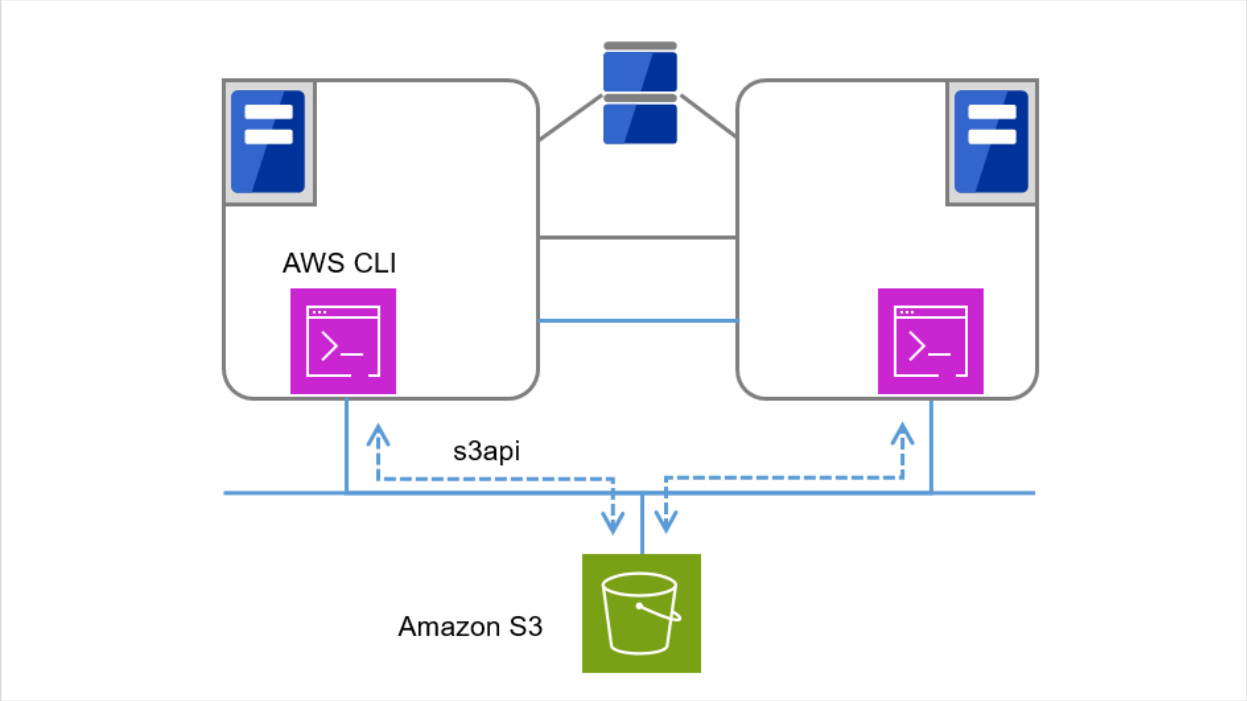


Fig. 3.32: Object storage heartbeat

Heartbeat Resource Name	Abbreviation	Functional Overview
LAN heartbeat resource (1)(2)	lanhb	Uses a LAN to monitor if servers are active. Used for communication within the cluster as well.
Kernel mode LAN heartbeat resource (1)(2)	lankhb	A kernel mode module uses a LAN to monitor if servers are active. Used for communication within the cluster as well.
Disk heartbeat resource (3)	diskhb	Uses a dedicated partition in the shared disk to monitor if servers are active.
Witness heartbeat resource (4)	witnesshb	Uses the Witness server to monitor whether servers are active.
Object storage heartbeat resource (5)	objhb	Uses object storage to monitor the availability of servers.

- For an interconnect with the highest priority, configure LAN heartbeat resources or kernel mode LAN heartbeat resources which can be exchanged between all servers.
- Configuring at least two kernel mode LAN heartbeat resources is recommended unless it is difficult to add a network to an environment such as the cloud or a remote cluster.

- It is recommended to register both an interconnect-dedicated LAN and a public LAN as LAN heartbeat resources.

3.8 Understanding network partition resolution resources

Network partitioning refers to the status where all communication channels have problems and the network between servers is partitioned.

In a cluster system that is not equipped with solutions for network partitioning, a failure on a communication channel cannot be distinguished from an error on a server. This can cause data corruption brought by access from multiple servers to the same resource. EXPRESSCLUSTER, on the other hand, distinguishes a failure on a server from network partitioning when the heartbeat from a server is lost. If the lack of heartbeat is determined to be caused by the server failure, the system performs a failover by activating each resource and rebooting applications on a server running normally. When the lack of heartbeat is determined to be caused by network partitioning, emergency shutdown is executed because protecting data has higher priority over continuity of the operation. Network partitions can be resolved by the following methods:

- **Ping method**
  - A device that is always active to receive and respond to the ping command (hereafter described as ping device) is required.
  - More than one ping device can be specified.
  - When the heartbeat from the other server is lost, but the ping device is responding to the ping command, it is determined that the server without heartbeat has failed and a failover takes place. If there is no response to the ping command, the local server is isolated from the network due to network partitioning, and emergency shutdown takes place. This will allow a server that can communicate with clients to continue operation even if network partitioning occurs.
  - When the status where no response returns from the ping command continues before the heartbeat is lost, which is caused by a failure in the ping device, the network partitions cannot be resolved. If the heartbeat is lost in this status, a failover takes place in all servers. Because of this, using this method in a cluster with a shared disk can cause data corruption due to access to a resource from multiple servers.
- **HTTP method**
  - A Web server that is always active is required.
  - When the heartbeat from the other server is lost, but there is a response to an HTTP HEAD request, it is determined that the server without heartbeat has failed and a failover takes place. If there is no response to an HTTP HEAD request, it is determined that the local server is isolated from the network due to network partitioning, and an emergency shutdown takes place. This will allow a server that can communicate with clients to continue operation even if network partitioning occurs.
  - When there remains no response to an HTTP HEAD request before the heartbeat is lost, which is caused by a failure in Web server, the network partitions cannot be resolved. If the heartbeat is lost in this status, emergency shutdowns occur in all the servers.
- **Not solving the network partition**
  - If a failure occurs on all the network channels between servers in a cluster, all the servers fail over.

The following are the recommended methods to resolve the network partition:

Method to resolve a network partition	Number of nodes	Required hardware	Circumstance where failover cannot be performed	When all network channels are disconnected	Circumstance where both servers fail over	Time required to resolve network partition
Ping	No limit	Device to receive the ping command and return a response	None	Server that responses to the ping command survives	All networks are disconnected after the ping command timeouts the specified times consecutively.	0
HTTP	No limit	Web server	Web server failure	A server that can communicate with the Web server survives	None	0
None	No limit	None	None	All servers fail over	All the networks are disconnected	0

CHAPTER

FOUR

INSTALLING EXPRESSCLUSTER

This chapter provides instructions for installing EXPRESSCLUSTER.
This chapter covers:

- 4.1. *Steps from Installing EXPRESSCLUSTER to creating a cluster*
- 4.2. *Setting up the EXPRESSCLUSTER Server*

See also:

Refer to "10.1. *How to upgrade EXPRESSCLUSTER*" to upgrade EXPRESSCLUSTER from a previous version.

4.1 Steps from Installing EXPRESSCLUSTER to creating a cluster

The following describes the steps of installing EXPRESSCLUSTER, registering the license, creating a cluster and verifying the installation.

Before proceeding to the steps, make sure to read "2. *Determining a system configuration*" and "3. *Configuring a cluster system*" and check system requirements and the configuration of a cluster.

1. Set up the EXPRESSCLUSTER Server
   Install the EXPRESSCLUSTER Server, which is the core EXPRESSCLUSTER module, to each server that constitutes a cluster.
   (See "4.2. *Setting up the EXPRESSCLUSTER Server*.") **Reboot the server**
2. Register the license
   Register the license by running the clplcnsc command.
   (See "5. *Registering the license*.") **Reboot the server**
3. Create the cluster configuration data using the Cluster WebUI
   Create the cluster configuration data using the Cluster WebUI.
   (See "6. *Creating the cluster configuration data*.")
4. Create a cluster
   Create a cluster using the configuration data created with the Cluster WebUI.
   (See "6. *Creating the cluster configuration data*.")
5. Verify the cluster status using the Cluster WebUI
   Verify the status of a cluster that you have created using the Cluster WebUI
   (See "7. *Verifying a cluster system*.")

See also:

Refer to the "Reference Guide" as you need when operating EXPRESSCLUSTER by following the procedures introduced in this guide. See the "Getting Started Guide" for installation requirements.

4.2 Setting up the EXPRESSCLUSTER Server

The EXPRESSCLUSTER Server, which is the core component of EXPRESSCLUSTER, consists of the following system services. It is set up by installing the EXPRESSCLUSTER Server RPM/deb package.

System Service Name	Description
clusterpro	EXPRESSCLUSTER daemon: A service of EXPRESSCLUSTER itself.
clusterpro_evt	EXPRESSCLUSTER event: A service to control syslog and logs being output from EXPRESSCLUSTER.
clusterpro_nm	EXPRESSCLUSTER Node Manager: A service to control heartbeat resources and network partition resolution resources of EXPRESSCLUSTER.
clusterpro_trn	EXPRESSCLUSTER data transfer: A service to control license synchronization and configuration data transfer in a cluster.
clusterpro_ib	EXPRESSCLUSTER Information Base: A service to manage EXPRESSCLUSTER information.
clusterpro_api	EXPRESSCLUSTER API: A service to control the EXPRESSCLUSTER RESTful API.
clusterpro_md	EXPRESSCLUSTER mirror agent A service to control mirror disk resource, hybrid disk resource and mirror driver of EXPRESSCLUSTER.
clusterpro_alertsync	EXPRESSCLUSTER alert synchronization: A service to synchronize alerts among servers in the cluster.

continues on next page

Table 4.1 – continued from previous page

System Service Name	Description
clusterpro_webmgr	EXPRESSCLUSTER WebManager: A WebManager server service.
clusterpro_dbridge	EXPRESSCLUSTER Data Bridge: Connector to an external service currently available in Japan only

4.2.1 Installing the EXPRESSCLUSTER RPM

Install the EXPRESSCLUSTER Server RPM on all servers that constitute the cluster by following the procedures below.

Note:

- Log in as root user when installing the EXPRESSCLUSTER Server RPM.
- The EXPRESSCLUSTER X installation media may not include an rpm package that supports newer kernel versions. Refer to "Supported distributions and kernel versions" - "Installation requirements for EXPRESSCLUSTER" in the "Getting Started Guide", check the kernel version used in your operating environment, and then apply an update that matches the versions listed in "EXPRESSCLUSTER Version".

1. Mount the installation media.
2. Run the rpm command to install the package file.
   The installation RPM varies depending on the products.
   Navigate to the folder, /Linux/6.0/en/server, in the installation media and run the following:

   `rpm -i expresscls-<version>.<architecture>.rpm [--prefix <Install Path>]`

   There are x86_64 and ARM64 for architecture. Select one of them according to the environment where the server RPM is installed. Verify the architecture by running the arch command.
   The installation starts.

   Note:

   If you omit the `--prefix` option, EXPRESSCLUSTER will be installed in the following directory:
   Installation Directory: `/opt/nec/clusterpro`
   This directory must remain unchanged and not be a symbolic link.

   Note:

   If you use the `--prefix` option with an *installation path* specified, EXPRESSCLUSTER will be installed in the following directory:

Installation directory: <specified installation path>/nec/clusterpro
This directory must remain unchanged and not be a symbolic link.

Note:

The following lists what to pay attention to in specifying an *installation path* of the `--prefix` option:

- Set an *installation path* to an empty directory or a nonexistent path.
- Define the *installation path* with its length up to 32 bytes and with no multibyte (e.g., Japanese) or blank characters included.
- For an upgrade by executing the `rpm -U` command, specify the same *installation path* as that defined for the installation.

3. When the installation is completed, unmount the installation media.
4. Remove the installation media.

See also:

To use EXPRESSCLUSTER with SELinux enabled, execute the clpselctrl.sh command.
For more information, see "4.2.3. *Setting for SELinux*".

See also:

The use of the SNMP linkage function requires additional settings.
For how to set up the SNMP linkage function, see "4.2.4. *Setting up the SNMP linkage function*".

4.2.2 Installing the EXPRESSCLUSTER deb package

Install the EXPRESSCLUSTER Server deb package on all servers that constitute the cluster by following the procedures below.

Note: Log in as the root user when installing the EXPRESSCLUSTER Server deb package.

1. Mount the installation media.
2. Run the dpkg command to install the package file.
   The installation deb package varies depending on the product.
   Navigate to the folder, /Linux/6.0/en/server, in the installation media and run the following:

   `dpkg -i expresscls-<version>.amd64.deb`

   The installation starts.

Note:

EXPRESSCLUSTER will be installed in the following directory. Do not change this directory. Do not replace this directory with a symbolic link.
Installation Directory: `/opt/nec/clusterpro`
For the deb package, you cannot specify an installation path.

3. When the installation is completed, unmount the installation media.
4. Remove the installation media.
   Proceed to a license registration procedure.

See also:

The use of the SNMP linkage function requires additional settings.
For how to set up the SNMP linkage function, see "4.2.4. *Setting up the SNMP linkage function*".

4.2.3 Setting for SELinux

To use EXPRESSCLUSTER with SELinux enabled: Immediately after installing EXPRESSCLUSTER, execute the clpselctrl.sh command as below.
To enable SELinux after installing EXPRESSCLUSTER: Before enabling SELinux, execute the clpselctrl.sh command as below.

```
clpselctrl.sh --add
```

Note:

The clpselctrl.sh command requires the semanage command and the restorecon command.
If these two commands are not installed, install them beforehand.

```
dnf -y install policycoreutils-python-utils
```

Note: To check if SELinux is enabled or disabled, use the getenforce command.

```
getenforce
```

One of the following words appears, each of which means:

- Enforcing : Enabled (SELinux security policy is enforced.)
- Permissive : SELinux prints warnings instead of enforcing.
- Disabled : Disabled (No SELinux policy is loaded.)

Note: For more information on the clpselctrl.sh command, see "Reference Guide" -> "EXPRESSCLUSTER command reference" -> "Setting for SELinux (clpselctrl.sh command)".

4.2.4 Setting up the SNMP linkage function

Note: If you are using only the SNMP trap transmission function, you do not need to perform this procedure.

To handle information acquisition requests on SNMP, Net-SNMP must be installed separately and the SNMP linkage function must be registered separately.
Follow the procedure below to set up the SNMP linkage function.

Note:

- To set up the SNMP linkage function, you must log in as the root user.
- The description related to Net-SNMP in the installation procedure may vary depending on the distribution.

1. Install Net-SNMP.
2. Check the snmpd version.
   Run the following command:

```
snmpd -v
```

3. Stop the snmpd daemon.

   Note: The daemon can usually be stopped by the following command:

   - For an init.d environment:

```
/etc/init.d/snmpd stop
```

   - For a systemd environment:

```
systemctl stop snmpd
```

4. Register the SNMP linkage function of EXPRESSCLUSTER in the configuration file for the snmpd daemon.
   Open the configuration file with a text editor.
   Add the following description to the end of the file according to the snmpd version.

   If the snmpd version is earlier than 5.7:

```
dlmod clusterManagementMIB /opt/nec/clusterpro/lib/libclpmgtmib.so
```

   If the snmpd version is 5.7 or later:

```
dlmod clusterManagementMIB /opt/nec/clusterpro/lib/libclpmgtmib2.so
```

   Note:

   - The configuration file for the Net-SNMP snmpd daemon is usually located in the following directory:

```
/etc/snmp/snmpd.conf
```

- Add the OID of EXPRESSCLUSTER in the MIB view (view definition by snmpd.conf) permitted by the snmpd daemon.
  The OID of EXPRESSCLUSTER is .1.3.6.1.4.1.119.2.3.207.

5. Create symbolic links to libraries needed by the SNMP linkage function.
   The following three symbolic links are needed.

```
libnetsnmp.so
libnetsnmpagent.so
libnetsnmphelpers.so
```

Follow the procedure below to create the symbolic links.

5-1. Confirm the presence of the symbolic links.
Change to following directory.
If those symbolic links exist in the following directory, proceed to step 6.

```
/usr/lib64
```

5-2. Create symbolic links
Run the following commands.

```
ln -s libnetsnmp.so.X libnetsnmp.so
ln -s libnetsnmpagent.so.X libnetsnmpagent.so
ln -s libnetsnmphelpers.so.X libnetsnmphelpers.so
```

Substitute a numeric value for *X* according to the environment.

6. Start the snmpd daemon.

Note: The daemon can usually be started by the following command:

- For an init.d environment:

```
/etc/init.d/snmpd start
```

- For a systemd environment:

```
systemctl start snmpd
```

See also:

You must cancel the settings of the SNMP function when uninstalling the EXPRESSCLUSTER Server. For how to cancel the settings of the SNMP linkage function, see "Canceling the SNMP linkage function settings."

Note: The settings required for SNMP communication are to be made on the SNMP agent.

CHAPTER

FIVE

REGISTERING THE LICENSE

To run EXPRESSCLUSTER as a cluster system, you need to register the license. This chapter describes how to register an EXPRESSCLUSTER license.
This chapter covers:

- 5.1. *Registering the CPU license*
- 5.2. *Registering the VM node license*
- 5.3. *Registering the node license*
- 5.4. *Registering the fixed term license*

5.1 Registering the CPU license

It is required to register the CPU license to run the cluster system you create.

See also:

When the virtual server exists in the cluster system to be constructed, VM node license can be used not CPU license for the virtual server.
For the details about registration of VM node license, see "5.2. *Registering the VM node license*".

The names of the products to which the CPU license applies are listed below.

Licensed Product Name
EXPRESSCLUSTER X 6.0 for Linux
EXPRESSCLUSTER X SingleServerSafe 6.0 for Linux
EXPRESSCLUSTER X SingleServerSafe for Linux Upgrade

Among servers that constitute the cluster, use the master server to register the CPU license. There are two ways of license registration; using the information on the license sheet and specifying the license file. These two ways are described for both the product and trial versions.

Product version

- Specify the license file as the parameter of the license management command. Refer to "5.1.2. *Registering the license by specifying the license file (for both product version and trial version)*".
- Register the license by running the license management command and interactively entering the license information that comes with the licensed product. Refer to "5.1.3. *Registering the license interactively from the command line (Product version)*".

Trial version

- Specify the license file as the parameter of the license management command. Refer to "5.1.2. *Registering the license by specifying the license file (for both product version and trial version)*".

5.1.1 Notes on the CPU license

Notes on using the CPU license are as follows:

- After registration of the CPU license on the master server, Cluster WebUI on the master server must be used in order to edit and reflect the cluster configuration data as described in "6. *Creating the cluster configuration data*".

5.1.2 Registering the license by specifying the license file (for both product version and trial version)

The following describes how to register the license by specifying the license file when you have a license for the product version or trial version.

Check the following before executing these steps.

- Allow logon as root user to the server that will be set as a master server among servers that configures a cluster system.
- Store the license file in the server that will be set as a master server among servers that constitute the cluster system.

1. Log on to the master server as root user and run the following command.

   ```
   # clplcnsc -i <filepath>
   ```

   Specify the path to the license file for *filepath* specified by the -i option.
   When the command is successfully executed, the message "License registration succeeded." is displayed in the console. When a message other than this is displayed, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

2. Run the following command to verify the licenses registered.

   ```
   # clplcnsc -l -a
   ```

3. When an optional product is used, refer to "5.3. *Registering the node license*" in this chapter.
4. When an optional product is not used, run the OS shutdown command to reboot all servers. By doing this, the license registration becomes effective and you can start using the cluster.
   After rebooting all servers, proceed to "6. *Creating the cluster configuration data*" and follow the steps.

Note: You can ignore that clusterpro_md fails at the time the operating system is started up. It is because the cluster is yet to be created.

5.1.3 Registering the license interactively from the command line (Product version)

The following describes how you register a license for the product version interactively from the command line.

Before you register the license, make sure to:

- Have the official license sheet that comes with the product. The license sheet is sent to you when you purchase the product. You will enter the values on the license sheet.
- Allow logon as root user to the server that will be set as a mater server among servers that constitute the cluster system.

See also:

The clplcnsc command is used in the following procedures. For more information on how to use the clplcnsc command, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

1. Have the license sheet.
   The instruction here is given using the values in the following license sheet as an example. When actually entering the values, modify them according to the information on your license sheet.

```
Product name: EXPRESSCLUSTER X 6.0 for Linux
License information:
Type Product Version
License Key A1234567-B1234567-C1234567-D1234567
Serial Number AAAAAAAA000000
Number Of Licensed CPUs 2
```

2. Log on to the master server as root user and run the following command.

   ```
   # clplcnsc -i
   ```

3. The text that prompts you to enter the product division is displayed. Enter **1 to select "product version" for license version**:

   ```
   Selection of License Version.
     1 Product version
     2 Trial version
     e Exit
   Select License Version. [1, 2, or e (default:1)]...1
   ```

4. The text that prompts you to enter the serial number is displayed. Enter the serial number written in your license sheet. Note this is case sensitive.

   ```
   Enter serial number [Ex. XXXXXXXX000000]... AAAAAAAA000000
   ```

5. The text that prompts you to enter the license key is displayed. Enter the license key written in your license sheet. Note this is case sensitive.

   ```
   Enter license key
     [XXXXXXXX- XXXXXXXX- XXXXXXXX- XXXXXXXX]...
   A1234567-B1234567-C1234567-D1234567
   ```

   When the command is successfully executed, the message "License registration succeeded." is displayed in the console. When a message other than this is displayed, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

6. Run the following command to verify the licenses registered.

   ```
   # clplcnsc -l -a
   ```

7. When an optional product is used, refer to "5.3. *Registering the node license*" in this chapter.

8. When an optional product is not used, run the OS shutdown command to reboot all servers. By doing this, the license registration becomes effective and you can start using the cluster. After rebooting all servers, proceed to "6. *Creating the cluster configuration data*" and follow the steps.

Note: You can ignore that clusterpro_md fails at the time the operating system is started up. It is because the cluster yet to be created.

5.2 Registering the VM node license

When the virtual server exists in the cluster system to be constructed, VM node license can be used not CPU license for the virtual server.

The names of the products to which the VM node license applies are listed below.

License Product Name
EXPRESSCLUSTER X 6.0 for Linux VM
EXPRESSCLUSTER X SingleServerSafe 6.0 for Linux VM
EXPRESSCLUSTER X SingleServerSafe for Linux VM Upgrade

Registering the VM node license is done on all the virtual servers of the servers constructing the cluster. Of servers constituting the cluster, register the VM node license on all the virtual servers. There are two ways of license registration; using the information on the license sheet and specifying the license file.

Product version

- Specify the license file as the parameter of the license management command. Refer to "5.2.1. *Registering the VM node license by specifying the license file (for both product and trial versions)*".
- Register the license by running the license management command and interactively entering the license information that comes with the licensed product. Refer to "5.2.2. *Registering the VM node license interactively from the command line (Product version)*".

Trial version

- Specify the license file as a parameter of the license management command, and register the license with the command. Refer to "5.2.1. *Registering the VM node license by specifying the license file (for both product and trial versions)*".

5.2.1 Registering the VM node license by specifying the license file (for both product and trial versions)

The following describes how you register the license by specifying the license file when you have a license for the product version.
Before you register the license, make sure to:

- Be allowed to logon as root user to the virtual servers of servers constituting the cluster system.

1. Among virtual servers of which you intend to construct a cluster, log on to the server as root user and run the following command.

   ```
   # clplcnsc -i filepath
   ```

   Specify the path to the license file for *filepath* specified by the -i option.

   When the command is successfully executed, the message "License registration succeeded." is displayed on the console. When a message other than this is displayed, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

2. Run the following command to verify the licenses registered.

   ```
   # clplcnsc -l -a
   ```

3. If there are other virtual servers in a cluster system, register the VM node license by following the same procedures.

4. When using option products, see "5.3. *Registering the node license*".
5. When not using option products, run the OS shutdown command to reboot all the servers. By doing this, the license registration becomes effective and you can start using the cluster.
   After rebooting all servers, proceed to "6. *Creating the cluster configuration data*" and follow the steps.

Note: You can ignore that clusterpro_md fails at the time the operating system is starting up. It is because the cluster is yet to be created.

5.2.2 Registering the VM node license interactively from the command line (Product version)

The following describes how you register the license for the product version interactively from the command line.
Before you register the license, make sure to:

- Have the official license sheet that comes with the product. The license sheet is sent to you when you purchase the product. You will enter the values on the license sheet.
- Be allowed to logon as root user to the virtual servers of servers constituting the cluster system.

See also:

The clplcnsc command is used in the following procedures. For more information on how to use the clplcnsc command, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

1. Have the license sheet.
   The instruction here is given using the values in the following license sheet as an example. When actually entering the values, modify them according to the information on your license sheet.

   ```
   Product name: EXPRESSCLUSTER X 6.0 for Linux VM
   License information:
   Type Product Version
   License Key A1234567- B1234567- C1234567- D1234567
   Serial Number AAAAAAAA000000
   Number Of Licensed Server 1
   ```

2. Among virtual servers of which you intend to construct a cluster, log on to the server as root user and run the following command.

   ```
   # clplcnsc -i
   ```

3. The text that prompts you to enter the license version is displayed. Enter **1** because it is a product version:

   ```
   Selection of License Version.
     1 Product version
     2 Trial version
     e Exit
   Select License Version. [1, 2, or e (default:1)]...1
   ```

4. The text that prompts you to enter the serial number is displayed. Enter the serial number written in your license sheet. Note this is case sensitive.

- Enter serial number [Ex. XXXXXXXX000000]... **AAAAAAAA000000**

5. The text that prompts you to enter the license key is displayed. Enter the license key written in your license sheet. Note this is case sensitive.

```
Enter serial number [Ex. XXXXXXXX000000]... AAAAAAAA000000
```

A1234567-B1234567-C1234567-D1234567

When the command is successfully executed, the message "License registration succeeded." is displayed on the console. When a message other than this is displayed, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

6. Run the following command to verify the licenses registered.

   ```
   # clplcnsc -l -a
   ```

7. If there is any other virtual server in the cluster, register the VM license by repeating the same steps.
8. When using option products, see "5.3. *Registering the node license*".
9. When not using option products, run the OS shutdown command to reboot all the servers.
   After rebooting all servers, proceed to "6. *Creating the cluster configuration data*" and follow the steps.

Note: You can ignore that clusterpro_md fails at the time the operating system is starting up. It is because the cluster is yet to be created.

5.3 Registering the node license

It is required to register the node license for the X 6.0 Replicator, X 6.0 Replicator DR, X 6.0 Agent products, and X 6.0 Alert Service (hereafter referred to as "optional product") to operate the cluster system where those products are constituted.

The names of the optional products to which the node license applies are listed below.

License Product Name
EXPRESSCLUSTER X Replicator 6.0 for Linux
EXPRESSCLUSTER X Database Agent 6.0 for Linux
EXPRESSCLUSTER X Internet Server Agent 6.0 for Linux
EXPRESSCLUSTER X File Server Agent 6.0 for Linux
EXPRESSCLUSTER X Application Server Agent 6.0 for Linux
EXPRESSCLUSTER X Java Resource Agent 6.0 for Linux
EXPRESSCLUSTER X System Resource Agent 6.0 for Linux
EXPRESSCLUSTER X Alert Service 6.0 for Linux
EXPRESSCLUSTER X Replicator DR 6.0 for Linux
EXPRESSCLUSTER X Replicator DR 6.0 for Linux Upgrade license

Among servers constituting the cluster, register the node license on the server that uses an optional product. There are two ways of license registration; using the information on the license sheet and specifying the license file. These two ways are described for both the product and trial versions.

Product version

- Specify the license file as a parameter of the license management command, and register the license with the command. Refer to "5.3.1. *Registering the node license by specifying the license file (for both product version and trial version)*".
- Register the license by running the license management command and interactively entering the license information that comes with the licensed product. Refer to "5.3.2. *Registering the node license interactively from the command line (Product version)*".

Trial version

- Specify the license file as the parameter of the license management command. Refer to "5.3.1. *Registering the node license by specifying the license file (for both product version and trial version)*"

5.3.1 Registering the node license by specifying the license file (for both product version and trial version)

The following describes how you register the license by specifying the license file when you have a license for the product version or trial version.
Before you register the license, make sure to:

- Allow logon as root user to the server for which you plan to use the option product among servers constituting the cluster system.

1. Among servers of which you intend to construct a cluster and use the optional product, log on to the server you plan to use as a master server as root user and run the following command.

   ```
   # clplcnsc -i filepath
   ```

Specify the path to the license file for **filepath** *specified by the -i option.*

Note:

If the licenses for optional products have not been installed, the resources and monitor resources corresponding to those licenses are not shown in the list on the Cluster WebUI

If the licenses are registered but the corresponding resources do not appear in the list, or if the licenses are registered after the Cluster WebUI is started, click the **Get License Info** button.

When the command is successfully executed, the message "License registration succeeded." is displayed in the console. When a message other than this is displayed, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

2. Run the following command to verify the licenses registered.

   ```
   # clplcnsc -l -a
   ```

3. If there is other server in a cluster system that uses the optional product, register the node license by following the same procedures. Register the license for the Replicator / Replicator DR to both servers.
4. Run the OS shutdown command to reboot all the servers. By doing this, the license registration becomes effective and you can start using the cluster. After rebooting all servers, proceed to "6. *Creating the cluster configuration data*" and follow the steps.

Note: You can ignore that clusterpro_md fails at the time the operating system is started up. It is because the cluster is yet to be created.

Note: If the Replicator / Replicator DR license is registered after starting the cluster operation, once shutdown and reboot the cluster. After the reboot, the Replicator / Replicator DR is operable.

5.3.2 Registering the node license interactively from the command line (Product version)

The following describes how you register the license for the product version interactively from the command line. Before you register the license, make sure to:

- Have the official license sheet that comes with the product. The license sheet is sent to you when you purchase the product. The number of license sheets required is the number of servers for which you use the optional product. You will enter the values on the license sheet.
- Allow logon as root user to the server for which you plan to use the option product among servers constituting the cluster system.

See also:

The clplcnsc command is used in the following procedures. For more information on how to use the clplcnsc command, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

1. Have the license sheet.
   The instruction here is given using the values in the following license sheet (Replicator) as an example. When actually entering the values, modify them according to the information on your license sheet.

   ```
   Product name: EXPRESSCLUSTER X Replicator 6.0 for Linux
   License information:
   ```

```
Type Product Version
License Key A1234567-B1234567-C1234567-D1234567
Serial Number AAAAAAAA000000
Number of Nodes 1
```

2. Among servers that constitute the cluster, log on as root user to the server for which you are intending to use the option product as root, and then run the following command:

```
# clplcnsc -i
```

Note: If the licenses for optional products have not been installed, the resources and monitor resources corresponding to those licenses are not shown in the list on the Cluster WebUI.

If the licenses are registered but the corresponding resources do not appear in the list, or if the licenses are registered after the Cluster WebUI is started, click the **Get License Info** button.

---

3. The text that prompts you to enter the license version is displayed. Enter **1** because it is a product version:

```
Selection of License Version.
  1 Product Version
  2 Trial Version
  e Exit
Select License Version. [1, 2, or e (default:1)]...1
```

4. The text that prompts you to enter the serial number is displayed. Enter the serial number written in your license sheet. Note this is case sensitive.

```
Enter serial number [Ex. XXXXXXXX000000]... AAAAAAAA000000
```

5. The text that prompts you to enter the license key is displayed. Enter the license key written in your license sheet. Note this is case sensitive.

```
Enter license key
  [XXXXXXXX-XXXXXXXX-XXXXXXXX-XXXXXXXX]...
A1234567-B1234567-C1234567-D1234567
```

When the command is successfully executed, the message "License registration succeeded." is displayed in the console. When a message other than this is displayed, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

6. Run the following command to verify the licenses registered.

```
# clplcnsc -l -a
```

7. If there is any other server in the cluster that uses an optional product, register the node license by repeating the same steps.
   Register the license for the Replicator / Replicator DR to both servers.

8. Run the OS shutdown command to reboot all the servers. By doing this, the license registration becomes effective and you can start using the cluster. After rebooting all servers, proceed to "6. *Creating the cluster configuration data*" and follow the steps.

Note: You can ignore that clusterpro_md fails at the time the operating system is started up. It is because the cluster is yet to be created.

Note: If the Replicator / Replicator DR license is registered after starting the cluster operation, once shutdown and reboot the cluster. After the reboot, the Replicator / Replicator DR is operable.

5.4 Registering the fixed term license

Use the fixed term license to operate the cluster system which you intend to construct for a limited period of time.

This license becomes effective on the date when the license is registered and then will be effective for a certain period of time.

In preparation for the expiration, the license for the same product can be registered multiple times. Extra licenses are saved and a new license will take effect when the current license expires.

The names of the products to which the fixed term license applies are listed below.

main product

Licensed Product Name
EXPRESSCLUSTER X 6.0 for Linux VM

optional product

Licensed Product Name
EXPRESSCLUSTER X Replicator 6.0 for Linux
EXPRESSCLUSTER X Database Agent 6.0 for Linux
EXPRESSCLUSTER X Internet Server Agent 6.0 for Linux
EXPRESSCLUSTER X File Server Agent 6.0 for Linux
EXPRESSCLUSTER X Application Server Agent 6.0 for Linux
EXPRESSCLUSTER X Java Resource Agent 6.0 for Linux
EXPRESSCLUSTER X System Resource Agent 6.0 for Linux
EXPRESSCLUSTER X Alert Service 6.0 for Linux
EXPRESSCLUSTER X Replicator DR 6.0 for Linux

Among the servers that you intend to use to build a cluster, use the master server to register the fixed term license regardless of the main product or optional product. Specify the license file to register the license.

For details, see "5.4.2. *Registering the fixed term license by specifying the license file*".

5.4.1 Notes on the fixed term license

Notes on using the fixed term license are as follows:

- The fixed term license cannot be registered to several of the servers constituting the cluster to operate them.
- After registration of the license on the master server, Cluster WebUI on the master server must be used in order to edit and reflect the cluster configuration data as described in "6. *Creating the cluster configuration data*".
- The number of the fixed term license must be larger than the number of the servers constituting the cluster.
- After starting the operation of the cluster, additional fixed term license must be registered in the master server.
- Once enabled, the fixed term license cannot be reregistered despite its validity through the license/server removal or the server replacement.

5.4.2 Registering the fixed term license by specifying the license file

The following describes how you register a fixed term license.
Check the following before executing these steps.

- Allow logon as root user to the server that will be set as a master server among servers that configures a cluster system.
- The license files for all the products you intend to use are stored in the server that will be set as a master server among servers that constitute the cluster system.

Follow the following steps to register all the license files for the products to be used.

1. Log on to the master server as root user and run the following command.

   ```
   # clplcnsc -i filepath
   ```

Specify the path to the license file for **filepath** specified by the -i option.

Note: If the licenses for optional products have not been installed, the resources and monitor resources corresponding to those licenses are not shown in the list on the Cluster WebUI.

If the licenses are registered but the corresponding resources do not appear in the list, or if the licenses are registered after the Cluster WebUI is started, click the **Get License Info** button.

When the command is successfully executed, the message "License registration succeeded." is displayed in the console. When a message other than this is displayed, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

If you have two or more license files for the same product in preparation for the expiration, execute the command to register the extra license files in the same way as above.

2. If there are other products you intend to use, repeat the step 1.
3. Run the following command to verify the licenses registered.

   ```
   # clplcnsc -l -a
   ```

Note: The license will be in an "inactive" state if the cluster is not yet created, but there is no problem because it will be activated once the cluster creation is completed.

---

4. Run the OS shutdown command to reboot all servers. By doing this, the license registration becomes effective and you can start using the cluster.
   After rebooting all servers, proceed to "6. *Creating the cluster configuration data*" and follow the steps.

Note: You can ignore that clusterpro_md fails at the time the operating system is started up. It is because the cluster is yet to be created.

Note: If the Replicator license is registered after starting the cluster operation, once shutdown and reboot the cluster. After the reboot, the Replicator is operable.

CHAPTER

SIX

CREATING THE CLUSTER CONFIGURATION DATA

In EXPRESSCLUSTER, data that contains information on how a cluster system is configured is called "cluster configuration data." Generally, This data is created using the Cluster WebUI. This chapter provides the procedures to start up the Cluster WebUI and to create the cluster configuration data using the Cluster WebUI with a sample cluster configuration.

This chapter covers:

- 6.1. *Creating the cluster configuration data*
- 6.2. *Starting up the Cluster WebUI*
- 6.3. *Checking the values to be configured in the cluster environment with two nodes*
- 6.4. *Creating the configuration data of a 2-node cluster*
- 6.5. *Checking the values to be configured in the cluster environment with three nodes*
- 6.6. *Creating the configuration data of a 3-node cluster*
- 6.7. *Checking the values to be configured in the cluster environment with three nodes (hybrid type)*
- 6.8. *Creating the configuration data of a 3-node cluster (hybrid type)*
- 6.9. *Saving the cluster configuration data*
- 6.10. *Check the cluster configuration data*
- 6.11. *Creating a cluster*

6.1 Creating the cluster configuration data

Creating the cluster configuration data is performed by using the config mode of Cluster WebUI, the function for creating and modifying cluster configuration data

Start the Cluster WebUI accessed from the management PC and create the cluster configuration data. The cluster configuration data will be applied in the cluster system by the Cluster WebUI.

6.2 Starting up the Cluster WebUI

Accessing to the Cluster WebUI is required to create cluster configuration data. This section describes the overview of the Cluster WebUI, and how to create cluster configuration data.

See also:

For the system requirements of the Cluster WebUI, refer to "Installation requirements for EXPRESSCLUSTER" in the "Getting Started Guide".

6.2.1 What is Cluster WebUI?

The Cluster WebUI is a function for setting up the cluster, monitoring its status, starting up or stopping servers and groups, and collecting cluster operation logs through a Web browser. The overview of the Cluster WebUI is shown in the following figures.

(a) EXPRESSCLUSTER Server (Main module)

(b) Cluster WebUI

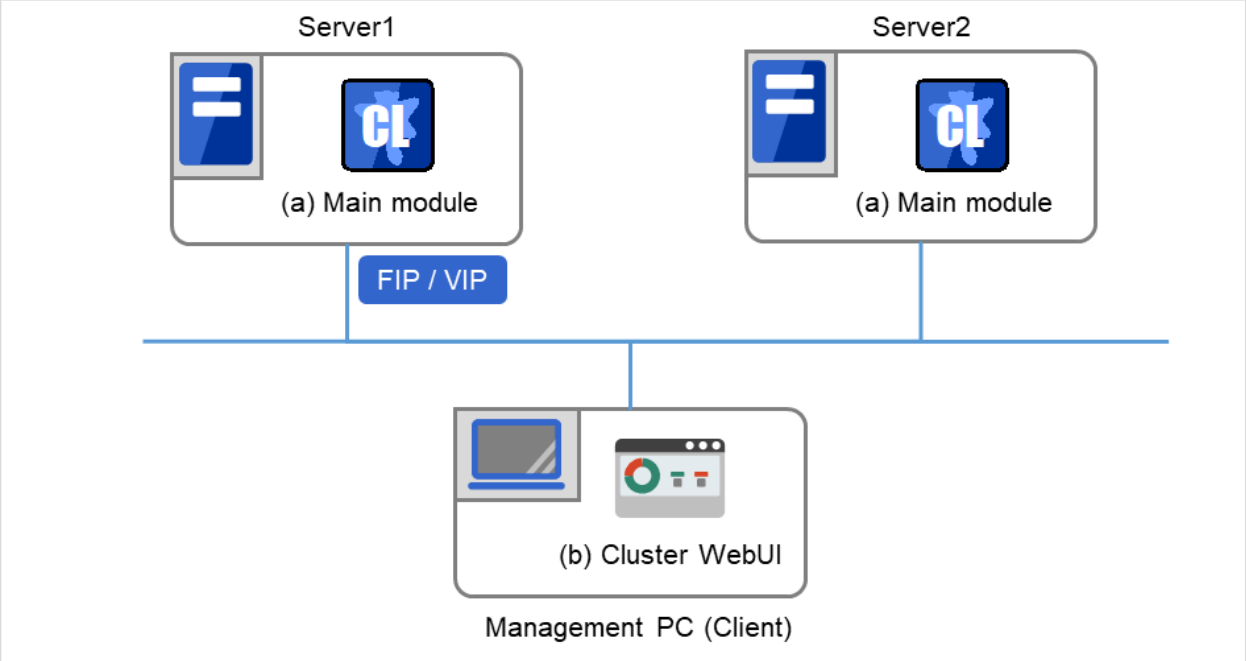


Fig. 6.1: Cluster WebUI

This figure shows two servers with EXPRESSCLUSTER installed. You can display the Cluster WebUI screen, by using a Web browser on the Management PC to access one of the servers. For this access, specify the management group's floating IP (FIP) address or virtual IP (VIP) address.

6.2.2 Browsers supported by the Cluster WebUI

For information of the latest system requirements of the Cluster WebUI (supported operating systems and browsers, required memory and disk size), see the Getting Started Guide.

6.2.3 Starting the Cluster WebUI

The following describes how to start the Cluster WebUI.

1. Start your Web browser.
2. Enter the actual IP address and port number of the server where the EXPRESSCLUSTER Server is installed in the Address bar of the browser.

   `http://ip-address:port/`

   ip-address

   Specify the actual IP address of the first server in the cluster, because no management group exists just after the installation.

   port

   Specify the same port number as that of WebManager specified during the installation (default: 29003).
3. The Cluster WebUI starts. To create the cluster configuration data, select **Config Mode** from the drop down menu of the tool bar.
4. Click **Cluster generation wizard** to start the wizard.

See also:

For encrypted communication with EXPRESSCLUSTER Server, see "WebManager tab" of "Cluster properties" in "Parameter details" in the "Reference Guide". Enter the following to perform encrypted communication.

`https``://ip-address:29003/`

6.3 Checking the values to be configured in the cluster environment with two nodes

Before you create the cluster configuration data using Cluster Generation Wizard, check values you are going to enter. Write down the values to see whether your cluster is efficiently configured and there is no missing information.

6.3.1 Sample cluster environment

As shown in the diagram below, this chapter uses a typical configuration with two nodes as a cluster example.

When a disk resource is used

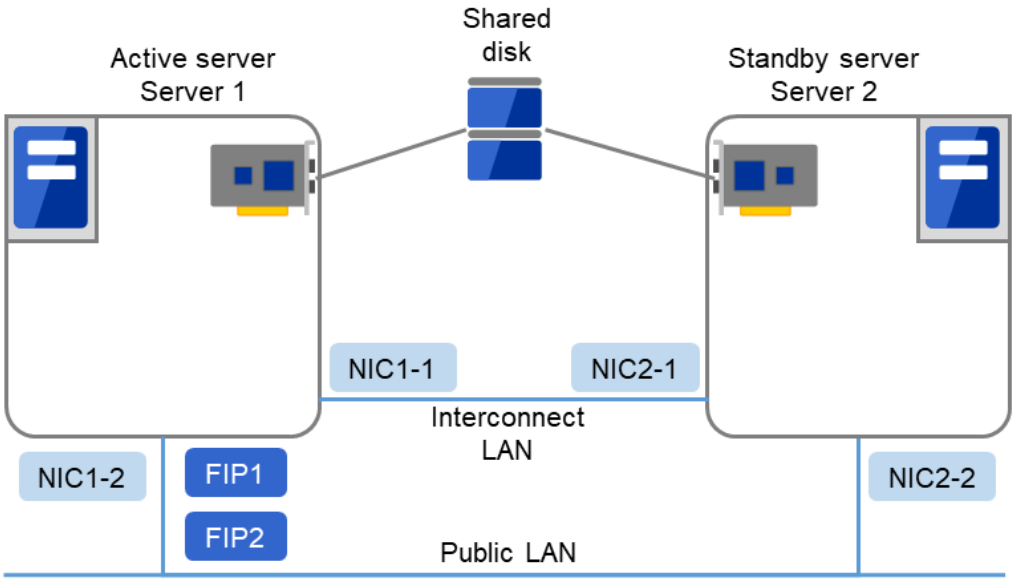


Fig. 6.2: Example of a 2-node cluster with a disk resource

FIP1	10.0.0.11 (to be accessed by Cluster WebUI clients)
FIP2	10.0.0.12 (to be accessed by operation clients)
NIC1-1	192.168.0.1
NIC1-2	10.0.0.1
NIC2-1	192.168.0.2
NIC2-2	10.0.0.2

- Shared disk
  - Disk heartbeat resource

Device name	/dev/disk/by-id/scsi-222850001557d9443-part1

  - Disk resource

Shared disk device	/dev/disk/by-id/scsi-222850001557d9443-part2
Mount point	/mnt/sd1
File system	ext4

  - Disk monitor resource

Device name	/dev/disk/by-id/scsi-222850001557d9443-part2
Monitoring method	READ(O_DIRECT)

Check the values to be configured before creating the cluster configuration data. The following table lists sample values of the cluster configuration data to achieve the cluster system shown above. These values and configuration are applied hereafter in the step-by-step instruction to create the cluster configuration data. When you actually set the values, you may need to modify them according to the cluster you are intending to create. For information on how you determine the values, refer to the "Reference Guide".

Example of configuration with two nodes

Target	Parameter	Value
Cluster configuration	Cluster name	cluster
	Number of servers	2
	Number of failover groups	2
	Number of monitor resources	4
Heartbeat resources	Number of kernel mode LAN heartbeats	2
	Number of disk heartbeats	1
NP resource	PingNP	0
First server information (Master server)	Server name[1]	server1
	Interconnect IP address (Dedicated)	192.168.0.1 (NIC1-1)
	Interconnect IP address (Backup)	10.0.0.1 (NIC1-2)
	Public IP address	10.0.0.1 (NIC1-2)
	Disk heartbeat device	/dev/disk/by-id/scsi-222850001557d9443-part1
Second server information	Server name[Page 92, 1]	server2

continues on next page

Table 6.5 – continued from previous page

Target	Parameter	Value
	Interconnect IP address (Dedicated)	192.168.0.2 (NIC2-1)
	Interconnect IP address (Backup)	10.0.0.2 (NIC2-2)
	Public IP address	10.0.0.2 (NIC2-2)
	Disk heartbeat device	/dev/disk/by-id/scsi-222850001557d9443-part1
Group resources for management (For the Cluster WebUI)	Type	failover
	Group name	ManagementGroup
	Startup server	All servers
	Number of group resources	1
Group resources for management[2]	Type	Floating IP resource
	Group resource name	ManagementIP
	IP address	10.0.0.11 (FIP1)
Group resources for operation	Type	failover
	Group name	failover1
	Startup server	All servers
	Number of group resources	3
First group resources	Type	Floating IP resource
	Group resource name	fip1
	IP address	10.0.0.12 (FIP2)
Second group resources	Type	Disk resource
	Group resource name	disk1
	Disk type	disk
	File system	ext4
	Device name	/dev/disk/by-id/scsi-222850001557d9443-part2
	Mount point	/mnt/sd1
Third group resources	Type	EXEC resource
	Group resource name	exec1
	Script	Standard Script
First monitor resources (Created by default)	Type	User mode monitor
	Monitor resource name	userw
Second monitor resources	Type	Disk monitor
	Monitor resource name	diskw1
	Device name	/dev/disk/by-id/scsi-222850001557d9443-part2
	Monitor method	READ (O_DIRECT)
	Monitor timing	Always
	Monitor target	-
	When an error is detected	Stop the cluster service and shut down the OS.

continues on next page

Table 6.5 – continued from previous page

Target	Parameter	Value
Third monitor resources (Automatically created after creating ManagementIP resources)	Type	Floating IP monitor
	Monitor resource name	fipw1
	Monitor target	ManagementIP
	When an error is detected	"ManagementGroup" group's failover[3]
Fourth monitor resources (Automatically created after creating fip1 resources)	Type	Floating IP monitor
	Monitor resource name	fipw2
	Monitor target	fip1
	When an error is detected	"failover1" group's Failover[Page 92, 3]
Fifth monitor resources	Type	IP monitor
	Monitor resource name	ipw1
	Monitor IP address	10.0.0.254 (gateway)
	When an error is detected	Failover of all groups[3]

[1] "Host name" represents the short name that excludes the domain name from a frequently qualified domain name (FQDN).
[2] You should have a floating IP address to access the Cluster WebUI. You can access the Cluster WebUI from your Web browser with a floating IP address when an error occurs.
[3] For the settings to execute a failover when all interconnect LANs are disconnected, see "Monitor resource details" in the "Reference Guide".

When mirror disk resources are used

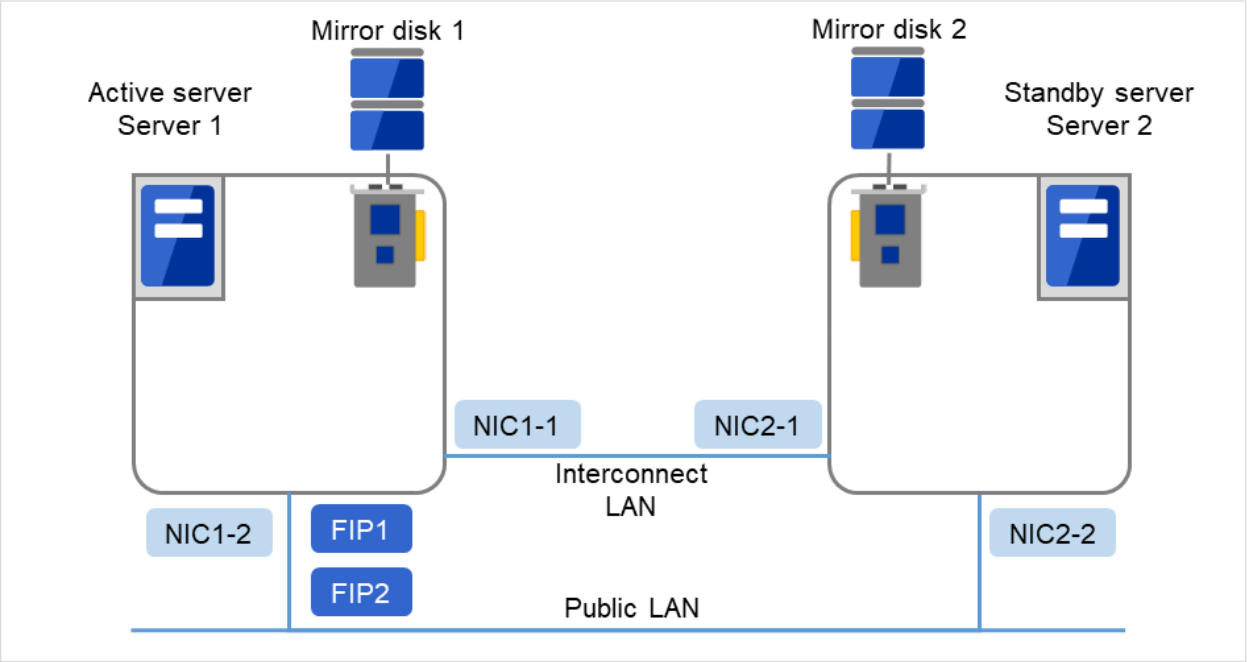


Fig. 6.3: Example of a 2-node cluster with mirror disk resources

FIP1	10.0.0.11 (to be accessed by Cluster WebUI clients)
FIP2	10.0.0.12 (to be accessed by operation clients)
NIC1-1	192.168.0.1
NIC1-2	10.0.0.1
NIC2-1	192.168.0.2
NIC2-2	10.0.0.2

- Mirror disk resource configuration

Mirror disk 1 Cluster partition	/dev/disk/by-id/scsi-222850001557d9443-part1
Mirror disk 1 Data partition	/dev/disk/by-id/scsi-222850001557d9443-part2
Mirror disk 2 Cluster partition	/dev/disk/by-id/scsi-2222400015526436d-part1
Mirror disk 2 Data partition	/dev/disk/by-id/scsi-2222400015526436d-part2
Mount point	/mnt/md1
File system	ext4

- Disk monitor configuration

Server 1 Device name	/dev/disk/by-id/scsi-222850001557d9443-part2
Server 2 Device name	/dev/disk/by-id/scsi-2222400015526436d-part2
Monitoring method	READ(O_DIRECT)

Check the values to be configured before creating the cluster configuration data. The following table lists sample values of the cluster configuration data to achieve the cluster system shown above. These values and configuration are applied hereafter in the step-by-step instruction to create the cluster configuration data. When you actually set the values, you may need to modify them according to the cluster you are intending to create. For information on how you determine the values, refer to the "Reference Guide".

Example of configuration with two nodes

Target	Parameter	Value
Cluster configuration	Cluster name	cluster
	Number of servers	2
	Number of failover groups	2
	Number of monitor resources	6
Heartbeat resources	Number of kernel mode LAN heartbeats	2
	Number of disk heartbeats	0
NP resource	PingNP	0
First server information (Master server)	Server name[4]	server1
	Interconnect IP address (Dedicated)	192.168.0.1 (NIC1-1)
	Interconnect IP address (Backup)	10.0.0.1 (NIC1-2)
	Public IP address	10.0.0.1 (NIC1-2)
	Mirror disk connect	192.168.0.1 (NIC1-1)
Second server information	Server name[Page 96, 4]	server2
	Interconnect IP address (Dedicated)	192.168.0.2 (NIC2-1)
	Interconnect IP address (Backup)	10.0.0.2 (NIC2-2)
	Public IP address	10.0.0.2 (NIC2-2)
	Mirror disk connect	192.168.0.2 (NIC2-1)
Group resources for management (For the Cluster WebUI)	Type	failover

continues on next page

Table 6.9 – continued from previous page

Target	Parameter	Value
	Group name	ManagementGroup
	Startup server	All servers
	Number of group resources	1
Group resources for management[5]	Type	Floating IP resource
	Group resource name	ManagementIP
	IP address	10.0.0.11 (FIP1)
Group resources for operation	Type	failover
	Group name	failover1
	Startup server	All servers
	Number of group resources	3
First group resources	Type	Floating IP resource
	Group resource name	fip1
	IP address	10.0.0.12 (FIP2)
Second group resources	Type	Mirror disk resource
	Group resource name	md1
	Mirror partition device name	/dev/NMP1
	Mount point	/mnt/md1
	Data partition device name	Server 1: /dev/disk/by-id/scsi-222850001557d9443-part2 Server 2: /dev/disk/by-id/scsi-2222400015526436d-part2
	Cluster partition device name	Server 1: /dev/disk/by-id/scsi-222850001557d9443-part1 Server 2: /dev/disk/by-id/scsi-2222400015526436d-part1
	File system	ext4
Third group resources	Type	EXEC resource
	Group resource name	exec1
	Script	Standard Script
First monitor resources (Created by default)	Type	User mode monitor
	Monitor resource name	userw
Second monitor resources	Type	Disk monitor
	Monitor resource name	diskw1
	Device name	Server 1: /dev/disk/by-id/scsi-222850001557d9443-part2 Server 2: /dev/disk/by-id/scsi-2222400015526436d-part2
	Monitor method	READ (O_DIRECT)
	Monitor timing	Always
	Monitor target	-

continues on next page

Table 6.9 – continued from previous page

Target	Parameter	Value
	When an error is detected	Stop the cluster service and shut down the OS.
Third monitor resources (Automatically created after creating ManagementIP resources)	Type	Floating IP monitor
	Monitor resource name	fipw1
	Monitor target	ManagementIP
	When an error is detected	"ManagementGroup" group's failover[6]
Fourth monitor resources (Automatically created after creating fip1 resources)	Type	Floating IP monitor
	Monitor resource name	fipw2
	Monitor target	fip1
	When an error is detected	"failover1" group's Failover[Page 96, 6]
Fifth monitor resources	Type	IP monitor
	Monitor resource name	ipw1
	Monitor IP address	10.0.0.254 (gateway)
	When an error is detected	Failover of all groups[6]
Sixth monitor resource (Automatically created after creating mirror disk resource)	Type	Mirror disk connect monitor
	Monitor resource name	mdnw1
	Monitor mirror disk resource	md1
	When an error is detected	No Operation
Seventh monitor resource (Automatically created after creating mirror disk resource)	Type	Mirror disk monitor
	Monitor resource name	mdw1
	Monitor mirror disk resource	md1
	When an error is detected	No Operation

[4] "Host name" represents the short name that excludes the domain name from a frequently qualified domain name (FQDN).
[5] You should have a floating IP address to access the Cluster WebUI. You can access the Cluster WebUI from your Web browser with a floating IP address when an error occurs.
[6] For the settings to execute a failover when all interconnect LANs are disconnected, see "Monitor resource details" in the "Reference Guide".

Remote configuration when mirror disk resources are used

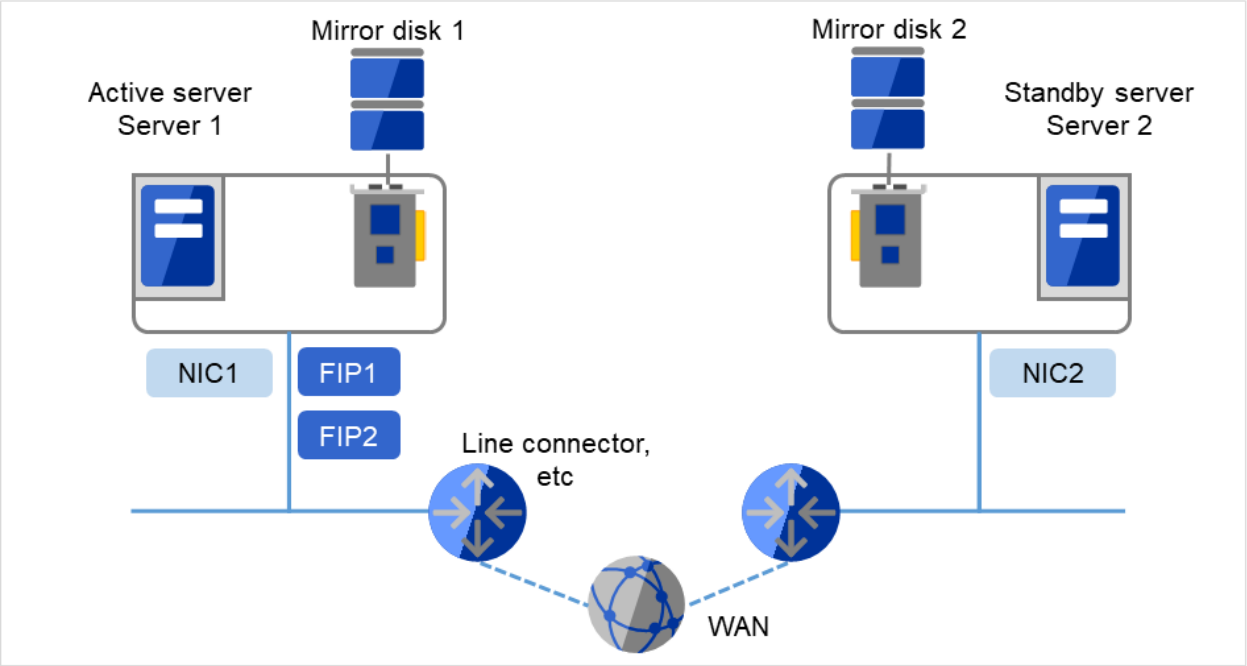


Fig. 6.4: Example of a 2-node cluster with a remote configuration using mirror disk resources

FIP1	10.0.0.11 (to be accessed by Cluster WebUI clients)
FIP2	10.0.0.12 (to be accessed by operation clients)
NIC1	10.0.0.1
NIC2	10.0.0.2

- Mirror disk resource configuration

Mirror disk 1 Cluster partition	/dev/disk/by-id/scsi-222850001557d9443-part1
Mirror disk 1 Data partition	/dev/disk/by-id/scsi-222850001557d9443-part2
Mirror disk 2 Cluster partition	/dev/disk/by-id/scsi-2222400015526436d-part1
Mirror disk 2 Data partition	/dev/disk/by-id/scsi-2222400015526436d-part2
Mount point	/mnt/md1
File system	ext4

- Disk monitor configuration

Server 1 Device name	/dev/disk/by-id/scsi-222850001557d9443-part2
Server 2 Device name	/dev/disk/by-id/scsi-2222400015526436d-part2
Monitoring method	READ(O_DIRECT)

- This configuration is an example for a layer-2 WAN, on which the same network address can be used between the locations.

Check the values to be configured before creating the cluster configuration data. The following table lists sample values of the cluster configuration data to achieve the cluster system shown above. These values and configuration are applied hereafter in the step-by-step instruction to create the cluster configuration data. When you actually set the values, you may need to modify them according to the cluster you are intending to create. For information on how you determine the values, refer to the "Reference Guide".

Example of configuration with two nodes

Target	Parameter	Value
Cluster configuration	Cluster name	cluster
	Number of servers	2
	Number of failover groups	2
	Number of monitor resources	6
Heartbeat resources	Number of kernel mode LAN heartbeats	1
	Number of disk heartbeats	0
NP resource	PingNP	1
First server information (Master server)	Server name[7]	server1
	Interconnect IP address (Dedicated)	10.0.0.1 (NIC1-2)
	Interconnect IP address (Backup)	--
	Public IP address	10.0.0.1 (NIC1-2)
	Mirror disk connect	10.0.0.1 (NIC1-2)
Second server information	Server name[Page 100, 7]	server2
	Interconnect IP address (Dedicated)	10.0.0.2 (NIC2-2)
	Interconnect IP address (Backup)	--
	Public IP address	10.0.0.2 (NIC2-2)
	Mirror disk connect	10.0.0.2 (NIC2-2)
Group resources for management (For the Cluster WebUI)	Type	failover

continues on next page

Table 6.13 – continued from previous page

Target	Parameter	Value
	Group name	ManagementGroup
	Startup server	All servers
	Number of group resources	1
Group resources for management[8]	Type	Floating IP resource
	Group resource name	ManagementIP
	IP address	10.0.0.11 (FIP1)
Group resources for operation	Type	failover
	Group name	failover1
	Startup server	All servers
	Number of group resources	3
First group resources	Type	Floating IP resource
	Group resource name	fip1
	IP address	10.0.0.12 (FIP2)
Second group resources	Type	Mirror disk resource
	Group resource name	md1
	Mirror partition device name	/dev/NMP1
	Mount point	/mnt/md1
	Data partition device name	Server 1: /dev/disk/by-id/scsi-222850001557d9443-part2 Server 2: /dev/disk/by-id/scsi-2222400015526436d-part2
	Cluster partition device name	Server 1: /dev/disk/by-id/scsi-222850001557d9443-part1 Server 2: /dev/disk/by-id/scsi-2222400015526436d-part1
	File system	ext4
Third group resources	Type	EXEC resource
	Group resource name	exec1
	Script	Standard Script
First monitor resources (Created by default)	Type	User mode monitor
	Monitor resource name	userw
Second monitor resources	Type	Disk monitor
	Monitor resource name	diskw1
	Device name	Server 1: /dev/disk/by-id/scsi-222850001557d9443-part2 Server 2: /dev/disk/by-id/scsi-2222400015526436d-part2
	Monitor method	READ (O_DIRECT)
	Monitor timing	Always
	Monitor target	-

continues on next page

Table 6.13 – continued from previous page

Target	Parameter	Value
	When an error is detected	Stop the cluster service and shut down the OS.
Third monitor resources (Automatically created after creating ManagementIP resources)	Type	Floating IP monitor
	Monitor resource name	fipw1
	Monitor target	ManagementIP
	When an error is detected	"ManagementGroup" group's failover[9]
Fourth monitor resources (Automatically created after creating fip1 resources)	Type	Floating IP monitor
	Monitor resource name	fipw2
	Monitor target	fip1
	When an error is detected	"failover1" group's FailoverPage 100, 9
Fifth monitor resources	Type	IP monitor
	Monitor resource name	ipw1
	Monitor IP address	10.0.0.254 (gateway)
	When an error is detected	Failover of all groups[9]
Sixth monitor resource (Automatically created after creating mirror disk resource)	Type	Mirror disk connect monitor
	Monitor resource name	mdnw1
	Monitor mirror disk resource	md1
	When an error is detected	No Operation
Seventh monitor resource (Automatically created after creating mirror disk resource)	Type	Mirror disk monitor
	Monitor resource name	mdw1
	Monitor mirror disk resource	md1
	When an error is detected	No Operation

[7] "Host name" represents the short name that excludes the domain name from a frequently qualified domain name (FQDN).

[8] You should have a floating IP address to access the Cluster WebUI. You can access the Cluster WebUI from your Web browser with a floating IP address when an error occurs.

[9] For the settings to execute a failover when all interconnect LANs are disconnected, see "Monitor resource details" in the "Reference Guide".

When a volume manager resource is used

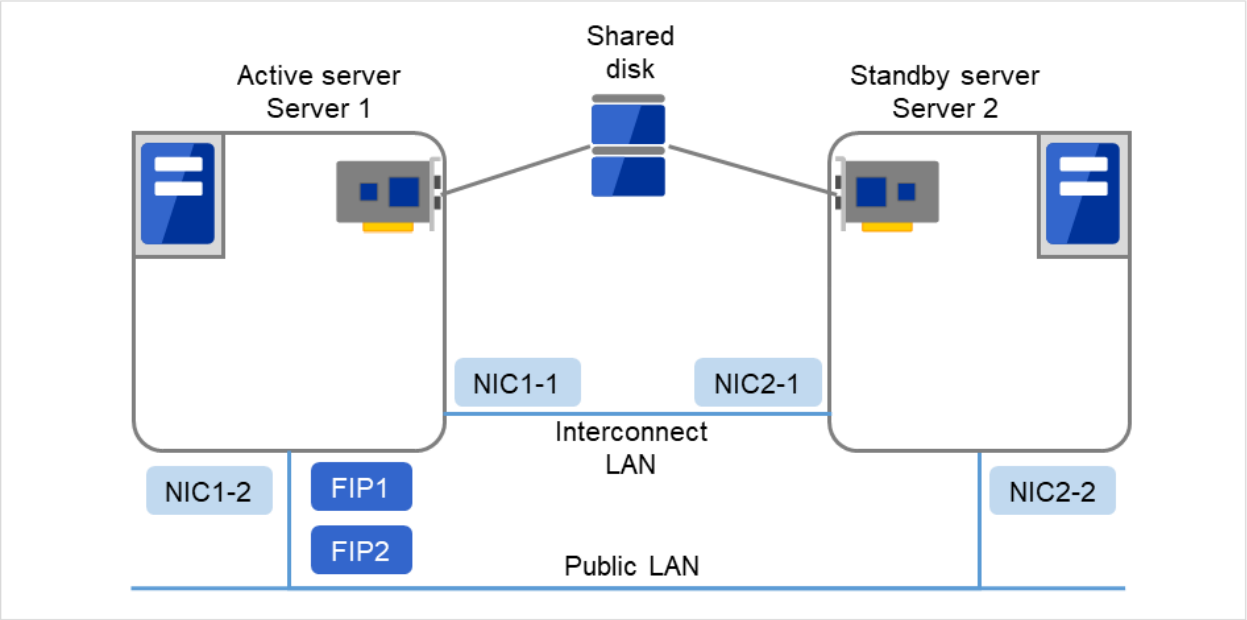


Fig. 6.5: Example of a 2-node cluster with a volume manager resource

- FIP1: to be accessed by Cluster WebUI clients
- FIP2: to be accessed by operation clients

Check the values to be configured before creating the cluster configuration data. The following table lists sample values of the cluster configuration data to achieve the cluster system shown above. These values and configuration are applied hereafter in the step-by-step instruction to create the cluster configuration data. When you actually set the values, you may need to modify them according to the cluster you are intending to create. For information on how you determine the values, refer to the "Reference Guide".

Example of configuration with two nodes

Target	Parameter	Value
Cluster configuration	Cluster name	cluster
	Number of servers	2
	Number of failover groups	2
	Number of monitor resources	5
Heartbeat resources	Number of kernel mode LAN heartbeats	2
	Number of disk heartbeats	1
NP resource	PingNP	0
First server information (Master server)	Server name[10]	server1
	Interconnect IP address (Dedicated)	192.168.0.1 (NIC1-1)

continues on next page

Table 6.14 – continued from previous page

Target	Parameter	Value
	Interconnect IP address (Backup)	10.0.0.1 (NIC1-2)
	Public IP address	10.0.0.1 (NIC1-2)
	Disk heartbeat device	/dev/disk/by-id/scsi-222850001557d9443-part1
Second server information	Server name[Page 103, 10]	server2
	Interconnect IP address (Dedicated)	192.168.0.2 (NIC2-1)
	Interconnect IP address (Backup)	10.0.0.2 (NIC2-2)
	Public IP address	10.0.0.2 (NIC2-2)
	Disk heartbeat device	/dev/disk/by-id/scsi-222850001557d9443-part1
Group resources for management (For the Cluster WebUI)	Type	failover
	Group name	ManagementGroup
	Startup server	All servers
	Number of group resources	1
Group resources for management[11]	Type	Floating IP resource
	Group resource name	ManagementIP
	IP address	10.0.0.11 (FIP1)
Group resources for operation	Type	failover
	Group name	failover1
	Startup server	All servers
	Number of group resources	4
First group resources	Type	Floating IP resource
	Group resource name	fip1
	IP address	10.0.0.12 (FIP2)
Second group resources	Type	Disk resource
	Group resource name	disk1
	Disk type	lvm
	File system	ext4
	Device name	/dev/vg1/lv1
	Mount point	/mnt/disk1
Third group resources	Type	EXEC resource
	Group resource name	exec1
	Script	Standard Script
Fourth group resources (Only when the volume manager is used)	Type	Volume manager resource
	Group resource name	volmgr1
	Volume Manager	lvm
	Target Name	vg1

continues on next page

Table 6.14 – continued from previous page

Target	Parameter	Value
First monitor resources (Created by default)	Type	User mode monitor
	Monitor resource name	userw
Second monitor resources	Type	Disk monitor
	Monitor resource name	diskw1
	Device name	/dev/vg1/lv1
	Monitor method	READ (O_DIRECT)
	Monitor timing	Active
	Monitor target	volmgr1
	When an error is detected	Stop the cluster service and shut down the OS.
Third monitor resources (Automatically created after creating ManagementIP resources)	Type	Floating IP monitor
	Monitor resource name	fipw1
	Monitor target	ManagementIP
	When an error is detected	"ManagementGroup" group's failover[12]
Fourth monitor resources (Automatically created after creating fip1 resources)	Type	Floating IP monitor
	Monitor resource name	fipw2
	Monitor target	fip1
	When an error is detected	"failover1" group's Failover[Page 103, 12]
Fifth monitor resources	Type	IP monitor
	Monitor resource name	ipw1
	Monitor IP address	10.0.0.254 (gateway)
	When an error is detected	Failover of all groups[12]
Sixth monitor resources (Only when the volume manager is used. Automatically created after creating volume manager resource)	Type	Volume manager monitor
	Monitor resource name	volmgrw1
	Volume Manager	lvm
	Target Name	vgl
	Monitor Timing	Active
	Monitor target	volmgr1

[10] "Host name" represents the short name that excludes the domain name from a frequently qualified domain name (FQDN).
[11] You should have a floating IP address to access the Cluster WebUI. You can access the Cluster WebUI from your Web browser with a floating IP address when an error occurs.
[12] For the settings to execute a failover when all interconnect LANs are disconnected, see "Monitor resource details" in the "Reference Guide".

6.4 Creating the configuration data of a 2-node cluster

6. *Creating the cluster configuration data* involves creating a cluster, group resources, and monitor resources. The steps you need to take to create the data are described in this section.

Note: The following instruction can be repeated as many times as necessary. Most of the settings can be modified later by using the rename function or properties view function.

---

1. "6.4.1. *Creating a cluster*"

   Create a cluster.

   - "6.4.1. *Add a cluster*": Add a cluster you want to construct and enter its name.
   - "6.4.1. *Add a server*": Add a server. Make settings such as IP addresses.
   - "6.4.1. *Set up the network configuration*": Set up the network configuration between the servers in the cluster.
   - "6.4.1. *Set up the network partition resolution*": Set up the network partition resolution.

2. "6.4.2. *Creating a failover group*"

   Create a failover group that works as a unit when a failover occurs.

   - "6.4.2. *Add a failover group*": Add a group that used as a unit when a failover occurs.
   - "6.4.2. *Add a group resource (Floating IP resource)*": Add a resource that constitutes a group.
   - "6.4.2. *Add a group resource (Volume manager resource)*": Add a resource that constitutes a group.
   - "6.4.2. *Add a group resource (Disk resource)*": Add a resource that constitutes a group when the disk resource is used.
   - "6.4.2. *Add a group resource (Mirror disk resource)*": Add a resource that constitutes a group when the mirror disk resource is used.
   - "6.4.2. *Add a group resource (EXEC resource)*": Add a resource that constitutes a group.

3. "6.4.3. *Creating monitor resources*"

   Create a monitor resource that monitors specified target in a cluster.

   - "6.4.3. *Add a monitor resource (Disk monitor)*": Add a monitor resource to use.
   - "6.4.3. *Add a monitor resource (IP monitor)*": Add a monitor resource to use.

4. "6.4.4. *Disabling the cluster operation*"

   Enable or disable the cluster operation.

6.4.1 Creating a cluster

Create a cluster. Add a server that constitute a cluster and determine a heartbeat priority.

Add a cluster

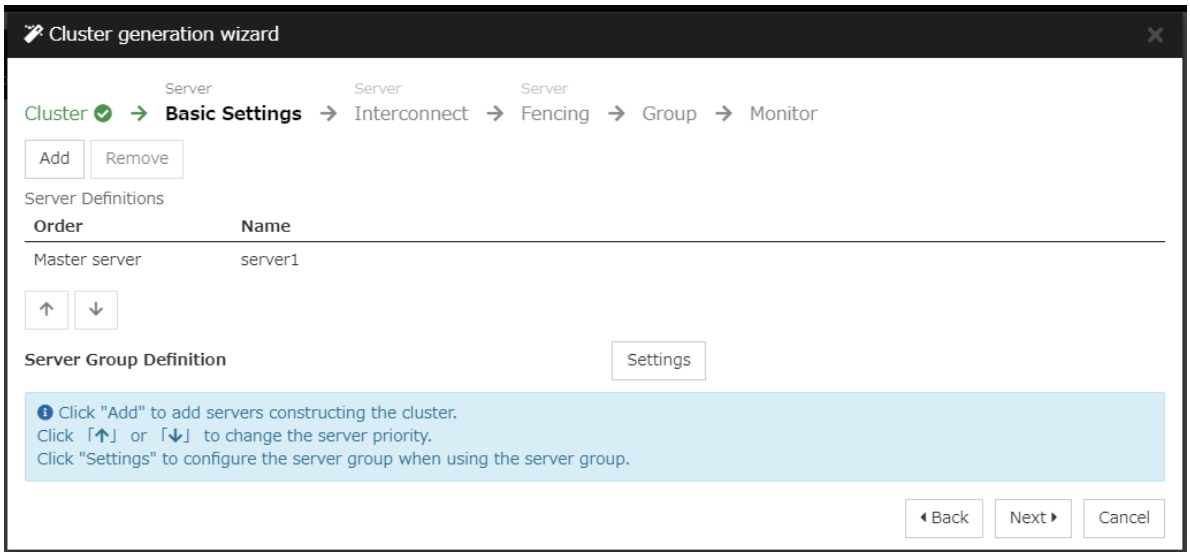
1. Click **Languages** field in **Cluster** window of **Cluster generation wizard**, select a language that is used on the machine that the Cluster WebUI works.

Note: Only one language is available within one cluster. If multiple languages are used within a cluster, specify English to avoid garbled characters.

---

2. In the **Cluster Definition** dialog box, type the cluster name (**cluster**) in the **Name** box.
3. Enter the Floating IP address (**10.0.0.11**) used to connect the Cluster WebUI in the **Management IP Address** box. Click **Next**.

The **Basic Settings** window for the server is displayed. The server (**server1**) for which the IP address was specified as the URL when starting up the Cluster WebUI is registered in the list.



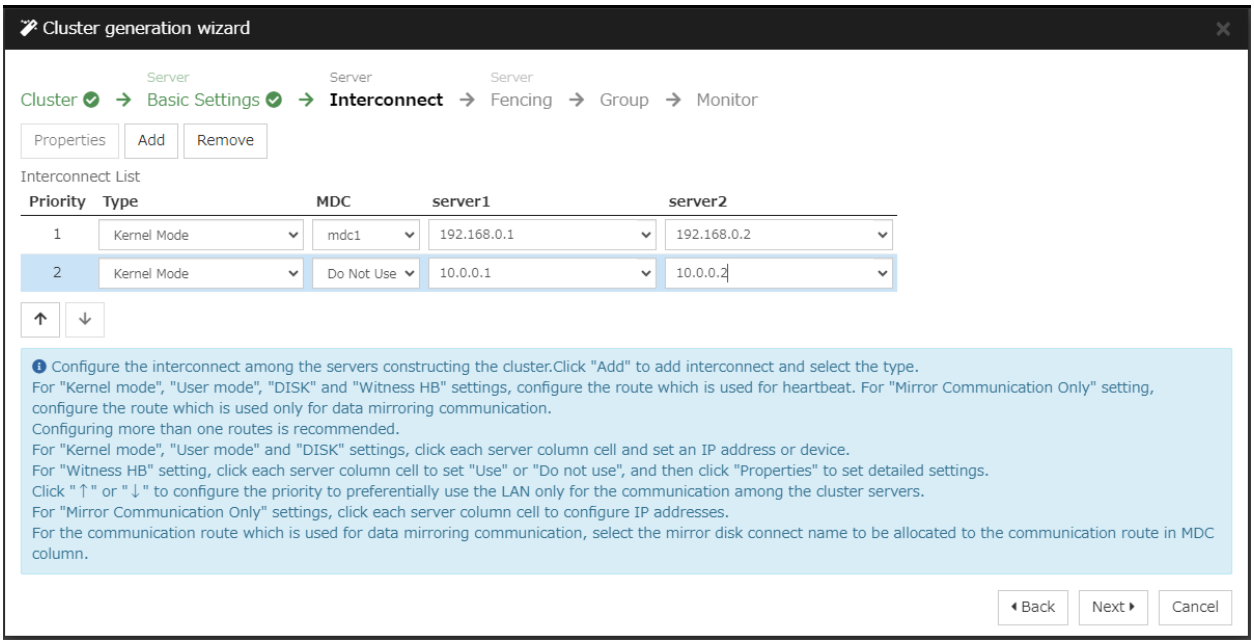
Add a server

Add the second server to the cluster.

1. In the **Server Definitions**, click **Add**.
2. The **Server Addition** dialog box is displayed. Enter the server name, FQDN name, or IP address of the second server, and then click **OK**. The second server (**server2**) is added to the **Server Definitions**.
3. Click **Next**.

Set up the network configuration

Set up the network configuration between the servers in the cluster.



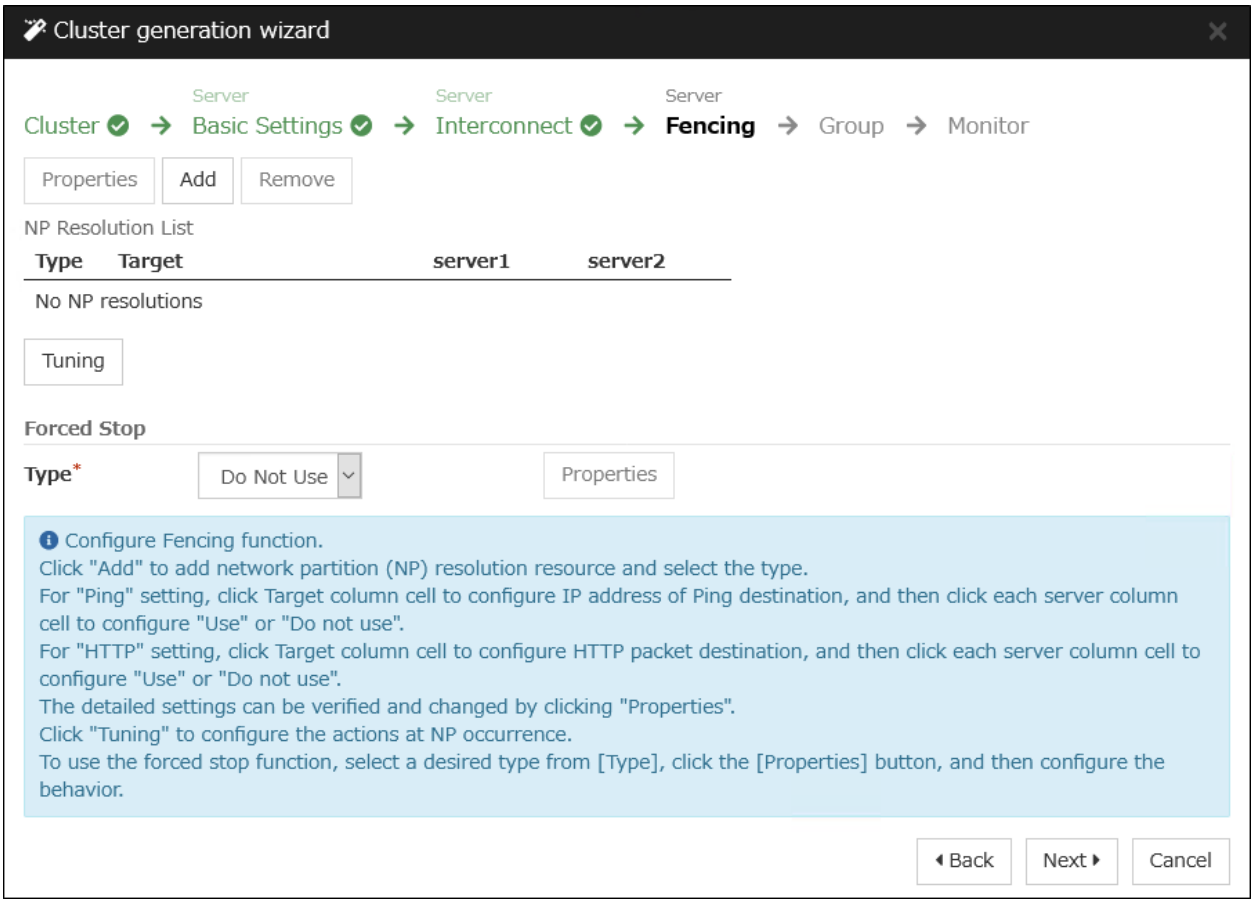
1. Add or remove them by using **Add** or **Remove**, click a cell in each server column, and then select or enter the IP address. For a communication route to which some servers are not connected, leave the cells for the unconnected servers blank.
2. For a communication route used for heartbeat transmission (interconnect) , click a cell in the **Type** column, and then select **Kernel Mode**. Select **Mirror Communication Only** when using only for data mirroring communication of the mirror disk resource or hybrid disk resource, not using heartbeat.

   At least one communication route must be specified for the interconnect. Specify as many communication routes for the interconnect as possible.

   If multiple interconnects are set up, the communication route for which the **Priority** column contains the smallest number is used preferentially for internal communication between the servers in the cluster.To change the priority, change the order of communication routes by selecting arrows.
3. When using DISK heartbeat, click **Type** column cell and select **DISK**. Click **Server name** column cell and select or enter disk device. For the server not using DISK heartbeat, set blank to **Server name** column cell.
4. When using Witness heartbeat, click a cell in the **Type** column, and select **Witness**. Next, click **Properties**, and enter the address of Witness server for **Target Host**. Then enter the port number for **Service Port**. For servers that do not use Witness heartbeat, click the cells of those servers, and select **Do Not Use**.
5. When using object storage heartbeat, click a cell in the **Type** column , and select **Object Storage**. Next, click **Properties**, and enter values for other items according to the settings for **platform**. For servers that do not use object storage heartbeat, click the cell of each server, and select **Do Not Use**.
6. For a communication route used for data mirroring communication for mirror disk resources (mirror disk connect), click a cell in the **MDC** column, and then select the mirror disk connect name (**mdc1** to **mdc16**) assigned to the communication route. Select **Not Used** for communication routes not used for data mirroring communication.
7. Click **Next**.

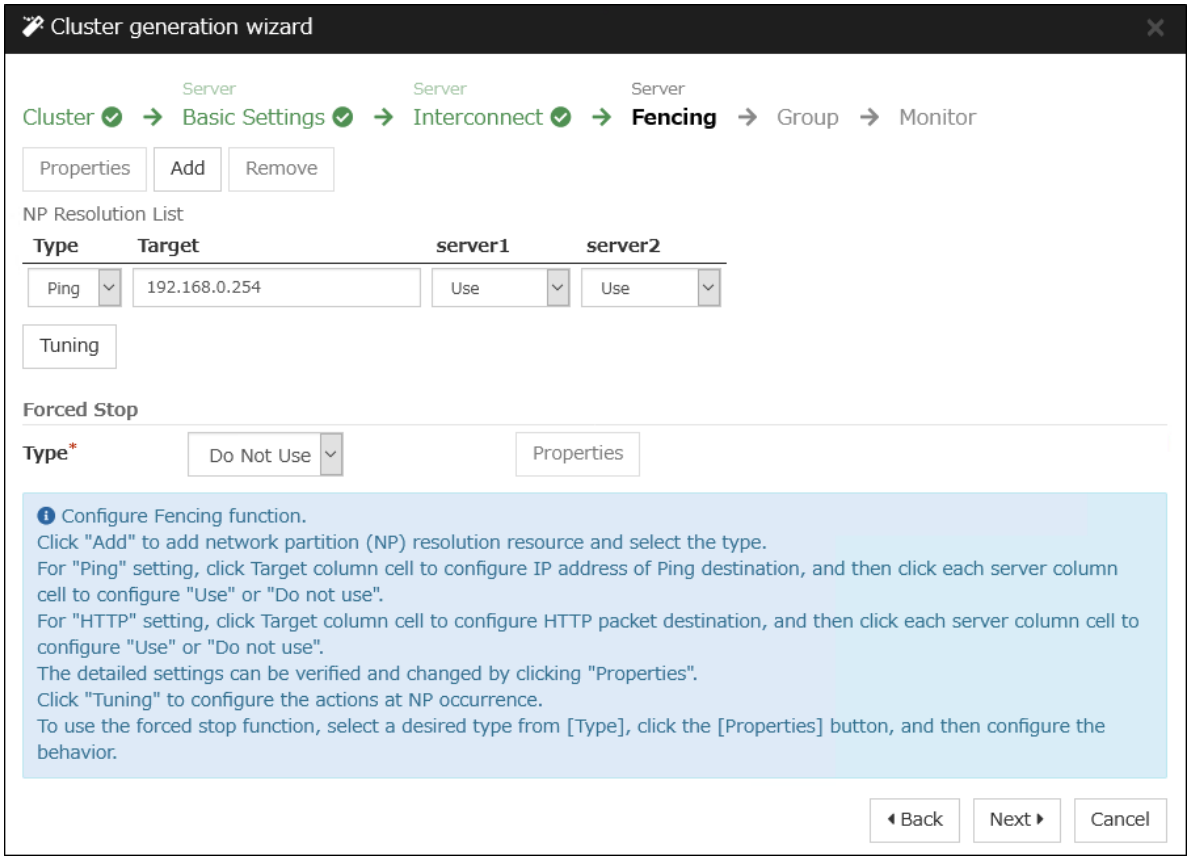
Set up the network partition resolution

Set up the network partition resolution resource.



1. To use NP resolution in the PING mode, click **Add** and add a row to **NP Resolution List**, click **Type** and select **Ping**, click the cell of **Target**, and then click the cell of each server and enter the IP addresses of the ping destination target devices (such as a gateway). When multiple IP addresses separated by commas are entered, they are regarded as isolated from the network if there is no ping response from any of them.
   If the PING mode is used only on some servers, set the cell of the server not to be used to **Do Not Use**.

   For the setup example in this chapter, 192.168.0.254 is specified for **Target**.



2. To use NP resolution in the HTTP mode, add a row to **NP Resolution List** by clicking **Add**, click the cell in **Type** column, and select **HTTP**. Then click **Properties**, enter the address of the Web server in **Target Host**, and enter the port number in **Service Port**. If the HTTP mode is used only on some servers, set the cells of the servers not to be used to **Do Not Use**.

   For the setup example in this chapter, the HTTP mode is not used.

3. Specify the operation to perform when a network partition is detected. Select **Stop the cluster service** or **Stop the cluster service and shutdown OS**.

   To use the mirror disk, **Stop the cluster service** is selected.

4. Click **Next**.

6.4.2 Creating a failover group

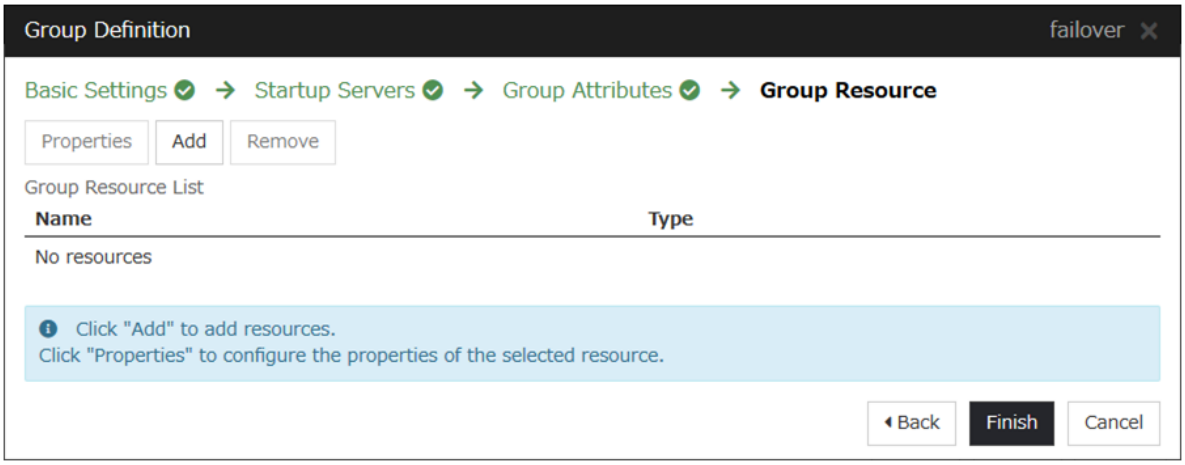
Add a failover group that executes an application to the cluster. (Below, *failover group* is sometimes abbreviated to *group*.)

Add a failover group

Set up a group that works as a unit of failover at the time an error occurs.

1. In the **Group List** click **Add**.
2. The **Group Definition** dialog box is displayed. Enter the group name (**failover1**) in the **Name** box, and click **Next**.
3. Specify a server on which the failover group can start up. For the setup example in this chapter, select the **Failover is possible at all servers** check box to use the shared disk and mirror disk.
4. Specify each attribute value of the failover group. Because all the default values are used for the setup example in this chapter, click **Next**.

   The **Group Resource** is displayed.



Add a group resource (Floating IP resource)

Add a group resource, a configuration element of the group, to the failover group you have created in "6.4.2. *Add a failover group*".

1. In the **Group Resource List**, click **Add**.
2. The **Resource Definition of Group | failover1** dialog box is displayed. In this dialog box, select the group resource type **Floating IP resource** in the **Type** box, and enter the group name **fip1** in the **Name** box. Click **Next**.
3. The **Dependent Resources** page is displayed. Specify nothing. Click **Next**.
4. **The Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** pages are displayed. Click **Next**.
5. Enter IP address (192.168.0.12) to **IP Address** box. Click **Finish**.

Add a group resource (Volume manager resource)

If using a shared disk in the cluster environment, add a shared disk as a group resource.

1. In the **Group Resource List,** click **Add**.
2. The **Resource Definition of Group | failover1** dialog box is displayed. In this dialog box, select the group resource type **Volume manager resource** in the **Type** box, and enter the group resource name **volmgr1** in the **Name** box. Click **Next**.
3. The **Dependent Resources** page is displayed. Specify nothing. Click **Next**.
4. **The Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** pages are displayed. Click **Next**.
5. Select volume manager name to be used (lvm1) and enter the target name (vg1) in the box. Click **Finish**.

Add a group resource (Disk resource)

If a shared disk is used in a cluster system, add a shared disk as a group resource.

1. In the **Group Resource List**, click **Add**.
2. In the **Resource Definition of Group | failover1**, select the group resource type **Disk resource** in the **Type** box, and enter the group resource name **disk1** in the **Name** box. Click **Next**.
3. The **Dependent Resources** page is displayed. Specify nothing. Click **Next**.
4. **The Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** pages are displayed. Click **Next**.
5. Select disk type (disk) in the **Disk Type** box and file system (ext4) in the **File System** box, and enter device name (/dev/disk/by-id/scsi-222850001557d9443-part2) and mount point (/mnt/sd1) to each box. Click **Finish**.

Note: For disk device names, it is recommended to use persistent device name (e.g., /dev/disk/by-id/[device name], /dev/disk/by-partuuid/[device name]).If non-persistent device names (e.g., /dev/sdX or /dev/nvmeX) are specified, an unintended device may be mounted when device file names are reassigned during OS startup, which could result in data corruption.

Add a group resource (Mirror disk resource)

If a cluster system is a data mirror type, add a mirror disk as a group resource.

1. In the **Group Resource List**, click **Add**.
2. The **Resource Definition of Group | failover1** box is displayed. Select the group resource type **Mirror disk resource** in the **Type** box, and enter the group resource name **md1** in the **Name** box. Click **Next**.

   Note: If a Mirror disk resource does not appear in the **Type** box, check whether the EXPRESSCLUSTER X Replicator license has been registered, then click the **Get License Info** button.

   ---

3. The **Dependent Resources** page is displayed. Specify nothing. Click **Next**.
4. **The Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** pages are displayed. Click **Next**.

5. Select mirror partition device name (/dev/NMP1) in the **Mirror Partition Device Name** box. Enter mount point (/mnt/md1), data partition device name (/dev/disk/by-id/scsi-222850001557d9443-part2) and cluster partition device name (/dev/disk/by-id/scsi-222850001557d9443-part1) to each box. Select file system (ext4) in the **File System** box.
6. Select **server1** tab in the **Resource Definition of Group | failover1** dialog box, and check **Set Up Individually** on. Re-enter mount point (/mnt/md1), data partition device name (/dev/disk/by-id/scsi-222850001557d9443-part2) and cluster partition device name (/dev/disk/by-id/scsi-222850001557d9443-part1).
7. Select **server2** tab in the **Resource Definition of Group | failover1** dialog box, and check **Set Up Individually** on. Re-enter mount point (/mnt/md1), data partition device name (/dev/disk/by-id/scsi-2222400015526436d-part2) and cluster partition device name (/dev/disk/by-id/scsi-2222400015526436d-part1).
8. Click **Finish**.

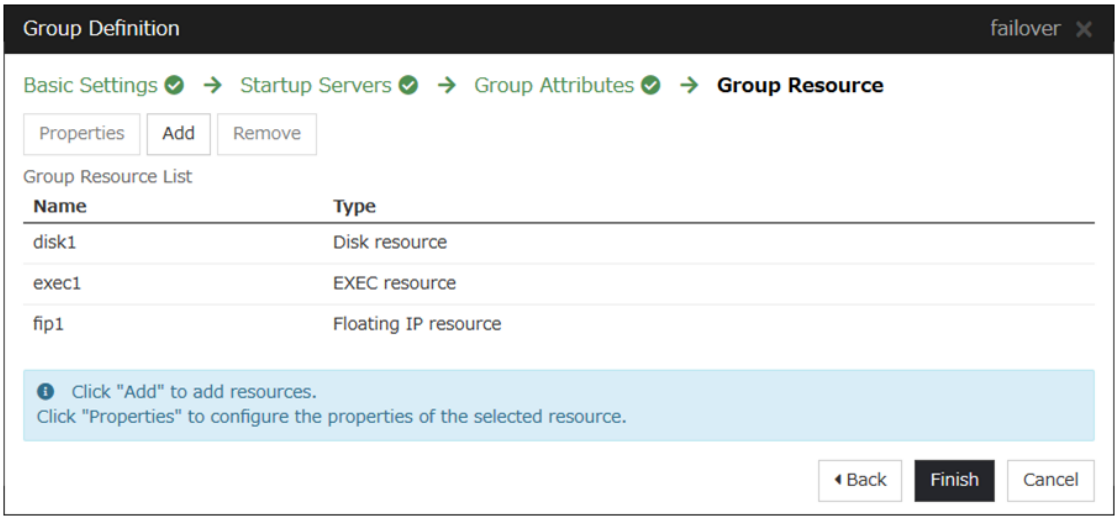
Note: For disk device names(e.g., cluster partition, data partition), it is recommended to use persistent device name (e.g., /dev/disk/by-id/[device name], /dev/disk/by-partuuid/[device name]).If non-persistent device names (e.g., /dev/sdX or /dev/nvmeX) are specified, an unintended device may be mounted when device file names are reassigned during OS startup, which could result in data corruption.

Add a group resource (EXEC resource)

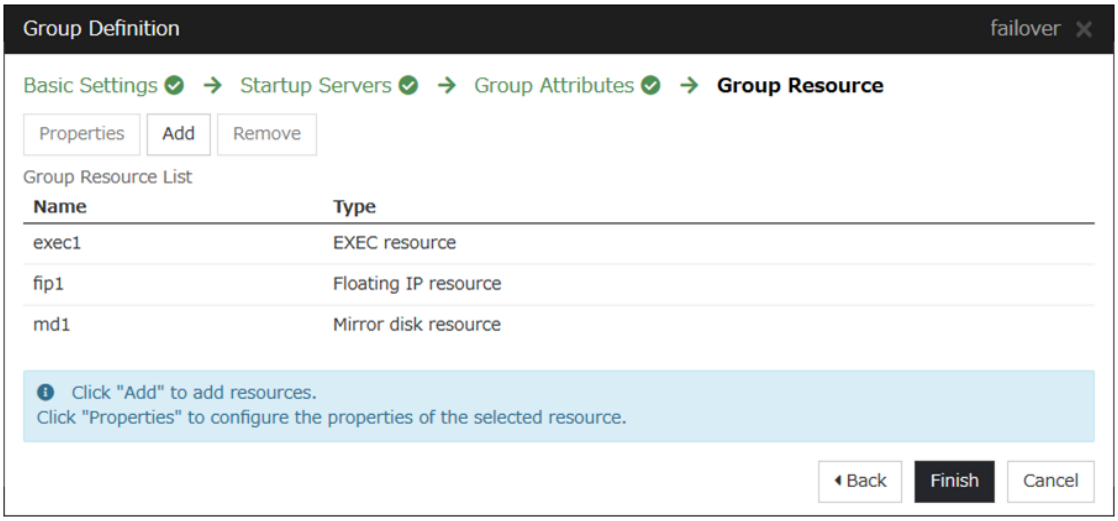
Add an EXEC resource that can start and stop the application from a script.

1. In the **Group Resource List**, click **Add**.
2. In the **Resource Definition of Group | failover1**, select the group resource **execute resource** in the **Type** box, and enter the group resource name **exec1** in the **Name** box. Click **Next**.
3. The **Dependent Resources** page is displayed. Specify nothing. Click **Next**.
4. **The Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** pages are displayed. Click **Next**.
5. Check **Script created with this product**. Describe start or stop procedures of the application by editing this script. When the application to be used by EXPRESSCLUSTER is decided, edit the script here. Click **Finish**.

   When a shared disk is used in a cluster system, the **Group Resource List** of the failover1 should look similar to the following:



When a cluster system is a data mirror type, the **Group Resource List** of the failover1 should look similar to the following:



6. Click **Finish**.

6.4.3 Creating monitor resources

Add a monitor resource that monitors a specified target to the cluster.

Add a monitor resource (Disk monitor)

Add monitor resources to monitor the target disk. Disk monitor is used as an example of a monitor resource to be added.

1. In the **Group** , click **Next**.
2. In the **Monitor Resource List**, click **Add**.
3. The **Monitor Resource Definition** dialog box is displayed. When a shared disk is used in the cluster environment, the first monitor resource information is created by default when the cluster name is defined. When a mirror disk is used in the cluster environment, the first monitor resource information is created by default when the cluster name is defined. The sixth and seventh monitor resource information is created by default when the mirror disk resource is added. Select the monitor resource type Disk monitor in the **Type** box, and enter the monitor resource name (diskw1) in the **Name** box. Click **Next**.
4. Configure the monitor settings. When using volume manager, enter the monitor timing (active) and monitor target (volmgr1). When volume manager is not used, do not change the default value and click **Next**.
5. When using volume manager, enter **Method** (READ(O_DIRECT)) and **Monitor Target** (/dev/vg1/lv1). When volume manager is not used, enter **Method** (READ(O_DIRECT)) and **Monitor Target** (/dev/disk/by-id/scsi-222850001557d9443-part2). Click **Next**.
6. When using mirror disk, Select **server1** tab In the **Monitor Resource Definition | diskw** dialog box, and check **Set Up Individually** on. Re-enter **Method** (READ(O_DIRECT)) and **Monitor Target** (/dev/disk/by-id/scsi-222850001557d9443-part2).
7. When using mirror disk, Select **server2** tab In the **Monitor Resource Definition | diskw** dialog box, and check **Set Up Individually** on. Re-enter **Method** (READ(O_DIRECT)) and **Monitor Target** (/dev/disk/by-id/scsi-2222400015526436d-part2).
8. Click **Next**.
9. Set **Recovery Target**. Click **Browse**.
10. Select **LocalServer** on the tree view being displayed, and click **OK**. **LocalServer** is set to **Recovery Target**.
11. Select **Stop the cluster service and shut down OS** in the **Final Action** box, and click **Finish**.

Add a monitor resource (IP monitor)

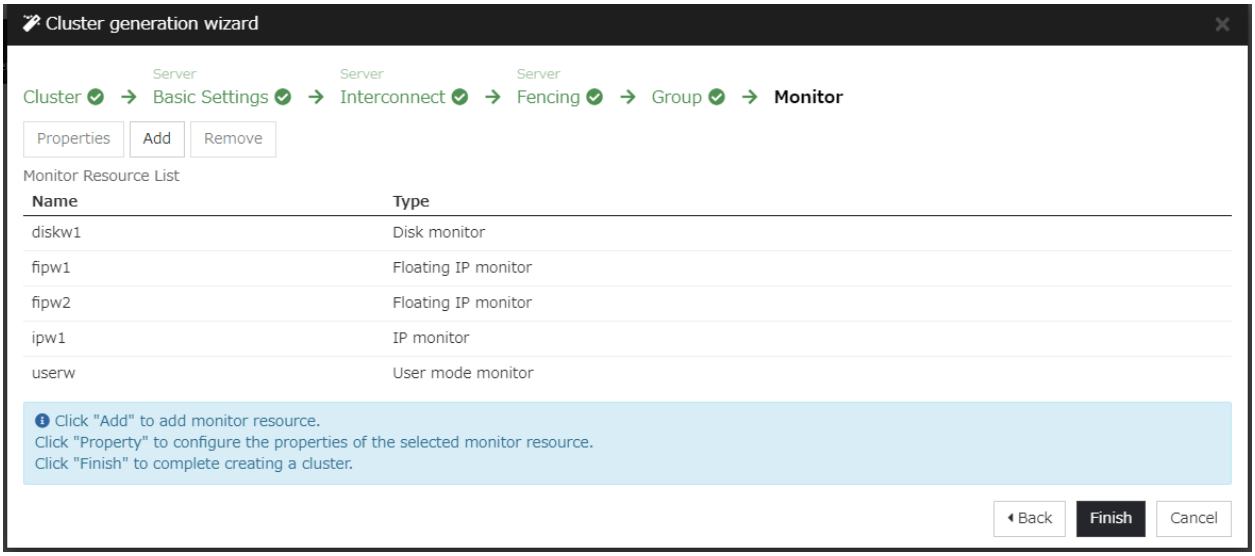
Add monitor resources that monitor networks.

1. In the **Monitor Resource List**, click **Add**.
2. In the **Monitor Resource Definition** dialog box, select the monitor resource type **IP monitor** in the **Type** box, and enter the monitor resource name **ipw1** in the **Name** box. Click **Next**.
3. Enter the monitor settings. Change nothing from the default values. Click **Next**.
4. Click **Add**.
   Enter the IP address to be monitored (10.0.0.254) in the **IP Address** box, and then click **OK**.

Note: For the monitoring target of the IP monitor resource, specify the IP address of a device (such as a gateway) that is assumed to always be active on the public LAN.

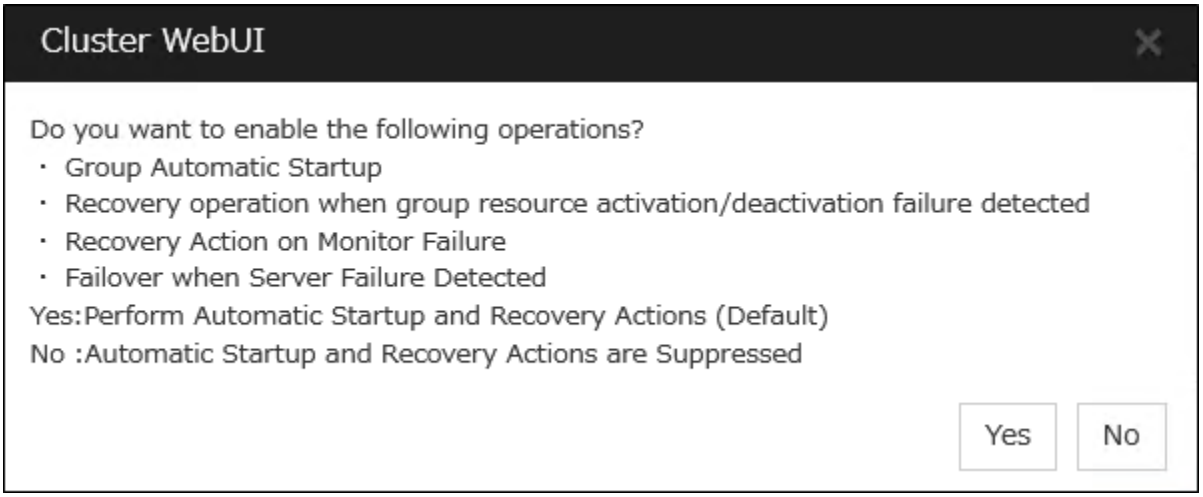
5. The entered IP address is specified in the **IP Addresses** list. Click **Next**.
6. Specify the recovery target. Click **Browse**.
7. Select **All Groups** in the tree view and click **OK**. **All Groups** is set to **Recovery Target**.
8. Click **Finish**.

The **Monitor Resource Definition** list displays resources as shown below. When the Mirror disk resource is used, mdnw1 and mdw1 will also appear in the list. When the Volume manager resource is used, volmgrw1 will also appear in the list.



6.4.4 Disabling the cluster operation

When you click **Finish** after creating a monitor resource, the following popup message appears:



Clicking **No** disables automatic group startup, recovery on the activation/deactivation failure of a group resource, recovery on the failure of a monitor resource, failover on a server failure, action on NP occurrence, and forced-stop action. When you start a cluster for the first time after creating the cluster configuration data, it is recommended that you disable the automatic startup and the recovery and check the cluster configuration data for errors.

To disable the cluster operation, go to **Cluster properties** -> **Extension** tab -> **Disable cluster operation**.

Note: Disabling the recovery on the failure of a monitor resource is not applied to user mode monitor resources.

Creating the cluster configuration data is completed. Proceed to "6.11. *Creating a cluster* ".

6.5 Checking the values to be configured in the cluster environment with three nodes

6.5.1 Sample cluster environment

As shown in the diagram below, this chapter uses a configuration with three nodes mirror as a cluster example.

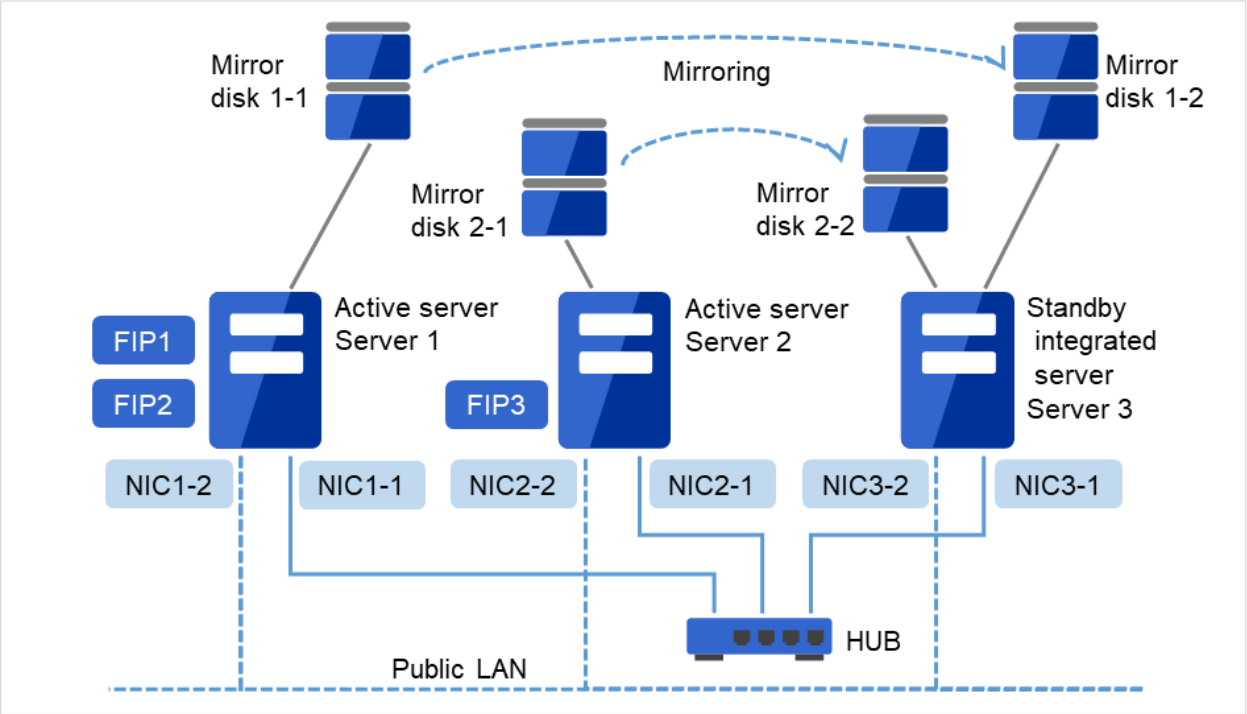


Fig. 6.6: Example of a 3-node cluster with mirror disks

- FIP1: to be accessed by Cluster WebUI clients
- FIP2: to be accessed by operation clients

The following table lists sample values of the cluster configuration data to achieve the cluster system shown above. These values and configuration are applied hereafter in the step-by-step instruction to create the cluster configuration data. When you actually set the values, you may need to modify them according to the cluster you are intending to create. For information on how you determine the values, refer to the "Reference Guide".

Example of configuration with three nodes

Target	Parameter	Value
Cluster configuration	Cluster name	cluster
	Number of servers	3
	Number of failover groups	3
	Number of monitor resources	10
Heartbeat resources	Number of kernel mode LAN heartbeats	2

continues on next page

Table 6.15 – continued from previous page

Target	Parameter	Value
First server information (Master server)	Server name[13]	server1
	Interconnect IP address (Dedicated)	192.168.0.1 (NIC1-1)
	Interconnect IP address (Backup)	10.0.0.1 (NIC1-2)
	Public IP address	10.0.0.1 (NIC1-2)
	Mirror disk connect 1	192.168.0.1
Second server information	Server name[Page 122, 13]	server2
	Interconnect IP address (Dedicated)	192.168.0.21 (NIC2-1)
	Interconnect IP address (Backup)	10.0.0.2 (NIC2-2)
	Public IP address	10.0.0.2 (NIC2-2)
	Mirror disk connect 1	192.168.0.2 (NIC2-1)
Third server information (Standby integrated server)	Server name[Page 122, 13]	server3
	Interconnect IP address (Dedicated)	192.168.0.3 (NIC3-1)
	Interconnect IP address (Backup)	10.0.0.3 (NIC3-2)
	Public IP address	10.0.0.3 (NIC3-2)
	Mirror disk connect 1	192.168.0.3 (NIC3-1)
Group resources for management (For the Cluster WebUI	Type	failover
	Group name	ManagementGroup
	Startup server	All servers
	Number of group resources	1

continues on next page

Table 6.15 – continued from previous page

Target	Parameter	Value
Group resources for management[14]	Type	Floating IP resource
	Group resource name	ManagementIP
	IP address	10.0.0.11 (FIP1)
Group resources for operation 1	Type	failover
	Group name	failover1
	Startup server	server1 -> server3
	Number of group resources	3
First group resources	Type	Floating IP resource
	Group resource name	fip1
	IP address	10.0.0.12 (FIP2)
Second group resources (Mirror disk 1-1 Mirror disk 1-2)	Type	Mirror disk resource
	Group resource name	md1
	Mirror partition device name	/dev/NMP1
	Mount point	/mnt/md1
	Data partition device name	/dev/disk/by-id/scsi-222850001557d9443-part2
	Cluster partition device name	/dev/disk/by-id/scsi-222850001557d9443-part1
	Data partition device name (server1 individual server setting)	/dev/disk/by-id/scsi-222850001557d9443-part2
	Cluster partition device name (server1 individual server setting)	/dev/disk/by-id/scsi-222850001557d9443-part1
	Data partition device name (server3 individual server setting)	/dev/disk/by-id/scsi-2222400015526436d-part2
	Cluster partition device name (server3 individual server setting)	/dev/disk/by-id/scsi-2222400015526436d-part1
	File system	ext4
	Mirror disk connect	mdc1
Third group resources (Mirror disk 2-1 Mirror disk 2-2)	Type	EXEC resource

continues on next page

Table 6.15 – continued from previous page

Target	Parameter	Value
	Group resource name	exec1
	Script	Standard Script
Group resources for operation 2	Type	failover
	Group name	failover2
	Startup server	server2 -> server3
	Number of group resources	3
First group resources	Type	Floating IP resource
	Group resource name	fip2
	IP address	10.0.0.13 (FIP3)
Second group resources	Type	Mirror disk resource
	Group resource name	md2
	Mirror partition device name	/dev/NMP2
	Mount point	/mnt/md2
	Data partition device name	/dev/disk/by-id/scsi-222850001557d9445-part2
	Cluster partition device name	/dev/disk/by-id/scsi-222850001557d9445-part1
	Data partition device name (server2 individual server setting)	/dev/disk/by-id/scsi-222850001557d9445-part2
	Cluster partition device name (server2 individual server setting)	/dev/disk/by-id/scsi-222850001557d9445-part1
	Data partition device name (server3 individual server setting)	/dev/disk/by-id/scsi-2222400015526436e-part2
	Cluster partition device name (server3 individual server setting)	/dev/disk/by-id/scsi-2222400015526436e-part1
	File system	ext4
	Mirror disk connect	mdc2
Third group resources	Type	EXEC resource
	Group resource name	exec2
	Script	Standard script
First monitor resources (Created by default)	Type	User mode monitor
	Monitor resource name	userw

continues on next page

Table 6.15 – continued from previous page

Target	Parameter	Value
Second monitor resources (Mirror disk 1-1 Mirror disk 1-2)	Type	Disk monitor
	Monitor resource name	diskw1
	Device name	/dev/disk/by-id/scsi-222850001557d9443-part2
	Device name (server1 individual server setting)	/dev/disk/by-id/scsi-222850001557d9443-part2
	Device name (server3 individual server setting)	/dev/disk/by-id/scsi-2222400015526436d-part2
	When error is detected	Stop the cluster service and shut down OS
	Monitoring method	READ(O_DIRECT)
Third monitor resources (Mirror disk 2-1 Mirror disk 2-2)	Type	Disk monitor
	Monitor resource name	diskw2
	Device name	/dev/disk/by-id/scsi-222850001557d9445-part2
	Device name (server2 individual server setting)	/dev/disk/by-id/scsi-222850001557d9445-part2
	Device name (server3 individual server setting)	/dev/disk/by-id/scsi-2222400015526436e-part2
	When error is detected	Stop the cluster service and shut down OS
	Monitoring method	READ(O_DIRECT)
	Startup server	server3
Fourth monitor resources (Automatically created after creating a ManagementIP resource)	Type	Floating IP monitor

continues on next page

Table 6.15 – continued from previous page

Target	Parameter	Value
	Monitor resource name	fipw1
	Monitored target	ManagementIP
	When error is detected	"ManagementGroup" group's Failover[15]
Fifth monitor resource (Automatically created after creating an fip1 resource)	Type	Floating IP monitor
	Monitor resource name	fipw2
	Monitored target	fip1
	When error is detected	"failover1" group's Failover[Page 122, 15]
Sixth monitor resource (Automatically created after creating an fip2 resource)	Type	Floating IP monitor
	Monitor resource name	fipw3
	Monitored target	fip2
	When error is detected	"failover2" group's Failover[Page 122, 15]
Seventh monitor resource	Type	IP monitor
	Monitor resource name	ipw1
	Monitor IP address	10.0.0.254 (gateway)
	When an error is detected	Failover of all groups[Page 122, 15]
Eighth monitor resource (Automatically created after creating mirror disk resource)	Type	Mirror disk connect monitor
	Monitor resource name	mdnw1
	Monitored mirror disk resource	md1
	When error is detected	No operation
Ninth monitor resource (Automatically created after creating mirror disk resource)	Type	Mirror disk connect monitor
	Monitor resource name	mdnw2
	Monitored mirror disk resource	md2
	When error is detected	No operation
Tenth monitor resource (Automatically created after creating mirror disk resource)	Type	mirror disk monitor
	Monitor resource name	mdw1
	Monitored mirror disk resource	md1
	When error is detected	No operation

continues on next page

Table 6.15 – continued from previous page

Target	Parameter	Value
Eleventh monitor resource (Automatically created after creating mirror disk resource)	Type	Mirror disk monitor
	Monitor resource name	mdw2
	Monitored mirror disk resource	md2
	When error is detected	No operation

[13] "Host name" represents the short name that excludes the domain name from a frequently qualified domain name (FQDN).

[14] You should have a floating IP address to access the Cluster WebUI. You can access the Cluster WebUI from your Web browser with a floating IP address when an error occurs.

[15] For the settings to execute a failover when all interconnect LANs are disconnected, see "Monitor resource details" in the "Reference Guide".

6.6 Creating the configuration data of a 3-node cluster

Creating the cluster configuration data involves creating a cluster, group resources, and monitor resources. The steps you need to take to create the data are described in this section.

Note: The following instruction can be repeated as many times as necessary. Most of the settings can be modified later by using the rename function or properties view function.

---

1. "6.6.1. *Creating a cluster*"

   Create a cluster.

   - "6.6.1. *Add a cluster*": Add a cluster you want to construct and enter its name.
   - "6.6.1. *Add a server*": Add a server. Make settings such as IP addresses.
   - "6.6.1. *Set up the network configuration*": Set up the network configuration between the servers in the cluster.
   - "6.6.1. *Set up the network partition resolution*": Set up the network partition resolution resource.

2. "6.6.2. *Creating a failover group*"

   Create a failover group that works as a unit when a failover occurs.

   - "6.6.2. *Add a failover group (group 1)*": Add a group used as a unit when a failover occurs.
   - "6.6.2. *Add a group resource (Floating IP resource)*": Add a resource that constitutes a group.
   - "6.6.2. *Add a group resource (Mirror disk resource)*": Add a resource that constitutes a group.
   - "6.6.2. *Add a group resource (EXEC resource)*": Add a resource that constitutes a group.
   - "6.6.2. *Add a failover group (group 2)*": Add a group used as a unit when a failover occurs.
   - "6.6.2. *Add a group resource (Floating IP resource)*": Add a resource that constitutes a group.
   - "6.6.2. *Add a group resource (Mirror disk resource)*": Add a resource that constitutes a group.
   - "6.6.2. *Add a group resource (EXEC resource)*": Add a resource that constitutes a group.

3. "6.6.3. *Creating monitor resources*"

   Create a monitor resource that monitors specified target in a cluster.

   - "6.6.3. *Add a monitor resource (Disk monitor resource)*": Add a monitor resource to use.
   - "6.6.3. *Add a monitor resource (Disk monitor resource)*": Add a monitor resource to use.
   - "6.6.3. *Add a monitor resource (IP monitor resource)*": Add a monitor resource to use.

4. "6.6.4. *Disabling the cluster operation*"

   Enable or disable the cluster operation.

6.6.1 Creating a cluster

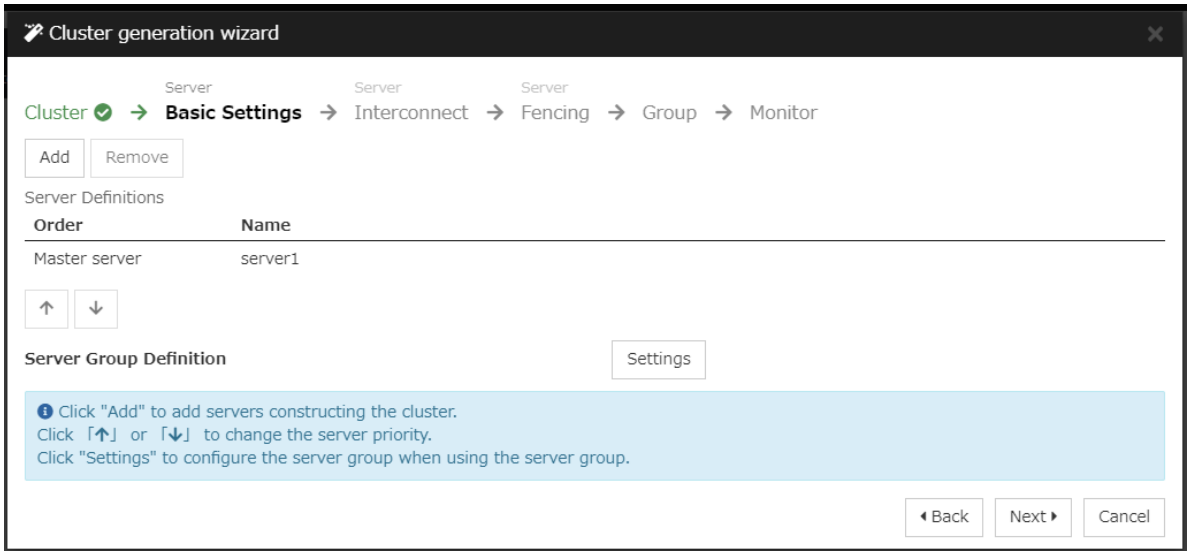
Create a cluster. Add a server that constitute a cluster and determine a heartbeat priority.

Add a cluster

1. In the config mode of Cluster WebUI, click **Cluster generation wizard** to display the **Cluster Generation Wizard**. In the **Language** field, select a language that is used on the machine that the Cluster WebUI works.

   Note: Only one language is available within one cluster. If multiple languages are used within a cluster, specify English to avoid garbled characters.

2. Enter the cluster name **cluster** in the **Cluster Name** box.
3. Enter the floating IP address (10.0.0.11) used to connect the Cluster WebUI in the **Management IP Address** box. Click **Next**.
   The **Basic Settings** window for the server is displayed. The server (server1) for which the IP address was specified as the URL when starting up the Cluster WebUI is registered in the list.



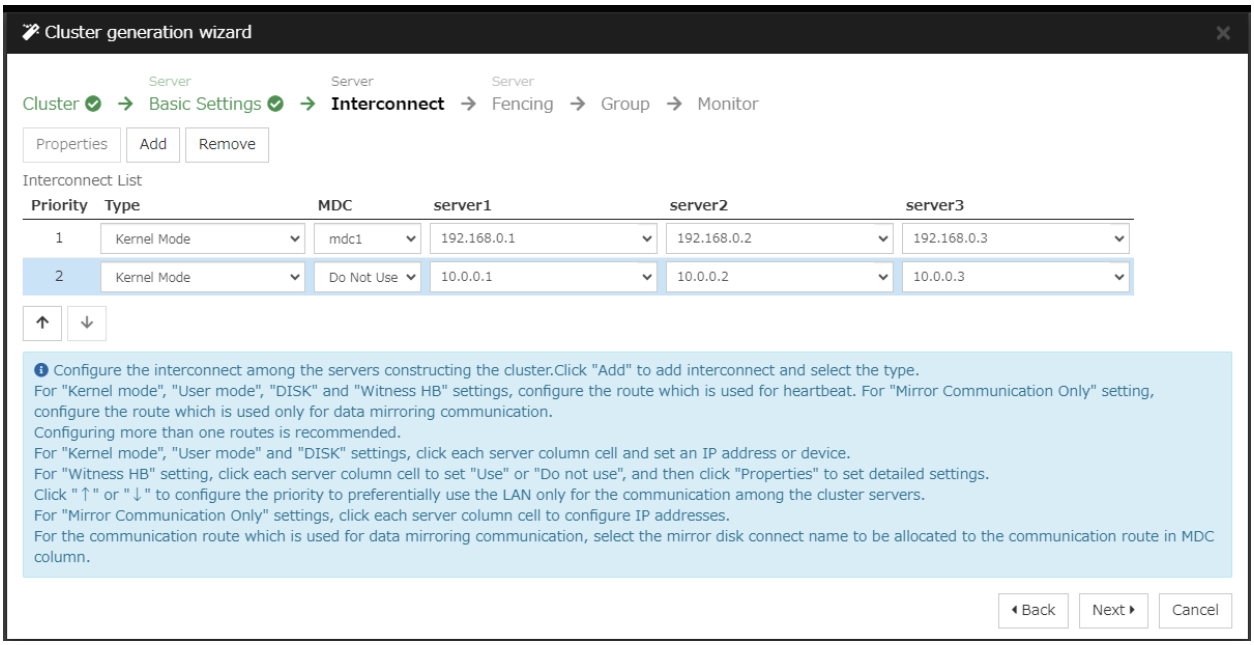
Add a server

Add the second and subsequent servers to the cluster.

1. In the **Server List**, click **Add**.
2. The **Add Server** dialog box is displayed. Enter the server name, FQDN name, or IP address of the second server, and then click **OK**. The second server (server2) is added to the **Server List**.
3. Add the third server (server3) in the same way.
4. Click **Next**.

Set up the network configuration

Set up the network configuration between the servers in the cluster.



1. Add or remove them by using **Add** or **Remove**, click a cell in each server column, and then select or enter the IP address. For a communication route to which some servers are not connected, leave the cells for the unconnected servers blank.
2. For a communication route used for heartbeat transmission (interconnect) , click a cell in the **Type** column, and then select **Kernel Mode**. Select **Mirror Communication Only** when using only for data mirroring communication of the mirror disk resource or hybrid disk resource, not using heartbeat.

   At least one communication route must be specified for the interconnect. Specify as many communication routes for the interconnect as possible.

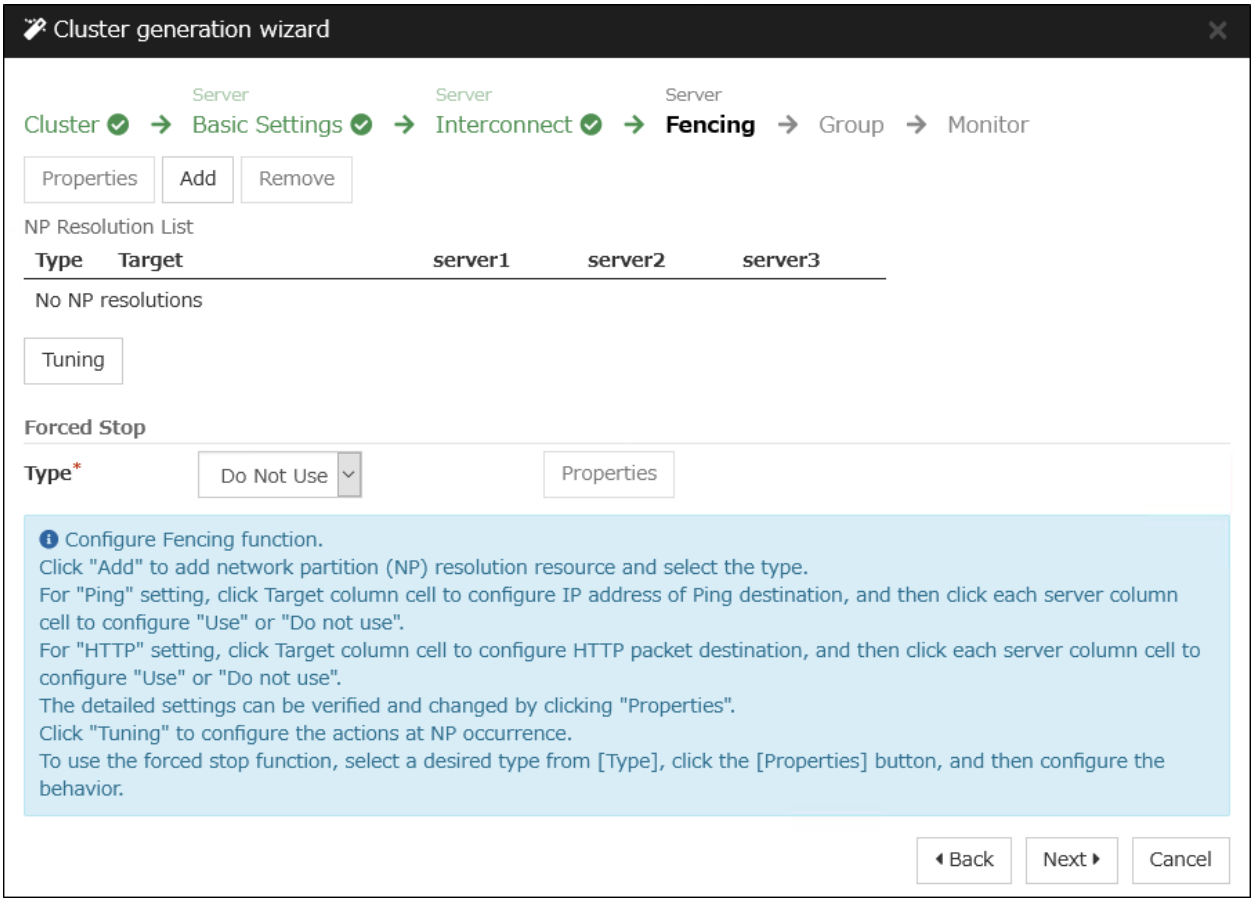
   If multiple interconnects are set up, the communication route for which the **Priority** column contains the smallest number is used preferentially for internal communication between the servers in the cluster. To change the priority, change the order of communication routes by selecting arrows.

3. When using DISK heartbeat, click **Type** column cell and select **DISK**. Click **Server name** column cell and select or enter disk device.
4. When using Witness heartbeat, click a cell in the **Type** column, and select **Witness**. Next, click **Properties**, and enter the address of Witness server for **Target Host**. Then enter the port number for **Service Port**. For servers that do not use Witness heartbeat, click the cells of those servers, and select **Do Not Use**.
5. When using object storage heartbeat, click a cell in the **Type** column , and select **Object Storage**. Next, click **Properties**, and enter values for other items according to the settings for **platform**. For servers that do not use object storage heartbeat, click the cell of each server, and select **Do Not Use**.
6. For a communication route used for data mirroring communication for mirror disk resources (mirror disk connect), click a cell in the **MDC** column, and then select the mirror disk connect name (mdc1 to mdc16) assigned to the communication route. Select **Not Used** for communication routes not used for data mirroring communication.

7. Click **Next**.

Set up the network partition resolution

Set up the network partition resolution resource.

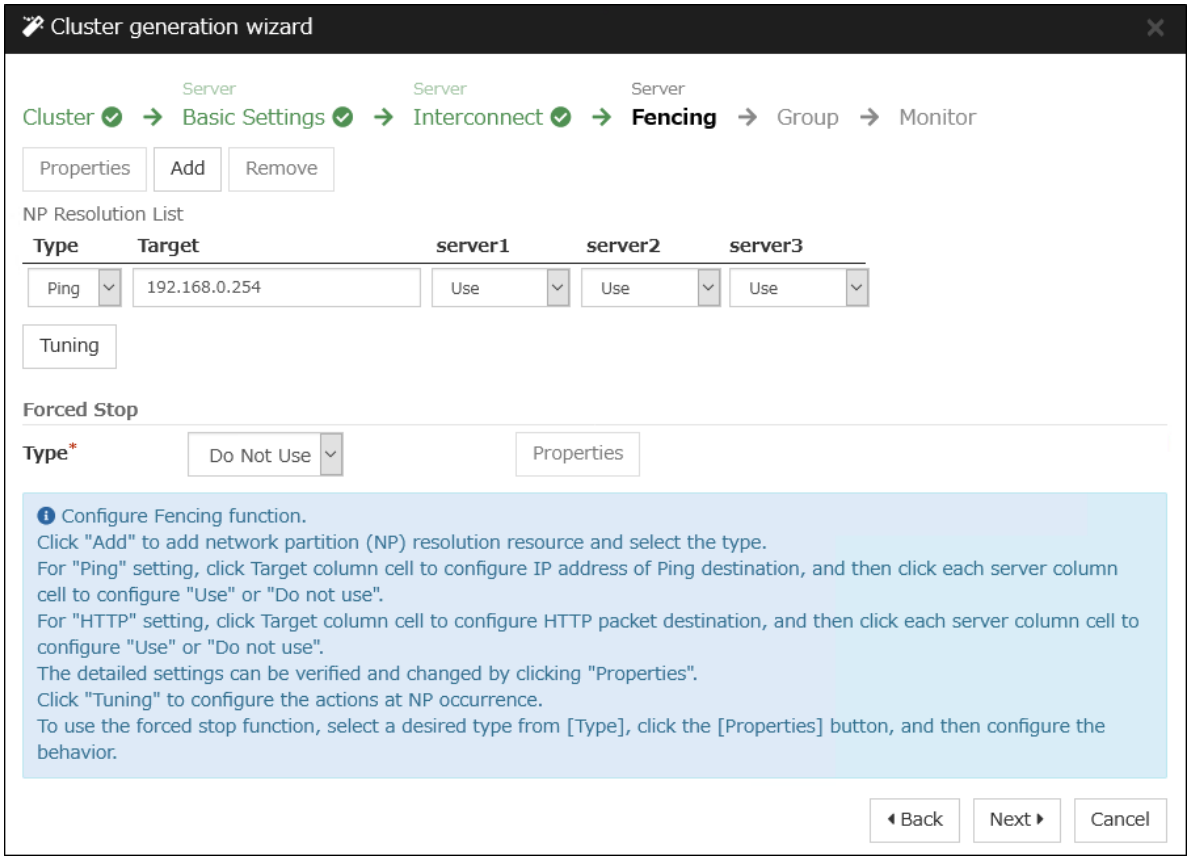


1. To use NP resolution in the PING mode, click **Add** and add a row to **NP Resolution List**, click **Type** and select **Ping**, click the cell of **Target**, and then enter the IP addresses of the ping destination target devices (such as a gateway). When multiple IP addresses separated by commas are entered, they are regarded as isolated from the network if there is no ping response from any of them.

   If the PING mode is used only on some servers, set the cell of the server not to be used to **Do Not Use**.

   If some ping-related parameters must be changed from their default values, select **Properties**, and then specify the settings in the **Ping NP Properties** dialog box.

   For the setup example in this chapter, a row for the PING mode is added and 192.168.0.254 is specified for **Target**.



2. To use NP resolution in the HTTP mode, add a row to **NP Resolution List** by clicking **Add**, click the cell in **Type** column, and select **HTTP**. Then click **Properties**, enter the address of the Web server in **Target Host**, and enter the port number in **Service Port**. If the HTTP mode is used only on some servers, set the cells of the servers not to be used to **Do Not Use**.

   For the setup example in this chapter, the HTTP mode is not used.

3. Specify the operation to perform when a network partition is detected. Select **Stop the cluster service** or **Stop the cluster service and shutdown OS**.

   For the setup example in this chapter, **Stop the cluster service** is selected.

4. Click **Next**.

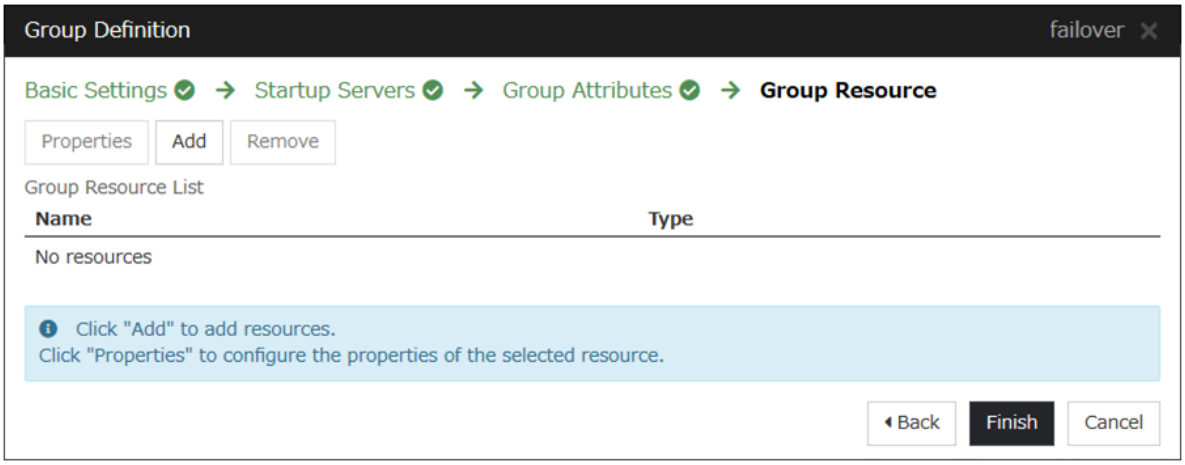
6.6.2 Creating a failover group

Add a failover group that executes an application to the cluster. (Below, *failover group* is sometimes abbreviated to *group*.)

Add a failover group (group 1)

Set up a group that works as a unit of failover at the time an error occurs.

1. In the **Group List**, click **Add**.
2. The **Group Definition** is displayed.
   Enter the group name (failover1) in the Name box, and then click **Next**.
3. Specify a server that the failover group can start up. In the setting example of this chapter, clear the **Failover is possible at all servers** check box and add **server1** and **server2** from the **Available Servers** to the **Servers that can run the Group** in this order.
4. Specify each attribute value of the failover group. Because all the default value are used in the setting example of this chapter, click **Next**.
   The **Group Resource** is displayed.



Add a group resource (Floating IP resource)

Add a group resource, a configuration element of the group, to the failover group you have created in "6.6.2. *Add a failover group (group 1)*".

1. Click **Add** in the **Group Resource List**.
2. The **Resource Definition of Group | failover1** dialog box is displayed. Select the group resource type **Floating IP resource** in the **Type** box, and enter the group name **fip1** in the **Name** box. Click **Next**.
3. The **Dependent Resources** page is displayed. Specify nothing. Click **Next**.
4. **Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** are displayed. Click **Next**.
5. Enter IP address (10.0.0.12) to **IP Address** box. Click **Finish**.

Add a group resource (Mirror disk resource)

1. In the **Group Resource List**, click **Add**.
2. In the **Resource Definition of Group | failover1** dialog box, select the group resource type **Mirror disk resource** in the **Type** box, and enter the group resource name **md1** in the **Name** box. Click **Next**.

   Note: If a Mirror disk resource does not appear in the **Type** box, check whether the EXPRESSCLUSTER X Replicator license has been registered, then click the **Get License Info** button.

3. The **Dependent Resources** page is displayed. Specify nothing. Click **Next**.
4. **Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** are displayed. Click **Next**.
5. Select the mirror partition device name **/dev/NMP1** in the **Mirror Partition Device Name** box. Enter the mount point **/mnt/md1**, the data partition device name **/dev/disk/by-id/scsi-222850001557d9443-part2**, and the cluster partition device name **/dev/disk/by-id/scsi-222850001557d9443-part1** in the respective box. In the **File System** dialog box, select the file system **ext4**.
6. Click **Select** in **Mirror Disk Connect**. Select **2** of **Order**, and click **Remove**. Confirm that only **1** of **Order** is selected in the **Mirror Disk Connects** list. Click **OK**.
7. Select **server1** tab In the **Resource Definition of Group | failover1** dialog box, and check **Set Up Individually** on. Re-enter the mount point **/mnt/md1**, the data partition device name **/dev/disk/by-id/scsi-222850001557d9443-part2**, and the cluster partition device name **/dev/disk/by-id/scsi-222850001557d9443-part1** in the respective box.
8. Select **server3** tab In the **Resource Definition of Group | failover1** dialog box, and check **Set Up Individually** on. Re-enter the mount point **/mnt/md1**, the data partition device name **/dev/disk/by-id/scsi-2222400015526436d-part2**, and the cluster partition device name **/dev/disk/by-id/scsi-2222400015526436d-part1** in the respective box.
9. In **Resource Definition of Group | failover1**, click **Finish**.

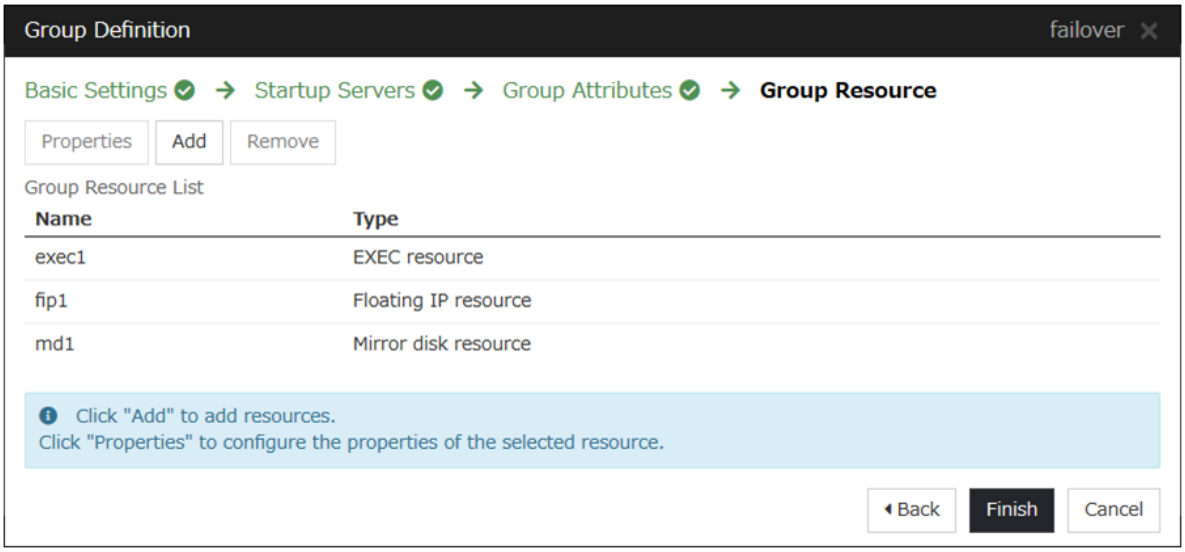
Note: For disk device names(e.g., cluster partition, data partition), it is recommended to use persistent device name (e.g., /dev/disk/by-id/[device name], /dev/disk/by-partuuid/[device name]).If non-persistent device names (e.g., /dev/sdX or /dev/nvmeX) are specified, an unintended device may be mounted when device file names are reassigned during OS startup, which could result in data corruption.

Add a group resource (EXEC resource)

Add an EXEC resource that can start and stop the application from a script.

1. In the **Group Resource List**, click **Add**.
2. In the **Resource Definition of Group | failover1** dialog box, select the group resource **execute resource** in the **Type** box, and enter the group name **exec1** in the **Name** box. Click **Next**.
3. The **Dependent Resources** page is displayed. Specify nothing. Click **Next**.
4. **Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** are displayed. Click **Next**.
5. Select **Script created with this product**. Edit the script if applications to be used in EXPRESSCLUSTER are already decided. Users may edit this script to describe the procedure to start and stop a group of applications. Click **Finish**.

The **Group Resource List** of the **failover1** should look similar to the following:



6. Click **Finish**.

Add a failover group (group 2)

Set up a group that works as a unit of failover at the time an error occurs.

1. In the **Group List**, click **Add**.
2. The **Group Definition** is displayed.
   Enter the group name (failover2) in the Name box, and then click **Next**.
3. Specify a server that the failover group can start up. In the setting example of this chapter, clear the **Failover is possible at all servers** check box and select **server2** from the **Available Servers** and click Add. Server2 is added to the **Servers that can run the Group**. And in the same way, add server3 and click **Next**.
4. Specify each attribute value of the failover group. Because all the default value are used in the setting example of this chapter, click **Next**.
   The **Group Resource** is displayed.

Add a group resource (Floating IP resource)

Add a group resource, a configuration element of the group, to the failover group you have created in "6.6.2. *Add a failover group (group 2)*".

1. Click **Add** in the **Group Resource List**.
2. In the **Resource Definition of Group | failover2** dialog box, select the group resource type **Floating IP resource** in the **Type** box, and enter the group name **fip2** in the **Name** box. Click **Next**.
3. A page for setting up a dependency is displayed. Click **Next**.
4. **Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** are displayed. Click **Next**.
5. Enter IP address (10.0.0.13) to **IP Address** box. Click **Finish**.

Add a group resource (Mirror disk resource)

1. Click **Add** in the **Group Resource**.
2. In the **Resource Definition of Group | failover2** dialog box, select the group resource type **mirror disk resource** in the **Type** box, and enter the group name **md2** in the **Name** box. Click **Next**.

   Note: If a Mirror disk resource does not appear in the **Type** box, check whether the EXPRESSCLUSTER X Replicator license has been registered, then click the **Get License Info** button.

3. A page for setting up a dependency is displayed. Click **Next**.
4. **Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** are displayed. Click **Next**.
5. Select the mirror partition device name **/dev/NMP2** in the **Mirror Partition Device Name** box. Enter the mount point **/mnt/md2**, the data partition device name **/dev/disk/by-id/scsi-222850001557d9445-part2**, and the cluster partition device name **/dev/disk/by-id/scsi-222850001557d9445-part1** in the respective box. In the **File System** dialog box, select the file system **ext4**.
6. Click **Select** in **Mirror Disk Connect**. Select **2** of **Order**, and click **Remove**. Confirm that only **2** of **Order** is selected in the **Mirror Disk Connects** list. Click **OK**.
7. Select **server2** tab In the **Resource Definition of Group | failover2** dialog box, and check **Set Up Individually** on. Re-enter the mount point **/mnt/md1**, the data partition device name **/dev/disk/by-id/scsi-222850001557d9445-part2**, and the cluster partition device name **/dev/disk/by-id/scsi-222850001557d9445-part1** in the respective box.
8. Select **server3** tab In the **Resource Definition of Group | failover2** dialog box, and check **Set Up Individually** on. Re-enter the mount point **/mnt/md1**, the data partition device name **/dev/disk/by-id/scsi-2222400015526436e-part2**, and the cluster partition device name **/dev/disk/by-id/scsi-2222400015526436e-part1** in the respective box.
9. In **Resource Definition of Group | failover2**, click **Finish**.

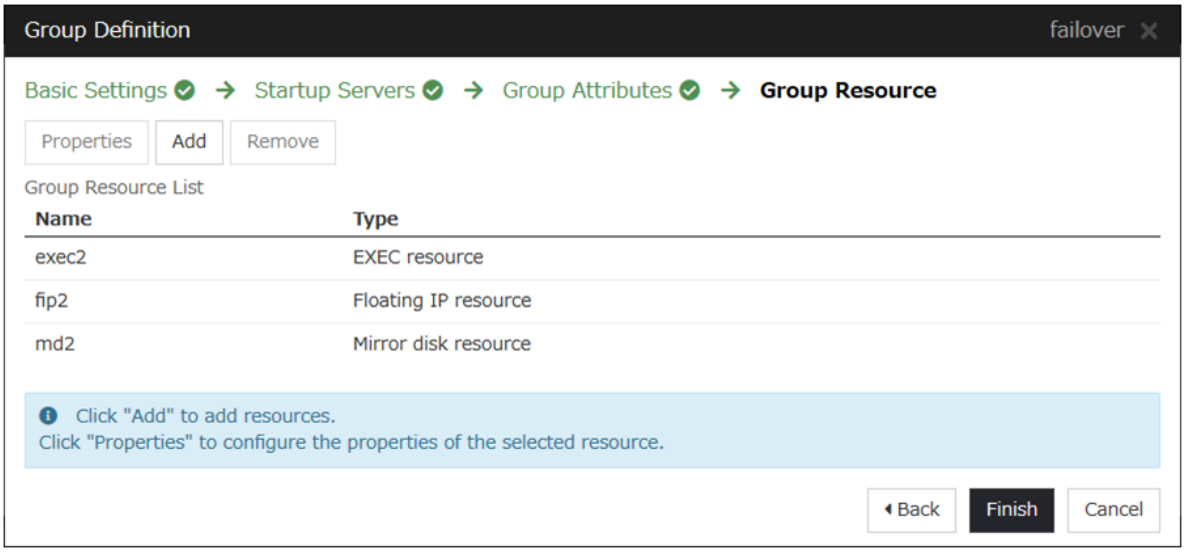
Note: For disk device names(e.g., cluster partition, data partition), it is recommended to use persistent device name (e.g., /dev/disk/by-id/[device name], /dev/disk/by-partuuid/[device name]).If non-persistent device names (e.g., /dev/sdX or /dev/nvmeX) are specified, an unintended device may be mounted when device file names are reassigned during OS startup, which could result in data corruption.

Add a group resource (EXEC resource)

Add an EXEC resource that can start and stop the application from a script.

1. Click **Add** in the **Group Resource List**.
2. In the **Resource Definition of Group | failover2** dialog box, select the group resource **EXEC resource** in the **Type** box, and enter the group name **exec2** in the **Name** box. Click **Next**.
3. A page for setting up a dependency is displayed. Click **Next**.
4. Select **Script created with this product**. Users may edit this script to describe the procedure to start and stop a group of applications. Edit the script if applications to be used in EXPRESSCLUSTER are already decided. Click **Next**.
5. **Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** are displayed. Click **Next**.

When a cluster system is a data mirror type, the **Group Resource** of the **failover2** should look similar to the following:



6. Click **Finish**.

6.6.3 Creating monitor resources

Add a monitor resource that monitors a specified target to the cluster.

Add a monitor resource (Disk monitor resource)

Add monitor resources to monitor the target disk. disk monitor resource is used as an example of a monitor resource to be added.

1. In the **Group** list, click **Next**.
2. In the **Monitor Resource List**, click **Add**.
3. In the **Monitor Resource Definition** dialog box, the first monitor resource information is created by default when the cluster name is defined. The monitor resource information from seventh to tenth is created by default when Mirror disk resource is added. Select the monitor resource type (Disk monitor) in the **Type** box, and enter the monitor resource name (diskw1) in the **Name** box. Click **Next**.
4. Configure the monitor settings. Do not change the default value and click **Next**.
5. Enter **Method** (READ(O_DIRECT)) and **Monitor Target**(/dev/disk/by-id/scsi-222850001557d9443-part2).
6. Select **server1** tab In the **Monitor Resource Definition | diskw** dialog box, and check **Set Up Individually** on. Re-enter **Method** (READ(O_DIRECT)) and **Monitor Target**(/dev/disk/by-id/scsi-222850001557d9443-part2).
7. Select **server3** tab In the **Monitor Resource Definition | diskw** dialog box, and check **Set Up Individually** on. Re-enter **Method** (READ(O_DIRECT)) and **Monitor Target**(/dev/disk/by-id/scsi-2222400015526436d-part2).
8. Click **Next**.
9. Set **Recovery Target**. Click **Browse**.
10. Select **LocalServer** on the tree view being displayed, and click **OK**. **LocalServer** is set to **Recovery Target**.
11. Select **Stop the cluster service and shut down OS** in the **Final Action** box, and click **Finish**.

Add a monitor resource (Disk monitor resource)

Add monitor resources to monitor the target disk. Disk monitor resource is used as an example of a monitor resource to be added.

1. In the **Monitor Resource List**, click **Add**.
2. In the **Monitor Resource Definition** dialog box, select the monitor resource type (Disk monitor) in the **Type** box, and enter the monitor resource name (diskw2)in the **Name** box. Click **Next**.
3. Enter **Method** (READ(O_DIRECT)) and **Monitor Target**(/dev/disk/by-id/scsi-222850001557d9445-part2).
4. Select **server2** tab In the **Monitor Resource Definition | diskw** dialog box, and check **Set Up Individually** on. Re-enter **Method** (READ(O_DIRECT)) and **Monitor Target**(/dev/disk/by-id/scsi-222850001557d9445-part2).
5. Select **server3** tab In the **Monitor Resource Definition | diskw** dialog box, and check **Set Up Individually** on. Re-enter **Method** (READ(O_DIRECT)) and **Monitor Target**(/dev/disk/by-id/scsi-2222400015526436e-part2).
6. Click **Next**.
7. Set **Recovery Target**. Click **Browse**.
8. Select **LocalServer** on the tree view being displayed, and click **OK**. **LocalServer** is set to **Recovery Target**.
9. Select **Stop the cluster service and shut down OS** in the **Final Action** box, and click **Finish**.

Add a monitor resource (IP monitor resource)

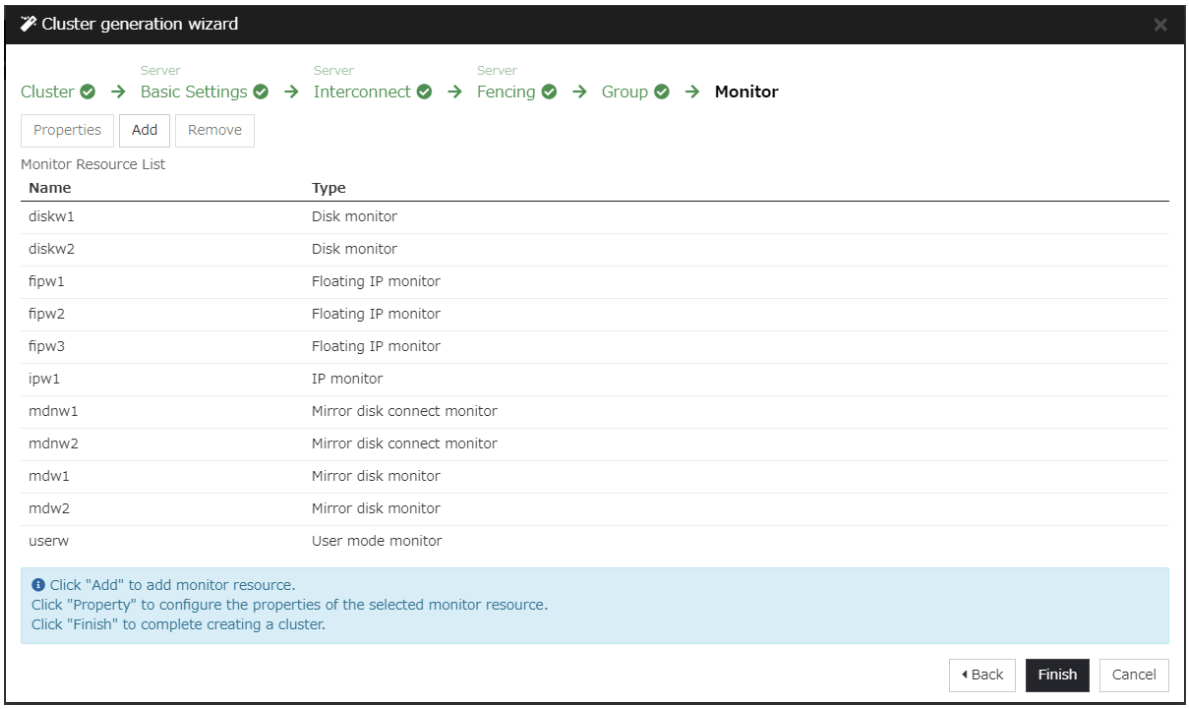
1. In the **Monitor Resource List**, click **Add**.
2. In the **Monitor Resource Definition** dialog box select the monitor resource type **IP monitor** in the **Type** box, and enter the monitor resource name **ipw1** in the **Name** box. Click **Next**.
3. Enter the monitor settings. Change nothing from the default values. Click **Next**.
4. Click **Add**.
   Enter the IP address to be monitored (10.0.0.254) in the **IP Address** box, and then click **OK**.

   Note: For the monitoring target of the IP monitor resource, specify the IP address of a device (such as a gateway) that is assumed to always be active on the public LAN.

   ---

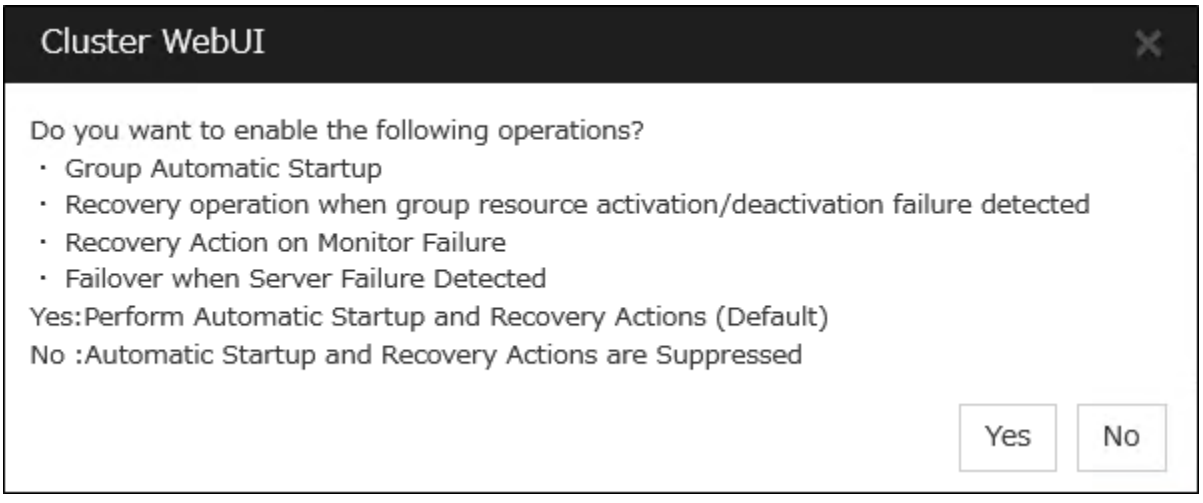
5. The entered IP address is specified in the **IP Addresses** list. Click **Next**.
6. Specify the recovery target. Click **Browse**.
7. Select **All Groups** in the tree view and click **OK**. **All Groups** is set to **Recovery Target**.
8. Click **Finish**

   The **Monitor Resource List** displays resources as shown below. When the Mirror disk resource is used, mdnw1 and mdw1 will also appear in the list.



6.6.4 Disabling the cluster operation

When you click **Finish** after creating a monitor resource, the following popup message appears:



Clicking **No** disables automatic group startup, recovery on the activation/deactivation failure of a group resource, recovery on the failure of a monitor resource, failover on a server failure, action on NP occurrence, and forced-stop action. When you start a cluster for the first time after creating the cluster configuration data, it is recommended that you disable the automatic startup and the recovery and check the cluster configuration data for errors.

To disable the cluster operation, go to **Cluster properties** -> **Extension tab** tab -> **Disable cluster operation**.

Note: Disabling the recovery on the failure of a monitor resource is not applied to user mode monitor resources.

Creating the cluster configuration data is completed. Proceed to "6.11. *Creating a cluster*".

6.7 Checking the values to be configured in the cluster environment with three nodes (hybrid type)

6.7.1 Sample cluster environment

As shown in the diagram below, this chapter uses a configuration with three nodes hybrid type as a cluster example.

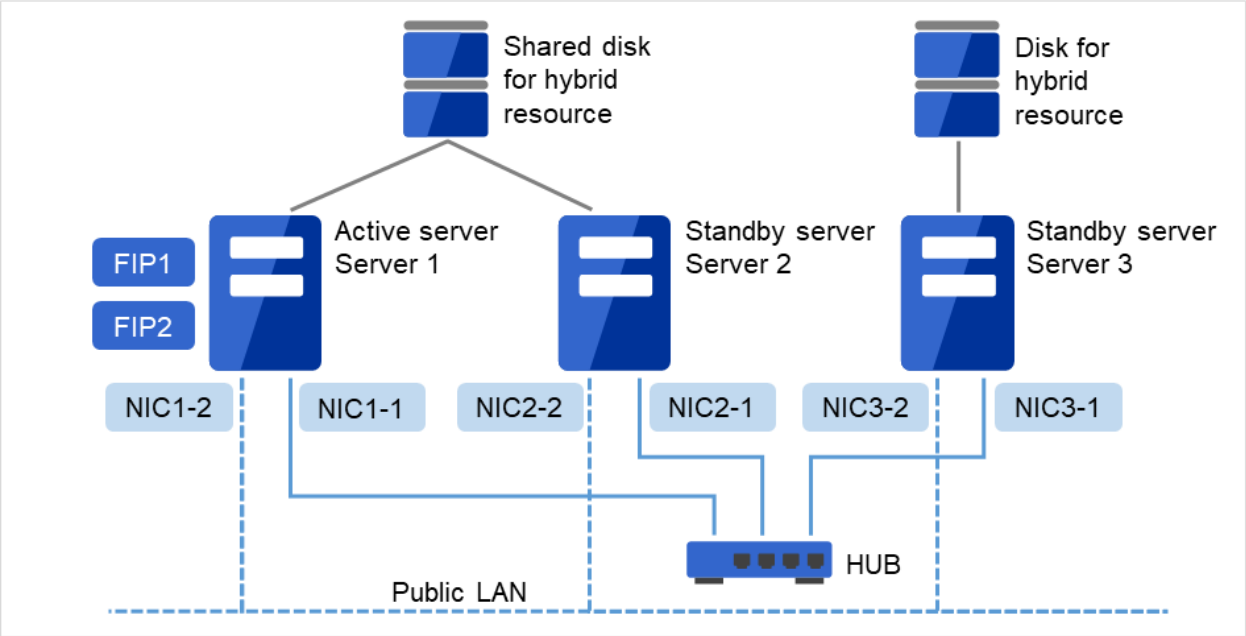


Fig. 6.7: Example of a 3-node cluster (hybrid)

- FIP1: to be accessed by Cluster WebUI clients
- FIP2: to be accessed by operation clients

The following table lists sample values of the cluster configuration data to achieve the cluster system shown above. These values and configuration are applied hereafter in the step-by-step instruction to create the cluster configuration data. When you actually set the values, you may need to modify them according to the cluster you are intending to create. For information on how you determine the values, refer to the "Reference Guide".

Example of configuration with three nodes

Target	Parameter	Value
Cluster configuration	Cluster name	cluster
	Number of servers	3
	Number of failover groups	2
	Number of server groups	2
	Number of monitor resources	6
	Server Down Notification	Off (not used)
Heartbeat resources	Number of kernel mode LAN heartbeats	2
	Number of disk heartbeats	1

continues on next page

Table 6.16 – continued from previous page

Target	Parameter	Value
First server information (Master server)	Server name	server1
	Interconnect IP address (Dedicated)	192.168.0.1
	Interconnect IP address (Backup)	10.0.0.1
	Public IP address	10.0.0.1
	Disk heartbeat device	/dev/disk/by-id/scsi-222850001557d9443-part3
	Mirror disk connect 1	192.168.0.1
	Mirror disk connect 2	-
Second server information	Server name	server2
	Interconnect IP address (Dedicated)	192.168.0.2
	Interconnect IP address (Backup)	10.0.0.2
	Public IP address	10.0.0.2
	Disk heartbeat device	/dev/disk/by-id/scsi-222850001557d9443-part3
	Mirror disk connect	192.168.0.2
Third server information	Server name	server3
	Interconnect IP address (Dedicated)	192.168.0.3
	Interconnect IP address (Backup)	10.0.0.3
	Public IP address	10.0.0.3
	Disk heartbeat device	Not configured
	Mirror disk connect	192.168.0.3
First server group	Server group name	svg1

continues on next page

Table 6.16 – continued from previous page

Target	Parameter	Value
	Belonging servers	server1 server2
Second server group	Server group name	svg2
	Belonging servers	server3
Group for management (For the Cluster WebUI)	Type	failover
	Group name	ManagementGroup
	Startup server	All servers
	Number of group resources	1
Group resources for management	Type	Floating IP resource
	Group resource name	ManagementIP
	IP address	10.0.0.11
Group resources for operation	Type	failover
	Group name	failover1
	Startup server	server1 -> server 2 -> server3
	Server Group	svg1 -> svg2
	Number of group resources	3
First group resources	Type	Floating IP resource
	Group resource name	fip1
	IP address	10.0.0.12
Second group resources (Shared disk for hybrid resource Disk for hybrid resource)	Type	Hybrid disk resource
	Group resource name	hd1
	Mirror partition device name	/dev/NMP1
	Mount point	/mnt/hd1
	Data partition device name	/dev/disk/by-id/scsi-222850001557d9443-part2
	Data partition device name (server1 individual server setting)	/dev/disk/by-id/scsi-222850001557d9443-part2
	Data partition device name (server2 individual server setting)	/dev/disk/by-id/scsi-222850001557d9443-part2

continues on next page

Table 6.16 – continued from previous page

Target	Parameter	Value
	Data partition device name (server3 individual server setting)	/dev/disk/by-id/scsi-2222400015526436d-part2
	Cluster partition device name	/dev/disk/by-id/scsi-222850001557d9443-part1
	Cluster partition device name (server1 individual server setting)	/dev/disk/by-id/scsi-222850001557d9443-part1
	Cluster partition device name (server2 individual server setting)	/dev/disk/by-id/scsi-222850001557d9443-part1
	Cluster partition device name (server3 individual server setting)	/dev/disk/by-id/scsi-2222400015526436d-part1
	File system	ext4
	Mirror disk connect	mdc1
Third group resources	Type	EXEC resource
	Group resource name	exec1
	Script	Standard Script
First monitor resources (Created by default)	Type	User mode monitor
	Monitor resource name	userw
Second monitor resources	Type	diskw
	Monitor resource name	diskw1
	Monitored target	/dev/disk/by-id/scsi-222850001557d9443-part2
	Monitored target (server1 individual server setting)	/dev/disk/by-id/scsi-222850001557d9443-part2
	Monitored target (server2 individual server setting)	/dev/disk/by-id/scsi-222850001557d9443-part2
	Monitored target (server3 individual server setting)	/dev/disk/by-id/scsi-2222400015526436d-part2
	Monitoring method	READ(O_DIRECT)

continues on next page

Table 6.16 – continued from previous page

Target	Parameter	Value
	When error is detected	Stop the cluster service and shut down OS
Third monitor resources (Automatically created after creating a ManagementIP resource)	Type	Floating IP monitor
	Monitor resource name	fipw1
	Monitored target	ManagementIP
	When error is detected	"ManagementGroup" group's Failover
Fourth monitor resources (Automatically created after creating an fip1 resource)	Type	Floating IP monitor
	Monitor resource name	fipw2
	Monitored target	fip1
	When error is detected	"failover1" group's Failover
Fifth monitor resource	Type	IP monitor
	Monitor resource name	ipw1
	Monitor target	10.0.0.254 (gateway)
	When an error is detected	Failover of all groups
Sixth monitor resource (Automatically created after creating hybrid disk resource)	Type	hybrid disk connect monitor
	Monitor resource name	hdnw1
	Monitored hybrid disk resource	hd1
	When error is detected	No operation
Seventh monitor resource (Automatically created after creating hybrid disk resource)	Type	Hybrid disk monitor
	Monitor resource name	hdw1
	Monitored hybrid disk resource	hd1
	When error is detected	No operation

6.8 Creating the configuration data of a 3-node cluster (hybrid type)

Creating the cluster configuration data involves creating a cluster, server group, group, monitor resources and modifying cluster properties. The steps you need to take to create the data are described in this section.

Note: The following instruction can be repeated as many times as necessary. Most of the settings can be modified later by using the rename function or properties view function.

1. "6.8.1. *Creating a cluster*"

   Create a cluster.

   - "6.8.1. *Add a cluster*": Add a cluster. Make settings such as IP addresses.
   - "6.8.1. *Add a server*": Add a server. Make settings such as IP addresses.
   - "6.8.1. *Create a server group*": Create a server group.
   - "6.8.1. *Set up the network configuration*": Set up the network configuration between the servers in the cluster.
   - "6.8.1. *Set up the network partition resolution*": Set up the network partition resolution resource.

2. "6.8.2. *Creating a failover group*"

   Create a failover group that works as a unit when a failover occurs.

   - "6.8.2. *Add a failover group*": Add a group used as a unit when a failover occurs.
   - "6.8.2. *Add a group resource (Floating IP address)*": Add a resource that constitutes a group.
   - "6.8.2. *Add a group resource (Hybrid disk resource)*": Add a resource that constitutes a group.
   - "6.8.2. *Add a group resource (EXEC resource)*": Add a resource that constitutes a group.

3. "6.8.3. *Creating monitor resources*"

   Create a monitor resource that monitors specified target in a cluster.

   - "6.8.3. *Add a monitor resource (Disk monitor resource)*": Add a monitor resource to use.
   - "6.8.3. *Add a monitor resource (IP monitor resource)*": Add a monitor resource to use.

4. "6.8.4. *Disabling the cluster operation*"

   Enable or disable the cluster operation.

5. "6.8.5. *Modify cluster properties*"

   Modify the settings not to perform server down notification.

6.8.1 Creating a cluster

Create a cluster. Add a server that constitute a cluster and determine a heartbeat priority.

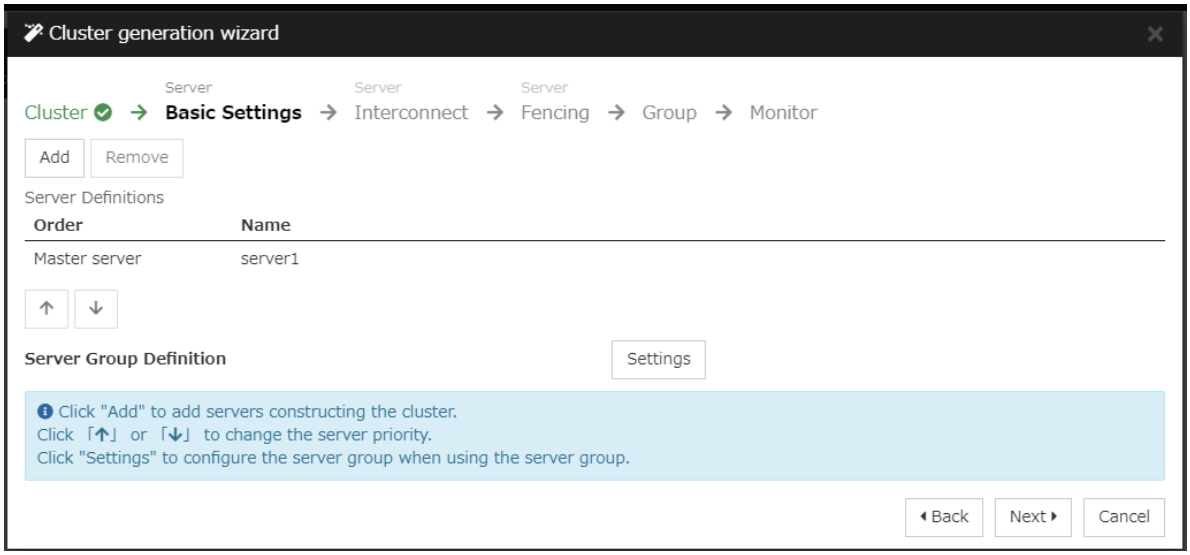
Add a cluster

1. In the config mode of Cluster WebUI, click **Cluster generation wizard** to display the **Cluster Generation Wizard** dialog box. In the **Language** field, select a language that is used on the machine that the Cluster WebUI works.

   Note: Only one language is available within one cluster. If multiple languages are used within a cluster, specify English to avoid garbled characters.

2. Enter the cluster name **cluster** in the **Name** box.
3. Enter the floating IP address (10.0.0.11) used to connect the Cluster WebUI in the **Management IP Address** box. Click **Next**.

   The **Basic Settings** window for the server is displayed. The server (server1) for which the IP address was specified as the URL when starting up the Cluster WebUI is registered in the list.



Add a server

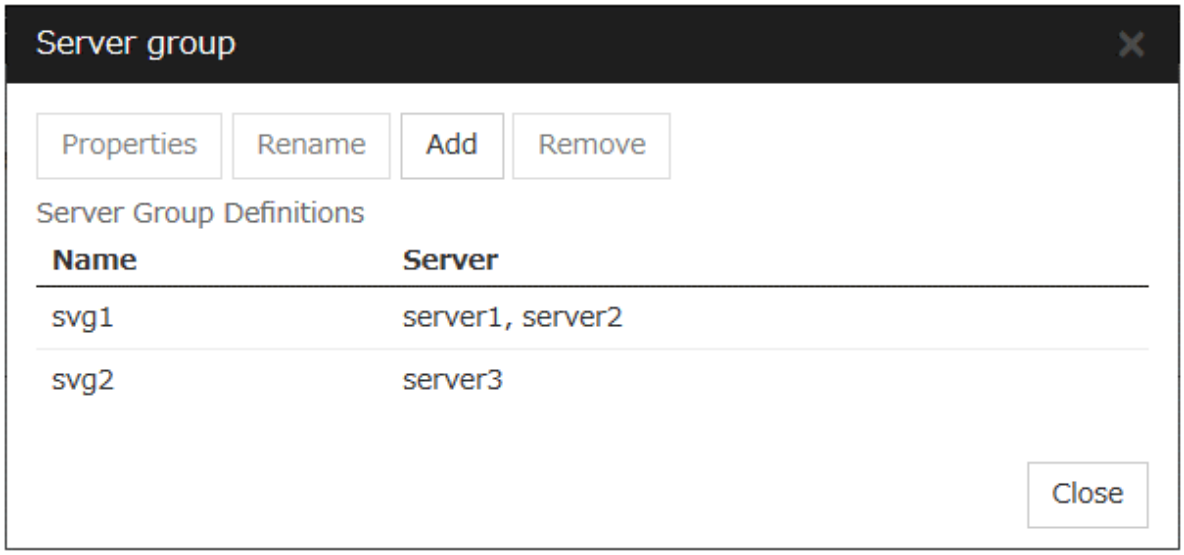
Add the second and subsequent servers to the cluster.

1. In the **Server Definitions**, click **Add**.
2. The **Server Addition** dialog box is displayed. Enter the server name, FQDN name, or IP address of the second server, and then click **OK**. The second server (server2) is added to the **Server Definitions**.
3. Add the third server (server3) in the same way.
4. When using hybrid disks, click **Settings** and create two server groups (svg1 and svg2), add **server1** and **server2** to **svg1** and add **server3** to **svg2**.
5. Click **Next**.

Create a server group

When configuring hybrid disks, create the server groups connecting to the disks for each disk to be mirrored before creating the hybrid disk resource.

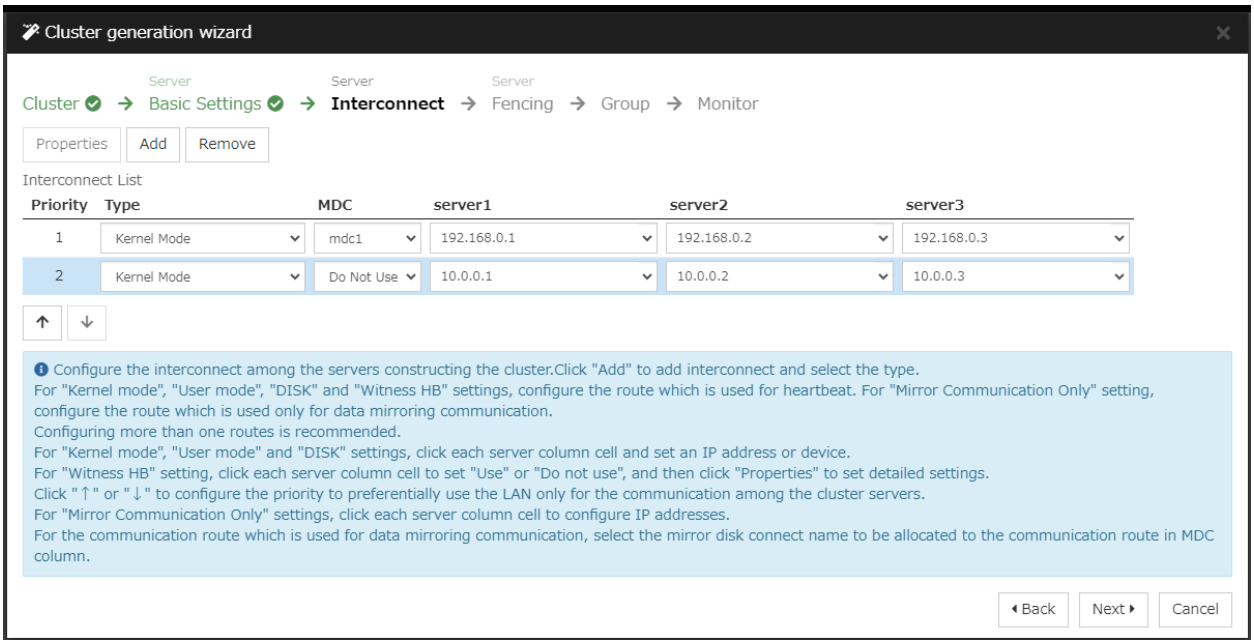
1. In the **Server Group Definition**, click **Settings**.
2. In the **Server Group Definitions**, click **Add**.
3. The **Server Group Definition** dialog box is displayed. Enter server group name (svg1) in the **Name** box, and then click **Next**.
4. In the **Available Servers**, click **server1**, and click **Add**. **Server1** is added to the **Servers that can run the Group**. In the same way, add **server2**.
5. Click **OK**. **Svg1** is displayed in the **Server Group Definitions**.
6. Click **Add** to open **Server Group Definition**, enter server group name (svg2) in the **Name** box, and then click **Next**.
7. Click **server3** in the **Available Server**s, and click **Add.** **Server3** is added to the **Servers that can run the Group**.
8. Click **OK**. **Svg1** and **svg2** is displayed in the **Server Group Definitions**.



9. Click **Close**.
10. Click **Next**.

Set up the network configuration

Set up the network configuration between the servers in the cluster.



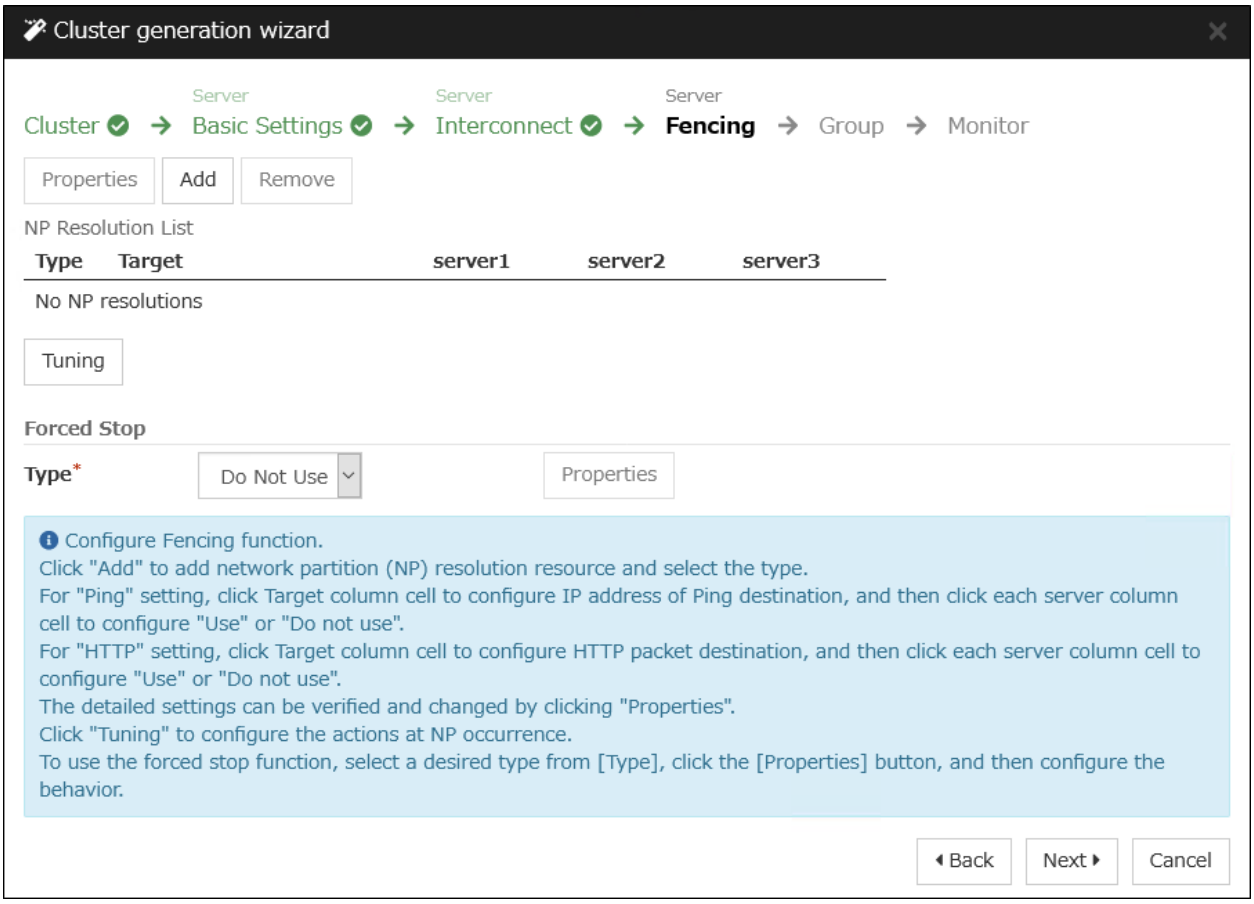
1. Add or remove them by using **Add** or **Remove**, click a cell in each server column, and then select or enter the IP address. For a communication route to which some servers are not connected, leave the cells for the unconnected servers blank.
2. For a communication route used for heartbeat transmission (interconnect) , click a cell in the **Type** column, and then select **Kernel Mode**. When using only for the data mirroring communication of the mirror disk resource or the hybrid disk resource and not using for the heartbeat, select **Mirror Communication Only**.

   At least one communication route must be specified for the interconnect. Specify as many communication routes for the interconnect as possible.

   If multiple interconnects are set up, the communication route for which the **Priority** column contains the smallest number is used preferentially for internal communication between the servers in the cluster. To change the priority, change the order of communication routes by selecting arrows.
3. When using Witness heartbeat, click a cell in the **Type** column, and select **Witness**. Next, click **Properties**, and enter the address of Witness server for **Target Host**. Then enter the port number for **Service Port**. For servers that do not use Witness heartbeat, click the cells of those servers, and select **Do Not Use**.
4. When using object storage heartbeat, click a cell in the **Type** column , and select **Object Storage**. Next, click **Properties**, and enter values for other items according to the settings for **platform**. For servers that do not use object storage heartbeat, click the cell of each server, and select **Do Not Use**.
5. For a communication route used for data mirroring communication for mirror disk resources (mirror disk connect), click a cell in the **MDC** column, and then select the mirror disk connect name (mdc1 to mdc16) assigned to the communication route. Select **Not Used** for communication routes not used for data mirroring communication.
6. Click **Next**.

Set up the network partition resolution

Set up the network partition resolution resource.

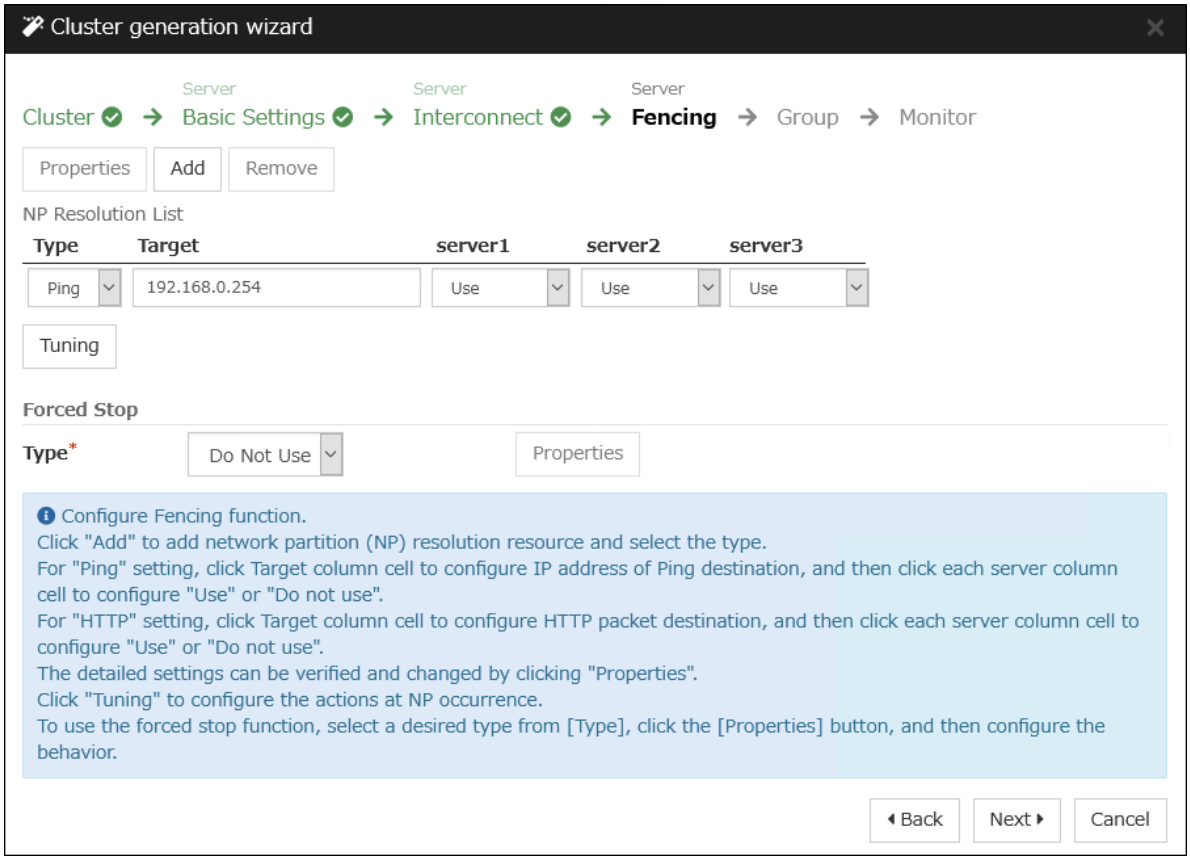


1. To use NP resolution in the PING mode, click **Add** and add a row to **NP Resolution List**, click **Type** and select **Ping**, click the cell of **Target**, and then enter the IP addresses of the ping destination target devices (such as a gateway). When multiple IP addresses separated by commas are entered, they are regarded as isolated from the network if there is no ping response from any of them.

   If the PING mode is used only on some servers, set the cell of the server not to be used to **Do Not Use**.

   If some ping-related parameters must be changed from their default values, select **Properties**, and then specify the settings in the **Ping NP Properties** dialog box.

   For the setup example in this chapter, a row for the PING mode is added and 192.168.0.254 is specified for **Target**.



2. To use NP resolution in the HTTP mode, add a row to **NP Resolution List** by clicking **Add**, click the cell in **Type** column, and select **HTTP**. Then click **Properties**, enter the address of the Web server in **Target Host**, and enter the port number in **Service Port**. If the HTTP mode is used only on some servers, set the cells of the servers not to be used to **Do Not Use**.

   For the setup example in this chapter, the HTTP mode is not used.

3. Specify the operation to perform when a network partition is detected. Select **Stop the cluster service** or **Stop the cluster service and shutdown OS**.

   For the setup example in this chapter, **Stop the cluster service** is selected.

4. Click **Next**.

6.8.2 Creating a failover group

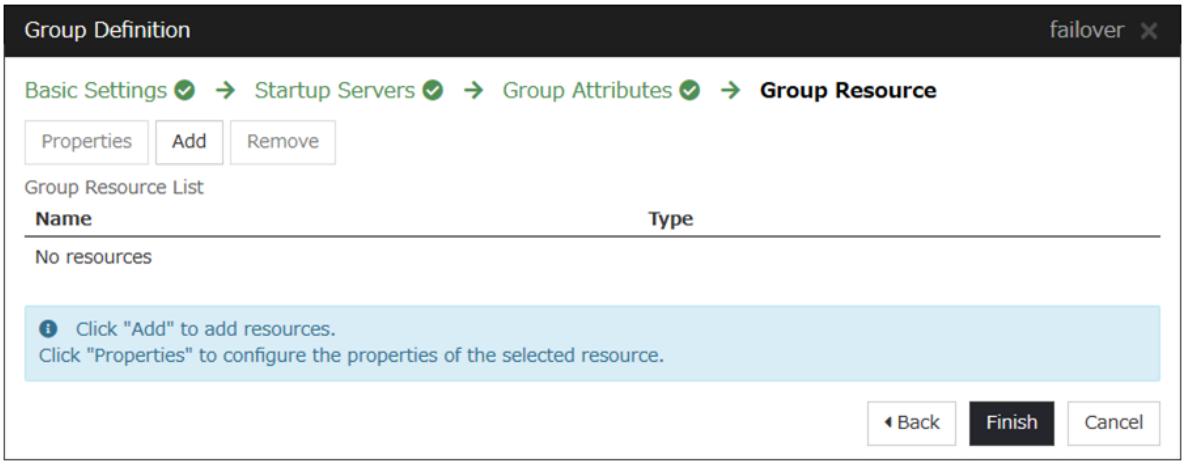
Add a failover group that executes an application to the cluster. (Below, *failover group* is sometimes abbreviated to *group*.)

Add a failover group

Set up a group that works as a unit of failover at the time an error occurs.

1. In the **Group List**, click **Add**.
2. In the **Group Definition** dialog box, enter the group name **(failover1)** in the **Name** box, and click **Next**.
3. Add **svg1** and **svg2** from the **Available Server Groups** list to the **Server Groups that can run the Grou**p in the order in the order of **svg1**, **svg2**.
4. Specify each attribute value of the failover group. Because all the default values are used for the setup example in this chapter, click **Next**.

   The **Group Resource** is displayed.



Add a group resource (Floating IP address)

Add a group resource, a configuration element of the group, to the failover group you have created in "6.8.2. *Add a failover group*".

1. Click **Add** in the **Group Resource List**.
2. The **Resource Definition of Group | failover1** dialog box is displayed. In this dialog box, select the group resource type **Floating IP resource** in the **Type** box, and enter the group name **fip1** in the **Name** box. Click **Next**.
3. The **Dependent Resources** page is displayed. Specify nothing. Click **Next**.
4. **The Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** pages are displayed. Click **Next**.
5. Enter the IP Address **10.0.0.12** in the **IP Address** box. Click **Finish**.

Add a group resource (Hybrid disk resource)

1. In the **Group Resource List**, click **Add**.
2. In the **Resource Definition of Group | failover1** dialog box, select the group resource type **Hybrid disk resource** in the **Type** box, and enter the group resource name **hd1** in the **Name** box. Click **Next**.

   Note: If a Hybrid disk resource does not appear in the **Type** box, check whether the EXPRESSCLUSTER X Replicator license has been registered, then click the **Get License Info** button.

3. The **Dependent Resources** page is displayed. Specify nothing. Click **Next**.
4. **The Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** pages are displayed. Click **Next**.
5. Select the mirror partition device name **/dev/NMP1** in **Mirror Partition Device Name** box. Enter the mount point **/mnt/hd1**, the data partition device name **/dev/disk/by-id/scsi-222850001557d9443-part2** and the cluster partition device name **/dev/disk/by-id/scsi-222850001557d9443-part1** in the respective box. In the **File System** dialog box, select the file system **ext4**. Click **Finish**.
6. Select **server1** tab In the **Resource Definition of Group | failover1** dialog box, and check **Set Up Individually** on. Re-enter the mount point **/mnt/hd1**, the data partition device name **/dev/disk/by-id/scsi-222850001557d9443-part2**, and the cluster partition device name **/dev/disk/by-id/scsi-222850001557d9443-part1** in the respective box.
7. Select **server2** tab In the **Resource Definition of Group | failover1** dialog box, and check **Set Up Individually** on. Re-enter the mount point **/mnt/hd1**, the data partition device name **/dev/disk/by-id/scsi-222850001557d9443-part2**, and the cluster partition device name **/dev/disk/by-id/scsi-222850001557d9443-part1** in the respective box.
8. Select **server3** tab In the **Resource Definition of Group | failover1** dialog box, and check **Set Up Individually** on. Re-enter the mount point **/mnt/hd1**, the data partition device name **/dev/disk/by-id/scsi-2222400015526436d-part2**, and the cluster partition device name **/dev/disk/by-id/scsi-2222400015526436d-part1** in the respective box.
9. In **Resource Definition of Group | failover1**, click **Finish**.

Note: For disk device names(e.g., cluster partition, data partition), it is recommended to use persistent device name (e.g., /dev/disk/by-id/[device name], /dev/disk/by-partuuid/[device name]).If non-persistent device names (e.g., /dev/sdX or /dev/nvmeX) are specified, an unintended device may be mounted when device file names are reassigned during OS startup, which could result in data corruption.

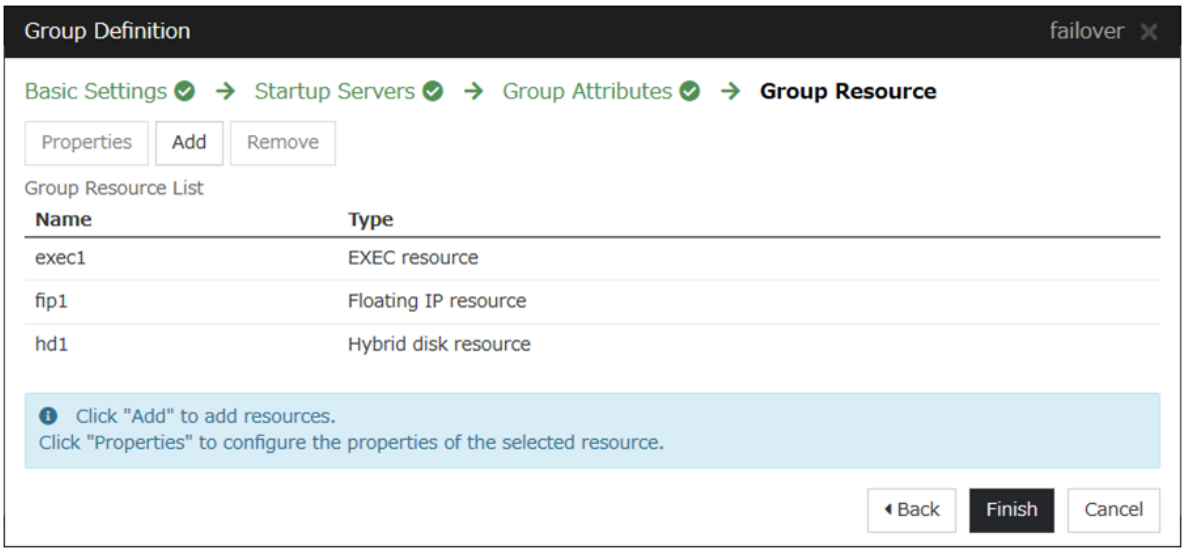
Add a group resource (EXEC resource)

Add an EXEC resource that can start and stop the application from a script.

1. In the **Group Resource List**, click **Add**.
2. In the **Resource Definition of Group | failover1** dialog box, select the group resource **EXEC resource** in the **Type** box, and enter the group resource name **exec1** in the **Name** box. Click **Next**.
3. The **Dependent Resources** page is displayed. Specify nothing. Click **Next**.
4. **The Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** pages are displayed. Click **Next**.

5. Select **Script created with this product**. Edit the script if applications to be used in EXPRESSCLUSTER are already decided. Users may edit this script to describe the procedure to start and stop a group of applications. Click **Next**.

   The **Group Resource List** of the failover1 should look similar to the following:



6. Click **Finish**.

6.8.3 Creating monitor resources

Add a monitor resource that monitors a specified target to the cluster.

Add a monitor resource (Disk monitor resource)

Add monitor resources to monitor the target disk. "diskw" is used as an example of a monitor resource to be added.

1. In the **Group** list, click **Next**.
2. In the **Monitor Resource List**, click **Add**.
3. The **Monitor Resource Definition** dialog box is displayed. The first monitor resource information is created by default when the cluster name is defined. The sixth and the seventh monitor resources are created in default when the hybrid disk resource is added. Select the monitor resource type **Disk monitor** in the **Type** box, and enter the monitor resource name **diskw1** in the **Name** box. Click **Next**.
4. Configure the monitor settings. Do not change the default value and click **Next**.
5. Enter **Method** (READ(O_DIRECT)) and **Monitor Target**(/dev/disk/by-id/scsi-222850001557d9443-part2).
6. Select **server1** tab In the **Monitor Resource Definition | diskw** dialog box, and check **Set Up Individually** on. Re-enter **Method** (READ(O_DIRECT)) and **Monitor Target**(/dev/disk/by-id/scsi-222850001557d9443-part2).
7. Select **server2** tab In the **Monitor Resource Definition | diskw** dialog box, and check **Set Up Individually** on. Re-enter **Method** (READ(O_DIRECT)) and **Monitor Target**(/dev/disk/by-id/scsi-222850001557d9443-part2).
8. Select **server3** tab In the **Monitor Resource Definition | diskw** dialog box, and check **Set Up Individually** on. Re-enter **Method** (READ(O_DIRECT)) and **Monitor Target**(/dev/disk/by-id/scsi-2222400015526436d-part2).

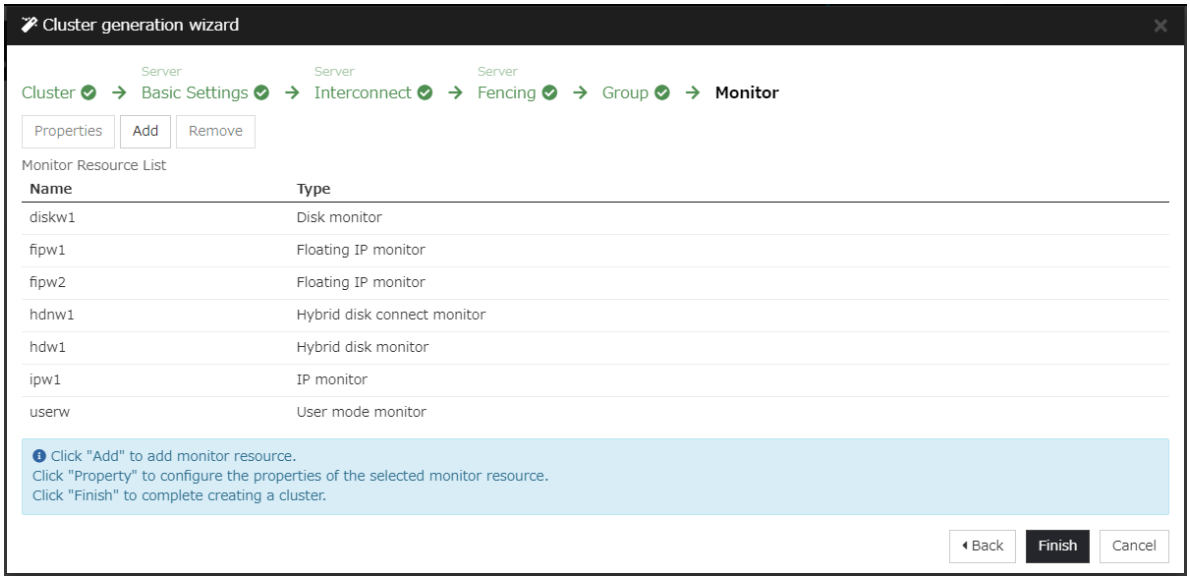
9. Click **Next**.
10. Set **Recovery Target**. Click **Browse**.
11. Select **LocalServer** on the tree view being displayed, and click **OK**. **LocalServer** is set to **Recovery Target**.
12. Select **Stop the cluster service and shut down OS** in the **Final Action** box, and click **Finish**.

Add a monitor resource (IP monitor resource)

1. In the **Monitor Resource List**, click **Add**.
2. In the **Monitor Resource Definition** dialog box, select the monitor resource type **IP monitor** in the **Type** box, and enter the monitor resource name **ipw1** in the **Name** box. Click **Next**.
3. Enter the monitor settings. Change nothing from the default values. Click **Next**.
4. Click **Add**.
   Enter the IP address to be monitored (10.0.0.254) in the **IP Address** box, and then click **OK**.

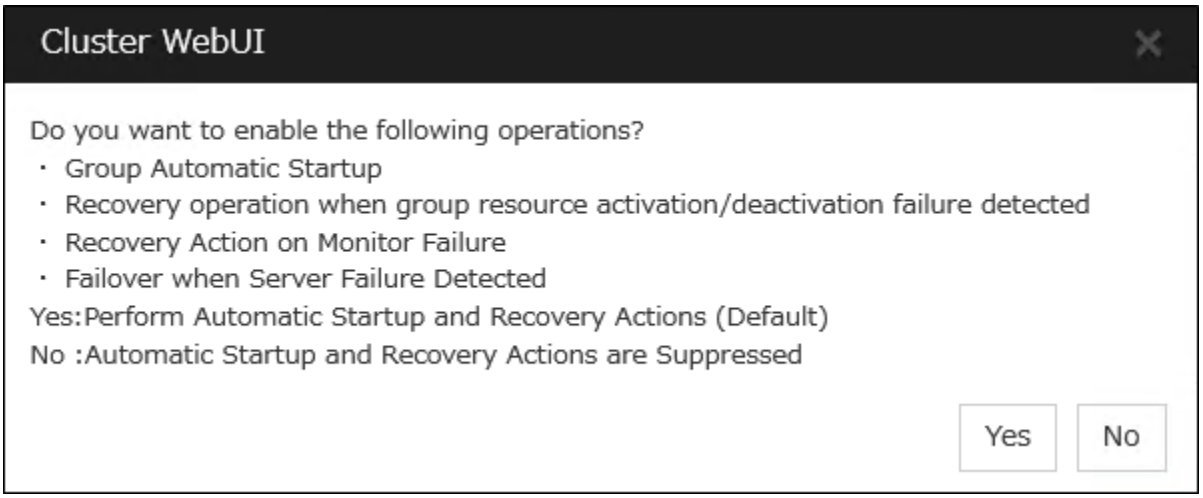
   Note: For the monitoring target of the IP monitor resource, specify the IP address of a device (such as a gateway) that is assumed to always be active on the public LAN.

5. The entered IP address is specified in the **IP Addresses** list. Click **Next**.
6. Specify the recovery target. Click **Browse**.
7. Select **All Groups** in the tree view and click **OK**. **All Groups** is set to **Recovery Target**.
8. Click **Finish**.
   The **Monitor Resource List** should look similar to the following:



6.8.4 Disabling the cluster operation

When you click **Finish** after creating a monitor resource, the following popup message appears:



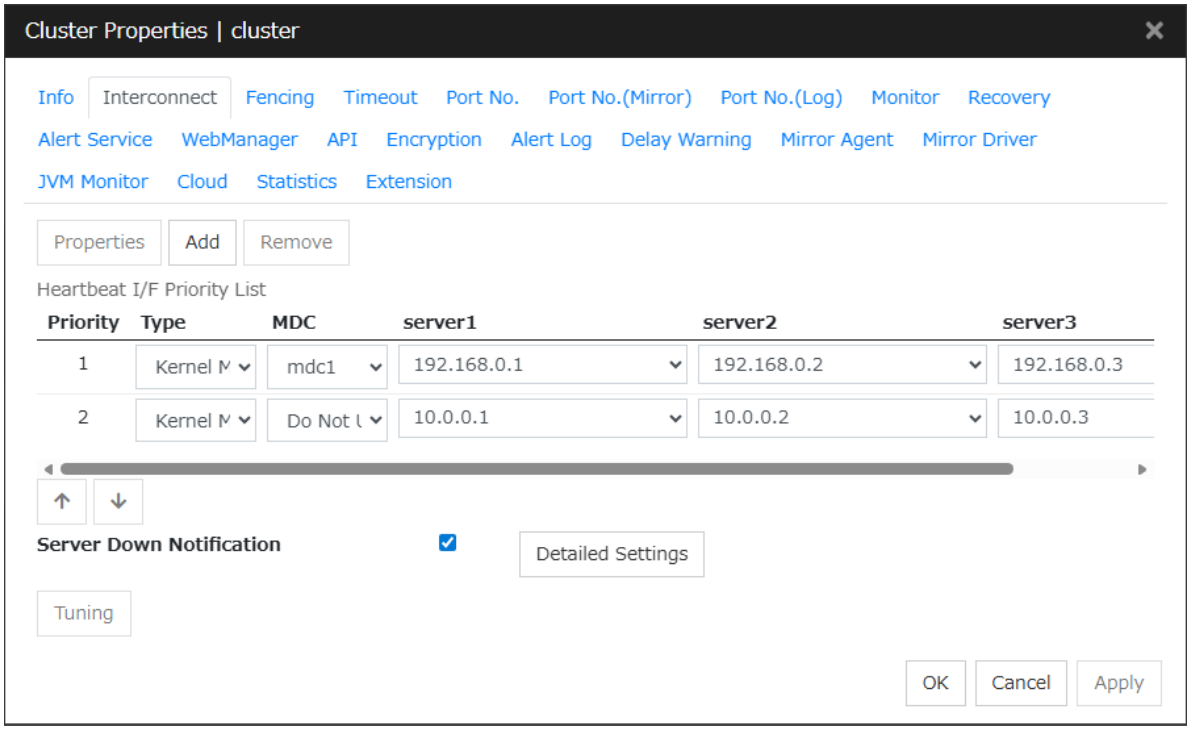
Clicking **No** disables automatic group startup, recovery on the activation/deactivation failure of a group resource, recovery on the failure of a monitor resource, failover on a server failure, action on NP occurrence, and forced-stop action. When you start a cluster for the first time after creating the cluster configuration data, it is recommended that you disable the automatic startup and the recovery and check the cluster configuration data for errors.

To disable the cluster operation, go to **Cluster properties** -> **Extension tab** tab -> **Disable cluster operation**.

Note: Disabling the recovery on the failure of a monitor resource is not applied to user mode monitor resources.

6.8.5 Modify cluster properties

1. In the config mode of Cluster WebUI, click **Properties** of **Cluster.**
2. The **Cluster Properties** dialog box is displayed. Click **Interconnect** tab. Clear the **Server Down Notification** check box.



3. Click **OK**.

This completes creating the cluster configuration information. Proceed to "6.11. *Creating a cluster*".

6.9 Saving the cluster configuration data

The created configuration data can be saved in a directory on your PC or in external media.

Follow the procedures below to save the cluster configuration.

1. Click **Export** in the config mode of Cluster WebUI.
2. Select a location to save the data and save it.

Note: A zip file containing one file (clp.conf) and one directory (scripts) is saved. If any of these are missing, the command to create a cluster does not run successfully. Make sure to treat these two as a set. When new configuration data is edited, clp.conf.bak is created in addition to these two.

Note: When installing EXPRESSCLUSTER, if the port number different from the default value is specified in **Port Number**, click **Cluster Properties** and click **Port Number** and specify the same values for **WebManager HTTP Port Number** and **Disk Agent Port Number** specified at the time of installation before saving the cluster configuration data.

6.10 Check the cluster configuration data

Before applying the cluster configuration data created on Cluster WebUI to the cluster servers, the cluster configuration data can be checked.

1. In the config mode of Cluster WebUI, click **Cluster Configuration Information Check**.
2. After the check is completed, the results are displayed in another window. It may take time for the check to be completed, depending on the settings for the created cluster configuration data.

Details of what is checked are as follows:

Cluster Properties

Check item	Description
Ping check on pingnp	Checks whether ping can reach the ping target for network partition resolution.
Target check for pingnp	This check ensures that the ping target for network partitioning resolution does not overlap with the IP addresses of cluster servers.
Port No. tab : port number check	Checks whether the range of automatically assigned communication port numbers managed by the OS does not overlap with that used by EXPRESSCLUSTER.
Port No.(Mirror) tab : port number check	Checks whether the range of automatically assigned communication port numbers managed by the OS does not overlap with that used by EXPRESSCLUSTER.
Port No.(Log) tab : port number check	Checks whether the range of automatically assigned communication port numbers managed by the OS does not overlap with that used by EXPRESSCLUSTER.
Port No. tab : port connection check	Checks whether the communication ports configured in the cluster are connectable.
Extension tab: 1st check item for the log storage destination path of settings of log storage period	Check if the specified path is outside the EXPRESSCLUSTER installation path.
Extension tab: 2nd check item for the log storage destination path of settings of log storage period	Check if the specified path exists.
/dev/watchdog usage check for Shutdown Monitor	Checks whether the /dev/watchdog device used for monitoring is not being used by anything other than EXPRESSCLUSTER.

Group Resources

Check item	Description
Ping check on fip	Checks whether the specified IP address is not yet used in the same network, by pinging the IP address.
Ping check on vip	Checks whether the specified IP address is not yet used in the same network, by pinging the IP address.
Partition presence check for disk	Checks whether the specified partition exists in the system.
Partition presence check for md	Checks whether the specified partition exists in the system.
Partition presence check for hd	Checks whether the specified partition exists in the system.

continues on next page

Table 6.18 – continued from previous page

Check item	Description
Cluster partition size check for md	Checks whether the size of the specified cluster partition is enough.
Cluster partition size check for hd	Checks whether the size of the specified cluster partition is enough.
/etc/fstab entry check for disk	Checks whether the specified partition is not entered in /etc/fstab. However, if "noauto" is specified as an option, the entry to /etc/fstab is accepted.
/etc/fstab entry check for md	Checks whether the specified partition is not entered in /etc/fstab. However, if "noauto" is specified as an option, the entry to /etc/fstab is accepted.
/etc/fstab entry check for hd	Checks whether the specified partition is not entered in /etc/fstab. However, if "noauto" is specified as an option, the entry to /etc/fstab is accepted.
Mount option check for md	Checks whether the mount option for the specified partition is appropriate.
Mount option check for hd	Checks whether the mount option for the specified partition is appropriate.
Port number check for md	Checks whether the range of automatically assigned communication port numbers managed by the OS does not overlap with that used by EXPRESSCLUSTER.
Port number check for hd	Checks whether the range of automatically assigned communication port numbers managed by the OS does not overlap with that used by EXPRESSCLUSTER.
Port Number Usage Check for lbpp	This check ensures that the configured port number is not in use by other applications.
File system check for disk	Checks whether the file system for the specified partition is appropriate.
File system check for md	Checks whether the file system for the specified partition is appropriate.
File system check for hd	Checks whether the file system for the specified partition is appropriate.
VG presence check for volmgr	Checks whether the specified volume exists.

Monitor Resources

Check item	Description
/dev/watchdog usage check for userw	Checks whether the /dev/watchdog device used for monitoring is not being used by anything other than EXPRESSCLUSTER.

Heartbeat Resources

Check item	Description
Ping check on khb	Checks whether the IP address specified as a heartbeat resource can be used, by pinging the IP address.
Ping check on hb	Checks whether the IP address specified as a heartbeat resource can be used, by pinging the IP address.
Device presence check for diskhb	Checks whether the specified device exists in the system.
/etc/fstab entry check for diskhb	Checks whether the specified partition is not entered in /etc/fstab. However, if "noauto" is specified as an option, the entry to /etc/fstab is accepted.

Others

Check item	Description
AWSCLI command execution check	Checks whether the AWS CLI can be run.
OS start time check	Checks whether the time for the OS startup is set longer than the heartbeat timeout.
Checking the configuration of SELinux	Checks whether SELinux is properly set.
Kernel check	Checks the kernel version.
Presence check for tar command	Checks whether the tar command has been installed.
Secure Boot check	Checks whether the secure boot has been disabled.

Unrecommended settings check

Check item	Description
Recovery action check for deactivation failure	Checks whether any setting other than **No operation** is set for the final action on the deactivation failure of each group resource.

Note: For the outputted message, refer to "Details on checking cluster configuration data".

6.11 Creating a cluster

After creating and/or modifying a cluster configuration data, apply the configuration data on the servers that constitute a cluster and create a cluster system.

6.11.1 How to create a cluster

After creation and modification of the cluster configuration data are completed, create a cluster in the following procedures.

1. Click **Apply the Configuration File** on the **File** in the config mode of Cluster WebUI.
   If the upload succeeds, the message saying "The application finished successfully."
2. Select the **Operation Mode** on the drop down menu of the toolbar in Cluster WebUI to switch to the operation mode.
3. Execute a relevant procedure below depending on the resource to use.

- When using a hybrid disk resource

  (1) For details about how to initialize the hybrid disk resources, see "2.8.3. *Partition settings for Hybrid disk resource (Required for the Replicator DR)*" in "2.8. *Settings after configuring hardware*" in this guide.

  (2) After executing above in the relevant server in the cluster, proceed the following steps.

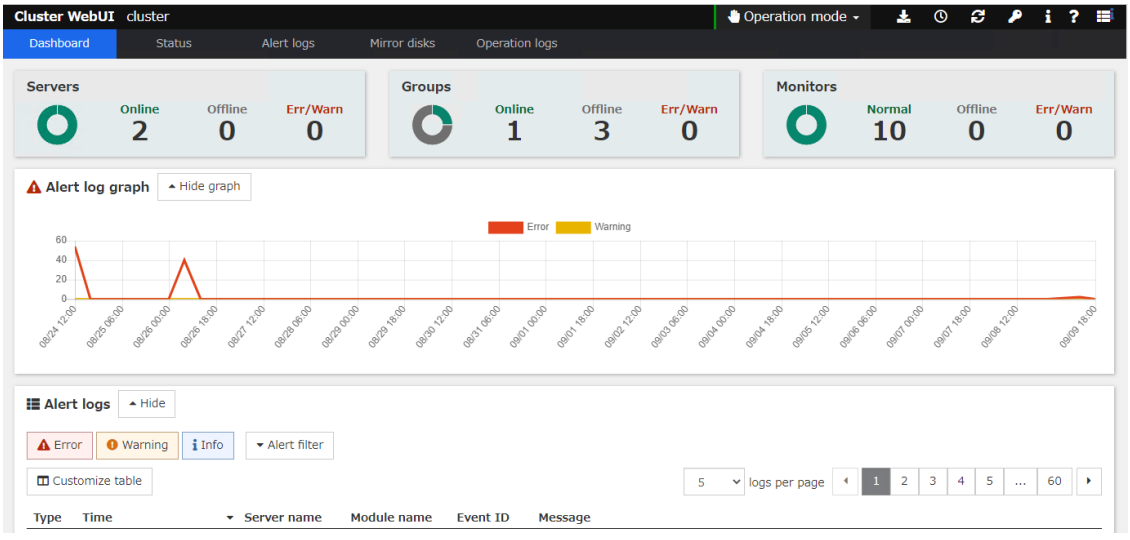
  (3) Restart all servers. After restarting the servers, clustering starts and the status of clustering is displayed on Cluster WebUI.

- When using mirror disk resource

  (1) Restart all servers. After restarting the servers, clustering starts and the status of clustering is displayed on Cluster WebUI.

- When using neither mirror disk resource nor hybrid disk resource

  (1) Select **Start Cluster** in the **Status** tab of Cluster WebUI and click. Clustering starts and the status of clustering is displayed on Cluster WebUI.



For how to operate and check the Cluster WebUI, see the online manual from the ? button on the upper right of the screen.

Note: When setting the firewall using the clpfwctrl command, it is necessary to execute the command even after applying the cluster configuration data.

CHAPTER

SEVEN

VERIFYING A CLUSTER SYSTEM

This chapter describes how you change the cluster configuration.

This chapter covers:

- 7.1. *Verifying operations using the Cluster WebUI*
- 7.2. *Verifying operation by using commands*

7.1 Verifying operations using the Cluster WebUI

This chapter provides instructions for verifying the cluster system using the Cluster WebUI. The Cluster WebUI is installed at the time of the EXPRESSCLUSTER Server installation. Therefore, it is not necessary to install it separately. The Cluster WebUI can be accessed from a management PC. The following describes how to access to the Cluster WebUI.

See also:

For system requirements of the Cluster WebUI, refer to "Installation requirements for EXPRESSCLUSTER" in the "Getting Started Guide".

Follow the steps below to verify the operation of the cluster after creating the cluster and connecting to the Cluster WebUI.

See also:

For details on how to use the Cluster WebUI, see. If any error is detected while verifying the operation, troubleshoot the error by referring to "Troubleshooting" in the "Reference Guide".

1. **Check heartbeat resources**
   Verify that the status of each server is online on the Cluster WebUI.
   Verify that the heartbeat resource status of each server is normal.
2. **Check monitor resources**
   Verify that the status of each monitor resource is normal on the Cluster WebUI.
3. **Start up a group**
   Start a group.
   Verify that the status of the group is online on the Cluster WebUI.
4. **Check a disk resource**
   Verify that you can access the disk mount point on the server where the group having a disk resource is active.
5. **Check a mirror disk resource/hybrid disk resource**
   Verify that you can access the disk mount point on the server where the group having a mirror disk resource/hybrid disk resource is active.
6. **Check a floating IP resource**
   Verify that you can ping a floating IP address while the group having the floating IP resource is active.
7. **Check an EXEC resource**
   Verify that an application is working on the server where the group having an EXEC resource is active.
8. **Stop a group**
   Stop a group.
   Verify that the status of the group is offline on the Cluster WebUI.
9. **Move a group**
   Move a group to another server.
   Verify that the status of the group is online on the Cluster WebUI.
   Move the group to all servers in the failover policy and verify that the status changes to online on each server.
10. **Perform failover**
    Shut down the server where a group is active.
    After the heartbeat timeout, check to see the group has failed over. Verify that the status of the group becomes online on the failover destination server on the Cluster WebUI.
11. **Perform failback**

When the automatic failback is set, start the server that you shut down in the previous step, "9. Failover." Verify that the group fail back to the original server after it is started using the clpstat command. Verify that the status of group becomes online on the failback destination server on the Cluster WebUI.

12. **Shut down the cluster**
    Shut down the cluster. Verify that all servers in the cluster are successfully shut down using the clpstat command.

7.2 Verifying operation by using commands

Follow the steps below to verify the operation of the cluster from a server constituting the cluster using command lines after the cluster is created.

See also:

For details on how to use commands, see "EXPRESSCLUSTER command reference" in the "Reference Guide". If any error is detected while verifying the operation, troubleshoot the error referring to "Troubleshooting" in the "Reference Guide".

1. **Check heartbeat resources**
   Verify that the status of each server is online by using the clpstat command.
   Verify that the heartbeat resource status of each server is normal.
2. **Check monitor resources**
   Verify that the status of each monitor resource is normal by using the clpstat command.
3. **Start groups**
   Start the groups with the clpgrp command.
   Verify that the status of groups is online by using the clpstat command.
4. **Stop a group**
   Stop a group with the clpgrp command.
   Verify that the status of the group is offline by using the clpstat command.
5. **Check a Disk resource**
   Verify that you can access a disk mount point on the server where the group having disk resources is active.
6. **Check a Mirror disk resource/hybrid disk resource**
   Verify that you can access the disk mount point on the server where the group having a mirror disk resource/hybrid disk resource is active.
7. **Check a Floating IP resource**
   Verify that you can ping a floating IP address while the group having a floating IP resource is active.
8. **Check an EXEC resource**
   Verify that an application is working on the server where the group having an EXEC resource is active.
9. **Move a group**
   Move a group to another server by using the clpstat command.
   Verify that the status of the group is online by using the clpstat command.
   Move the group to all servers in the failover policy and verify that the status changes to online on each server.
10. **Perform failover**
    Shut down a server where a group is active.
    After the heartbeat timeout, check to see the group has failed over by using the clpstat command. Verify that the status of the group becomes online on the failover destination server using the clpstat command.
11. **Perform failback**
    When the automatic failback is set, start the server which you shut down in the previous step, "9. Failover." Verify that the group fails back to the original server after it is started using the clpstat command. Verify that the status of the group becomes online on the failback destination server using the clpstat command.
12. **Shut down the cluster**
    Shut down the cluster by using the clpstdn command. Verify that all servers in the cluster are successfully shut down.

CHAPTER

EIGHT

VERIFYING OPERATION

This chapter provides information on how to run dummy-failure tests to see the behaviors of you r cluster system and how to adjust parameters.

This chapter covers:

- 8.1. *Operation tests*
- 8.2. *Backup procedures*
- 8.3. *Restoration procedures*

8.1 Operation tests

Verify how your cluster behaves by performing dummy-failure tests and/or backup restoration of the shared disk. Check for errors in monitor resources or stoppage of the server and OS.
If any error is detected in monitor resources or any stoppage of the server or the OS occurs, the time-out value or other settings need to be adjusted.

1. **Transition of recovery operation due to dummy failure**
   When dummy failure is enabled, a test must be conducted to check that recovery of the monitor resources in which an error was detected is performed as set.
   You can perform this test from Cluster WebUI or with the clpmonctrl command. For details, see the online manual or "EXPRESSCLUSTER command reference" in the "Reference Guide".
2. **Dummy-failure of the shared disks**
   (When the shared disks are RAID-configured and dummy-failure tests can be run)

   The test must include error, replacement, and recovery of RAID for a shared disk subsystem.

   - Set a dummy-failure to occur on a shared disk.
   - Recover RAID from the degenerated state to normal state.

   For some shared disks, I/O may temporarily stop or delay when they switch to the degenerated operation or when RAID is reconfigured.
   If any time-out and/or delay occurs in operations such as disk monitoring, adjust the time-out value of each monitor resources.

3. **Dummy-failure of the paths to shared disks**
   (When the path to the shared disk is redundant paths and dummy-failure tests can be run.)

   The test must include an error in the paths and switching of one path to another.

   - Set a dummy-failure to occur in the primary path.

   It takes time for some path-switching software (driver) to switch the failed path to the path normally working. In some cases, the control may not be returned to the operating system (software).
   If any time-out and/or delay occurs in operations such as disk monitoring, adjust the time-out value of each monitor resources.

4. **Backup/Restoration**

   If you plan to perform regular backups, run a test backup.
   Some backup software and archive commands make CPU and/or disk I/O highly loaded.

If any server and/or OS stop, heartbeat delays, delay in monitor resources, or time-out occur, adjust the heartbeat time-out value and/or time-out value of each monitor resources.

Different types of dummy-failure tests for each device and what happen after the tests are described below:

Device/Resource	Dummy-failure	What happens
Shared disk device SCSI/FC path	Unplug the cable on the server side (for a redundant server, unplug both cables)	When a disk is monitored, failover to the standby server occurs. When no disk is monitored, the operation stops.
		Disk heartbeat resource becomes offline. A warning is issued to the alert log. = Operation continues.
		Disk monitor resources detect an error
	For FC, power off the FC Switch	When a disk is monitored, failover to the standby server occurs. When no disk is monitored, the operation stops.
		Disk heartbeat resources become offline.
		Disk monitor resources detect an error
Interconnect LAN	Unplug the LAN cable (In the case of a virtual environment, instead of using OS commands, perform the procedure by disconnecting the guest OS's NIC from the virtualization platform side.)	Communication between servers continues using a business LAN Operation continues
		The kernel mode LAN heartbeat resource on the interconnect becomes offline. A warning is issued to the alert log. = Operation continues.
		An error is detected in an IP monitor resource Failover to the standby server occurs.

continues on next page

Table 8.1 – continued from previous page

Device/Resource	Dummy-failure	What happens
		An error is detected in a NIC Link Up/Down monitor resource Failover to the standby server occurs.
Business LAN	Unplug the LAN cable or power off the HUB	Communication stops, application stalls or an error occurs. =These do not result in failover.
		The kernel mode LAN heartbeat resource on the public LAN becomes inactive. A warning is issued to the alert log. = Operation continues.
		An error is detected in an IP monitor resource Failover to the standby server occurs.
		An error is detected in a NIC Link Up/Down monitor resource. Failover to the standby server occurs
UPS	Unplug the UPS from outlet	The active server shuts down Failover to the standby server occurs
Array UPS	Unplug the UPS from outlet	Both servers shut down Operation stops
LAN for UPS	Unplug the LAN cable	UPS becomes uncontrollable. Operation continues

continues on next page

Table 8.1 – continued from previous page

Device/Resource	Dummy-failure	What happens
OS error	Run the shutdown command on the active server	The active server shuts down Failover to a standby server occurs.
Mirror disk connect	Unplug the LAN cable	A warning is issued to the alert log (mirroring stops) Operation continues, but a switch to a standby server becomes impossible.
		An error is detected in mirror disk monitor resource Operation continues
Disk resource	Start up the group after mounting the disk (Example) # mount /dev/sda2 /mnt/sda2	A disk resource does not get activated.
EXEC resource	Write an invalid command in EXEC resource script Change "EXIT 0" in the end of script to "EXIT 1"	An EXEC resource does not get activated. Failover to a standby server occurs.
Floating IP address	Specify the already-used address (the one that is used for server) to make it overlapped	A floating IP resource does not get activated.
Virtual IP resource	Specify the already-used address (the one that is used for server) to make it overlapped	A virtual IP resource does not get activated.
Mirror disk resource Hybrid disk resource	Start up the group after mounting the disk (Example) # mount /dev/sda2 /mnt/sda2	A mirror disk resource/hybrid disk resource does not get activated.

continues on next page

Table 8.1 – continued from previous page

Device/Resource	Dummy-failure	What happens
PID monitor resource	Terminate resident process of monitored EXEC resource (Example) # kill <process-ID>	Failover to a standby server occurs.
Volume manager monitor resource	When Volume Manager is lvm Manually export the volume group from the standby server.	An error is detected in the monitor resource.
Dynamic DNS resource	Start the Dynamic DNS resource while the name resolution service on the DNS server is not running.	Dynamic DNS resource is not activated.
Dynamic DNS monitor resource	Shut down a normally operating DNS server or stop the running name resolution service.	Dynamic DNS monitor resource detects an error and takes action for it. The VHOST resource fails to stop when there is resource reactivation or a failover.
	use the nsupdate command to delete the virtual host name that is registered in the Dynamic DNS resource from the DNS server.	Dynamic DNS monitor resource registers the virtual host name on the DNS serve again within the monitor interval.

8.2 Backup procedures

Before you start using your cluster system, make sure to simulate a backup operation.

For details on the backup with the disk image, refer to "Maintenance Guide" -> "The system maintenance information", and the manual of your backup software.

To back up the file system, follow the procedures below.

8.2.1 Backing up while EXPRESSCLUSTER is active

To back up the file system while the EXPRESSCLUSTER daemon is active, follow the procedures below.

1. Make sure the cluster is working normally.
2. To prevent the heartbeat time-out caused by highly loaded user space from occurring, change the time-out ratio of EXPRESSCLUSTER by using the time-out temporary adjustment command.
   If you want to triple the current time-out and make this temporary setting valid for one hour, run the following command:
   ```
   # clptoratio -r 3 -t 1h
   ```
3. Back up the shared disk, mirrored disk or hybrid disk.
   For backing up a shared disk, the disk resource in group resources needs to be activated on the server for backup.
   For backing up a mirror disk or hybrid disk, the mirror disk resource or hybrid disk resource in group resources needs to be activated on the server for backup. However, a backup command for directly accessing partition devices is not supported for mirror disks and hybrid disk.
4. Set the time-out ratio adjusted with the time-out temporary adjustment command back to the original:
   ```
   # clptoratio -i
   ```

For details on the command that temporarily adjusts the time-out, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

8.2.2 Backing up while EXPRESSCLUSTER is inactive

To back up the file system while the EXPRESSCLUSTER daemon is inactive, follow the procedures below.

1. Make sure the cluster is working normally.
2. Stop the EXPRESSCLUSTER daemon.
   ```
   # clpcl -t -a
   ```
3. Back up the file system and shared disk.
   For the shared disk, manually mount the file system on the shared disk you want to back up. Make sure to unmount the file system after you have completed the backup.
4. Start the EXPRESSCLUSTER daemon.
   ```
   # clpcl -s -a
   ```

8.2.3 Backing up while EXPRESSCLUSTER is inactive (For Replicator or Replicator DR)

It is not recommended to back up the file system while the EXPRESSCLUSTER daemon is inactive.
For details on emergency backup, see "Mounting mirror disks manually" of "Troubleshooting" in "Trouble shooting" in the "Reference Guide".

8.3 Restoration procedures

You also need to simulate restoration operation before starting to use your cluster system. For details on the restoration with the disk image, refer to "Maintenance Guide" -> "The system maintenance information", and the manual of your backup software. To restore the file system, follow the procedures below.

8.3.1 Restoring the file system containing the /opt/nec/clusterpro directory

1. From a server normally running in the cluster, back up the cluster configuration data to an external medium.

   ```
   # clpcfctrl --pull -l -x <the path to the directory where the configuration data is␣
   ↪stored>
   ```

   After backing up the data, unmount the external medium.

   Note: Perform the subsequent procedure on the server to be restored.

2. Run the following command to disable services on the server to be restored.

   ```
   clpsvcctrl.sh --disable -a
   ```

3. Execute cluster shutdown by using Cluster WebUI or the clpstdn command, and then, restart the server.
4. Restore the file system on the server to be recovered (there is no cluster-dependent work).
5. Verify if the EXPRESSCLUSTER Server is installed on the restored file system with the following command:

   ```
   rpm -qi expresscls
   ```

   For Ubuntu, run the following command.

   ```
   dpkg -s clusterpro
   ```

   When the EXPRESSCLUSTER Server is installed, proceed to Step (6).
   When the EXPRESSCLUSTER Server is not installed, proceed to Step (7).

6. If the EXPRESSCLUSTER Server is installed, run the following command to uninstall it:

   ```
   rpm -e expresscls
   ```

   For Ubuntu, run the following command.

```
dpkg -r clusterpro
```

Note: Do not specify options other than the one stated above.

For troubleshooting a problem that occurs when you uninstall the EXPRESSCLUSTER Server, see "11.1.1. *Uninstalling the EXPRESSCLUSTER Server*" in "11.1. *Uninstallation*".

7. Install the EXPRESSCLUSTER Server.
   For details, see "4.2. *Setting up the EXPRESSCLUSTER Server*" in "4. *Installing EXPRESSCLUSTER*" in this guide. If there is any server in the cluster on which an update of the EXPRESSCLUSTER Server is applied, apply the same update to this server. Make sure that the same version of the EXPRESSCLUSTER Server is installed on all servers in the cluster.
8. Mount an external medium in the server where the EXPRESSCLUSTER Server was reinstalled.

Note: You have to restart the server where the EXPRESSCLUSTER Server was reinstalled after reinstallation.

9. Register the cluster configuration data which was backed up in Step 1 with the server by running the cluster creation command:

   ```
   # clpcfctrl --push -x <path to the directory where configuration data is saved>
   ↪Command succeeded.(code:0)
   ```

   if the command is successfully displayed and completed.

   See also:

   For details on the cluster creation command, see "EXPRESSCLUSTER command reference" in the "Reference Guide".
10. Unmount the external media and then restart the server.

8.3.2 Restoring the data on the shared disk

The following describes how to restore the data in the disk resource on the shared disk. If you use a hybrid disk resource for the shared disk, see "8.3.3. *Restoring the data on the mirror disk or the hybrid disk*".

Restoring while EXPRESSCLUSTER is active

1. Make sure that the cluster is working normally.
2. To prevent the heartbeat time-out caused by heavily loaded user space from occurring, change the time-out ratio of EXPRESSCLUSTER with the time-out temporary adjustment command.
   If you want to triple the current time-out and make this temporary setting valid for one hour, run the following command:

   ```
   # clptoratio -r 3 -t 1h
   ```
3. Restore the shared disk.
   The disk resource of the group resource should be active on the server to be restored.

4. Set the time-out ratio adjusted with the timeout temporary adjustment command back to the original ratio:

   ```
   # clptoratio -i
   ```

   See also:

   For details on the command for adjusting time-out temporarily, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

Restoring while EXPRESSCLUSTER is inactive

1. Make sure that the cluster is working normally.
2. Stop the EXPRESSCLUSTER daemon.

   ```
   # clpcl -t -a
   ```

3. Run the command below to set the disk resource partition to ReadWrite as needed.[16]
   For example, when the disk resource partition device is /dev/disk/by-id/scsi-222850001557d9443-part2:

   ```
   # clproset -w -d /dev/disk/by-id/scsi-222850001557d9443-part2
   ```

4. Manually mount the file system on the shared disk to be restored. Make sure to unmount the file system when you have completed restoration.
5. Run the command below to set the disk resource partition to ReadOnly as needed.[Page 173, 16] Do not specify ReadOnly for the device used by a volume manager resource.
   For example, when the disk resource partition device is /dev/disk/by-id/scsi-222850001557d9443-part2:

   ```
   # clproset -o -d /dev/disk/by-id/scsi-222850001557d9443-part2
   ```

6. Start the EXPRESSCLUSTER daemon.

   ```
   # clpcl -s -a
   ```

   See also:

   For details on the command for operating a cluster, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

8.3.3 Restoring the data on the mirror disk or the hybrid disk

The following describes how to restore the data on the mirrored disk resource or the hybrid disk resource.

Restoring while EXPRESSCLUSTER is active

1. Make sure that the cluster is working normally.
2. To prevent the heartbeat time-out caused by heavily loaded user space from occurring, change the time-out ratio of EXPRESSCLUSTER with the time-out temporary adjustment command.
   If you want to triple the current time-out and make this temporary setting valid for one hour, run the following command.

   ```
   # clptoratio -r 3 -t 1h
   ```

3. Restore the mirrored disk or the hybrid disk.
   Mirror disk resource or hybrid disk resource of the group resource should be active on the server where you want to restore them.
4. Set the time-out ratio adjusted with the time-out temporary adjustment command back to the original.

   ```
   # clptoratio -i
   ```

[16] This is necessary only if Disk is specified for Disk Type for the disk resource.

See also:

For details on the command for adjusting time-out temporarily, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

Restoring while EXPRESSCLUSTER is inactive

It is not recommended to restore mirror disk while EXPRESSCLUSTER is inactive.

CHAPTER

NINE

PREPARING TO OPERATE A CLUSTER SYSTEM

This chapter describes what you have to do before you start operating a cluster system.
This chapter covers:

- 9.1. *Operating the cluster system*
- 9.2. *Suspending EXPRESSCLUSTER*
- 9.3. *Modifying the cluster configuration data*
- 9.4. *Introducing Integrated Cluster WebUI*

9.1 Operating the cluster system

Before you start using your cluster system, check to see your cluster system work properly and make sure you can use the system properly. The operations described below can be executed by using Cluster WebUI or EXPRESSCLUSTER commands. For details of functions of Cluster WebUI, see the online manual.
For the details of EXPRESSCLUSTER commands, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

The following describes procedures to start up and shut down a cluster and to shut down a server.

9.1.1 Activating a cluster

To activate a cluster, follow the instructions below:

1. When you are using any shared or external mirror disk, start the disk.
2. Start all the servers in the cluster.

Note: When you start all the servers in the cluster, make sure they are started within the duration of time set to **Server Sync Wait Time** on the **Timeout** tab of the **Cluster Properties** in the Cluster WebUI. Note that failover occurs if startup of any server fails to be confirmed within the specified time duration.

Note: The shared disk spends a few minutes for initialization after its startup. If a server starts up during the initialization, the shared disk cannot be recognized. Make sure to set servers to start up after the shared disk initialization is completed.

9.1.2 Shutting down a cluster and server

To shut down a cluster or server, use EXPRESSCLUSTER commands or shut down through the Cluster WebUI.

Note: When you are using the Replicator, mirror break may occur if you do not use any EXPRESSCLUSTER commands or Cluster WebUI to shut down a cluster.

9.1.3 Shutting down the entire cluster

The entire cluster can be shut down by running the clpstdn command or executing cluster shutdown from the Cluster WebUI. By shutting down a cluster, all servers in the cluster can be stopped properly as a cluster system.

9.1.4 Shutting down a server

Shut down a server by running the clpdown command or executing server shutdown from the Cluster WebUI.
Failover occurs when you shut down a server. A mirror break occurs as well when you are using the Replicator.
If you intend to use a standby server while performing hardware maintenance, shut down the active server.

9.1.5 Suspending/resuming a cluster

When you want to update the cluster configuration information or EXPRESSCLUSTER, you can stop the EXPRESSCLUSTER daemon without stopping the current operation. Stopping the EXPRESSCLUSTER in this way is referred to as "suspending". Returning from the suspended status to the normal operation status is referred to as "resuming".
When suspending or resuming a cluster, a request for processing is issued to all the servers in the cluster. Suspending of a cluster must be executed while the EXPRESSCLUSTER daemon is active on all the servers in the cluster.
Use EXPRESSCLUSTER commands or Cluster WebUI to suspend or resume a cluster.
When a cluster is suspended, some functions are disabled, as described below because the EXPRESSCLUSTER stops while the active resources are kept active.

- All heartbeat resources stop.
- All monitor resources stop.
- Groups or group resources are disabled (cannot be started, stopped, or moved).
- The following commands cannot be used:
  - clpcl command options other than --resume
  - clpdown
  - clpstdn
  - clpgrp
  - clptoratio
  - clpmonctrl (except for the -c and -v options)
  - clprsc

9.1.6 How to suspend a cluster

You can suspend a cluster by executing the clpcl command or by using Cluster WebUI.

9.1.7 How to resume a cluster

You can resume a cluster by executing the clpcl command or by using Cluster WebUI.

9.2 Suspending EXPRESSCLUSTER

There are two ways to stop running EXPRESSCLUSTER. One is to stop the EXPRESSCLUSTER daemon, and the other is to disable the EXPRESSCLUSTER daemon.

9.2.1 Stopping the EXPRESSCLUSTER daemon

To stop only the EXPRESSCLUSTER daemon without shutting down the operating system, use the clpcl command.

See also:

For more information on the clpcl command, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

9.2.2 Disabling the EXPRESSCLUSTER daemon

To make the EXPRESSCLUSTER daemon not start at the time the operating system is started up, you can disable it with the command. The following describes how to disable the EXPRESSCLUSTER daemon.
Follow the procedures below to disable the EXPRESSCLUSTER daemon:

1. Run the following command to disable services on the server where you want to disable the EXPRESSCLUSTER daemon.

```
clpsvcctrl.sh --disable core mgr
```

2. Restart the server by using the Cluster WebUI or the clpdown command.

9.2.3 Enabling the disabled EXPRESSCLUSTER daemon

Follow the procedures below to enable the disabled EXPRESSCLUSTER daemon again:

1. On the server where the EXPRESSCLUSTER daemon is disabled, run the following command in the following order to enable services.

```
clpsvcctrl.sh --enable core mgr
```

2. Restart the server.

9.3 Modifying the cluster configuration data

The following describes procedures and precautions of modifying the cluster configuration data after creating a cluster.

9.3.1 Modifying the cluster configuration data by using the Cluster WebUI

1. Start the Cluster WebUI.
2. Select the Config Mode from the drop down menu of the tool bar in Cluster WebUI.
3. Modify the configuration data after the current cluster configuration data is displayed
4. Upload the modified configuration data. Depending on the modified data, it may become necessary to suspend or stop the cluster and/or to restart by shutting down the cluster. In such a case, uploading is canceled once and the required operation is displayed. Follow the displayed message and do as instructed to perform upload again.

9.3.2 Applying the modified cluster configuration data

Apply the cluster configuration data on the EXPRESSCLUSTER Server environment. The way to apply them varies depending on the nature of the changes. For details on how to change parameters and how to apply them, refer to "Parameter details" in the "Reference Guide".

The way you apply changed parameters may affect behavior of the EXPRESSCLUSTER X. For details, see the table below:

The way to apply changes	Effect
Upload Only	The operation of the applications and EXPRESSCLUSTER Server is not affected. Heartbeat resources, group resources or resource monitor does not stop.
Uploading data and restarting the API service	The operation of the applications and EXPRESSCLUSTER Server is not affected. Heartbeat resources, group resources or resource monitor does not stop.
Uploading data and restarting the WebManager service	The operation of the applications and EXPRESSCLUSTER Server is not affected. Heartbeat resources, group resources or resource monitor does not stop.
Uploading data and restarting the Information Base service	The operation of the applications and EXPRESSCLUSTER Server is not affected. Heartbeat resources, group resources or resource monitor does not stop.
Uploading data and restarting the Node Manager service	As long as the EXPRESSCLUSTER Node Manager service is stopped, heartbeat resources are also stopped. However, the applications on the system continue to operate because group resources do not stop.
Uploading data after suspending the monitor	The monitor resource stops. The application continues to run because the group resource does not stop.
Uploading data after suspending the cluster	The operation of the EXPRESSCLUSTER Server partly stops. While the EXPRESSCLUSTER daemon is suspended, heartbeat resources and monitor resources stop. Applications continue operations because group resources do not stop.
Uploading data after stopping the monitor	The group resource stops. The application stops until the resource is started.

continues on next page

Table 9.1 – continued from previous page

The way to apply changes	Effect
Uploading data after suspending the group	The group stops. The application stops until the group is started.
Uploading data after stopping the cluster	All the operations of the EXPRESSCLUSTER Server stop. Because groups are also stopped, applications are stopped until a cluster and groups are started after uploading data.
Uploading data after stopping the cluster and mirror agent	The operation of the whole EXPRESSCLUSTER stops. The application stops until the data is uploaded, the cluster is started and the group is started.
Shutdown the cluster and restart after uploading data	The application stops until the cluster is restarted and the group is started.

Note:

If the EXPRESSCLUSTER daemon needs to be suspended or stopped to apply the modified data, ensure it is suspended or stopped before applying the cluster configuration data.

Check if the message on the Cluster WebUI **Alert logs** shows "Type : Info, Module name: pm, Event ID: 2". For more information on messages, see "Error Messages" in the "Reference Guide".

When the Cluster WebUI is not available to use, check the syslog to see if "Module type: pm, Event type: information, Event ID: 2" is reported.

After checking the message above, apply the cluster configuration data to the EXPRESSCLUSTER environment.

9.4 Introducing Integrated Cluster WebUI

Integrated Cluster WebUI, a Web application, allows you to manage cluster systems in a centralized way, such as to monitor their statuses.

9.4.1 Browsers supported by Integrated Cluster WebUI

For information on supported browsers, see "Getting Started Guide" -> "Installation requirements for EXPRESSCLUSTER".

9.4.2 Setting up Integrated Cluster WebUI

Integrated Cluster WebUI is used by connecting it from a Web browser to a server where EXPRESSCLUSTER Server is installed.

Starting Integrated Cluster WebUI requires choosing **OS Authentication Method**, a method to log in to Cluster WebUI for EXPRESSCLUSTER Server.

For information on how to choose the method, see "Reference Guide" -> "Parameter details" -> "Cluster properties" -> "WebManager tab".

9.4.3 Starting Integrated Cluster WebUI

To start Integrated Cluster WebUI, follow these steps:

1. Start a Web browser.
2. In the address bar of the browser, enter the IP address and port number of a server where EXPRESSCLUSTER Server is installed, and add integ.html to the URL as follows:

   http://ip-address:port/integ.html

   ip-address
   Specify the actual IP address of a server where EXPRESSCLUSTER Server is installed.

   port
   Specify the same port number as that of WebManager specified during the installation (default, 29003).
3. Integrated Cluster WebUI is started.
   When the login screen appears, enter a username and password to log in.

   If you establish an encrypted connection to the EXPRESSCLUSTER server, see "Reference Guide" -> "Parameter details" -> "Cluster properties" -> "WebManager tab". In this case, enter the URL as follows:

   https://ip-address:29003/integ.html

9.4.4 Registering a cluster system in Integrated Cluster WebUI

Registering a cluster in Integrated Cluster WebUI also requires choosing **OS Authentication Method**, a method to log in to Cluster WebUI.

For information on how to register it, see the online help of Integrated Cluster WebUI.

In case of disconnected communication to the IP address entered during the registration, also register an IP address connectable to each server, in **IP address for Integrated Cluster WebUI**. (See "Reference Guide" -> "Parameter details" -> "Cluster properties" -> "WebManager tab" -> "IP address for Integrated Cluster WebUI".)

9.4.5 Notes on Integrated Cluster WebUI

Requirements for all clusters to be registered:

- Set the same usernames and passwords for the OS authentication method.
- Set the same communication method (HTTP/HTTPS) for WebManager.
- If the communication with a connected server is disconnected in the Integrated Cluster WebUI, please log in to that server again.

CHAPTER

TEN

UPGRADING EXPRESSCLUSTER

This chapter provides information on how to upgrade EXPRESSCLUSTER.

This chapter covers:

- 10.1. *How to upgrade EXPRESSCLUSTER*

10.1 How to upgrade EXPRESSCLUSTER

A major version upgrade of EXPRESSCLUSTER is called an upgrade.

Before starting the upgrade, read the following notes.

- The upgrade procedure described in this section is valid for EXPRESSCLUSTER X 3.3 for Linux (internal version 3.3.5-1) or later.
- In EXPRESSCLUSTER X 4.2 for Linux or later, port numbers for EXPRESSCLUSTER have been added. If you upgrade from EXPRESSCLUSTER X 4.1 for Linux or earlier, make necessary ports accessible beforehand.
  For information on port numbers for EXPRESSCLUSTER, refer to "Getting Started Guide" -> "Communication port number".
- If mirror disk resources or hybrid disk resources are set, cluster partitions require space of 1024 MB or larger. And also, executing full copy of mirror disk resources or hybrid disk resources is required.
- If mirror disk resources or hybrid disk resources are set, it is recommended to backup data in advance. For details of a backup procedure, refer to "*Backup procedures*" and "*Restoration procedures*" in "8. *Verifying operation*" in this guide.
- Upgrade the EXPRESSCLUSTER as root user.
- In EXPRESSCLUSTER X 6.0 or later, the execution permissions of directories and files under /opt/nec/clusterpro have been changed.
  (The directories and files do not have read, write, and execute permissions for group and other users.)

See also:

For the procedure of updating between the different versions of the same major version, refer to the "Update Procedure Manual".

The following explains the procedures for upgrading EXPRESSCLUSTER.

1. Before upgrading, confirm that the servers in the cluster and all the resources are in normal status by using Cluster WebUI, WebManager or the command.
2. Save the current cluster configuration file with the Cluster WebUI, Builder or clpcfctrl command. For details about saving the cluster configuration file with clpcfctrl command, refer to "Changing, backing up, and checking cluster configuration data (clpcfctrl command)" -> "Backing up the cluster configuration data" in "EXPRESSCLUSTER command reference" in the "Reference Guide".
3. Uninstall the EXPRESSCLUSTER from all the servers. For the uninstallation procedure, refer to the "Installation and Configuration Guide" for the version you are uninstalling.

   Note: A computer restart is required to complete the uninstallation of the EXPRESSCLUSTER.

4. Install the EXPRESSCLUSTER on all the servers. For details, refer to "*Setting up the EXPRESSCLUSTER Server*" in "4. *Installing EXPRESSCLUSTER*" and "5. *Registering the license*" in this guide.
5. In any of the servers with EXPRESSCLUSTER installed as above, execute the command for converting cluster configuration data.
   a. Move to the work directory (such as /tmp) in which the conversion command is to be executed.
   b. To the moved work directory, copy and deploy the cluster configuration data backed up in step 2.
      Deploy clp.conf and the scripts directory.

      Note:

If backed up on Cluster WebUI, the cluster configuration data is zipped.
Unzip the file, and clp.conf and the scripts directory will be extracted.

c. Execute the following command to convert the cluster configuration data:

```
# clpcfconv.sh -i .
```

d. Under the work directory, zip the cluster configuration data (clp.conf) and the scripts directory.

Note: Create the zip file so that when unzipped, the clp.conf file and scripts directory are created.

6. Open the config mode of Cluster WebUI, and click **Import**.
   Import the cluster configuration data zipped in step 5.
7. Of the cluster configuration data, manually update its items if necessary.
   - See "Getting Started Guide" -> "Removed Functions". Then, if you have used any of the functions with its corresponding action described in the Action column of the table, change the cluster configuration data according to the described action.
   - If a password was set on the cluster password method, the password has been cleared.
     Please set the password again by using Cluster WebUI.
     For information on how to set a password, see "Reference Guide" -> "Parameter details" -> "Cluster properties" -> "WebManager tab".
8. If you upgrade from EXPRESSCLUSTER X 3.3 and are using mirror disk resources or hybrid disk resources, perform the following steps:
   a. Allocate cluster partition (The cluster partition should be 1024 MB or larger).
   b. If the cluster partition is different from the configuration, modify the configuration. And regarding the groups which mirror disk resources or hybrid disk resources belong to, if Startup Attribute is Auto Startup on the Attribute tab of Group Properties, change it to Manual Startup.
   c. If mirror disk resources are set, perform the following steps for each mirror disk resource.
      - Click **Tuning** on the **Details** tab of **Resource Properties**. Then, **Mirror disk resource tuning properties** dialog box is displayed.
      - Uncheck **Execute the initial mirror construction** on **Mirror** tab of the **Mirror disk resource tuning properties** dialog box.
9. If the forced stop function or the forced stop script is used, perform the following steps:
   a. Set the **Type** of **Forced Stop** on the **Fencing** tab of **Cluster Properties**.
      If the forced stop script is used: Select **Custom**.
      If the forced stop script is not used: With EXPRESSCLUSTER operated on physical machines, select **BMC**; with EXPRESSCLUSTER operated on virtual machines, select **vCenter**.
   b. Click **Properties** to display the properties window for the forced stop, and set each parameter.
10. Click **Apply the Configuration File** of the Cluster WebUI to apply the configuration data.

    If using a fixed-term license, execute the following command:

```
clplcnsc --distribute
```

11. If you upgrade from EXPRESSCLUSTER X 3.3 and are using mirror disk resources or hybrid disk resources, perform the following steps:

Initialize the cluster partition of all mirror disk resources and hybrid disk resources as below on each server.
For the mirror disk

```
clpmdinit --create force <mirror disk resource name>
```

For the hybrid disk

```
clphdinit --create force <hybrid disk resource name>
```

12. Open the operation mode of Cluster WebUI, and start the cluster.
13. If you upgrade from EXPRESSCLUSTER X 3.3 and are using mirror disk resources or hybrid disk resources, perform the following steps:
    a. Execute a full copy assuming that the server with the latest data is the copy source from the Mirror disks.
    b. Start the groups and confirm that each resource starts normally.
    c. If **Startup Attribute** or **Execute the initial mirror construction** was changed in the step 8, change back the setting with Cluster WebUI and click **Apply the Configuration File** to apply the cluster configuration data to the cluster.
14. This completes the procedure for upgrading the EXPRESSCLUSTER. Check that the servers are operating normally as the cluster by the clpstat command or Cluster WebUI

CHAPTER

ELEVEN

UNINSTALLING AND REINSTALLING EXPRESSCLUSTER

This chapter provides instructions for uninstalling and reinstalling EXPRESSCLUSTER.
This chapter covers:

- 11.1. *Uninstallation*
- 11.2. *Reinstallation*

11.1 Uninstallation

11.1.1 Uninstalling the EXPRESSCLUSTER Server

Note: You must log on as root user when uninstalling the EXPRESSCLUSTER Server. It is recommended that you obtain a cluster configuration before uninstalling the EXPRESSCLUSTER Server. For details, refer to "EXPRESSCLUSTER command reference" in the "Reference Guide".

Follow the procedures below to uninstall the EXPRESSCLUSTER Server:

1. If the SNMP linkage function has been used, you must cancel the linkage before uninstalling EXPRESSCLUSTER Server. For how to cancel the settings of the SNMP linkage function, see "11.1.2. *Canceling the SNMP linkage function settings*".
2. Run the following command to disable the following services.

```
clpsvcctrl.sh --disable -a
```

3. Restart the server by using the Cluster WebUI or the clpdown command.
4. If SELinux is enabled, delete its settings by executing the following command:

```
clpselctrl.sh --delete
```

Note: `ValueError` messages may appear during execution, but there is no problem as long as `clpselctrl.sh: Command succeeded.` is displayed at the end.

5. Run the **rpm -e expresscls** command.
   For Ubuntu, run **dpkg -r expresscls.** However, this does not delete the configuration data or internal log under the installation directory of Ubuntu. If they are unnecessary, manually delete them.

Note: Do not specify other options than the one stated above.

11.1.2 Canceling the SNMP linkage function settings

You must cancel the SNMP function settings before uninstalling the EXPRESSCLUSTER Server.
Follow the procedure below to cancel the SNMP linkage function settings.

Note:

- To cancel the SNMP linkage function settings, you must log in as the root user.
- The description related to Net-SNMP in the uninstallation procedure may vary depending on the distribution.

1. Stop the snmpd daemon.

Note:

The daemon can usually be stopped by the following command:

- For an init.d environment:

```
/etc/init.d/snmpd stop
```

- For a systemd environment:

```
systemctl stop snmpd
```

2. Cancel registration of the SNMP linkage function in the configuration file for the snmpd daemon.

Open the configuration file with a text editor.
Delete the following lines from the configuration file:

```
dlmod clusterManagementMIB /opt/nec/clusterpro/lib/libclpmgtmib.so
dlmod clusterManagementMIB /opt/nec/clusterpro/lib/libclpmgtmib2.so
```

Note:

The configuration file for the snmpd daemon is usually located in the following directory:
/etc/snmp/snmpd.conf

Note:

Delete the OID of EXPRESSCLUSTER from the MIB view (view definition by snmpd.conf) permitted by the snmpd daemon.
The OID of EXPRESSCLUSTER is ".1.3.6.1.4.1.119.2.3.207".

3. If you created symbolic links at "4.2.4. *Setting up the SNMP linkage function*", delete them.
4. Start the snmpd daemon.

Note:

The daemon can usually be started by the following command:

- For an init.d environment:

```
/etc/init.d/snmpd start
```

- For a systemd environment:

```
systemctl start snmpd
```

11.2 Reinstallation

11.2.1 Reinstalling the EXPRESSCLUSTER Server

To reinstall the EXPRESSCLUSTER Server, you have to prepare the cluster configuration data created by the Cluster WebUI.
If you do not have the cluster configuration data created by the Cluster WebUI at hand, you can back up the data with the clpcfctrl command. For details, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

To reinstall EXPRESSCLUSTER Server on the entire cluster

To reinstall the EXPRESSCLUSTER Server, follow the procedures below:

1. Uninstall the EXPRESSCLUSTER Server.
   For details, see "11.1.1. *Uninstalling the EXPRESSCLUSTER Server*" in "11.1. *Uninstallation*".
2. Install the EXPRESSCLUSTER Server and recreate the cluster.
   For details, see "4.2. *Setting up the EXPRESSCLUSTER Server*"

To reinstall EXPRESSCLUSTER Server on some servers in the cluster

To reinstall the EXPRESSCLUSTER X, follow the procedures below:

1. Uninstall the EXPRESSCLUSTER Server.
   For details, see "11.1.1. *Uninstalling the EXPRESSCLUSTER Server*" in "11.1. *Uninstallation*".
2. Install the EXPRESSCLUSTER Server RPM.
   For details, refer to "4.2. *Setting up the EXPRESSCLUSTER Server*".

   Note: You have to restart the server on which you reinstalled the EXPRESSCLUSTER Server.

3. Distribute the configuration data to servers of which the EXPRESSCLUSTER Server has been reinstalled from the server where it has not been reinstalled. Log on to one of the server where the EXPRESSCLUSTER Server has not been reinstalled. Run one of the following commands:

   ```
   clpcfctrl --push -h <Host_name_of_a_server_where_the_EXPRESSCLUSTER_Server_was_
   ↪reinstalled>
   ```

   ```
   clpcfctrl --push -h <IP_address_of_a_server_where_the_EXPRESSCLUSTER_Server_was_
   ↪reinstalled>
   ```

   The following message is displayed if the data has successfully been distributed.

   ```
   Command succeeded.(code:0)
   ```

   If the fixed-term license is used, run the following command.

   ```
   clplcnsc --reregister <a folder path for saved license files>
   ```

Note: For troubleshooting problems that occur while you are running the clpcfctrl command, see "EXPRESSCLUSTER command reference" in the "Reference Guide".

4. If mirror resources are configured on the distributed configuration data, initializing the device specified as a cluster partition of mirror resources is required. Run the clpmdinit command to initialize it. For details, see "EXPRESSCLUSTER command reference" in the "Reference Guide".
5. Register the license only if the option of the node license will be used on the server where the EXPRESSCLUSTER Server is reinstalled. For more information, refer to "5.3. *Registering the node license* ".
6. Restart the server on which you reinstalled the EXPRESSCLUSTER Server.

CHAPTER

TWELVE

TROUBLESHOOTING

12.1 Error messages when installing the EXPRESSCLUSTER Server

Behavior and Message	Cause	Action
failed to open /var/lib/rpm/packages.rpm error: cannot open /var/lib/rpm/packages.rpm	The user logged on is not root user.	Log on as root user.
error: package expresscls-* is already installed	The EXPRESSCLUSTER is already installed.	Uninstall the EXPRESSCLUSTER and reinstall it.
warning: EXPRESSCLUSTER : The mirror driver is not supported this distribution.	The mirror driver does not support the distribution of a server where EXPRESSCLUSTER is installed.	The mirror disk resource does not run on the distribution the mirror driver does not support.
warning: EXPRESSCLUSTER : The khb driver is not supported this distribution.	The clpkhb driver does not support the distribution of a server where EXPRESSCLUSTER is installed.	The kernel mode LAN heartbeat does not run on the distribution the clpkhb does not support.
warning: EXPRESSCLUSTER : The ka driver is not supported this distribution.	The clpka driver does not support the distribution of a server where EXPRESSCLUSTER is installed.	The module which uses the clpka driver does not run on the distribution the clpka does not support.

12.2 Error messages when uninstalling the EXPRESSCLUSTER Server

Behavior and Message	Cause	Action
failed to open /var/lib/rpm/packages.rpm error: cannot open /var/lib/rpm/packages.rpm	The user logged on is not root user.	Log on as root user.
error: EXPRESSCLUSTER is running	The EXPRESSCLUSTER is active.	Disable Auto Startup of services, restart the server, and uninstall the EXPRESSCLUSTER again.

12.3 Licensing

Behavior and Message	Cause	Action
When the command was executed, the following message appeared in the console: Log in as root.	The command was executed by a general user.	Log on as root user or log on again after changing to root user with su -.
When the command was executed at the license registration, the following message appeared in the console: Command succeeded. But the license was not applied to all the servers in the cluster because there are one or more servers that are not started up.	The transaction server may not be active, or the cluster configuration data may be yet to be distributed.	Check again whether the transaction server is activated and the cluster configuration data is distributed on all servers. If either of them is not done yet, complete the task and register the license again.
When the cluster was shut down and rebooted after distribution of the configuration data created by the Cluster WebUI to all servers, the following message was displayed on the alert log, and the cluster stopped. The license is not registered. (Product name:%1) %1: Product name	The cluster has been shut down and rebooted without its license being registered.	Register the license according to "5. *Registering the license*".

continues on next page

Table 12.3 – continued from previous page

Behavior and Message	Cause	Action
When the cluster was shut down and rebooted after distribution of the configuration data created by the Cluster WebUI to all servers, the following message appeared on the alert log, but the cluster is working properly. The number of licenses is insufficient. The number of insufficient licenses is %1. (Product name:%2) %1: The number of licenses in short of supply %2: Product name	The number of licenses is insufficient.	Obtain a license and register it.
While the cluster was operated on the trial license, the following message appeared and the cluster stopped. The trial license has expired in %1. (Product name:%2) %1: Trial end date %2: Product name	The license has already expired.	Ask your sales agent for extension of the trial version license, or obtain and register the product version license.
While the cluster was operated on the fixed term license, the cluster operation was disabled with the following message outputted: The fixed term license has expired in %1. (Product name:%2) %1: Fixed term end date %2: Product name Cluster operation is forcibly disabled since a valid license has not been registered.	The license has already expired.	Obtain the license for the product version from the vendor, and then register the license.

CHAPTER

THIRTEEN

GLOSSARY

Cluster partition

A partition on a mirror disk. Used for managing mirror disks.
(Related term: Disk heartbeat partition)

Interconnect

A dedicated communication path for server-to-server communication in a cluster.
(Related terms: Private LAN, Public LAN)

Virtual IP address
IP address used to configure a remote cluster.

Management client
Any machine that uses the Cluster WebUI to access and manage a cluster system.

Startup attribute
A failover group attribute that determines whether a failover group should be started up automatically or manually when a cluster is started.

Shared disk
A disk that multiple servers can access.

Shared disk type cluster
A cluster system that uses one or more shared disks.

Switchable partition

A disk partition connected to multiple computers and is switchable among computers.
(Related terms: Disk heartbeat partition)

Cluster system
Multiple computers are connected via a LAN (or other network) and behave as if it were a single system.

Cluster shutdown
To shut down an entire cluster system (all servers that configure a cluster system).

Active server

A server that is running for an application set.
(Related term: Standby server)

Secondary server

A destination server where a failover group fails over to during normal operations.
(Related term: Primary server)

Standby server
A server that is not an active server. (Related term: Active server)

Disk heartbeat partition
A partition used for heartbeat communication in a shared disk type cluster.

Data partition

A local disk that can be used as a shared disk for switchable partition. Data partition for mirror disks or hybrid disks.
(Related term: Cluster partition)

Network partition

All heartbeat is lost and the network between servers is partitioned.
(Related terms: Interconnect, Heartbeat)

Node
A server that is part of a cluster in a cluster system. In networking terminology, it refers to devices, including computers and routers, that can transmit, receive, or process signals.

Heartbeat

Signals that servers in a cluster send to each other to detect a failure in a cluster.
(Related terms: Interconnect, Network partition)

Public LAN

A communication channel between clients and servers.
(Related terms: Interconnect, Private LAN)

Failover
The process of a standby server taking over the group of resources that the active server previously was handling due to error detection.

Failback
A process of returning an application back to an active server after an application fails over to another server.

Failover group
A group of cluster resources and attributes required to execute an application.

Moving failover group
Moving an application from an active server to a standby server by a user.

Failover policy
A priority list of servers that a group can fail over to.

Private LAN

LAN in which only servers configured in a clustered system are connected.
(Related terms: Interconnect, Public LAN)

Primary (server)

A server that is the main server for a failover group.
(Related term: Secondary server)

Floating IP address

Clients can transparently switch one server from another when a failover occurs.
Any unassigned IP address that has the same network address that a cluster server belongs to can be used as a floating address.

Master server
The server displayed at the top of the Master Server in Server Common Properties of the config mode of Cluster WebUI

Mirror disk connect
LAN used for data mirroring in mirror disk or hybrid disk. Mirror connect can be used with primary interconnect.

Mirror disk type cluster
A cluster system that does not use a shared disk. Local disks of the servers are mirrored.

CHAPTER

FOURTEEN

LEGAL NOTICE

14.1 Disclaimer

- Information in this document is subject to change without notice.
- NEC Corporation is not liable for technical or editorial errors or omissions in the information in this document.
  You are completely liable for all risks associated with installing or using the product as described in this manual to obtain expected results and the effects of such usage.
- The information in this document is copyrighted by NEC Corporation.
  No part of this document may be reproduced or transmitted in any form by any means, electronic or mechanical, for any purpose, without the express written permission of NEC Corporation.

14.2 Trademark Information

- EXPRESSCLUSTER® is a registered trademark of NEC Corporation .
- Linux is a registered trademark of Linus Torvalds in the United States and other countries.
- Microsoft, Windows, Windows Server, Internet Explorer, Azure, and Hyper-V are registered trademarks of Microsoft Corporation in the United States and other countries.
- Ubuntu is a registered trademark of Canonical Ltd.
- Amazon Web Services and all AWS-related trademarks, as well as other AWS graphics, logos, page headers, button icons, scripts, and service names are trademarks, registered trademarks or trade dress of AWS in the United States and/or other countries.
- Veritas, the Veritas Logo, and all other Veritas product names and slogans are trademarks or registered trademarks of Veritas Technologies LLC or its affiliates in the United States and other countries.
- Oracle, Oracle Database, Solaris, MySQL, Tuxedo, WebLogic Server, Container, Java, and all Java-based trademarks and logos are trademarks or registered trademarks of Oracle Corporation and/or its affiliates.
- IBM, DB2, and WebSphere are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both.
- PostgreSQL is a registered trademark of the PostgreSQL Global Development Group.
- RPM is a registered trademark of Red Hat, Inc. or its subsidiaries in the United States and other countries.
- F5, F5 Networks, BIG-IP, and iControl are trademarks or registered trademarks of F5 Networks, Inc. in the United States and other countries.
- WebOTX is a registered trademark of NEC Corporation.
- Google Cloud is a trademark or a registered trademark of Google LLC.
- Other product names and slogans written in this manual are trademarks or registered trademarks of their respective companies.

CHAPTER

FIFTEEN

REVISION HISTORY

Edition	Revised Date	Description
1st	Apr 08, 2026	New manual
2nd	Apr 24, 2026	Corrected typographical errors and other mistakes.
3rd	Jul 13, 2026	Corrected typographical errors and other mistakes.
4th	Oct 02, 2026	Corrected typographical errors and other mistakes.

© Copyright NEC Corporation 2026. All rights reserved.