

EXPRESSCLUSTER[®] X 4.0 **for Linux**

Installation and Configuration Guide

September 14, 2018
2nd Edition



Revision History

| Edition | Revised Date | Description |
|---------|--------------|--|
| 1st | Apr 17, 2018 | New manual. |
| 2nd | Sep 14, 2018 | Corresponds to the internal version 4.0.1-1. |

© Copyright NEC Corporation 2018. All rights reserved.

Disclaimer

Information in this document is subject to change without notice. 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.

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.

Asianux is registered trademark of Cybertrust Japan Co., Ltd. in Japan

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.

Sybase is a registered trademark of Sybase, Inc.

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.

Other product names and slogans written in this manual are trademarks or registered trademarks of their respective companies.

Table of Contents

| | |
|---|-----------|
| Preface | xi |
| Who Should Use This Guide | xi |
| How This Guide is Organized | xi |
| EXPRESSCLUSTER X Documentation Set | xii |
| Conventions | xiii |
| Contacting NEC | xiv |
| Section I Configuring a cluster system | 15 |
| Chapter 1 Determining a system configuration | 17 |
| Steps from configuring a cluster system to installing EXPRESSCLUSTER | 18 |
| What is EXPRESSCLUSTER? | 19 |
| EXPRESSCLUSTER modules | 20 |
| Planning system configuration | 21 |
| Shared disk type and data mirror type | 21 |
| Example 1: configuration using a shared disk with two nodes | 22 |
| Example 2: configuration using mirror disks with two nodes | 23 |
| Example 3: configuration using mirror disks with two nodes and one LAN | 24 |
| Example 4: configuration using mirror partitions on the disks for OS with two nodes | 25 |
| Example 5: configuration with three nodes | 26 |
| Example 6: configuration with four nodes | 27 |
| Example 7: Configuration of hybrid type with three nodes | 28 |
| Example 8: Configuration for using BMC-related functions with two nodes | 29 |
| Checking system requirements for each EXPRESSCLUSTER module | 30 |
| Example of EXPRESSCLUSTER (main module) hardware configuration | 31 |
| General requirements | 31 |
| Verifying system requirements for the Cluster WebUI / WebManager | 32 |
| Determining a hardware configuration | 33 |
| Settings after configuring hardware | 34 |
| Shared disk settings for disk resource (Required for disk resource) | 35 |
| Shared disk settings for hybrid disk resource (Required for Replicator DR) | 37 |
| Partition settings for hybrid disk resource (Required for the Replicator DR) | 40 |
| Partition settings for mirror disk resource (when using Replicator) | 42 |
| Adjustment of the operating system startup time (Required) | 44 |
| Verification of the network settings (Required) | 46 |
| Verification of the root file system (Required) | 46 |
| Verification of the firewall settings (Required) | 47 |
| Server clock synchronization (Required) | 50 |
| Chapter 2 Configuring a cluster system | 51 |
| Configuring a cluster system | 52 |
| Determining a cluster topology | 53 |
| Failover in uni-directional standby cluster | 54 |
| Failover in multi-directional standby cluster | 55 |
| Determining applications to be duplicated | 56 |
| Configuration relevant to the notes | 56 |
| Server applications | 56 |
| Note 1: Data recovery after an error | 56 |
| Note 2: Application termination | 56 |
| Note 3: Location to store the data | 56 |
| Note 4: Multiple application service groups | 57 |
| Note 5: Mutual interference and compatibility with applications | 58 |
| Solution to the problems relevant to the notes | 58 |
| How to determine a cluster topology | 58 |
| Planning a cluster configuration | 59 |
| Understanding group resources | 60 |

| | |
|--|-----------|
| Understanding monitor resources | 61 |
| Understanding heartbeat resources | 63 |
| Understanding network partition resolution resources | 64 |
| Section II Installing and configuring EXPRESSCLUSTER X..... | 67 |
| Chapter 3 Installing EXPRESSCLUSTER..... | 69 |
| Steps from Installing EXPRESSCLUSTER to creating a cluster | 70 |
| Setting up the EXPRESSCLUSTER Server | 71 |
| Installing the EXPRESSCLUSTER RPM | 72 |
| Installing the EXPRESSCLUSTER deb package | 73 |
| Installing the Builder (Offline version)..... | 74 |
| Starting the Builder..... | 75 |
| Setting up the SNMP linkage function | 76 |
| Chapter 4 Registering the license..... | 79 |
| Registering the CPU license | 80 |
| Notes on the CPU license | 80 |
| Registering the license by specifying the license file (for both product version and trial version) | 81 |
| Registering the license interactively from the command line (Product version)..... | 82 |
| Registering the VM node license..... | 84 |
| Registering the VM node license by specifying the license file (for both product and trial versions) | 85 |
| Registering the VM node license interactively from the command line (Product version)..... | 86 |
| Registering the node license | 88 |
| Registering the node license by specifying the license file (for both product version and trial version) | 89 |
| Registering the node license interactively from the command line (Product version) | 91 |
| Registering the fixed term license | 93 |
| Notes on the fixed term license..... | 93 |
| Registering the fixed term license by specifying the license file | 95 |
| Chapter 5 Creating the cluster configuration data | 97 |
| Creating the cluster configuration data | 98 |
| Starting up the Cluster WebUI | 99 |
| What is Cluster WebUI? | 99 |
| Browsers supported by the Cluster WebUI..... | 99 |
| Starting the Cluster WebUI | 100 |
| Starting up the WebManager | 101 |
| What is WebManager? | 101 |
| Browsers supported by the WebManager | 102 |
| Setting up Java runtime environment to a management PC..... | 102 |
| Starting the WebManager | 102 |
| Checking the values to be configured in the cluster environment with two nodes | 104 |
| Sample cluster environment | 104 |
| Creating the configuration data of a 2-node cluster..... | 112 |
| 1. Creating a cluster..... | 113 |
| 1-1. Add a cluster | 113 |
| 1-2. Add a server | 114 |
| 1-3. Set up the network configuration..... | 115 |
| 1-4. Set up the network partition resolution..... | 116 |
| 2. Creating a failover group | 118 |
| 2-1. Add a failover group..... | 118 |
| 2-2. Add a group resource (floating IP address) | 119 |
| 2-3. Add a group resource (volume manager resource) | 119 |
| 2-4. Add a group resource (disk resource)..... | 119 |
| 2-5. Add a group resource (mirror disk resource)..... | 120 |
| 2-6. Add a group resource (EXEC resource) | 120 |
| 3. Creating monitor resources..... | 122 |
| 3-1. Add a monitor resource (disk monitor) | 122 |
| 3-2. Add a monitor resource (IP monitor) | 122 |
| 3-3. Configure a monitor resource (volume manager monitor) | 123 |
| 4. Disabling recovery action caused by monitor resource error | 124 |
| Checking the values to be specified in a cluster environment that has two nodes (using VxVM) | 125 |

| | |
|--|-----|
| Configuration of VERITAS Volume Manager | 125 |
| Sample cluster environment | 127 |
| Creating Configuration Information for a Cluster that Has Two Nodes (Using VxVM)..... | 133 |
| 1. Creating a cluster | 135 |
| 1-1. Add a cluster | 135 |
| 1-2. Add a server..... | 135 |
| 1-3. Set up the network configuration | 136 |
| 1-4. Set up the network partition resolution | 137 |
| 2. Creating a failover group..... | 139 |
| 2-1. Add a failover group (first group) | 139 |
| 2-2. Add a group resource (floating IP address)..... | 140 |
| 2-3. Add a group resource (volume manager resource)..... | 140 |
| 2-4. Add a group resource (disk resource) | 140 |
| 2-5. Add a failover group (second group) | 141 |
| 2-6. Add a group resource (floating IP address)..... | 142 |
| 2-7. Add a group resource (volume manager resource)..... | 142 |
| 2-8. Add a group resource (disk resource) | 142 |
| 3. Creating monitor resources | 144 |
| 3-1. Configure a monitor resource (volume manager monitor resource)..... | 144 |
| 3-2. Add a monitor resource (disk monitor resource)..... | 144 |
| 3-3. Add a monitor resource (IP monitor resource)..... | 146 |
| 4. Disabling recovery action caused by monitor resource error | 147 |
| Checking the values to be configured in the cluster environment with three nodes | 148 |
| Sample cluster environment | 148 |
| Creating the configuration data of a 3-node cluster | 153 |
| 1. Creating a cluster | 155 |
| 1-1. Add a cluster | 155 |
| 1-2. Add a server..... | 155 |
| 1-3. Set up the network configuration | 156 |
| 1-4. Set up the network partition resolution | 157 |
| 2. Creating a failover group..... | 159 |
| 2-1. Add a failover group (group 1) | 159 |
| 2-2. Add a group resource (floating IP address)..... | 160 |
| 2-3. Add a group resource (mirror disk resource) | 160 |
| 2-4. Add a group resource (EXEC resource)..... | 161 |
| 2-5. Add a failover group (group 2) | 162 |
| 2-6. Add a group resource (floating IP address)..... | 162 |
| 2-7. Add a group resource (mirror disk resource) | 162 |
| 2-8. Add a group resource (EXEC resource)..... | 163 |
| 3. Creating monitor resources | 164 |
| 3-1. Add a monitor resource (disk monitor resource)..... | 164 |
| 3-2. Add a monitor resource (disk monitor resource)..... | 164 |
| 3-3. Add a monitor resource (IP monitor resource)..... | 165 |
| 4. Disabling recovery action caused by monitor resource error | 166 |
| Checking the values to be configured in the cluster environment with three nodes (hybrid type) | 167 |
| Sample cluster environment | 167 |
| Creating the configuration data of a 3-node cluster (hybrid type) | 171 |
| 1. Creating a cluster | 173 |
| 1-1. Add a cluster | 173 |
| 1-2. Add a server..... | 173 |
| 1-3. Create a server group | 174 |
| 1-4. Set up the network configuration | 175 |
| 1-5. Set up the network partition resolution | 176 |
| 2. Creating a failover group..... | 178 |
| 2-1. Add a failover group..... | 178 |
| 2-2. Add a group resource (floating IP address)..... | 179 |
| 2-3. Add a group resource (hybrid disk resource) | 179 |
| 2-4. Add a group resource (EXEC resource)..... | 179 |
| 3. Creating monitor resources | 181 |
| 3-1. Add a monitor resource (disk monitor resource)..... | 181 |
| 3-2. Add a monitor resource (IP monitor resource)..... | 182 |
| 4. Disabling recovery action caused by monitor resource error | 183 |
| 5. Modify cluster properties | 184 |
| Saving the cluster configuration data..... | 185 |

| | |
|--|------------|
| Saving the cluster configuration data (Linux)..... | 185 |
| Saving the cluster configuration data (Windows)..... | 185 |
| Creating a cluster | 187 |
| How to create a cluster | 187 |
| Chapter 6 Verifying a cluster system..... | 189 |
| Verifying operations using the WebManager | 190 |
| Verifying operation by using commands..... | 192 |
| Chapter 7 Modifying the cluster configuration data..... | 195 |
| Modifying the cluster configuration data | 196 |
| Add the server | 196 |
| Add a group | 196 |
| Add a group resource..... | 196 |
| Add a monitor resource | 197 |
| Modifying the cluster configuration data by using the Builder (online version)..... | 197 |
| Modifying the cluster configuration data by using the Builder (offline version)..... | 197 |
| Applying the cluster configuration data | 199 |
| Online version Builder | 200 |
| Uploading data only..... | 200 |
| Uploading data and restarting the WebManager..... | 200 |
| Uploading data after suspending a cluster | 200 |
| Uploading data after stopping a cluster | 200 |
| Shutting down and restarting a cluster after uploading data | 201 |
| Uploading data after stopping mirror agents..... | 201 |
| Section III Evaluation before operating a cluster system..... | 203 |
| Chapter 8 Verifying operation | 205 |
| Operation tests | 206 |
| Backup procedures | 210 |
| Backing up while EXPRESSCLUSTER is active | 210 |
| Backing up while EXPRESSCLUSTER is inactive | 210 |
| Backing up while EXPRESSCLUSTER is inactive (For Replicator or Replicator DR)..... | 211 |
| Restoration procedures | 212 |
| Restoring the file system containing the /opt/nec/clusterpro directory | 212 |
| Restoring the data on the shared disk | 213 |
| Restoring the data on the mirror disk or the hybrid disk..... | 214 |
| Chapter 9 Preparing to operate a cluster system | 217 |
| Operating the cluster system..... | 218 |
| Activating a cluster..... | 218 |
| Shutting down a cluster and server | 218 |
| Shutting down the entire cluster | 218 |
| Shutting down a server | 218 |
| Suspending/resuming a cluster | 219 |
| How to suspend a cluster..... | 219 |
| How to resume a cluster | 219 |
| Suspending EXPRESSCLUSTER..... | 221 |
| Stopping the EXPRESSCLUSTER daemon..... | 221 |
| Disabling the EXPRESSCLUSTER daemon..... | 221 |
| Enabling the disabled EXPRESSCLUSTER daemon..... | 221 |
| Chapter 10 Uninstalling and reinstalling EXPRESSCLUSTER..... | 223 |
| Uninstallation | 224 |
| Uninstalling the EXPRESSCLUSTER Server..... | 224 |
| Uninstalling the Builder (Offline version)..... | 225 |
| Canceling the SNMP linkage function settings | 226 |
| Reinstallation..... | 227 |
| Reinstalling the EXPRESSCLUSTER Server | 227 |

| | |
|---|------------|
| Appendix A. Troubleshooting | 229 |
| Errors messages when installing the EXPRESSCLUSTER X Builder | 229 |
| Error messages when uninstalling the EXPRESSCLUSTER X Builder | 229 |
| Error messages when installing the EXPRESSCLUSTER Server | 229 |
| Error messages when uninstalling the EXPRESSCLUSTER Server | 230 |
| Troubleshooting for licensing | 231 |
| Appendix B. Glossary..... | 233 |
| Appendix C. Index..... | 235 |

Preface

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.

How This Guide is Organized

| | |
|--------------------|---|
| Section I | Configuring a cluster system Determines cluster hardware configuration required before installing EXPRESSCLUSTER and how to create the cluster configuration data with the Builder before installing EXPRESSCLUSTER. |
| Chapter 1 | Determining a system configuration Provides instructions for how to verify system requirements and determine the system configuration. |
| Chapter 2 | Configuring a cluster system Helps you understand how to configure a cluster system. |
| Section II | Installing and configuring EXPRESSCLUSTER X Install EXPRESSCLUSTER to the server machine and configure a cluster system using the cluster configuration data that you have created in Section I. Then run the operation tests and verify if the system operates successfully. |
| Chapter 3 | Installing EXPRESSCLUSTER Provides instructions for how to install EXPRESSCLUSTER. |
| Chapter 4 | Registering the license Provides instructions for how to register the license. |
| Chapter 5 | Creating the cluster configuration data Provides instructions for how to create the cluster configuration data with the Builder. |
| Chapter 6 | Verifying a cluster system Verify if the cluster system that you have configured operates successfully. |
| Chapter 7 | Modifying the cluster configuration data Provides instructions for how to modify the cluster configuration data. |
| Section III | Evaluation before operating a cluster system Evaluate the system before start operating the cluster. Verify the required settings after checking the behavior of the cluster system. Instruction on how to uninstall and reinstall EXPRESSCLUSTER is provided as well. |
| Chapter 8 | Verifying operation Run the pseudo-failure test and adjust the parameters. |
| Chapter 9 | Preparing to operate a cluster system Provides information on what you need to consider before actually start operating EXPRESSCLUSTER. |
| Chapter 10 | Uninstalling and reinstalling EXPRESSCLUSTER Provides instructions for how to uninstall and reinstall EXPRESSCLUSTER. |
| Appendix A | Troubleshooting |
| Appendix B | Glossary |
| Appendix C | Index |

EXPRESSCLUSTER X Documentation Set

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

Getting Started Guide

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

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.

Reference Guide

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

EXPRESSCLUSTER X Integrated WebManager Administrator's Guide

This guide is intended for system administrators who manage cluster system using EXPRESSCLUSTER with EXPRESSCLUSTER Integrated WebManager and for system engineers who introduce the Integrated WebManager. In this guide, details on required items for introducing the cluster system using the Integrated WebManager are explained in accordance with the actual procedures.

Conventions

In this guide, **Note**, **Important**, **Related Information** 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.

Related Information:

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. | <code>clpstat -s[-h <i>host_name</i>]</code> |
| # | Prompt to indicate that a Linux user has logged on as root user. | <code># clpcl -s -a</code> |
| Monospace (courier) | Indicates path names, commands, system output (message, prompt, etc.), directory, file names, functions and parameters. | <code>/Linux/4.0/eng/server/</code> |
| Monospace bold (courier) | Indicates the value that a user actually enters from a command line. | Enter the following: <code># clpcl -s -a</code> |
| <i>Monospace italic</i> (courier) | Indicates that users should replace italicized part with values that they are actually working with. | <code>rpm -i expresscls-<version_number>-<release_number>.x86_64.rpm</code> |

Contacting NEC

For the latest product information, visit our website below:

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

Section I Configuring a cluster system

Before installing EXPRESSCLUSTER, it is important to plan your cluster system considering the hardware configuration and the operation requirements and needs. This section describes how to determine the hardware configuration required before installing EXPRESSCLUSTER and how to create the cluster configuration data with the Builder.

- Chapter 1 Determining a system configuration
- Chapter 2 Configuring a cluster system

Chapter 1 **Determining a system configuration**

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

This chapter covers:

- Steps from configuring a cluster system to installing EXPRESSCLUSTER 18
- What is EXPRESSCLUSTER?..... 19
- Planning system configuration 21
- Checking system requirements for each EXPRESSCLUSTER module 30
- Example of EXPRESSCLUSTER (main module) hardware configuration 31
- Verifying system requirements for the Cluster WebUI / WebManager 32
- Determining a hardware configuration 33
- Settings after configuring hardware..... 34

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:

Configuring a cluster system (Section I)

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

Step 1 Determining a system configuration (Chapter 1)

Step 2 Configuring a cluster system (Chapter 2)

Installing and configuring EXPRESSCLUSTER X (Section II)

Install EXPRESSCLUSTER to server machines, create a configuration data file by using setting information created on section I, and construct a cluster. After that, verify that a cluster system operates normally.

Step 3 Installing EXPRESSCLUSTER (Chapter 3)

Step 4 Registering the license (Chapter 4)

Step 5 Creating the cluster configuration data (Chapter 5)

Step 6 Verifying a cluster system (Chapter 6)

Step 7 Modifying the cluster configuration data (Chapter 7)

Evaluation before operating a cluster system (Section III)

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 8 Verifying operation (Chapter 8)

Step 9 Preparing to operate a cluster system (Chapter 9)

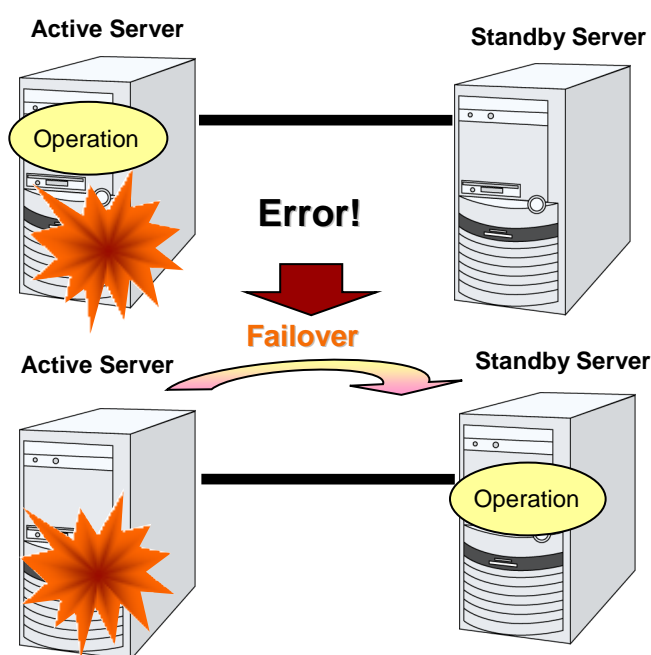
Step 10 Uninstalling and reinstalling EXPRESSCLUSTER (Chapter 10)

Related Information:

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.

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.



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.

Related Information:

For details on EXPRESSCLUSTER, refer to Section I “Introducing EXPRESSCLUSTER” in the *Getting Started Guide*.

EXPRESSCLUSTER modules

EXPRESSCLUSTER consists of following three modules:

◆ **EXPRESSCLUSTER Server**

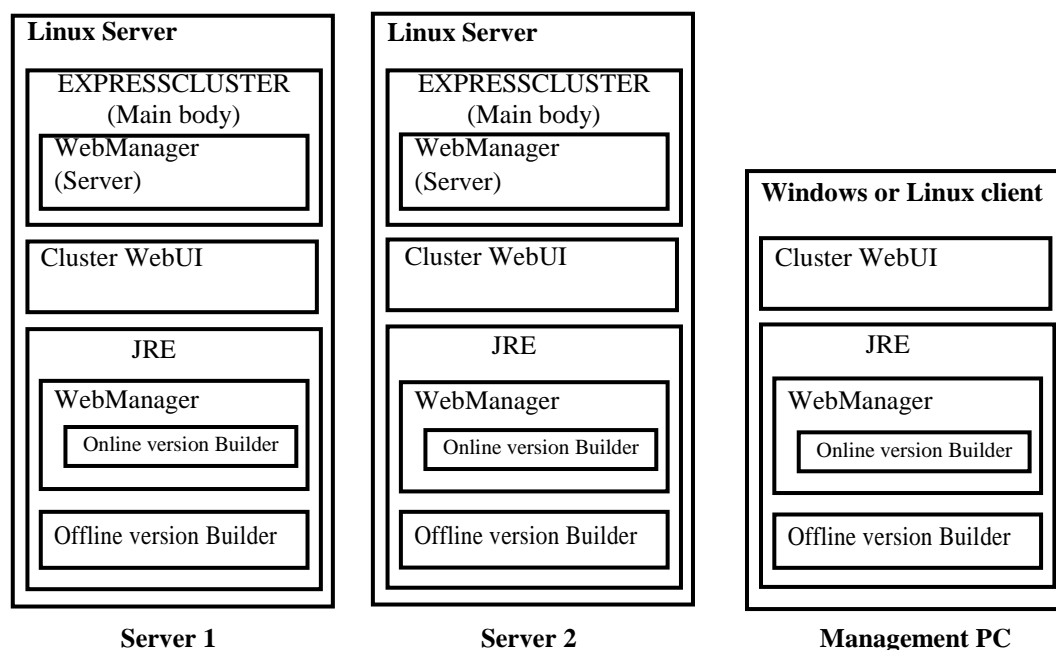
The main module of EXPRESSCLUSTER and has all high availability functions of the server. Install this module on each server constituting the cluster.

◆ **Cluster WebUI / WebManager**

A tool to manage EXPRESSCLUSTER operations and uses a Web browser as a user interface. The WebManager is installed in EXPRESSCLUSTER Server, but it is distinguished from the EXPRESSCLUSTER Server because the WebManager is operated through a Web browser on the management PC.

◆ **Builder**

A tool for editing the cluster configuration data. The following two versions of Builder are provided: an online version that operates as the setup mode of WebManager, and an offline version that is individually installed on the management PC. The online version is incorporated into WebManager. The Builder also uses a Web browser as a user interface the same way as the WebManager.



The WebManager and the Builder are Java applets that run on Java VMs. The Builder and WebManager can run on any Windows or Linux machines as long as Java Runtime Environment (JRE) is installed. This is because the WebManager and the Builder are Java applets that run on Java VM.

The WebManager and the Builder can be used on a server in the cluster as long as JRE is installed.

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.

Related Information:

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

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.

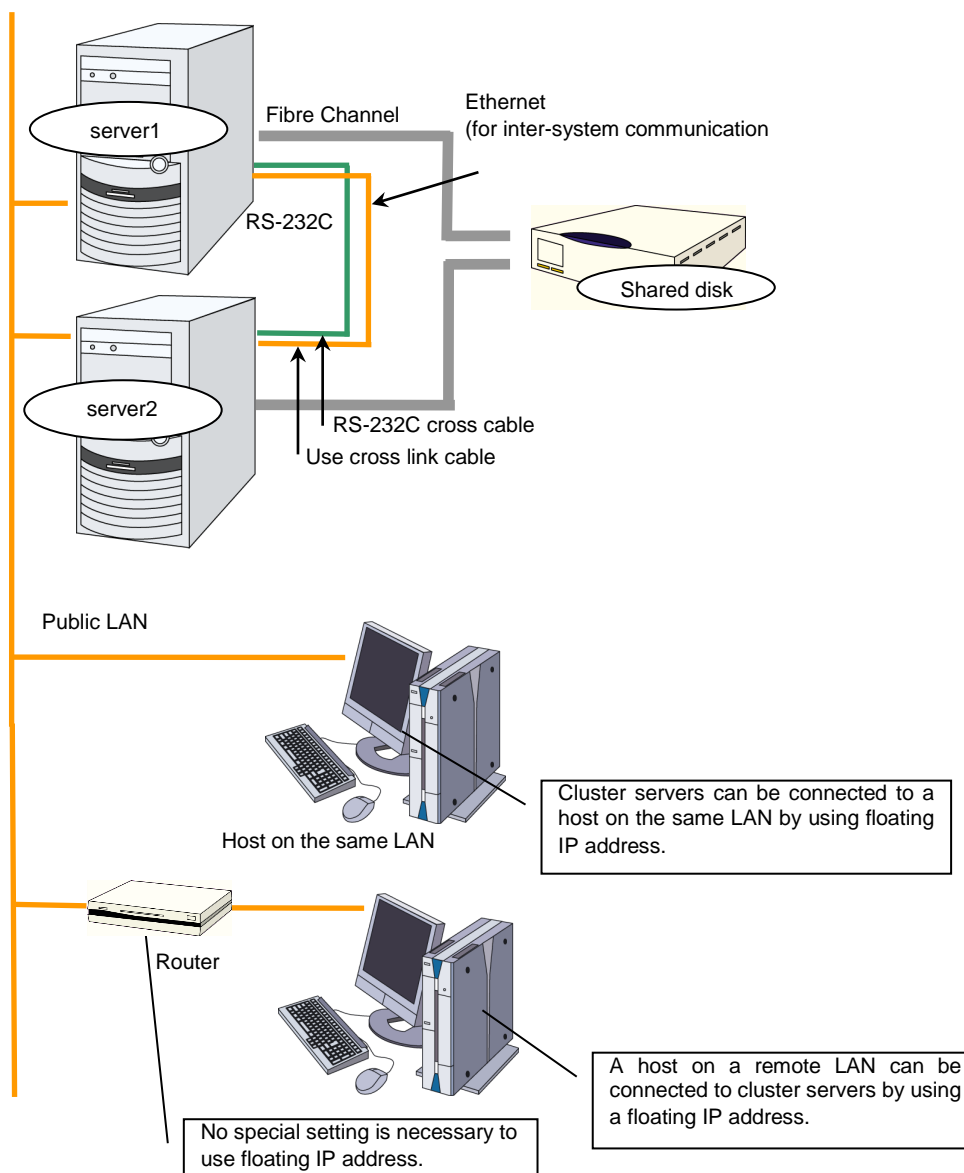
Data writing performance, operational topology and precautions of the mirror disk type apply to the hybrid type.

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

Example 1: configuration using a shared disk with two nodes

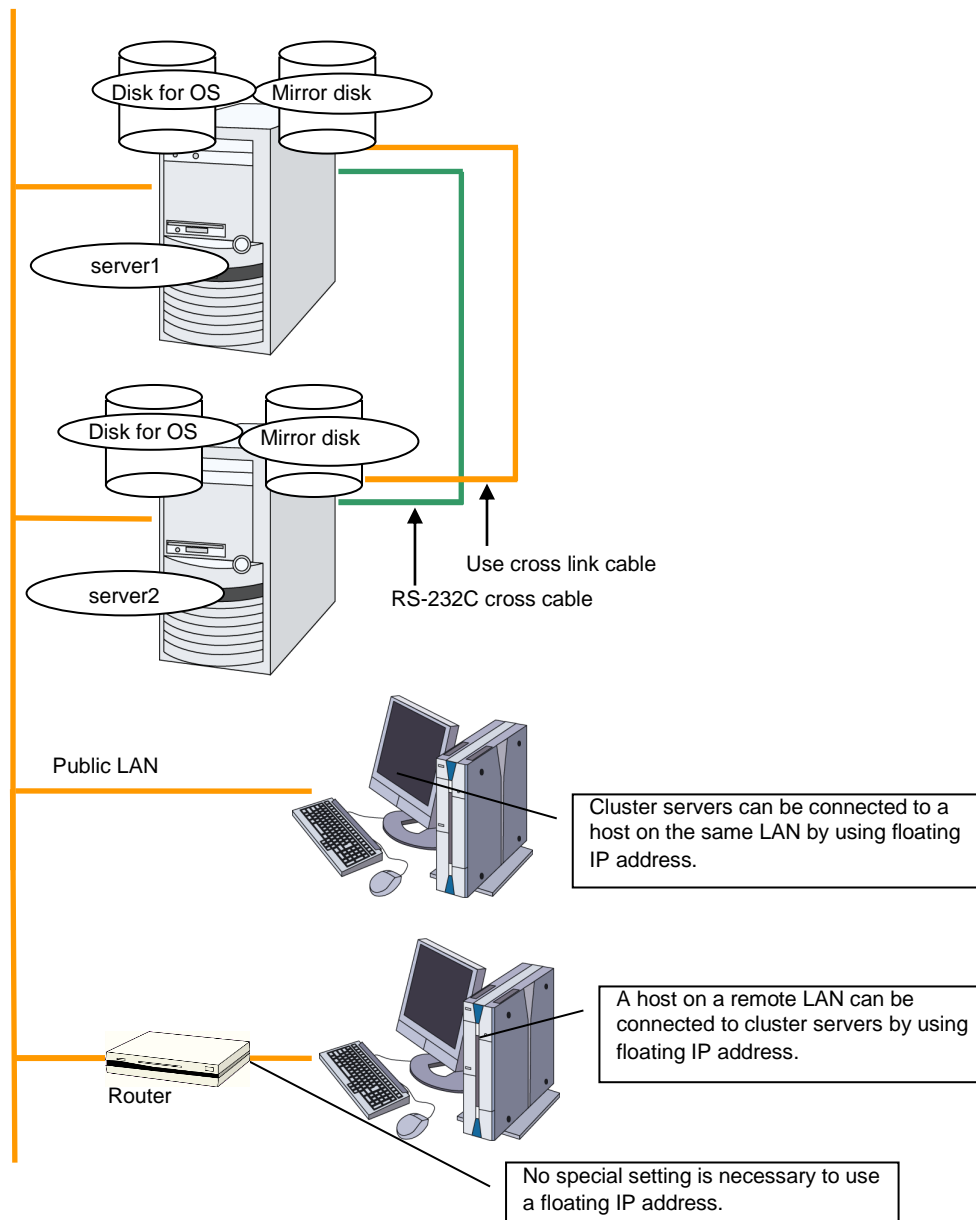
The most commonly used system configuration:

- ◆ Different models can be used for servers.
- ◆ Use cross cables for interconnection. (A dedicated HUB can be used for connection as in the case with the 4-nodes configuration)
- ◆ Connect COM (RS-232C) ports using a cross cable.



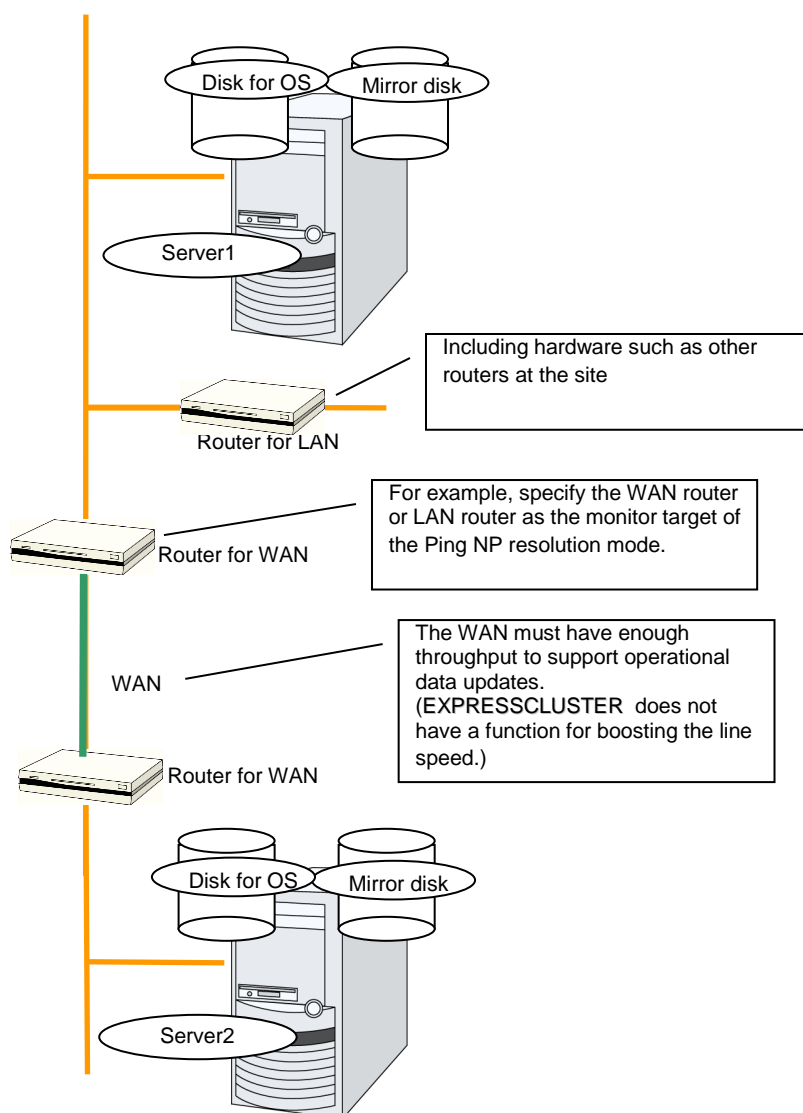
Example 2: configuration using mirror disks with two nodes

- ◆ Different models can be used for servers. However, servers should have the same architecture.
- ◆ Use cross cables for interconnection. Use cross cables for the interconnection between the mirror disks (mirror disk connect). Do not connect a HUB.
- ◆ Connect COM (RS-232C) ports using cross cables.



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

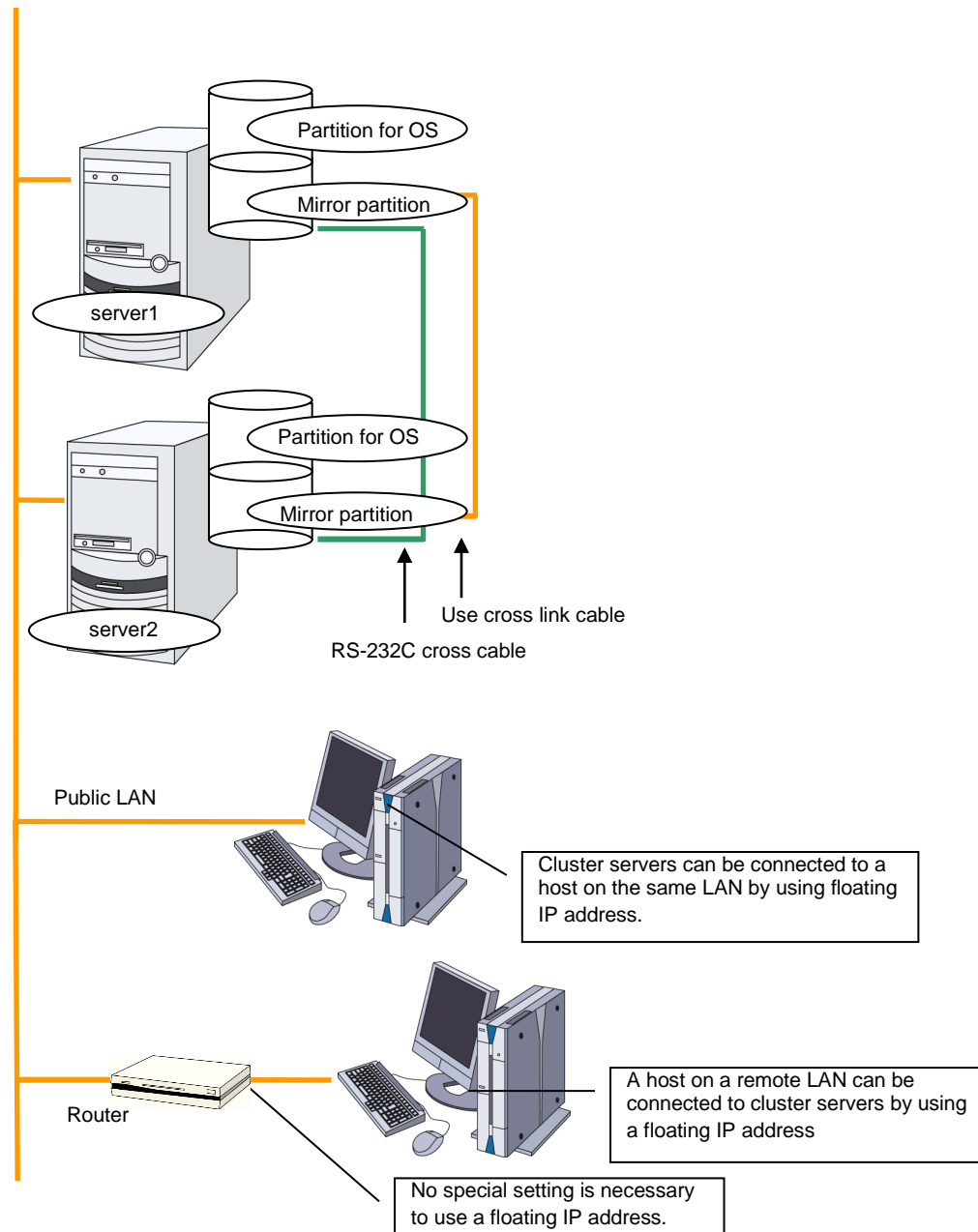
- ◆ Different models can be used for servers, but the servers must have the same architecture.



Clients are omitted from this figure.

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.

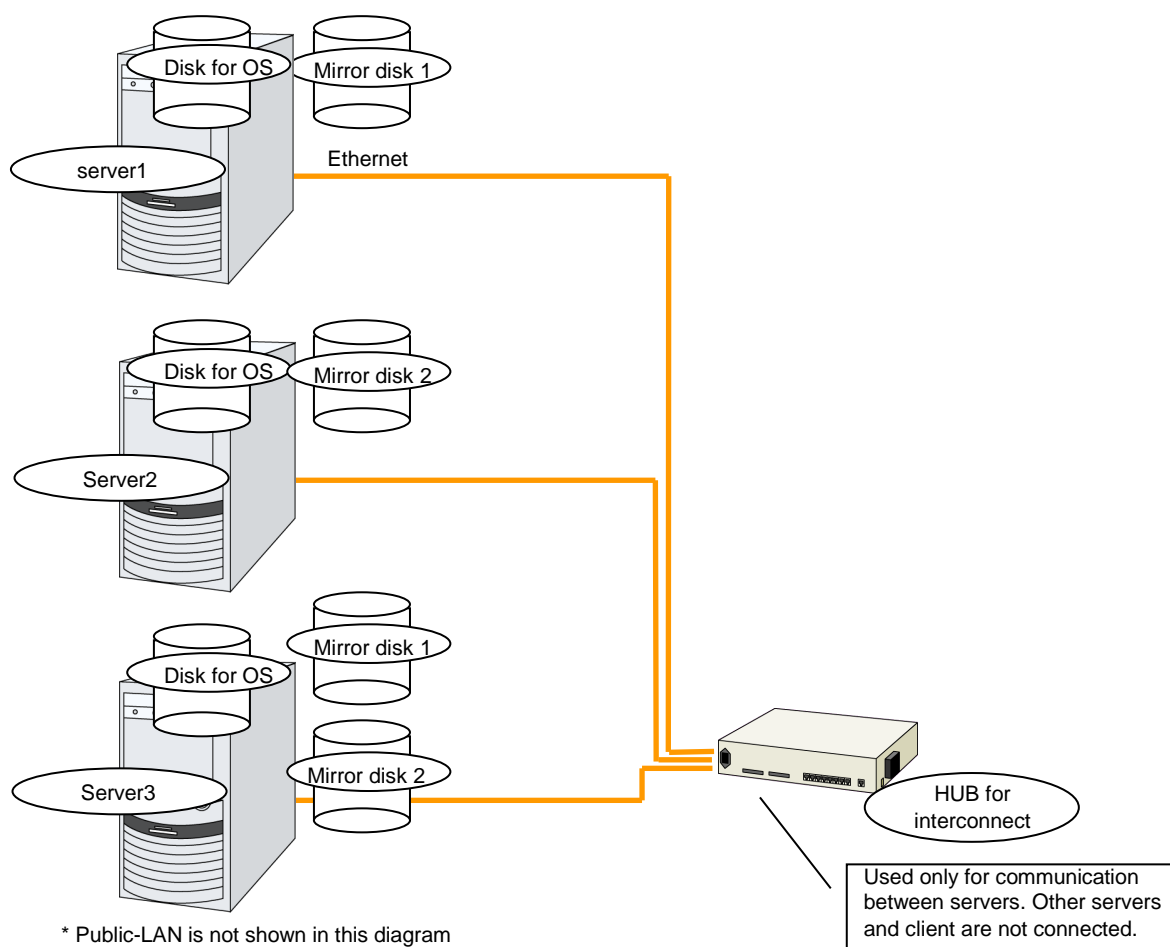


Related Information:

For mirror partition settings, refer to Chapter 4, “Group resource details” in the *Reference Guide*.

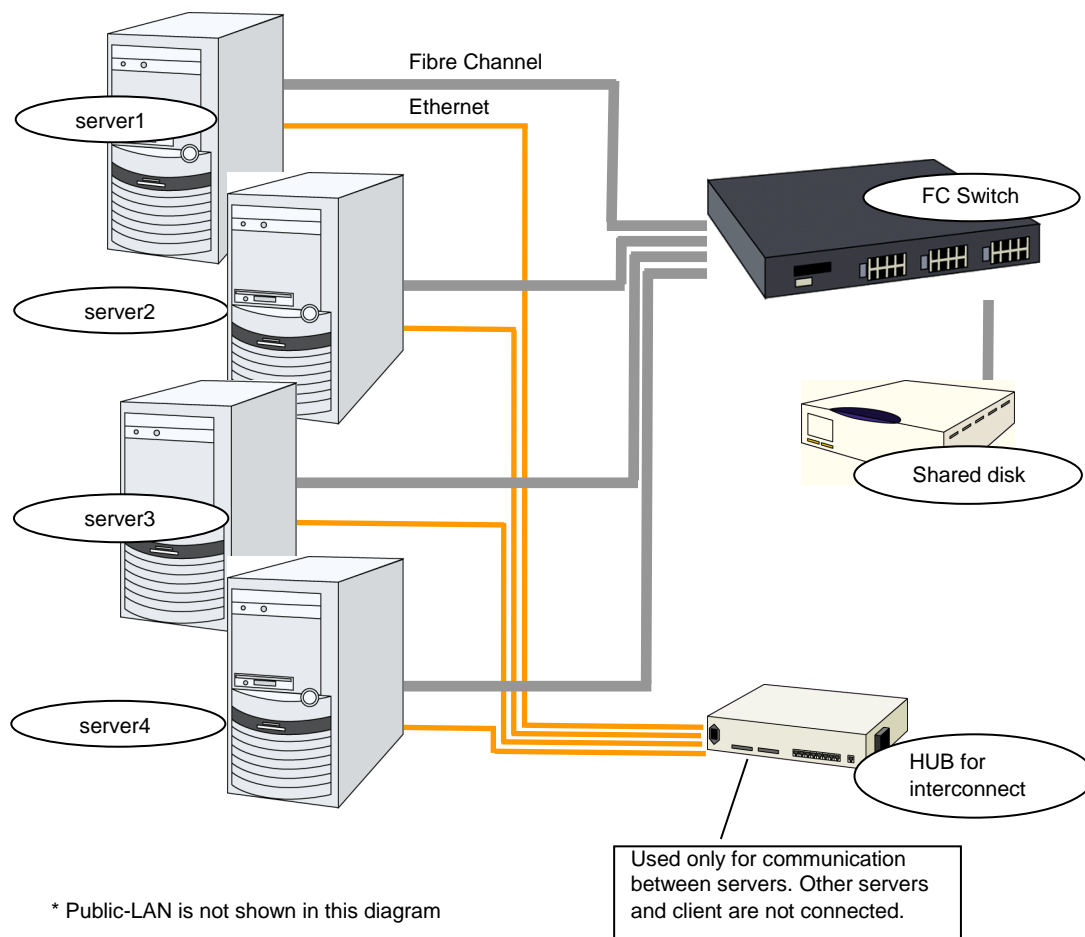
Example 5: configuration with three nodes

- ◆ 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.
- ◆ It is not necessary to establish connectivity between servers using the connect COM (RS-232C).



Example 6: configuration with four nodes

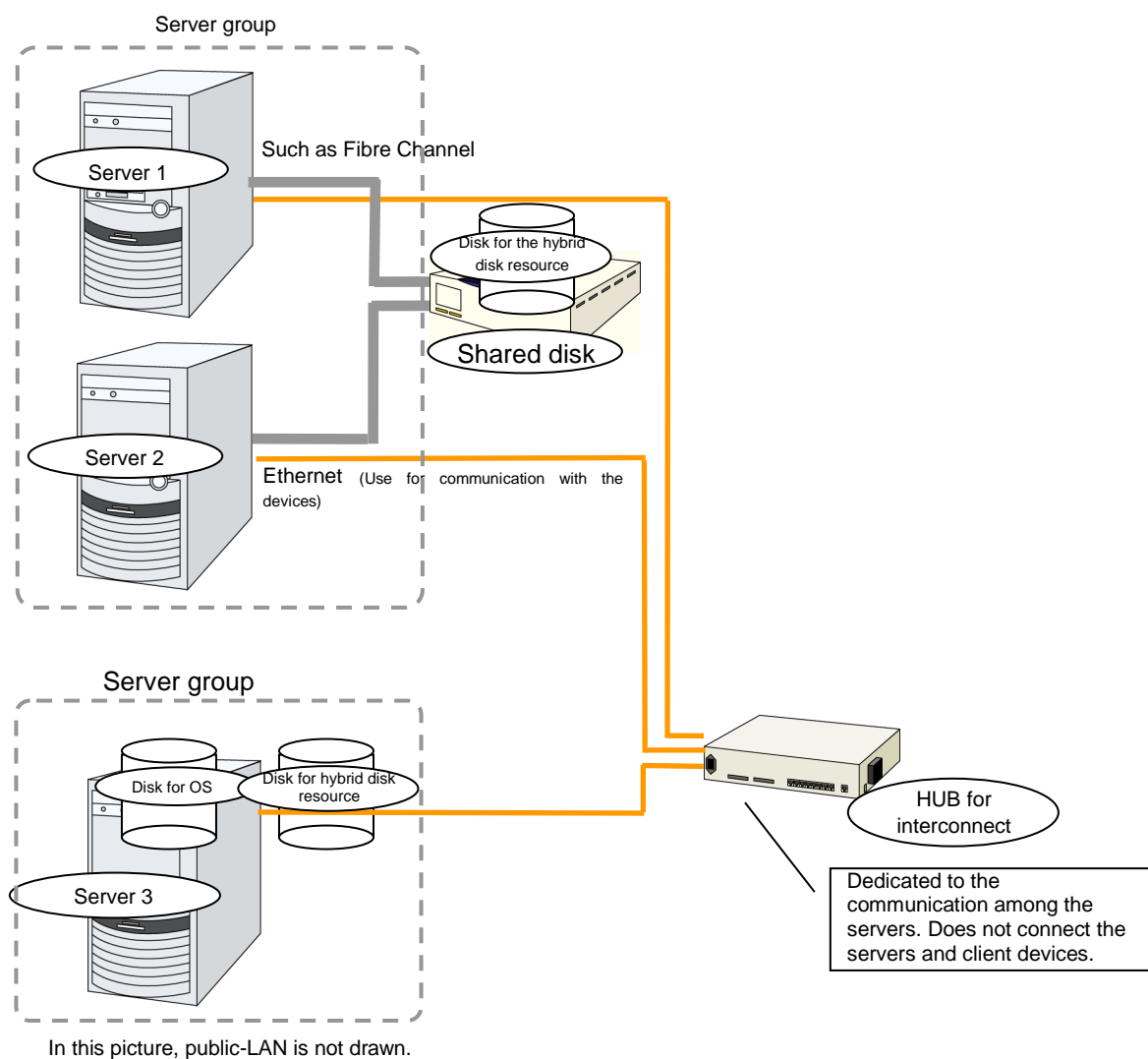
- ◆ As is the case with two nodes, connect a shared disk.
- ◆ Install a dedicated HUB for interconnect.
- ◆ It is not necessary to establish connectivity between servers using the connect COM (RS-232C).



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.

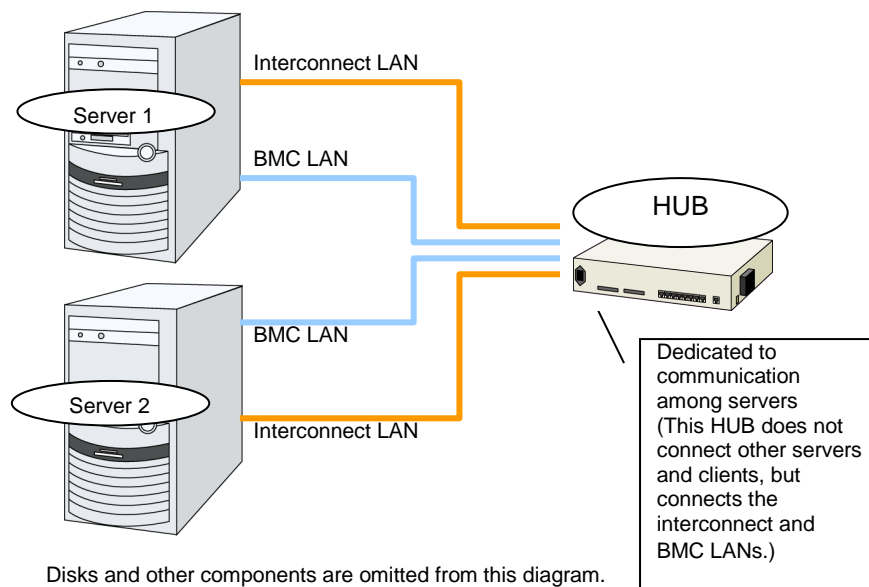
- ◆ Different models can be used for servers but the servers must be configured in the same architecture.
- ◆ Install a dedicated HUB for interconnection and LAN of mirror disk connect.
- ◆ For the HUB, use a fast HUB.



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, chassis identify function, BMC heartbeat resources, and external linkage monitor.

- ◆ Different models of server can be used together, but each server must support the use of BMC linkage functions. For information on BMC linkage functions for supported hardware, refer to Chapter 3, “Installation requirements for EXPRESSCLUSTER” in the *Getting Started Guide*.
- ◆ When using BMC-related functions other than BMC heartbeat resources, connect the interconnect LAN and BMC management LAN via a dedicated HUB.
- ◆ Use as fast a HUB as is available.



Checking system requirements for each EXPRESSCLUSTER module

EXPRESSCLUSTER consists of three modules: EXPRESSCLUSTER Server (main module), Cluster WebUI / WebManager, and Builder. Check configuration and operation requirements of each machine where these modules will be installed.

| Module | Reference to system requirements |
|-------------------------------------|---|
| EXPRESSCLUSTER Server (main module) | see "System requirements for EXPRESSCLUSTER Server" in Chapter 3, "Installation requirements for EXPRESSCLUSTER" in the <i>Getting Started Guide</i> . |
| Cluster WebUI / WebManager | see "System requirements for the Cluster WebUI" and "System requirements for the WebManager" in Chapter 3, "Installation requirements for EXPRESSCLUSTER" in the <i>Getting Started Guide</i> . |
| Builder | see "System requirements for the Builder" in Chapter 3, "Installation requirements for EXPRESSCLUSTER" in the <i>Getting Started Guide</i> . |

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 / WebManager is included in the EXPRESSCLUSTER Server and it is automatically installed once the EXPRESSCLUSTER Server is installed.

General requirements

Following is the recommended specification for the EXPRESSCLUSTER Server:

- ◆ RS-232C port: 1 port (not necessary when configuring a cluster with more than 3 nodes)
- ◆ 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)
- ◆ CD-ROM drive

Related Information:

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

Verifying system requirements for the Cluster WebUI / WebManager

To monitor a cluster system that uses EXPRESSCLUSTER, use Cluster WebUI / WebManager, 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 / WebManager (supported operating systems and browsers, Java runtime environment, required memory and disk size) see the *Getting Started Guide*.

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 Chapter 2, “Configuring a cluster system” before you determine a hardware configuration.

Settings after configuring hardware

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

1. Configuration of the shared disk for disk resource (Required for disk resource)
2. Configuration of the shared disk for hybrid disk resource (Required for the Replicator DR)
3. Configuration of the partition for hybrid disk resource (Required for the Replicator DR)
4. Configuration of the partition for the mirror disk resource (Required for the Replicator)
5. Adjustment of the operating system startup time (Required)
6. Verification of the network settings (Required)
7. Verification of the root file system (Required)
8. Verification of the firewall settings (Required)
9. Synchronization of the server clock (Recommended)

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 “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 1:

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 2:

It is recommended to use one or two disk heartbeat resources in the cluster even when multiple LUNs are used. When you set the heartbeat resource, consider how heavily the disk is loaded because it executes read/write to the disk per heartbeat interval.

Note 3:

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 1:

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

Note 2:

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

xfv
reiserfv
jfv
vxvfv
zfv

Note:

Distributions and kernels where vxvfv can be used depend on the support status of vxvfv.

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.

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 “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 “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 1024MB (1024*1024*1024 bytes) or larger. (The size will be actually larger than 1024MB even if you specify exactly 1024MB 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 1:

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

Note 2:

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
reiserfs
jfs
vxfs
```

Note 1: 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 2: Distributions or kernels which vxfs can use depends on the vxfs support circumstances.

Note 3: When problems occur because of forgetting creating file system, execute the following steps:

- (1) Stop cluster when the cluster is running.
For the WebManager, select **Service -> Stop Cluster**.
For the commands, use `clpctl -t -a` command.
- (2) Stop mirror agent when mirror agent is running.
For the WebManager, 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 ext3 <partition-device>`)
- (5) Reboot the system.

Note 4: When creating an ext4 file system, specify the options as follows.

For details, refer to the following topic in the *Getting Started Guide*:

Chapter 5, “Notes and Restrictons” -> “If using ext4 with a mirror disk resource or a hybrid disk resource”

<For RHEL7, Asianux Server 7, and Ubuntu>

```
mkfs -t ext4 -O -64bit,-uninit_bg <partition device>
```

<For other than RHEL7, Asianux Server 7, and Ubuntu>

```
mkfs -t ext4 -O -uninit_bg <partition device>
```

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 1:

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 2:

It is recommended to use one or two disk heartbeat resources in the cluster even when multiple LUNs are used. When you set heartbeat resources, consider how heavily the disk is loaded because each heartbeat resource executes read/write to the disk per heartbeat interval.

Note 3:

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.

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 “Partition settings for mirror disk resource (when using Replicator).”

When a shared disk is used as a hybrid disk resource, refer to “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 1024MB (1024*1024*1024 bytes) or larger. (The size will be actually larger than 1024MB even if you specify exactly 1024MB 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 1:

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

Note 2:

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
reiserfs
jfs
vxfs
```

Note 1:

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 2:

Distributions and kernels where `vxfs` can be used depend on the support status of `vxfs`.

Note 3:

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

- (1) Stop cluster when the cluster is running.
For the WebManager, select **Service -> Stop Cluster**.
For the commands, use `clpctl -t -a` command.
- (2) Stop mirror agent when mirror agent is running.
For the WebManager, 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 ext3 <partition_device>`)
- (5) Reboot the system.

Note 4:

When creating an ext4 file system, specify the options as follows.

For details, refer to the following topic in the *Getting Started Guide*:

Chapter 5, “Notes and Restrictions” -> “If using ext4 with a mirror disk resource or a hybrid disk resource”

<For RHEL7, Asianux Server 7, and Ubuntu>

```
mkfs -t ext4 -O -64bit,-uninit_bg <partition device>
```

<For other than RHEL7, Asianux Server 7, and Ubuntu>

```
mkfs -t ext4 -O -uninit_bg <partition device>
```

5. Create a mount point.

Create a directory to mount the partition for hybrid disk resource.

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 “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 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 1024MB (1024*1024*1024 bytes) or larger. (The size will be actually larger than 1024MB even if you specify exactly 1024MB 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 1:

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

Note 2:

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 Builder, 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 Builder, 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
reiserfs
jfs
vxfs
```

Note 1:

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 2:

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.)

Note 3:

Distributions and kernels where `vxfs` can be used depend on the `vxfs` support status.

Note 4:

When manually creating an `ext4` file system by using `mkfs`, specify the options as follows.

<For RHEL7, Asianux Server 7, and Ubuntu>

```
mkfs -t ext4 -O -64bit,-uninit_bg <partition device>
```

<For other than RHEL7, Asianux Server 7, and Ubuntu>

```
mkfs -t ext4 -O -uninit_bg <partition device>
```

For details, see the following topic in the *Getting Started Guide*:

Chapter 5, “Notes and Restrictions” -> “If using `ext4` with a mirror disk resource or a hybrid disk resource”

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.

Adjustment of the operating system startup time (Required)

It is necessary to configure the time from power-on of each node in the cluster to the server operating system startup to be longer than the following:

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

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

- ◆ Activating disk resources fails if the cluster system is started by powering on the shared disk and servers.
- ◆ A failover fails if a server, with data you want to fail over by rebooting the server, reboots within the heartbeat timeout. This is because a remote server assumes heartbeat is continued.

Consider the times durations above and adjust the operating system startup time by following the procedure below.

Note:

How you configure the time is determined by what is used as an operating system loader, LILO or GRUB.

When GRUB is used for the operating system loader

- ◆ Edit `/boot/grub/menu.lst`.

Specify the `timeout <startup_time>` (in seconds) option. In the following example, change only the underlined part.

```
---(Example: Startup time: 90 seconds)---
default 0
timeout 90

title linux
    kernel (hd0,1)/boot/vmlinuz
    root=/dev/sda2    vga=785
    initrd (hd0,1)/boot/initrd
```

When LILO is used for the operating system loader

- ◆ Edit `/etc/lilo.conf`.

Specify the `prompt` option and `timeout=<startup_time>` (in 1/10 seconds) option, or specify the `delay=<startup_time>` (in 1/10 seconds) option without specifying the `prompt` option. In the following example, change only the underlined part.

```
---(Example 1: Output prompt. Startup time: 90 seconds)---
boot=/dev/sda
map=/boot/map
install=/boot/boot.b
prompt
linear
timeout=900
image=/boot/vmlinuz
        label=linux
        root=/dev/sda1
        initrd=/boot/initrd.img
        read-only

---(Example 2: Not output prompt. Startup time: 90 seconds)---
boot=/dev/sda
map=/boot/map
install=/boot/boot.b
#prompt
linear
delay=900
image=/boot/vmlinuz
        label=linux
        root=/dev/sda1
        initrd=/boot/initrd.img
        read-only
```

- ◆ Run the `/sbin/lilo` command to make the changes of the setting effective.

Note:

When you are using an operating system loader other than LILO or GRUB is used, see the setup guide of the operating system loader.

When GRUB2 is used for the operating system loader

- Edit `/etc/default/grub`.

Specify `GRUB_TIMEOUT=<startup_time>` (in seconds).

```
---(Example: Startup time: 90 seconds)---
GRUB_TIMEOUT=90
```

- 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
```

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.

Verification of the root file system (Required)

It is recommended to use a file system which is capable of journaling for the root file system in the operating system. File systems such as `ext3`, `ext4`, `JFS`, `ReiserFS`, `XFS` are available for a journaling file system supported by Linux (version 2.6 or later).

Important:

If a file system that is not capable of journaling is used, you must run an interactive command (`fsck` the root file system) when rebooting from server or OS stop (for example, normal shutdown could not be done.) This is not limited to cluster system and the same is true for a single server.

Verification of the firewall settings (Required)

EXPRESSCLUSTER uses several port numbers. Change the firewall settings so that EXPRESSCLUSTER can use some port numbers.

For an AWS environment, configure to be able to access the following port numbers in the security group setting in addition to the firewall setting

The following is the list of port numbers used in EXPRESSCLUSTER:

| Server to Server (Loopback in Server) | | | | | |
|---------------------------------------|-----------------------------------|---|--------|------------------------|---|
| From | | | To | | Used for |
| Server | Automatic allocation ¹ | → | Server | 29001/TCP | Internal communication |
| Server | Automatic allocation | → | Server | 29002/TCP | Data transfer |
| Server | Automatic allocation | → | Server | 29002/UDP | Heartbeat |
| Server | Automatic allocation | → | Server | 29003/UDP | Alert synchronization |
| Server | Automatic allocation | → | Server | 29004/TCP | Communication between mirror agents |
| Server | Automatic allocation | → | Server | 29006/UDP | Heartbeat (kernel mode) |
| Server | Automatic allocation | → | Server | XXXX ² /TCP | Mirror disk resource data synchronization |
| Server | Automatic allocation | → | Server | XXXX ³ /TCP | Communication between mirror drivers |
| Server | Automatic allocation | → | Server | XXXX ⁴ /TCP | Communication between mirror drivers |
| | | | | | keepalive between mirror drivers |
| Server | icmp | → | Server | icmp | Duplication check of FIP/VIP resource |
| | | | | | Mirror agent |
| Server | Automatic allocation | → | Server | XXXX ⁵ /UDP | Communication for internal logs |
| Cluster WebUI / WebManager to Server | | | | | |
| From | | | To | | Used for |
| Cluster WebUI / WebManager | Automatic allocation | → | Server | 29003/TCP | http communication |

| Server connected to the Integrated WebManager to target server | | | | | |
|--|----------------------|---|----------------------------------|--|---|
| From | | | To | | Used for |
| Server connected to the Integrated WebManager | Automatic allocation | → | Server | 29003/TCP | http communication |
| Server to be managed by the Integrated WebManager | 29003 | → | Client | 29010/UDP | UDP communication |
| Others | | | To | | Used for |
| From | | | | | |
| Server | Automatic allocation | → | Network light | warning 514/TCP | Network warning light control |
| Server | Automatic allocation | → | BMC Management LAN of the server | 623/UDP | BMC control (Forced stop/chassis identify) |
| BMC Management LAN of the server | Automatic allocation | → | Server | 162/UDP | Monitoring target of the external linkage monitor set for BMC identify |
| BMC Management LAN of the server | Automatic allocation | → | BMC Management LAN of the server | 5570/UDP | BMC HB communication |
| Server | icmp | → | Monitoring target | icmp | IP monitor |
| Server | icmp | → | Monitoring target | icmp | Monitoring if NFS server of NAS resource is active |
| Server | icmp | → | Monitoring target | icmp | Monitoring target of PING method of network partition resolution resource |
| Server | Automatic allocation | → | Server | Management port number set by Builder ⁶ | JVM monitor |
| Server | Automatic allocation | → | Monitoring target | Connection port number set by Builder ⁷ | JVM monitor |
| Server | Automatic allocation | → | Server | Management port number set by Builder for load balancer linkage ⁸ | JVM monitor |

| | | | | | |
|--------|----------------------|---|--------------------------------|---|---|
| Server | Automatic allocation | → | BIG-IP LTM | Communication port number set by the Builder ⁹ | JVM monitor |
| Server | Automatic allocation | → | Server | Probe port set by the Builder ¹⁰ | Azure probe port resource |
| Server | Automatic allocation | → | AWS region endpoint | 443/tcp ¹¹ | AWS elastic ip resource AWS virtual ip resource AWS DNS resource AWS elastic ip monitor resource AWS virtual ip monitor resource AWS AZ monitor resource AWS DNS monitor resource |
| Server | Automatic allocation | → | Azure endpoint | 443/tcp ¹² | Azure DNS resource |
| Server | Automatic allocation | → | Azure authoritative DNS server | 53/udp | Azure DNS monitor resource |

1. In automatic allocation, a port number not being used at a given time is allocated.
2. This is a port number used on a mirror disk/hybrid disk resource basis and is set when creating mirror disk resource or hybrid disk. A port number 29051 is set by default. When you add a mirror disk resource or hybrid disk, this value is automatically incremented by 1. To change the value, click **Detail** tab of **Mirror Disk Resource Properties** or **Hybrid Disk Resource Properties** in the Builder. For more information, refer to Chapter 4, "Group resource details" in the *Reference Guide*.
3. This is a port number used on a mirror disk resource/hybrid disk basis and is set when creating mirror disk resource or hybrid disk. A port number 29031 is set by default. When you add a mirror disk resource or a hybrid disk, this value is automatically incremented by 1. To change the value, click **Detail** tab of **Mirror Disk Resource Properties** or **Hybrid Disk Resource Properties** in the Builder. For more information, refer to Chapter 4, "Group resource details" in the *Reference Guide*.
4. This is a port number used on a mirror disk resource/hybrid disk basis and is set when creating mirror disk resource or hybrid disk. A port number 29071 is set by default. When you add a mirror disk resource/hybrid disk, this value is automatically incremented by 1. To change the value, click **Detail** tab of **Mirror Disk Resource Properties** or **Hybrid Disk Resource Properties** in the Builder. For more information, refer to Chapter 4, "Group resource details" in the *Reference Guide*.
5. In the **Port Number** (log) tab in **Cluster Properties**, select **UDP** for log communication, and use the port number configured at **Port Number**. The default log communication method, **UNIX Domain**, does not use a communication port.
6. This management port number is a port number that the JVM monitor uses internally. To set the port number, open the **Cluster Properties** window of the Builder, select the **JVM Monitor** tab, and then open the **Connection Setting** dialog box. For more information, refer to Chapter 2, "Functions of the Builder" in the *Reference Guide*.
7. This connection port number is the port number used to connect to the Java VM on the monitoring target (WebLogic Server or WebOTX). To set the port number, open the **Properties** window for the relevant JVM monitoring resource name, and then select the

Monitor (special) tab. For more information, refer to Chapter 5, "Monitor resource details" in the *Reference Guide*.

8. This load balancer linkage port number is the port number used for load balancer linkage. When load balancer linkage is not used, the port number does not need to be set. To set the port number, open the **Cluster Properties** window of the Builder, select the **JVM monitor** tab, and then open the **Load Balancer Linkage Settings** dialog box. For more information, refer to Chapter 2, "Functions of the Builder" in the *Reference Guide*.
9. A communication port number is used to accomplish load balancer linkage with BIG-IP LTM. When load balancer linkage is not used, this number does not need to be set. To set the number, use the **Load Balancer Linkage Settings** dialog box opened from the **JVM monitor** tab in **Cluster Properties** of the Builder. For details, refer to Chapter 2, "Function of the Builder" in the *Reference Guide*.
10. Port number used by the Microsoft Azure load balancer for the alive monitoring of each server.
11. The AWS elastic IP resource, AWS virtual IP resource, AWS DNS resource, AWS elastic IP monitor resource, AWS virtual IP monitor resource, AWS AZ monitor resource, and AWS DNS monitor resource run the AWS CLI. The above port numbers are used by the AWS CLI.
12. The Azure DNS resource runs the Azure CLI. The above port numbers are used by the Azure CLI.

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.

Chapter 2 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:

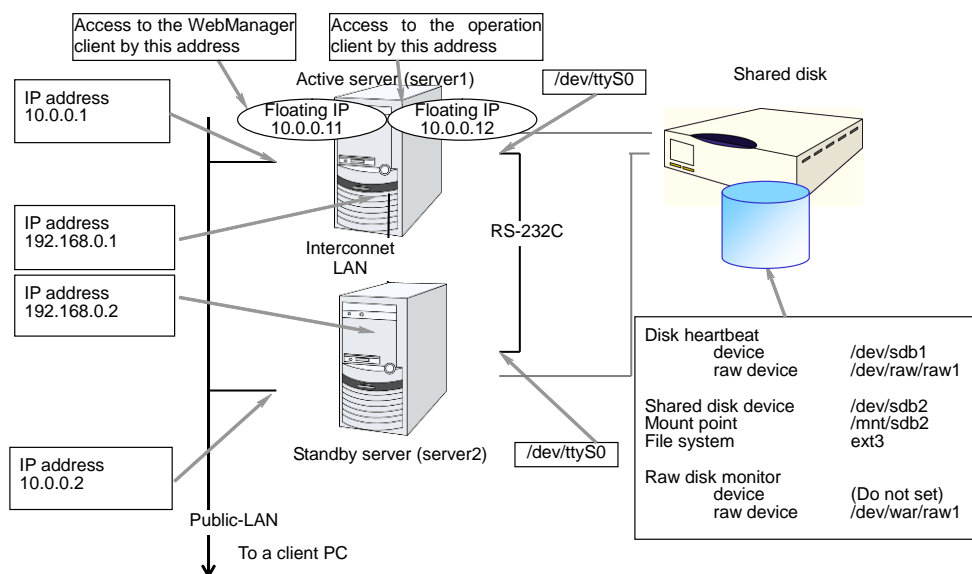
- Configuring a cluster system 52
- Determining a cluster topology..... 53
- Determining applications to be duplicated 56
- Planning a cluster configuration..... 59
- Understanding group resources..... 60
- Understanding monitor resources 61
- Understanding heartbeat resources..... 63
- Understanding network partition resolution resources 64

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.

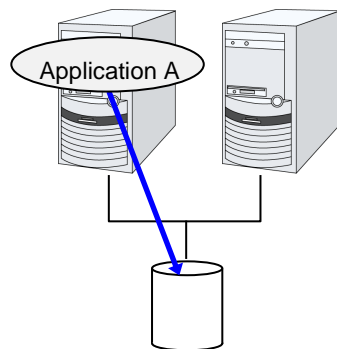


Determining a cluster topology

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.

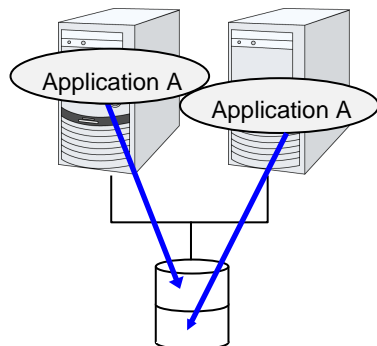
- ◆ **Uni-directional standby cluster system**

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.



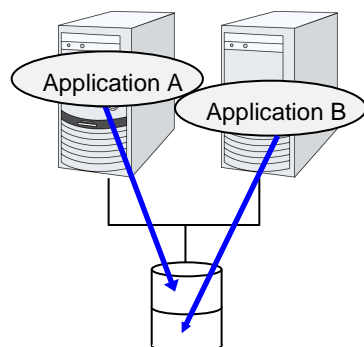
- ◆ **The same applications - multi-directional standby cluster system**

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



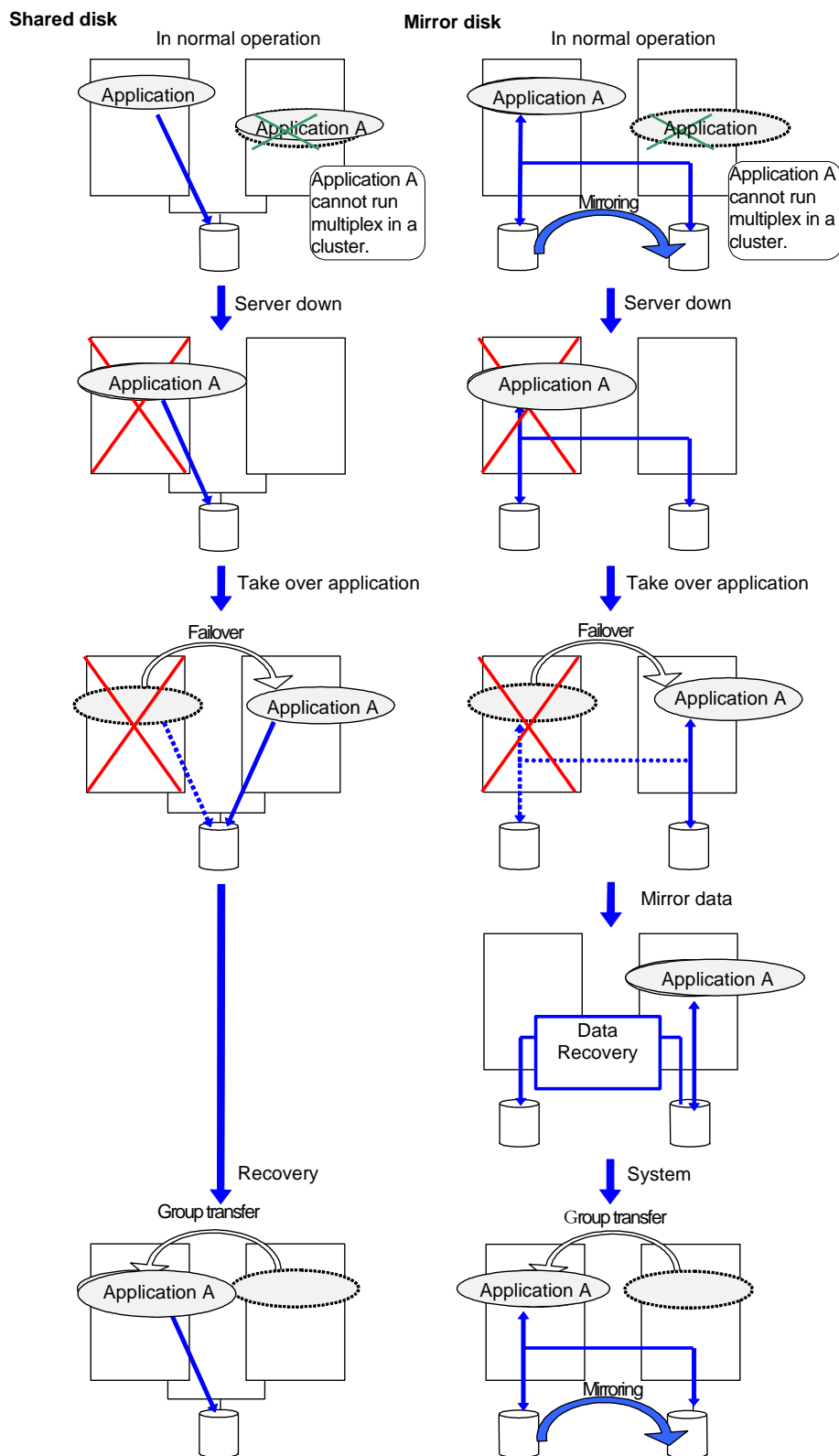
- ◆ **Different applications multi-directional standby cluster system**

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.



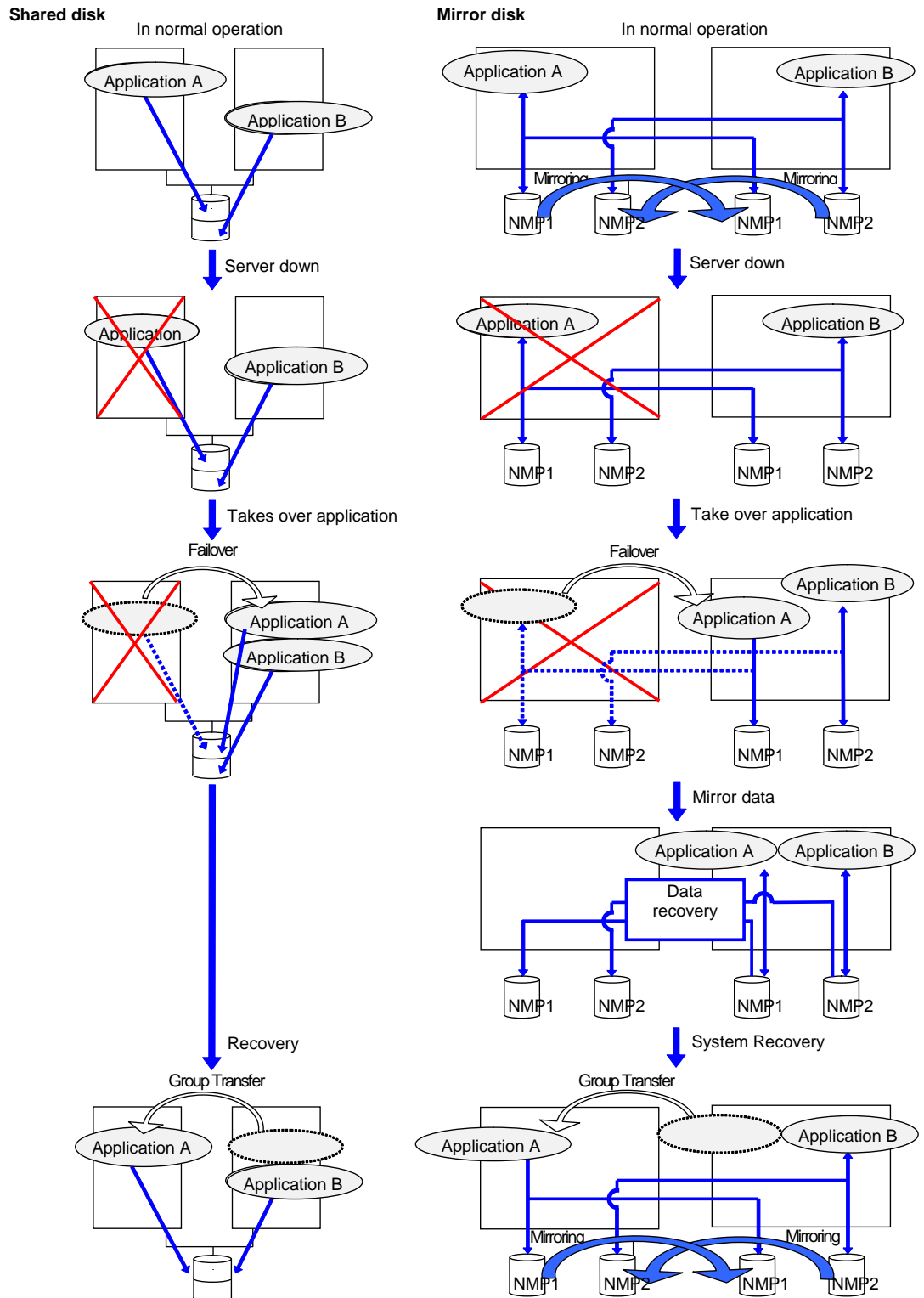
Failover in uni-directional standby cluster

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:



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:



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.

Configuration relevant to the notes

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

- ◆ 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.)

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 |

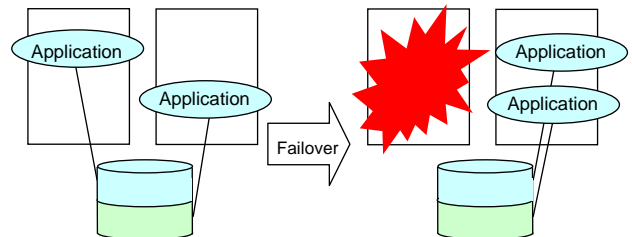
| | | |
|---------------------------|------------------------------|-------------------------|
| Data specific to a server | Programs, configuration data | On server's local disks |
|---------------------------|------------------------------|-------------------------|

Note 4: Multiple application service groups

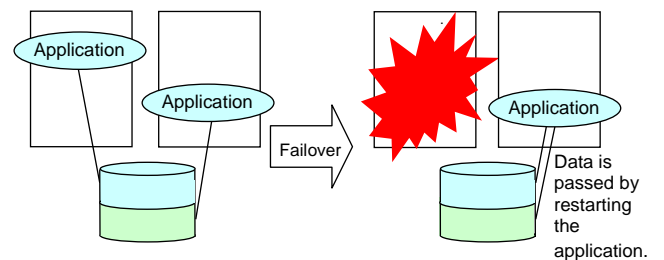
For multi-directional standby operation, you have to assume (in case of degeneration due to a failure) that multiple application groups are run by the same application on a server.

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:

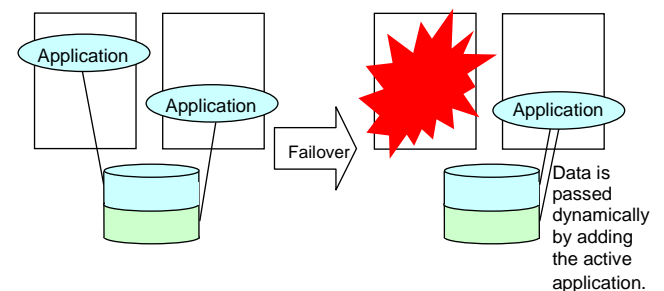
- ◆ **Starting up multiple instances**
This method invokes a new process. More than one application should co-exist and run.



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



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



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.

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 <code>sleep</code> 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 |

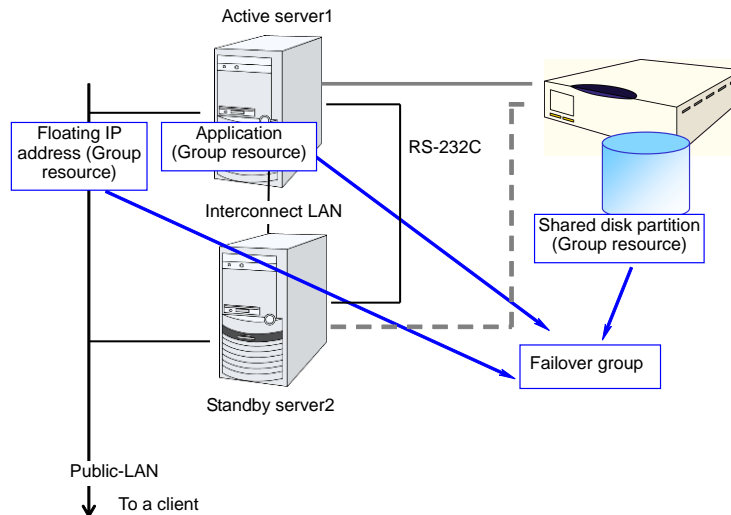
How to determine a cluster topology

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.

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.



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 address1, a failover of disk resource1 and a failover of floating IP address1 are concurrent (failover of disk resource 1 never takes place without that of floating IP address 1). Likewise, disk resources1 is never contained in other groups, such as group2.

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.

Related Information:

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

Following is the currently supported group resources:

| Group Resource Name | Abbreviation |
|---------------------------|--------------|
| EXEC resource | exec |
| Disk resource | disk |
| Floating IP resource | fip |
| Virtual IP resource | vip |
| Mirror disk resource | md |
| Hybrid disk resource | hd |
| NAS resource | nas |
| Volume manager resource | volmgr |
| VM resource | vm |
| Dynamic DNS resource | ddns |
| AWS elastic ip resource | awseip |
| AWS virtual ip resource | awsvip |
| AWS DNS resource | awsdns |
| Azure probe port resource | azurepp |
| Azure DNS resource | azuredns |

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.

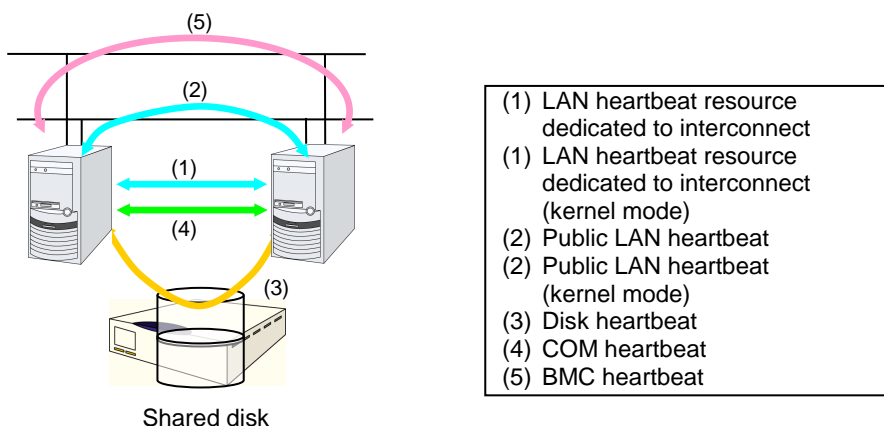
Following is the currently supported monitor resource:

| Monitor Resource Name | Abbreviation | Always monitors | Monitors while activated |
|--------------------------------------|--------------|-----------------|--------------------------|
| Disk monitor resource | diskw | Yes | Yes |
| IP monitor resource | ipw | Yes | Yes |
| NIC Link Up/Down monitor resource | miiw | Yes | Yes |
| BMC monitor resource | bmcw | Yes | |
| Mirror disk connect monitor resource | mdnw | Yes | |
| Mirror disk monitor resource | Mdw | Yes | |
| Hybrid disk connect monitor resource | Hdnw | Yes | |
| Hybrid disk monitor resource | hdw | Yes | |
| PID monitor resource | pidw | | Yes |
| User space monitor resource | userw | Yes | |
| Custom monitor resource | genw | Yes | |
| Volume manager monitor resource | volmgrw | Yes | Yes |
| Multi-target monitor resource | mtw | Yes | |
| Virtual IP monitor resource | vipw | | Yes |
| ARP monitor resource | arpw | | Yes |
| VM monitor resource | vmw | Yes | |
| Message receive monitor resource | mrw | Yes | Yes |
| Dynamic DNS monitor resource | ddnsw | | Yes |
| Process name monitor resource | psw | Yes | Yes |
| DB2 monitor resource | db2w | | Yes |
| Floating IP monitor resource | fipw | | Yes |
| FTP monitor resource | ftpw | Yes | Yes |
| HTTP monitor resource | httpw | Yes | Yes |
| IMAP4 monitor resource | imap4 | Yes | Yes |
| MySQL monitor resource | mysqlw | | Yes |
| NFS monitor resource | nfsw | Yes | Yes |
| Oracle monitor resource | oraclew | | Yes |
| Oracle Clusterware synchronization | osmw | Yes | |

| Monitor Resource Name | Abbreviation | Always monitors | Monitors while activated |
|-------------------------------------|--------------|-----------------|--------------------------|
| managemtnt monitor resource | | | |
| POP3 monitor resource | pop3w | Yes | Yes |
| PostgreSQL monitor resource | psqlw | | Yes |
| Samba monitor resource | sambaw | Yes | Yes |
| SMTP monitor resource | smtpw | Yes | Yes |
| Sybase monitor resource | sybasew | | Yes |
| Tuxedo monitor resource | tuxw | Yes | Yes |
| Websphere monitor resource | wasw | Yes | Yes |
| Weblogic monitor resource | wlsw | Yes | Yes |
| WebOTX monitor resource | otxw | Yes | Yes |
| JVM monitor resource | jraw | Yes | Yes |
| System monitor resource | sraw | Yes | |
| AWS elastic ip monitor resource | awseipw | | Yes |
| AWS virtual ip monitor resource | awsvipw | | Yes |
| AWS AZ monitor resource | awsazw | Yes | |
| AWS DNS monitor resource | awsdns | | Yes |
| Azure probe port monitor resource | azureppw | | Yes |
| Azure load balance monitor resource | azurelbw | Yes | |
| Azure DNS monitor resource | azuredns | | Yes |

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:



| 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. |
| COM heartbeat resource (4) | comhb | Uses a COM cable to connect two servers to monitor if servers are active. |
| BMC heartbeat resource (5) | bmchb | Uses BMC to monitor whether servers are active. |

- ◆ At least one LAN heartbeat resource or one kernel mode LAN heartbeat resource must be set. Setting up more than two LAN heartbeat resources is recommended.
- ◆ Set up one or more LAN heartbeat resource or kernel mode LAN heartbeat resource to be used among all the servers.
- ◆ Follow the specifications below to set the interface for disk heartbeat resource and COM heartbeat resource:

| | |
|---------------------------------|--|
| When a shared disk is used: | Up to two servers: In principle, COM interface and disk interface More than three servers: Disk interface |
| When a shared disk is not used: | Up to two servers: COM interface |

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.

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 responds to the ping command survives | All networks are disconnected after the ping command timeouts the specified times consecutively. | 0 |
| None | No limit | None | None | All servers fail over | All the networks are disconnected | 0 |

Section II Installing and configuring EXPRESSCLUSTER X

This section describes procedures to install EXPRESSCLUSTER. Configure a cluster system by installing EXPRESSCLUSTER to server machines and using the cluster configuration data that you have created in Section I. After that, run the operation tests and verify if the system operates successfully.

- Chapter 3 Installing EXPRESSCLUSTER
- Chapter 4 Registering the license
- Chapter 5 Creating the cluster configuration data
- Chapter 6 Verifying a cluster system
- Chapter 7 Modifying the cluster configuration data

Chapter 3 Installing EXPRESSCLUSTER

This chapter provides instructions for installing EXPRESSCLUSTER. It is not necessary to install the Cluster WebUI, WebManager and Builder separately.

This chapter covers:

- Steps from Installing EXPRESSCLUSTER to creating a cluster 70
- Setting up the EXPRESSCLUSTER Server 71

Related Information:

Refer to Chapter 6, “Upgrading EXPRESSCLUSTER” in the *Getting Started Guide* to upgrade EXPRESSCLUSTER from a previous version.

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 Section I 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 Chapter 3, “Installing EXPRESSCLUSTER.”)

Reboot the server

2. Register the license

Register the license by running the `clplcnsr` command. (See Chapter 4, “Registering the license.”)

Reboot the server

3. Create the cluster configuration data using the Builder

Create the cluster configuration data using the Builder. (See Chapter 5, “Creating the cluster configuration data.”)

4. Create a cluster

Create a cluster using the configuration data created with the Builder. (See Chapter 5, “Creating the cluster configuration data.”)

5. Verify the cluster status using the Cluster WebUI / WebManager

Verify the status of a cluster that you have created using the Cluster WebUI / WebManager. (See Chapter 6, “Verifying a cluster system.”)

Related Information:

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.

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_trn | EXPRESSCLUSTER data transfer: A service to control license synchronization and configuration data transfer in a cluster. |
| 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. |
| clusterpro_webmgr | EXPRESSCLUSTER WebManager: A WebManager service. |

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.

1. Mount the installation CD-ROM.
2. Run the `rpm` command to install the package file.
The installation RPM varies depending on the products.

Navigate to the folder, `/Linux/4.0/en/server`, in the CD-ROM and run the following:

```
rpm -i expresscls-<version>.<architecture>.rpm
```

There are `x86_64`, `IBM POWER` and `IBM POWER LE` 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:

EXPRESSCLUSTER will be installed in the following directory. You will not be able to uninstall the EXPRESSCLUSTER if you change this directory.

Installation Directory: `/opt/nec/clusterpro`

3. When the installation is completed, unmount the installation CD-ROM.
4. Remove the installation CD-ROM.
When you do not use the Builder (offline version), proceed to a license registration procedure.

Related Information:

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

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 CD-ROM.
 2. Run the `dpkg` command to install the package file.
The installation deb package varies depending on the product.
Navigate to the folder, `/Linux/4.0/en/server`, in the CD-ROM 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`

3. When the installation is completed, unmount the installation CD-ROM.
 4. Remove the installation CD-ROM.
When you do not use the Builder (offline version), proceed to a license registration procedure.
-

Related Information:

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

Installing the Builder (Offline version)

It is not necessary to install the Builder (offline version) to the server where configure a cluster. Install it only when modifying the cluster configuration data on a PC excluding the servers that configure a cluster.

Note:

The offline version of Builder supports only a Windows environment.

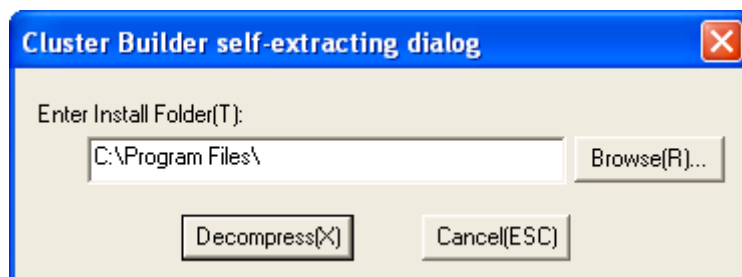
Follow the procedures below to install the Builder (offline version)

When you install the Builder, install it in a directory where you can access (read/write) by the security right granted to you.

Note:

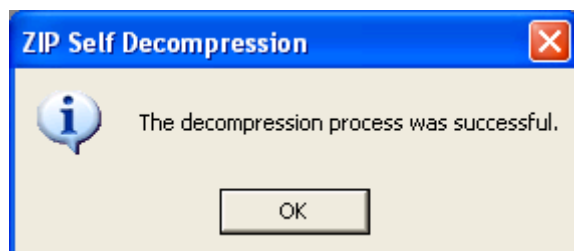
When the Builder has already been installed, uninstall then install again, or install in another location.

1. Set the Installation CD-ROM in the CD-ROM drive.
2. Navigate to the \Linux\4.0\en\builder\ in the CD-ROM and execute the following:
expresscls-[version #]-[release #].linux.x86_64.exe
3. The following dialog box is displayed.



Specify an install folder and click **Decompress**. The default install folder is Program Files. In the folder specified here, CLUSTERPRO\clpbuilder-1 directory is created. The Builder is installed in this directory.

When the installation is successfully completed, the following dialog box is displayed.



Note:

To change the location where the Builder is installed, move all files in your installation folder without changing the structure of the clpbuilder-1 directory.

Starting the Builder

1. Load the following html file by a Web browser and start the Builder.

`file:///<Installation_path>/clptrek.htm`

Note:

If the Builder does not start up successfully, check that
JRE is installed on the computer.

JRE is enabled on the browser.

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 1:

To set up the SNMP linkage function, you must log in as the root user.

Note 2:

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.

```
dlmod clusterManagementMIB /opt/nec/clusterpro/lib/libclpmgmtmib2.so
```

Note 1:

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

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

Note 2:

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
```

Related Information:

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 4 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:

- Registering the CPU license 80
- Registering the VM node license..... 84
- Registering the node license 88
- Registering the fixed term license..... 93

Registering the CPU license

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

Related Information: 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 “Registering the node license.”.

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

| Licensed Product Name | Product ID |
|---|------------|
| EXPRESSCLUSTER X 4.0 for Linux | BASE40 |
| EXPRESSCLUSTER X SingleServerSafe 4.0 for Linux | XSS40 |
| EXPRESSCLUSTER X SingleServerSafe for Linux Upgrade | UPGR40 |

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 page 81, “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 page 82, “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 page 81, “Registering the license by specifying the license file (for both product version and trial version).”

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 / WebManager / Builder on the master server must be used in order to edit and reflect the cluster configuration data as described in Chapter 5, “Creating the cluster configuration data”.

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.

```
# clplcns -i <filepath>
```

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

When the command is successfully executed, the message `Command succeeded.` is displayed in the console. When a message other than this is displayed, see Chapter 3, “EXPRESSCLUSTER command reference” in the *Reference Guide*.

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

```
# clplcns -l -a
```

3. When an optional product is used, refer to page 88, “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 Chapter 5, “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.

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.

Related Information:

The `clplcnscl` command is used in the following procedures. For more information on how to use the `clplcnscl` command, see Chapter 3, “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 4.0 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.

```
# clplcnscl -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 `Command succeeded` is displayed in the console. When a message other than this is displayed, see Chapter 3, “EXPRESSCLUSTER command reference” in the *Reference Guide*.

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

```
# clplcns -l -a
```

7. When an optional product is used, refer to page 88, “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 Chapter 5, “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.

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 | Product ID |
|--|------------|
| EXPRESSCLUSTER X 4.0 for Linux VM | BASE40 |
| EXPRESSCLUSTER X SingleServerSafe 4.0 for Linux VM | XSS40 |
| EXPRESSCLUSTER X SingleServerSafe for Linux VM Upgrade | UPGR40 |

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, Page 85, "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, Page 86, "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 "Registering the VM node license by specifying the license file (for both product and trial versions)."

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.

```
# clplcnsd -i <filepath>
```

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

When the command is successfully executed, the message `Command succeeded` is displayed on the console. When a message other than this is displayed, see Chapter 3, “EXPRESSCLUSTER command reference” in the *Reference Guide*.

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

```
# clplcnsd -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 “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 Chapter 5, “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.

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.

Related Information: The `clplcncs` command is used in the following procedures. For more information on how to use the `clplcncs` command, see Chapter 3, “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 4.0 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.

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

When the command is successfully executed, the message `Command succeeded` is displayed on the console. When a message other than this is displayed, see Chapter 3, “EXPRESSCLUSTER command reference” in the *Reference Guide*.

6. Run the following command to verify the licenses registered.
 - `# clplcns -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 “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 Chapter 5, “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.

Registering the node license

It is required to register the node license for the X 4.0 Replicator, X 4.0 Replicator DR, X 4.0 Agent products, and X 4.0 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 | Product ID |
|--|------------|
| EXPRESSCLUSTER X Replicator 4.0 for Linux | REPL40 |
| EXPRESSCLUSTER X Database Agent 4.0 for Linux | DBAG40 |
| EXPRESSCLUSTER X Internet Server Agent 4.0 for Linux | ISAG40 |
| EXPRESSCLUSTER X File Server Agent 4.0 for Linux | FSAG40 |
| EXPRESSCLUSTER X Application Server Agent 4.0 for Linux | ASAG40 |
| EXPRESSCLUSTER X Java Resource Agent 4.0 for Linux | JRAG40 |
| EXPRESSCLUSTER X System Resource Agent 4.0 for Linux | SRAG40 |
| EXPRESSCLUSTER X Alert Service 4.0 for Linux | ALRT40 |
| EXPRESSCLUSTER X Replicator DR 4.0 for Linux | RPDR40 |
| EXPRESSCLUSTER X Replicator DR 4.0 for Linux Upgrade license | RPUP40 |

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

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 optional 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.

```
# clplcnscl -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 Builder (online version)

If the licenses are registered but the corresponding resources do not appear in the list, or if the licenses are registered after the Builder (online version) is started, click the **Get License Info** button.

When the command is successfully executed, the message `Command succeeded` is displayed in the console. When a message other than this is displayed, see Chapter 3, “EXPRESSCLUSTER command reference” in the *Reference Guide*.

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

```
# clplcnscl -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 Chapter 5, “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.

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.

Related Information:

The `clplcnscl` command is used in the following procedures. For more information on how to use the `clplcnscl` command, see Chapter 3, “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 4.0 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:

```
# clplcnscl -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 Builder (online version).

If the licenses are registered but the corresponding resources do not appear in the list, or if the licenses are registered after the Builder (online version) 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 `Command succeeded` is displayed in the console. When a message other than this is displayed, see Chapter 3, “EXPRESSCLUSTER command reference” in the *Reference Guide*.

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

```
# clplcnc -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 Chapter 5, “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.

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.

| Licensed Product Name | Product ID |
|---|------------|
| main product | |
| EXPRESSCLUSTER X 4.0 for Linux | BASE40 |
| optional product | |
| EXPRESSCLUSTER X Replicator 4.0 for Linux | REPL40 |
| EXPRESSCLUSTER X Database Agent 4.0 for Linux | DBAG40 |
| EXPRESSCLUSTER X Internet Server Agent 4.0 for Linux | ISAG40 |
| EXPRESSCLUSTER X File Server Agent 4.0 for Linux | FSAG40 |
| EXPRESSCLUSTER X Application Server Agent 4.0 for Linux | ASAG40 |
| EXPRESSCLUSTER X Java Resource Agent 4.0 for Linux | JRAG40 |
| EXPRESSCLUSTER X System Resource Agent 4.0 for Linux | SRAG40 |
| EXPRESSCLUSTER X Alert Service 4.0 for Linux | ALRT40 |
| EXPRESSCLUSTER X Replicator DR 4.0 for Linux | RPDR40 |

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 "Registering the fixed term license by specifying the license file".

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 / WebManager / Builder on the master server must be used in order to edit and reflect the cluster configuration data as described in Chapter 5, "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.

- ◆ After starting the operation of the cluster, the registered license may become ineffective if the servers are added, removed, or replaced in the cluster.

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.

```
# clplcncs -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 Builder (online version)

If the licenses are registered but the corresponding resources do not appear in the list, or if the licenses are registered after the Builder (online version) is started, click the **Get License Info** button.

When the command is successfully executed, the message `Command succeeded.` is displayed in the console. When a message other than this is displayed, see Chapter 3, “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.

```
# clplcncs -l -a
```

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 Chapter 5, “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 5 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 or WebManager. This chapter provides the procedures to start up the Cluster WebUI or WebManager and to create the cluster configuration data using the Builder with a sample cluster configuration.

This chapter covers:

- Creating the cluster configuration data 98
- Starting up the Cluster WebUI 99
- Starting up the WebManager 101
- Checking the values to be configured in the cluster environment with two nodes..... 104
- Creating the configuration data of a 2-node cluster..... 112
- Checking the values to be specified in a cluster environment that has two nodes (using VxVM)..... 125
- Creating Configuration Information for a Cluster that Has Two Nodes (Using VxVM) 133
- Checking the values to be configured in the cluster environment with three nodes 148
- Creating the configuration data of a 3-node cluster..... 153
- Checking the values to be configured in the cluster environment with three nodes (hybrid type)..... 167
- Creating the configuration data of a 3-node cluster (hybrid type) 171
- Saving the cluster configuration data 185
- Creating a cluster..... 187

Creating the cluster configuration data

Creating the cluster configuration data is performed by using the Builder, the function for creating and modifying cluster configuration data

Create the cluster configuration data by starting the WebManager and Builder from the Cluster WebUI accessed from the management PC. The cluster configuration data will be applied in the cluster system by the Builder.

Starting up the Cluster WebUI

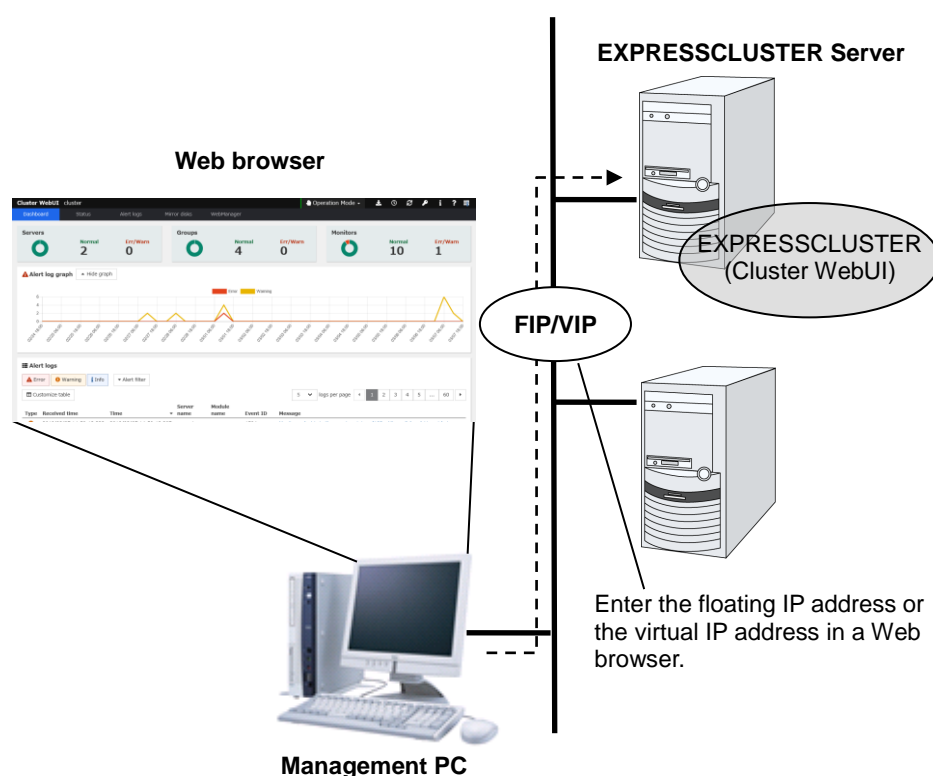
Accessing to the Cluster WebUI is required to create cluster configuration data. This section describes the overview of the Cluster WebUI, and how to create cluster configuration data.

Related Information:

For the system requirements of the Cluster WebUI, refer to Chapter 3, “Installation requirements for EXPRESSCLUSTER” in the Getting Started Guide.

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.



Browsers supported by the Cluster WebUI

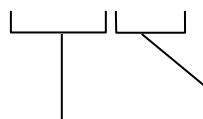
For information of the latest system requirements of the Cluster WebUI (supported operating systems and browsers, required memory and disk size), see the *Getting Started Guide*.

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.

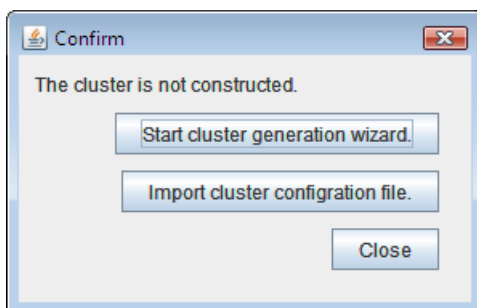
http://10.0.0.3:29003/



Specify the port number of the WebManager specified at installation. (Default: 29003)

Specify the actual IP address of the first server constituting the cluster because a management group does not exist right after the installation.

3. The Cluster WebUI starts. Click WebManager to create the cluster configuration data.
4. The WebManager starts and the following confirmation window is displayed.



5. Click **Start Cluster Generation Wizard** to start the wizard.

Related Information:

The Cluster WebUI supports encrypted communication (by using HTTPS). For details of encrypted communication, see Reference Guide. Enter the following to perform encrypted communication.

https://10.0.0.1:29003/

Starting up the WebManager

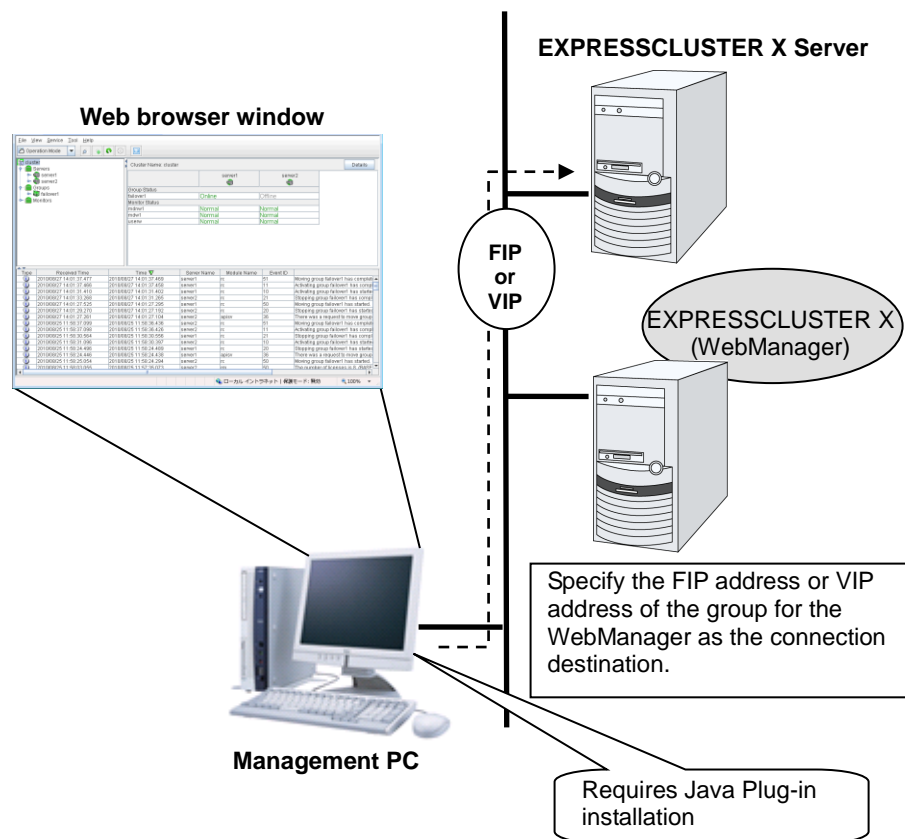
Accessing to the WebManager is required to create cluster configuration data. This section describes the overview of the WebManager, the access to the WebManager, and how to create cluster configuration data.

Related Information:

For the system requirements of the WebManager, refer to Chapter 3, “Installation requirements for EXPRESSCLUSTER” in the *Getting Started Guide*.

What is WebManager?

The WebManager 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 WebManager is shown in the following figures.



The WebManager in EXPRESSCLUSTER Server is configured to start up at the time when the operating system starts up.

Browsers supported by the WebManager

For information of the latest system requirements of the WebManager (supported operating systems and browsers, Java runtime environment, required memory and disk size), see the *Getting Started Guide*.

Setting up Java runtime environment to a management PC

To access the Java applet version of WebManager, a Java Plug-in (Java® Runtime Environment Version 8.0 Update 162 (1.8.0_162) or later) must be installed in a browser on a management PC.

When the version of Java Plug-in is older than the version written above, the browser might prompt you to install Java. In this case, install the Java Plug-in of the version of which the operation is verified on EXPRESSCLUSTER WebManager.

To install Java Plug-in on a browser, refer to the browser's help and the JavaVM installation guide.

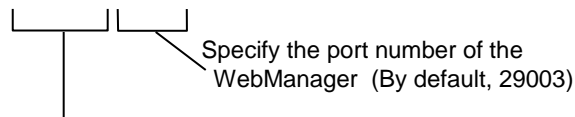
You have to add the Exception Site for Java on the machine connected to the WebManager. From **Control Panel**, open **Java** and add "URLs used to connect to the WebManager."

Starting the WebManager

The following describes how to start the WebManager.

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://10.0.0.11:29003/main.htm

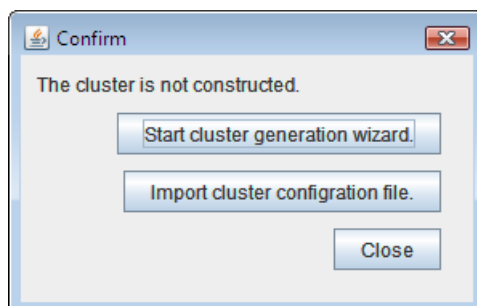


Note:

In Java Runtime Enviroment Version 9.0 or later, WebManager can be launched by using Java Web Start. When starting the Java WebManager, change "main.htm" of the URL above to "main.jnlp" and then enter the modified URL in the Address bar.

Example: http://10.0.0.11:29003/main.jnlp

3. The WebManager starts and the following confirmation window is displayed.



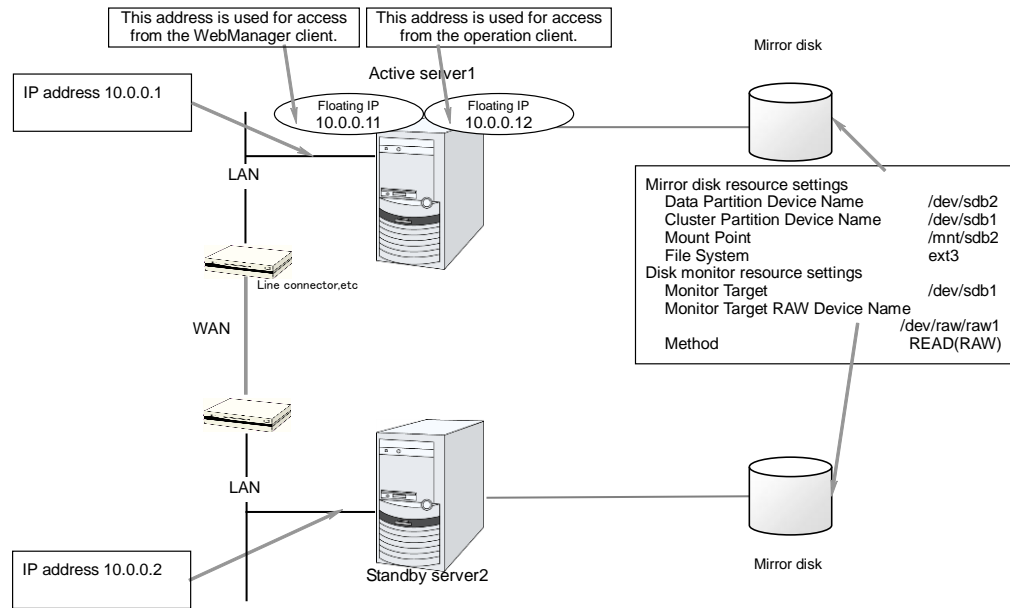
4. Click **Start Cluster Generation Wizard** to start the wizard.

Related Information:

The WebManager supports encrypted communication (by using HTTPS). For details of encrypted communication, see Reference Guide. Enter the following to perform encrypted communication.

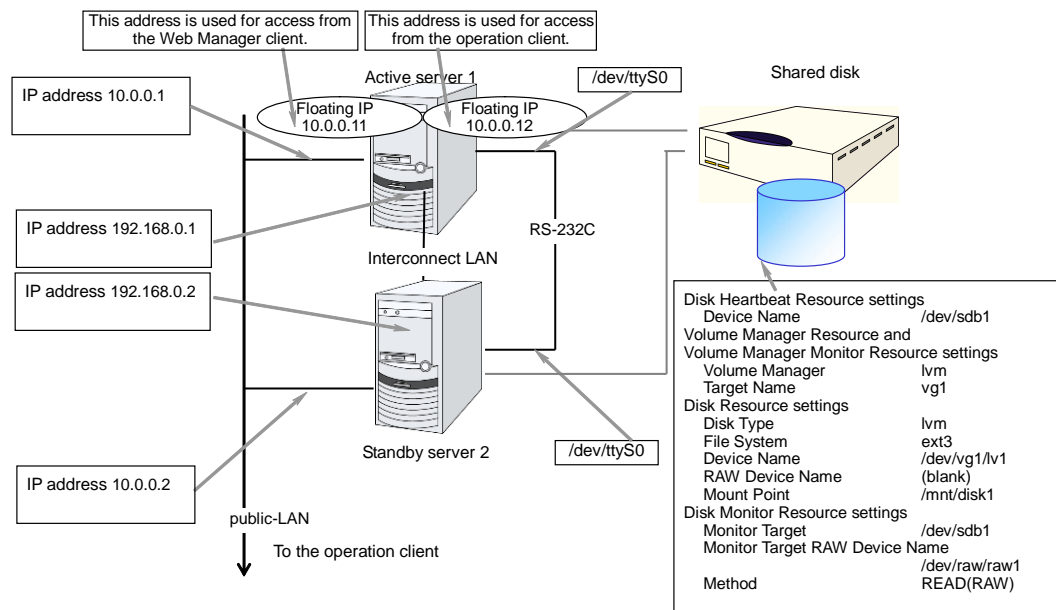
<https://10.0.0.1:29003/main.htm>

Remote configuration when mirror disk resources are used:



In this configuration example, the layer2 type WAN is used (The same network address can be used between sites).

When a volume manager resource is used:



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 *Referenced Guide*.

Example of configuration with two nodes

| Target | Parameter | Value (For disk resource) | Value (For mirror disk resource) | Value (For remote mirror disk resource) | Value (For volume manager resource) |
|--|---|---------------------------------|--|--|--|
| Cluster configuration | Cluster name | cluster | cluster | cluster | cluster |
| | Number of servers | 2 | 2 | 2 | 2 |
| | Number of failover groups | 2 | 2 | 2 | 2 |
| | Number of monitor resources | 4 | 6 | 6 | 5 |
| Heartbeat resources | Number of LAN heartbeats | 2 | 2 | 1 | 2 |
| | Number of kernel mode LAN heartbeats | 2 | 2 | 1 | 2 |
| | Number of COM heartbeats | 1 | 1 | 0 | 1 |
| | Number of disk heartbeats | 1 | 0 | 0 | 1 |
| NP resource | PingNP | 0 | 0 | 1 | 0 |
| First server information (Master server) | Server name*1 | server1 | server1 | server1 | server1 |
| | Interconnect IP address (Dedicated) | 192.168.0.1 | 192.168.0.1 | 10.0.0.1 | 192.168.0.1 |
| | Interconnect IP address (Backup) | 10.0.0.1 | 10.0.0.1 | -- | 10.0.0.1 |
| | Public IP address | 10.0.0.1 | 10.0.0.1 | 10.0.0.1 | 10.0.0.1 |
| | COM heartbeat device | /dev/ttyS0 | /dev/ttyS0 | -- | /dev/ttyS0 |
| | Disk heartbeat device | /dev/sdb1 | -- | -- | /dev/sdb1 |
| | Mirror disk connect | -- | 192.168.0.1 | 10.0.0.1 | -- |

| Target | Parameter | Value (For disk resource) | Value (For mirror disk resource) | Value (For remote mirror disk resource) | Value (For volume manager resource) |
|--|---|---------------------------------|--|--|--|
| Second server information | Server name*1 | server2 | server2 | server2 | server2 |
| | Interconnect IP address (Dedicated) | 192.168.0.2 | 192.168.0.2 | 10.0.0.2 | 192.168.0.2 |
| | Interconnect IP address (Backup) | 10.0.0.2 | 10.0.0.2 | -- | 10.0.0.2 |
| | Public IP address | 10.0.0.2 | 10.0.0.2 | 10.0.0.2 | 10.0.0.2 |
| | COM heartbeat device | /dev/ttyS0 | /dev/ttyS0 | -- | /dev/ttyS0 |
| | Disk heartbeat device | /dev/sdb1 | -- | -- | /dev/sdb1 |
| | Mirror disk connect | -- | 192.168.0.2 | 10.0.0.2 | -- |
| Group resources for management (For the WebManager) | Type | failover | failover | failover | failover |
| | Group name | Managemen tGroup | Management Group | Manageme ntGroup | Management Group |
| | Startup server | All servers | All servers | All servers | All servers |
| | Number of group resources | 1 | 1 | 1 | 1 |
| Group resources for management *2 | Type | floating IP resource | floating IP resource | floating IP resource | floating IP resource |
| | Group resource name | Managemen tIP | ManagementI P | Manageme ntIP | Management IP |
| | IP address | 10.0.0.11 | 10.0.0.11 | 10.0.0.11 | 10.0.0.11 |
| Group resources for operation | Type | failover | failover | failover | failover |
| | Group name | failover1 | failover1 | failover1 | failover1 |
| | Startup server | All servers | All servers | All servers | All servers |
| | Number of group resources | 3 | 3 | 3 | 4 |

| Target | Parameter | Value (For disk resource) | Value (For mirror disk resource) | Value (For remote mirror disk resource) | Value (For volume manager resource) |
|--|-------------------------------------|---------------------------------|--|--|--|
| First group resources | Type | floating IP resource | floating IP resource | floating IP resource | floating IP resource |
| | Group resource name | fip1 | fip1 | fip1 | fip1 |
| | IP address | 10.0.0.12 | 10.0.0.12 | 10.0.0.12 | 10.0.0.12 |
| Second group resources | Type | disk resource | mirror disk resource | mirror disk resource | disk resource |
| | Group resource name | disk1 | md1 | md1 | disk1 |
| | Disk type | disk | | | lvm |
| | File system | ext3 | | | ext3 |
| | Device name | /dev/sdb2 | | | /dev/dg1/lv1 |
| | Mount point | /mnt/sdb2 | | | /mnt/disk1 |
| | Mirror partition device name | | /dev/NMP1 | /dev/NMP1 | |
| | Mount point | | /mnt/sdb2 | /mnt/sdb2 | |
| | Data partition device name | | /dev/sdb1 | /dev/sdb1 | |
| | Cluster partition device name | | /dev/sdb1 | /dev/sdb1 | |
| | File system | | ext3 | ext3 | |
| Third group resources | Type | exec resource | exec resource | exec resource | exec resource |
| | Group resource name | exec1 | exec1 | exec1 | exec1 |
| | Script | Standard Script | Standard Script | Standard 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 |

| Target | Parameter | Value (For disk resource) | Value (For mirror disk resource) | Value (For remote mirror disk resource) | Value (For volume manager resource) |
|---|--------------------------------------|--|---|--|---|
| First monitor resources (Created by default) | Type | user mode monitor | user mode monitor | user mode monitor | user mode monitor |
| | Monitor resource name | userw | userw | userw | userw |
| Second monitor resources | Type | disk monitor | disk monitor | disk monitor | disk monitor |
| | Monitor resource name | diskw1 | diskw1 | diskw1 | diskw1 |
| | Device name | /dev/sdb1 | /dev/sdb1 | /dev/sdb1 | /dev/vg1/lv1 |
| | Monitor target raw device name | - | - | - | - |
| | Monitor method | read (O_DIRECT) | read (O_DIRECT) | read (O_DIRECT) | read (O_DIRECT) |
| | Monitor timing | Always | Always | Always | Active |
| | Monitor target | - | - | - | volmgr1 |
| | When an error is detected | Stop the cluster service and shut down the OS. | Stop the cluster service and shut down the OS. | Stop the cluster service and shut down the OS. | Stop the cluster service and shut down the OS. |
| Third monitor resources (Automatically created after creating ManagementIP resources) | Type | floating ip monitor | floating ip monitor | floating ip monitor | floating ip monitor |
| | Monitor resource name | fipw1 | fipw1 | fipw1 | fipw1 |
| | Monitor target | Management P | Management P | Management P | Management P |
| | When an error is detected | "Manageme ntGroup" group's failover *3 | "Managemen tGroup" group's failover *3 | "Manageme ntGroup" group's failover *3 | "Managemen tGroup" group's failover *3 |
| Fourth monitor resources (Automatically created after creating fip1 resources) | Type | floating ip monitor | floating ip monitor | floating ip monitor | floating ip monitor |
| | Monitor resource name | fipw2 | fipw2 | fipw2 | fipw2 |
| | Monitor target | fip1 | fip1 | fip1 | fip1 |
| | When an error is detected | "failover1" group's Failover *3 | "failover1" group's Failover *3 | "failover1" group's Failover *3 | "failover1" group's Failover *3 |

| Target | Parameter | Value (For disk resource) | Value (For mirror disk resource) | Value (For remote mirror disk resource) | Value (For volume manager resource) |
|--|------------------------------------|---------------------------------|--|--|--|
| Fifth monitor resources | Type | ip monitor | ip monitor | ip monitor | ip monitor |
| | Monitor resource name | ipw1 | ipw1 | ipw1 | ipw1 |
| | Monitor IP address | 10.0.0.254 (gateway) | 10.0.0.254 (gateway) | 10.0.0.254 (gateway) | 10.0.0.254 (gateway) |
| | When an error is detected | Failover of all groups *3 | Failover of all groups *3 | Failover of alld groups *3 | Failover of all groups *3 |
| Sixth monitor resource (Automatically created after creating mirror disk resource) | Type | | mirror disk connect monitor | mirror disk connect monitor | |
| | Monitor resource name | | mdnw1 | mdnw1 | |
| | Monitor mirror disk resource | | md1 | md1 | |
| | When an error is detected | | No Operation | No Operation | |
| Seventh monitor resource (Automatically created after creating mirror disk resource) | Type | | mirror disk monitor | mirror disk monitor | |
| | Monitor resource name | | mdw1 | mdw1 | |
| | Monitor mirror disk resource | | md1 | md1 | |
| | When an error is detected | | No Operation | No Operation | |
| Eighth 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 |
| First PingNP resources | Resource name | | | xxxx | |
| | Monitor target 1 | | | xxxx | |

| Target | Parameter | Value (For disk resource) | Value (For mirror disk resource) | Value (For remote mirror disk resource) | Value (For volume manager resource) |
|--------|---------------------|---------------------------------|--|--|--|
| | Monitor target 2 | | | xxxx | |

*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 WebManager. You can access the WebManager 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 Chapter 5, “Monitor resource details” in the *Reference Guide*.

Creating the configuration data of a 2-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. Creating a cluster

Create a cluster.

1-1. Add a cluster

Add a cluster you want to construct and enter its name.

1-2. Add a server

Add a server. Make settings such as IP addresses.

1-3. Set up the network configuration

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

1-4. Set up the network partition resolution

Set up the network partition resolution.

2. Creating a failover group

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

2-1. Add a failover group

Add a group that used as a unit when a failover occurs.

2-2. Add a group resource (floating IP address)

Add a resource that constitutes a group.

2-3. Add a group resource (volume manager resource)

Add a resource that constitutes a group.

2-4. Add a group resource (disk resource)

Add a resource that constitutes a group when the disk resource is used.

2-5. Add a group resource (mirror disk resource)

Add a resource that constitutes a group when the mirror disk resource is used.

2-6. Add a group resource (EXEC resource)

Add a resource that constitutes a group.

3. Creating monitor resources

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

3-1. Add a monitor resource (disk resource)

Add a monitor resource to use.

3-2. Add a monitor resource (IP monitor)

Add a monitor resource to use.

3-3. Configure a monitor resource (volume manager monitor resource)

Configure a monitor resource to use.

4. Disabling recovery action caused by monitor resource error

Enable or disable the recovery action caused by monitor resource error.

1. Creating a cluster

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

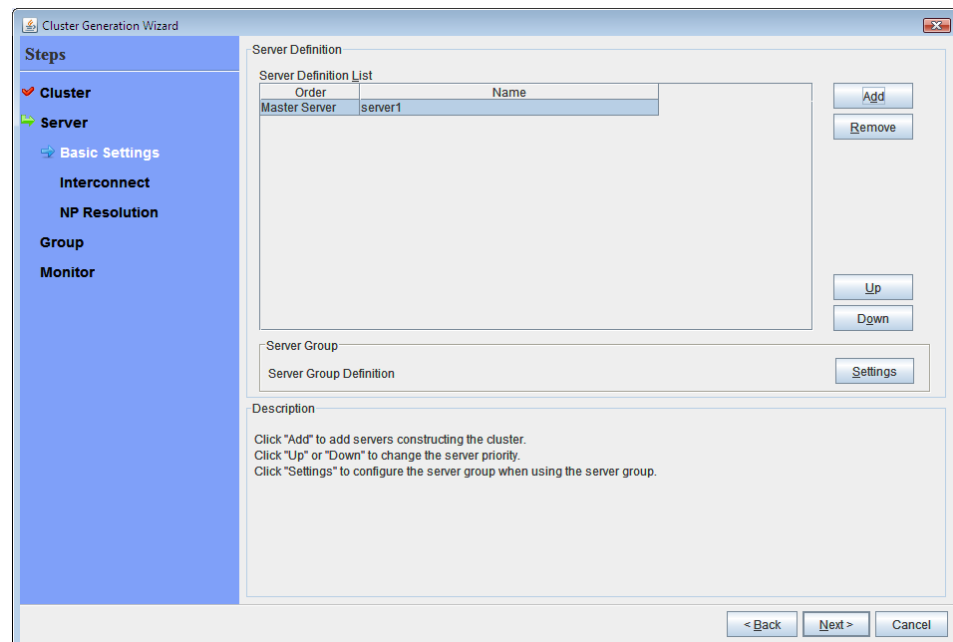
1-1. Add a cluster

1. Click **Languages** field in **Cluster Definition** window of **Cluster Generation Wizard**, select a language that is used on the machine that the Cluster WebUI / WebManager works.

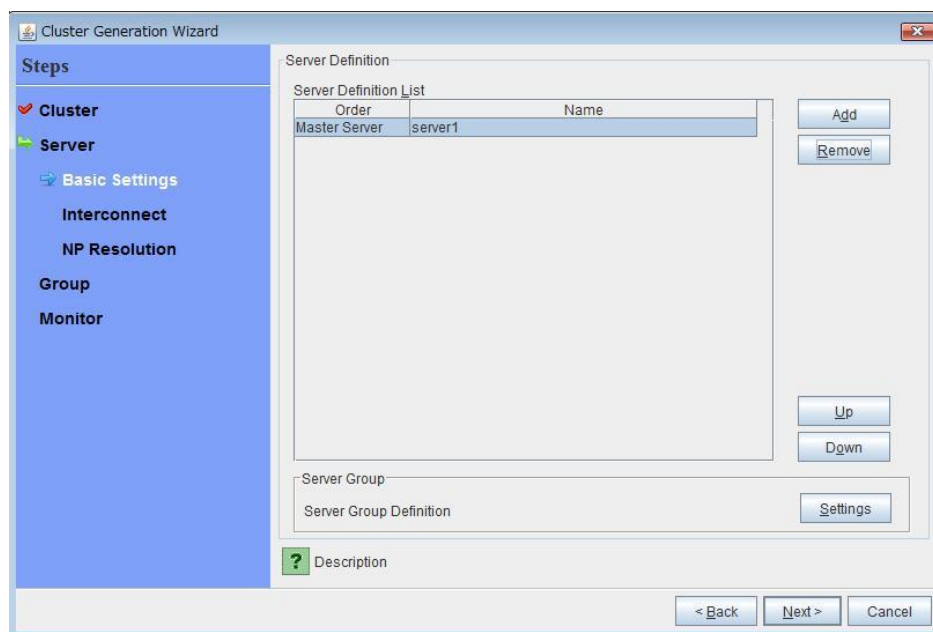
Note: Only one language is available within one cluster. If multiple languages are used within a cluster, specify English to avoid garbled characters.

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 /WebManager in the **Management IP Address** box. Click **Next**.

The **Servers Definition** is displayed. The server (**server1**) for which the IP address was specified as the URL when starting up the WebManager is registered in the list.



If the screen resolution is 800 x 600 pixels or less, the **Description** field will be displayed as a tool tip.



Positioning the mouse cursor to the ? icon displays a tool tip with the full description.

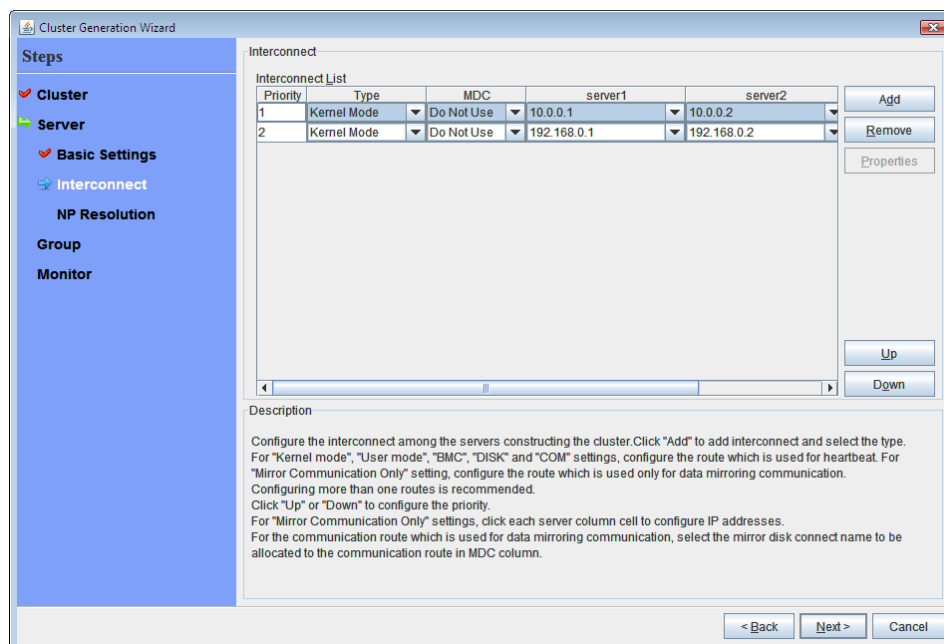
1-2. Add a server

Add the second server to the cluster.

1. In the **Servers List**, 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 **Servers List**.
3. Click **Next**.

1-3. Set up the network configuration

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



1. When the network communication routes between the servers in the cluster can be identified using a network address in the IP address format as in the setup example in this chapter, each communication route is automatically registered in **InterconnectList**. If the registered communication routes differ from the actual network configuration, 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.

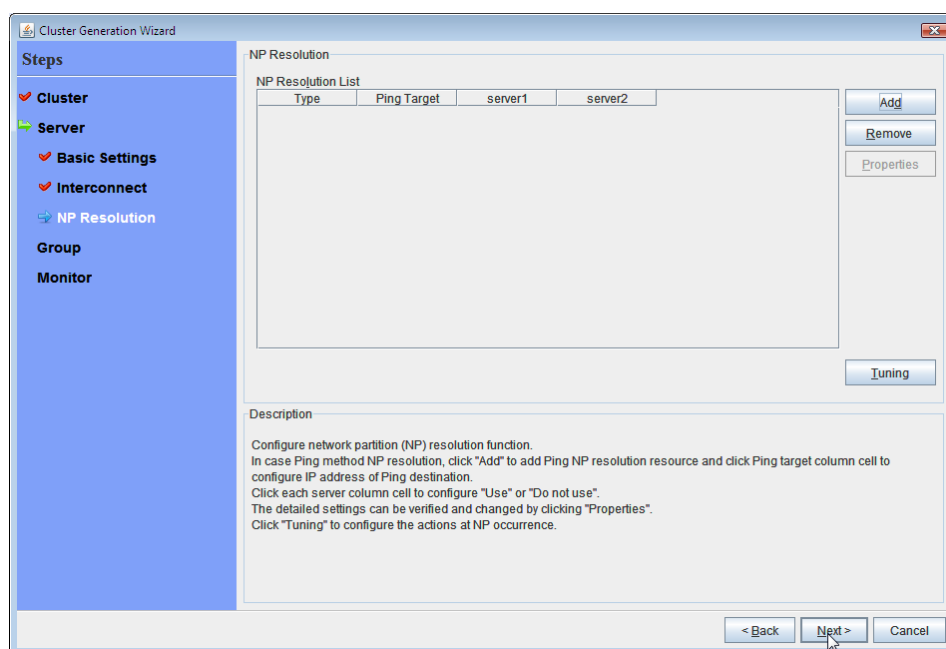
At least one communication route must be specified for the interconnect. Specify as many communication routes for the interconnect as possible.

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 using **Up** or **Down**.

3. When using COM heartbeat, click **Type** column cell and select **COM**. Click **Server name** column cell and select or enter COM device. For the server not using COM heartbeat, set blank to **Server name** column cell.
4. 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.
5. When using BMC heartbeat, click a cell in the **Type** column and then select **BMC**. Then, click the corresponding cell in the server name cell, and enter the IP address of BMC. For a server that does not use BMC heartbeat, leave the cell in the server name column blank.
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**.

1-4. Set up the network partition resolution

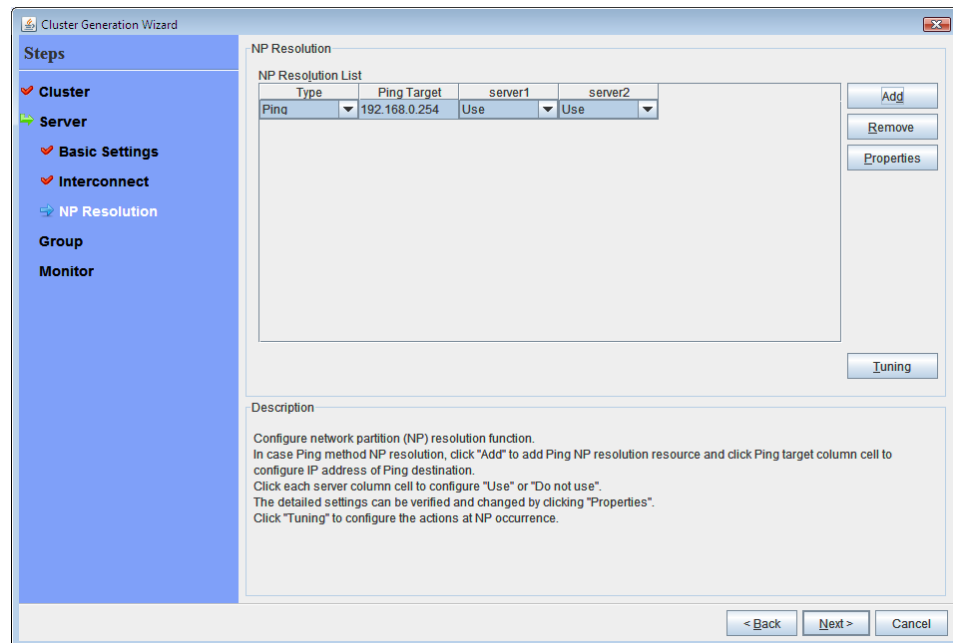
Set up the network partition resolution resource.



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 **Ping 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 **Ping Target**.



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

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

3. Click **Next**.

2. Creating a failover group

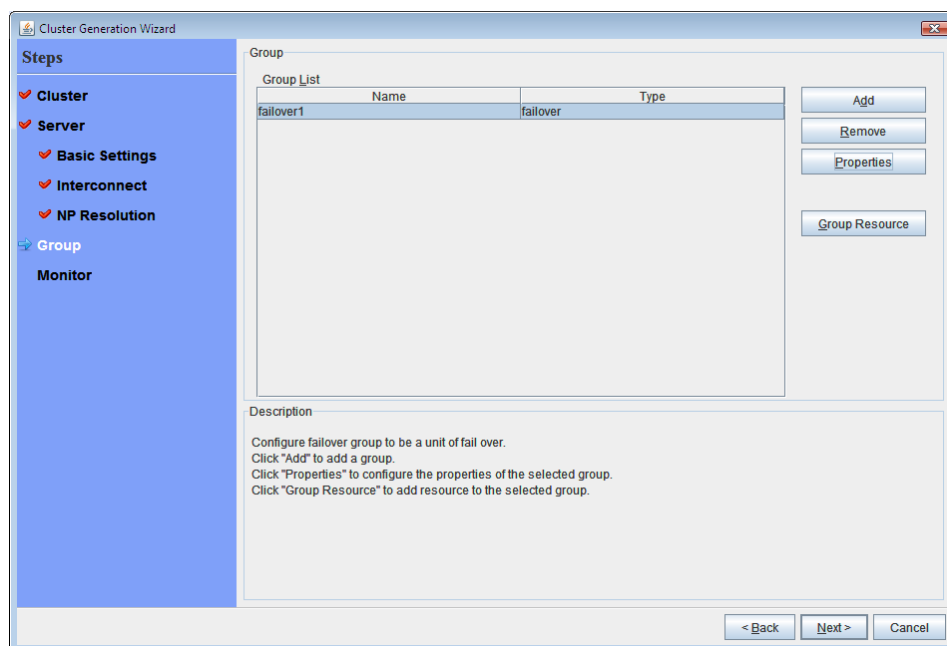
Add a failover group that executes an application to the cluster. (Below, *failover group* is sometimes abbreviated to *group*.)

2-1. 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** 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.



2-2. 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 Step 2-1.

1. In the **Group Resource** , click **Add**.
2. The **Resource Definition** 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**.

2-3. 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** , click **Add**.
2. The **Resource Definition** 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**.

2-4. 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** , click **Add**.
2. In the **Resource Definition**, 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 (**ext3**) in the **File System** box, and enter device name (**/dev/sdb2**) and mount point (**/mnt/sdb2**) to each box. Click **Finish**.

2-5. 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**, click **Add**.
2. The **Resource Definition** 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, click the **Get License Info** button.

If a mirror disk resource does not appear when you click the **Get License Info** button, the Replicator or Replicator DR license may not yet have been registered for the server. Check whether the Replicator or Replicator DR license has been registered for the server.

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/sdb2`), data partition device name (`/dev/sdb2`) and cluster partition device name (`/dev/sdb1`) to each box. Select file system (`ext3`) in the **File System** box. Click **Finish**.

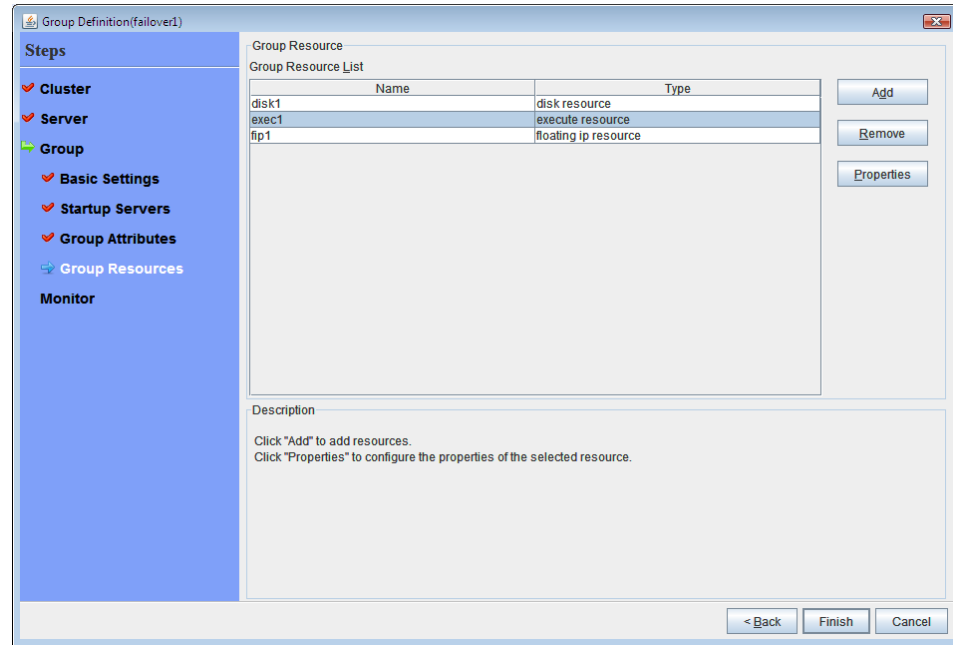
2-6. Add a group resource (EXEC resource)

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

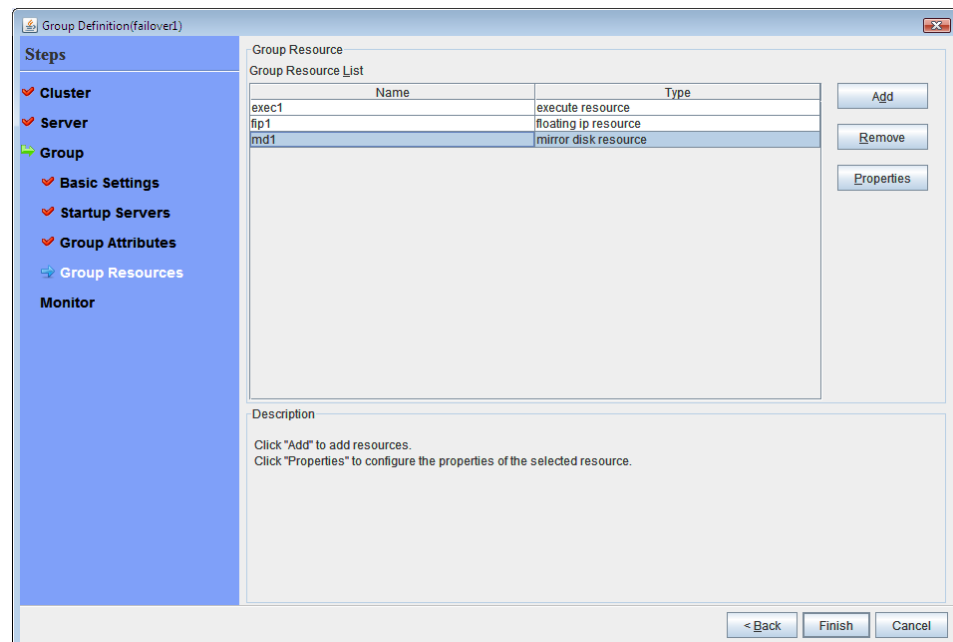
1. In the **Group Resource**, click **Add**.
2. In the **Resource Definition**, select the group resource **execute resource** in the **Type** box, and enter the group resource name **exec1** in the **Name** box. Click **Next**.
3. The **Dependent Resources** page is displayed. Specify nothing. Click **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**.

3. Creating monitor resources

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

3-1. 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** , 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/sdb1`). Click **Next**.
6. Set **Recovery Target**. Click **Browse**.
7. Select **LocalServer** on the tree view being displayed, and click **OK**. **LocalServer** is set to **Recovery Target**.
8. Select **Stop the cluster service and shut down OS** in the **Final Action** box, and click **Finish**.

3-2. Add a monitor resource (IP monitor)

Add monitor resources that monitor networks.

1. In the **Monitor Resource**, 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**.

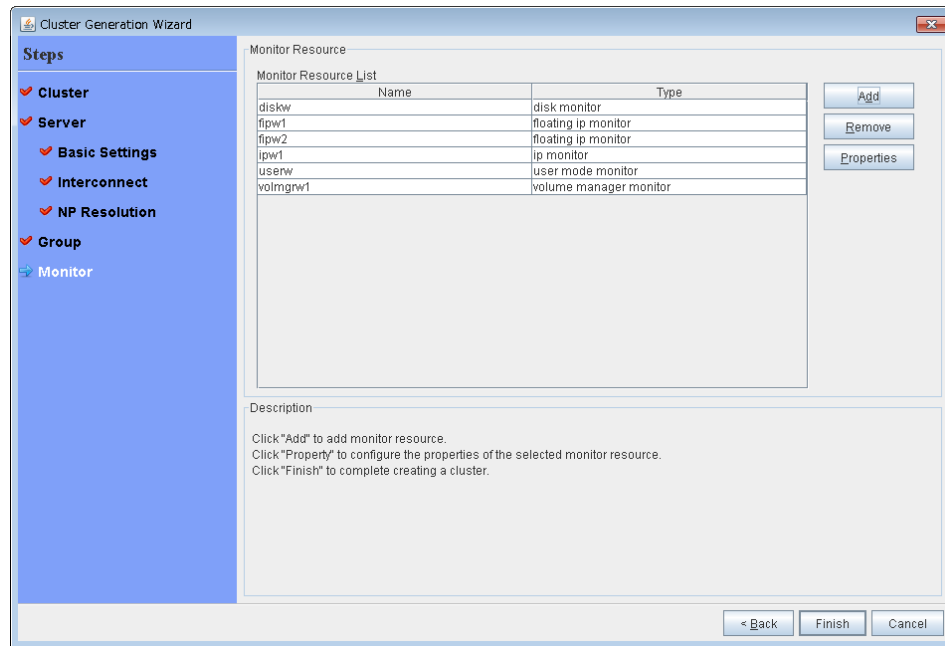
Note: For the monitoring target of the IP monitor resource, specify the IP address of a device (such as a gateway) that is assumed to always be active on the public LAN.

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**.

3-3. Configure a monitor resource (volume manager monitor)

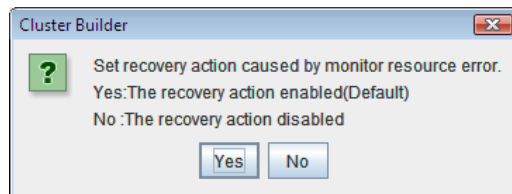
1. In the **Monitor Resource**, click **Add**. Select a volume manager monitor resource (volmgrw1), and then click **Properties**.
2. On the **Recovery Action** tab, check whether the recovery target and final action are appropriate, and then set the recovery target. Click **OK**.

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.



4. Disabling recovery action caused by monitor resource error

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



Clicking **No** disables the recovery operation even if a monitor resource error is detected. When you start a cluster for the first time after creating the cluster configuration information, it is recommended that you disable recovery action to check for setting errors in the cluster configuration information.

Note that this function can be set up by using the **Disable Recovery Action Caused by Monitor Resource Error** on the **Recovery** tab in the **Cluster Properties** window.

Note:

When recovery action was disabled, recovery action caused by monitor resource error is not performed. Even if this function is enabled, recovery from a group resource activation failure and failover upon a server failure will still be performed.

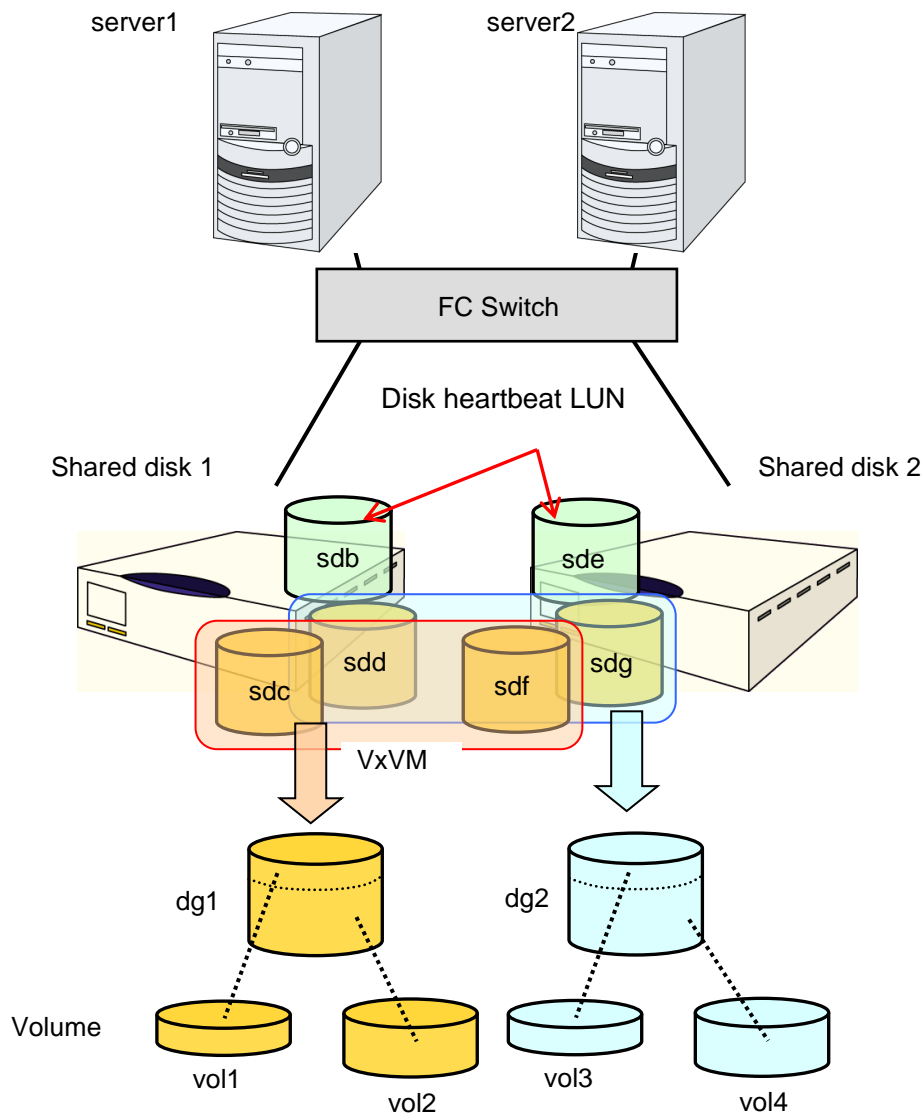
This function is not available on the monitor in user mode.

Creating the cluster configuration data is completed. Proceed to “Creating a cluster” on page 187.

Checking the values to be specified in a cluster environment that has two nodes (using VxVM)

Configuration of VERITAS Volume Manager

The following configuration of VERITAS Volume Manager is supported by EXPRESSCLUSTER.



The settings for the VxVM configuration on the previous page are listed in the table below.

| Disk group 1 | | | |
|-----------------------------|------------------------|------------------------|-----------------------|
| dg1 | Physical disk 1 | /dev/sdc | |
| | Physical disk 2 | /dev/sdf | |
| | Volume | | |
| | vol1 *1 | Volume device name | /dev/vx/dsk/dg1/vol1 |
| | | Volume raw device name | /dev/vx/rdsk/dg1/vol1 |
| | | File system | vxfs |
| | vol2 *1 | Volume device name | /dev/vx/dsk/dg1/vol2 |
| | | Volume raw device name | /dev/vx/rdsk/dg1/vol2 |
| | | File system | vxfs |
| Disk group 2 | | | |
| dg2 | Physical disk 1 | /dev/sdd | |
| | Physical disk 2 | /dev/sdg | |
| | Volume | | |
| | vol3 *1 | Volume device name | /dev/vx/dsk/dg2/vol3 |
| | | Volume RAW device name | /dev/vx/rdsk/dg2/vol3 |
| | | File system | vxfs |
| | vol4 *1 | Volume device name | /dev/vx/dsk/dg2/vol4 |
| | | Volume RAW device name | /dev/vx/rdsk/dg2/vol4 |
| | | File system | vxfs |
| Disk heartbeat resource LUN | | | |
| Shared disk 1 | Partition for /dev/sdb | | |
| Shared disk 2 | Partition for /dev/sde | | |

*1 For the environment for which operation was checked, multiple physical disks are registered in the disk group and their volumes are mirrored between shared disks.

| 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 |
| | COM heartbeat device | /dev/ttyS0 |
| | Disk heartbeat device | /dev/sdb1 /dev/raw/raw10 /dev/sde1 /dev/raw/raw11 |
| 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 |
| | COM heartbeat device | /dev/ttyS0 |
| | Disk heartbeat device | /dev/sdb1 /dev/raw/raw10 /dev/sde1 /dev/raw/raw11 |
| First group (for the WebManager) | Type | Failover |
| | Group name | ManagementGroup |
| | Startup server | All servers |
| | Number of group resources | 1 |
| First group resources *1 | Type | floating ip resource |
| | Group resource name | ManagementIP |
| | IP address | 10.0.0.11 |
| Second group (for operation) | Type | Failover |
| | Group name | failover1 |
| | Startup server | All servers |
| | Number of group resources | 4 |
| First group resources *1 | Type | floating ip resource |
| | Group resource name | fip1 |
| | IP address | 10.0.0.12 |

| Target | Parameter | Value |
|-----------------------------|---------------------------|-------------------------|
| Second group resources | Type | volume manager resource |
| | Group resource name | vx dg1 |
| | Volume manager | VXVM |
| | Import target | dg1 |
| | Clear host ID option | ON |
| | Forced import | OFF |
| Third group resources | Type | disk |
| | Group resource name | vxvol1 |
| | Disk type | VXVM |
| | File system | vxfs |
| | Device name | /dev/vx/dsk/dg1/vol1 |
| | RAW device name | /dev/vx/rdisk/dg1/vol1 |
| | Mount point | /mnt/vol1 |
| Fourth group resources | Type | disk |
| | Group resource name | vxvol2 |
| | Disk type | VXVM |
| | File system | vxfs |
| | Device name | /dev/vx/dsk/dg1/vol2 |
| | RAW device name | /dev/vx/rdisk/dg1/vol2 |
| | Mount point | /mnt/vol2 |
| Third group (for operation) | Type | Failover |
| | Group name | failover2 |
| | Startup server | server2 -> server1 |
| | Number of group resources | 4 |
| First group resources *1 | Type | floating ip resource |
| | Group resource name | fip2 |
| | IP address | 10.0.0.13 |
| Second group resources | Type | volume manager resource |
| | Group resource name | vx dg2 |
| | Volume manager | VXVM |
| | Import target | dg2 |
| | Clear host ID option | ON |
| | Forced import | OFF |

| Target | Parameter | Value |
|--|--------------------------------|--|
| Third group resources | Type | disk resource |
| | Group resource name | vxvol3 |
| | Disk type | VXVM |
| | File system | vxfs |
| | Device name | /dev/vx/dsk/dg2/vol3 |
| | RAW device name | /dev/vx/rdisk/dg2/vol3 |
| | Mount point | /mnt/vol3 |
| Fourth group resources | Type | disk resource |
| | Group resource name | vxvol4 |
| | Disk type | VXVM |
| | File system | Vxfs |
| | Device name | /dev/vx/dsk/dg2/vol4 |
| | RAW device name | /dev/vx/rdisk/dg2/vol4 |
| | Mount point | /mnt/vol4 |
| First monitor resources (Created by default) | Type | user mode monitor |
| | Monitor resource name | Userw |
| Second monitor resources (Automatically created after creating volume manager resource) | Type | volume manager monitor |
| | Monitor resource name | volmgrw1 |
| | Volume manager | VXVM |
| Third monitor resources (vxvol1 monitoring) | Type | disk monitor |
| | Monitor resource name | vxvolw1 |
| | Monitor method | READ(RAW) |
| | Monitor target raw device name | /dev/vx/rdisk/dg1/vol1 |
| | Monitor target resource | vxvol1 |
| | When an error is detected | Stop the cluster service and shut down the OS. |
| Fourth monitor resources (vxvol2 monitoring) | Type | disk monitor |
| | Monitor resource name | vxvolw2 |
| | Monitor method | READ(RAW) |
| | Monitor target raw device name | /dev/vx/rdisk/dg1/vol2 |
| | Monitor target resource | vxvol2 |
| | When an error is detected | Stop the cluster service and shut down the OS. |

| Target | Parameter | Value |
|--|--------------------------------|--|
| Fifth monitor resources (vxvol3 monitoring) | Type | disk monitor |
| | Monitor resource name | vxvolw3 |
| | Monitor method | READ(VXVM) |
| | Monitor target raw device name | /dev/vx/rdisk/dg2/vol3 |
| | Monitor target resource | vxvol3 |
| | When an error is detected | Stop the cluster service and shut down the OS. |
| Sixth monitor resources (vxvol4 monitoring) | Type | disk monitor |
| | Monitor resource name | vxvolw4 |
| | Monitor method | READ(VXVM) |
| | Monitor target raw device name | /dev/vx/rdisk/dg2/vol4 |
| | Monitor target resource | vxvol4 |
| | When an error is detected | Stop the cluster service and shut down the OS. |
| Seventh monitor resource (Automatically created after creating a ManagementIP resource) | Type | floating ip monitor |
| | Monitor resource name | fipw1 |
| | Monitor target | ManagementIP |
| | When an error is detected | "ManagementGroup" group's failover |
| Eighth monitor resource (Automatically created after creating an fip1 resource) | Type | floating ip monitor |
| | Monitor resource name | fipw2 |
| | Monitor target | fip1 |
| | When an error is detected | "failover1" group's Failover |
| Ninth monitor resource (Automatically created after creating an fip2 resource) | Type | floating ip monitor |
| | Monitor resource name | fipw3 |
| | Monitor target | fip2 |
| | When an error is detected | "failover1" group's Failover |
| Tenth 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 |

*1: Prepare a floating IP address to which the WebManager is connected and include it in a dedicated group. As long as the WebManager-dedicated group is available, the Web browser can access the server without awareness of its actual IP address.

- ◆ Correctly specify the disk resources to monitor and their volume raw devices as the disk monitor resources.
- ◆ The volume manager monitor resource monitors the VxVM vxconfigd daemon.
- ◆ Make sure that the raw device names specified for the following resources differ:
 - The raw device in the disk heartbeat resource
 - The actual raw device in the disk resource's volume raw device

- The monitor target raw device in the disk monitor resource

Creating Configuration Information for a Cluster that Has Two Nodes (Using VxVM)

Creating the cluster configuration information involves creating a cluster, group resources, and monitor resources. The steps for creating the information are described in this section.

NOTE: The operations below can be repeated as many times as necessary. Most of the settings can be modified later by using the renaming or property viewing function.

1. Creating a cluster

Create a cluster.

1-1. Add a cluster

Add a cluster you want to construct and enter its name.

1-2. Add a server

Add a server to the cluster and enter its name and ip address, etc.

1-3. Set up the network configuration

Set up the network configuration among the servers constructing the cluster.

1-4. Set up the network partition resolution

Set up the network partition resolution resource.

2. Creating a failover group

Create a failover group used as a unit when a failover occurs.

2-1. Add a failover group (first group)

Add a group used as a unit when a failover occurs.

2-2. Add a group resource (floating IP resource)

Add a resource that constitutes a group.

2-3. Add a group resource (volume manager resource)

Add a resource to the group when the volume manager resource is used.

2-4. Add a group resource (disk resource)

Add a resource to the group when the disk resource is used.

2-5. Add a failover group (second group)

Add a group that used as a unit when a failover occurs.

2-6. Add a group resource (floating IP address)

Add a resource that constitutes a group.

2-7. Add a group resource (volume manager resource)

Add a resource to the group when the volume manager resource is used.

2-8. Add a group resource (disk resource)

Add a resource to the group when the disk resource is used.

3. Creating monitor resources

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

3-1. Configure a monitor resource (volume manager monitor resource)

Configure a monitor resource to use.

3-2. Add a monitor resource (disk monitor resource)

Add a monitor resource to use.

3-3. Add a monitor resource (IP monitor resource)

Add a monitor resource to use.

4. Disabling recovery action caused by monitor resource error

Enable or disable the recovery action caused by the monitor resource error.

1. Creating a cluster

Create a cluster. Add a server to the created server and determine the heartbeat priority.

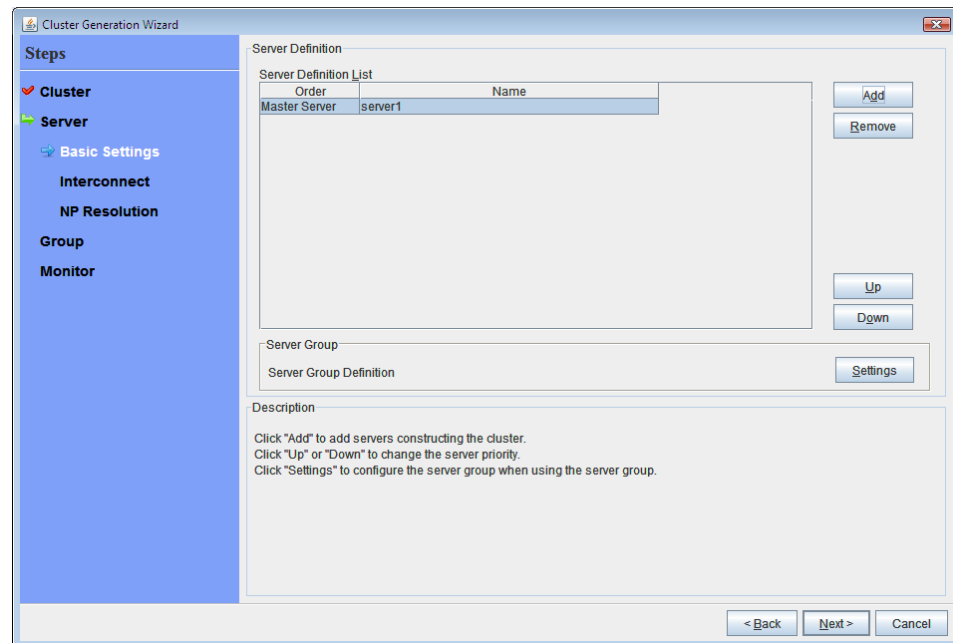
1-1. Add a cluster

1. On the **File** menu of the Builder, click **Cluster Generation Wizard** to display the **Cluster Generation Wizard** dialog box. In the **Language** field, select the language used on the machine where the Cluster WebUI / WebManager runs.

Note: Only one language can be used per cluster. If multiple languages are used in 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 / WebManager in the **Management IP Address** box. Click **Next**.

The **Servers List** is displayed. The server (`server1`) for which the IP address was specified as the URL when starting up the WebManager is registered in the list.



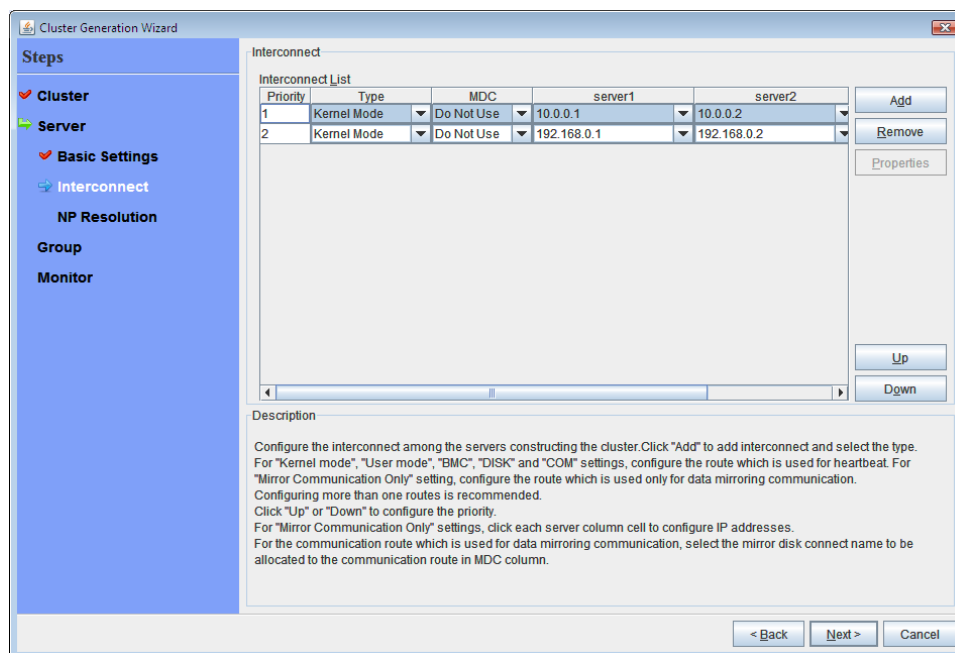
1-2. Add a server

Add the second server to the cluster.

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

1-3. Set up the network configuration

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



1. When the network communication routes between the servers in the cluster can be identified using a network address in the IP address format as in the setup example in this chapter, each communication route is automatically registered in **interconnectList**. If the registered communication routes differ from the actual network configuration, 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**.

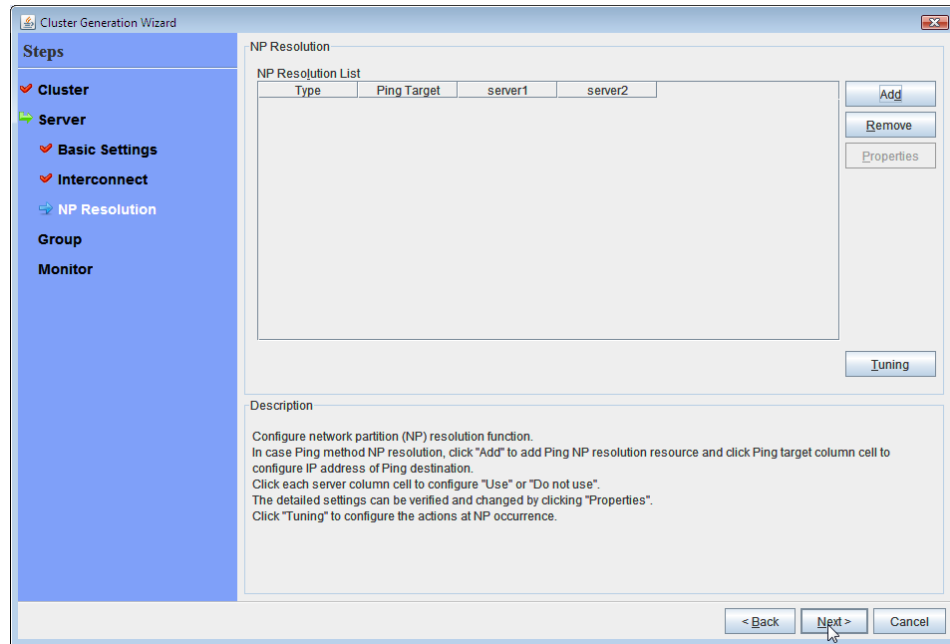
At least one communication route must be specified for the interconnect. Specify as many communication routes for the interconnect as possible.

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 using **Up** or **Down**.

3. When using COM heartbeat, click **Type** column cell and select **COM**. Click **Server name** column cell and select or enter the COM device.
4. When using DISK heartbeat, click Type column cell and select DISK. Click Server name column cell and select or enter disk device.
5. When using BMC heartbeat, click a cell in the **Type** column and then select **BMC**. Then, click the corresponding cell in the server name cell, and enter the IP address of BMC. For a server that does not use BMC heartbeat, leave the cell in the server name column blank.
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**.

1-4. Set up the network partition resolution

Set up the network partition resolution resource.

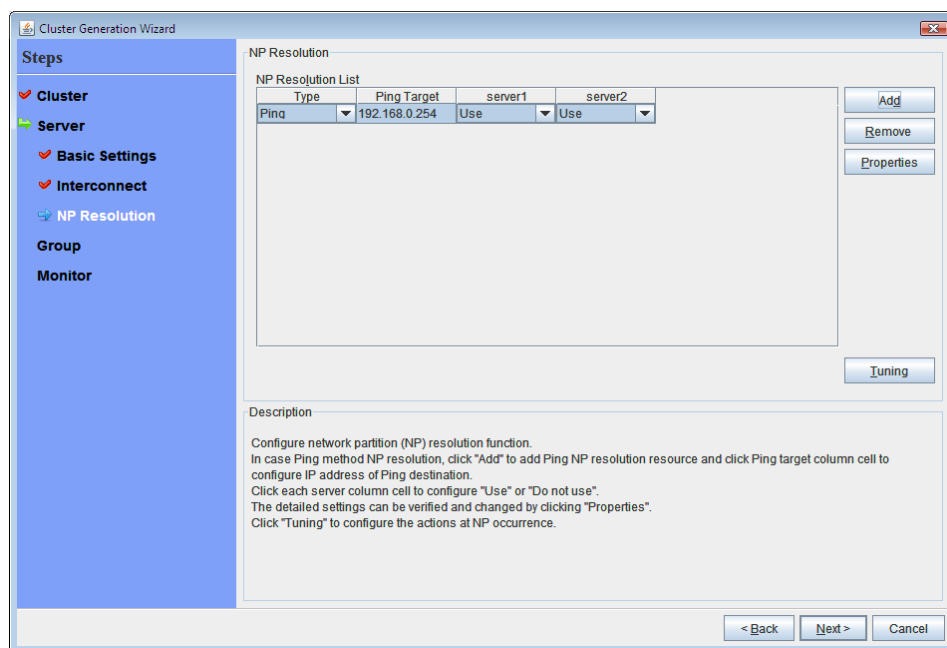


1. To use NP resolution in the PING mode, click **Add** and add a row to **NP Resolution List**, click **Type** and select **Ping**, click the cell of **Ping Target**, and then enter the IP addresses of the ping destination target devices (such as a gateway). When multiple IP addresses separated by commas 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 **Ping Target**.



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

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

3. Click **Next**.

2. Creating a failover group

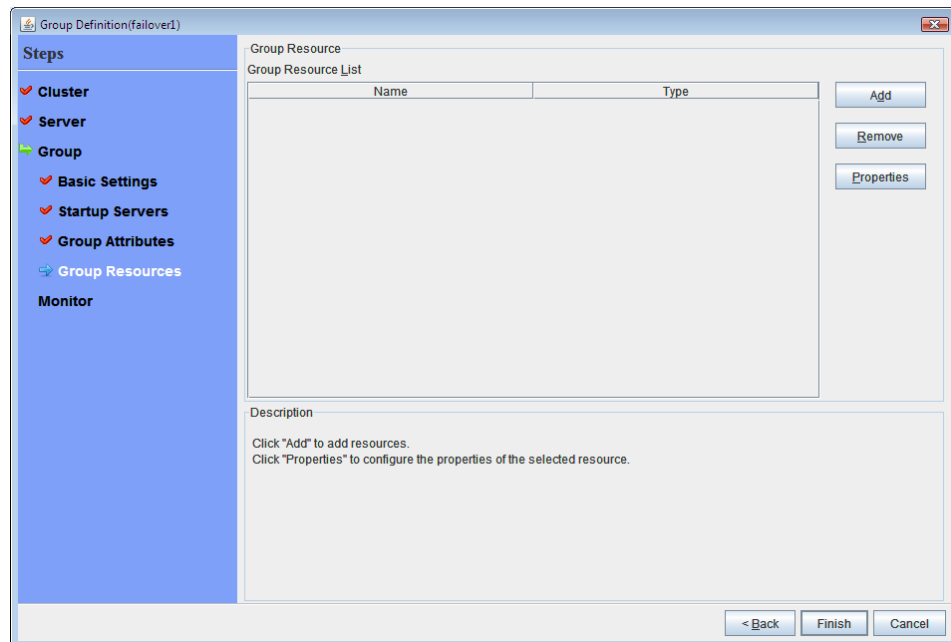
Add a failover group that executes an application to the cluster. (Below, failover group is sometimes abbreviated to group.)

2-1. Add a failover group (first group)

Set up a group used as a failover unit when an error occurs.

1. In the **Group**, 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.



2-2. Add a group resource (floating IP address)

1. The **Group Resource** is displayed. Click **Add**.
2. In the **Resource Definition** dialog box, enter the first group resource information. In the **Resource Definition** 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, and then click **Finish**.

2-3. 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**, click **Add**.
2. In the **Resource Definition** dialog box, enter the second group resource information. In the **Resource Definition** dialog box, select the group resource type **volume manager resource** in the **Type** box, and enter the group resource name **vxvg1** 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 **vxvm** in the **Volume Manager** box, enter the disk group name (**dg1**) in the **Target Name** box, and click **Finish**.

2-4. Add a group resource (disk resource)

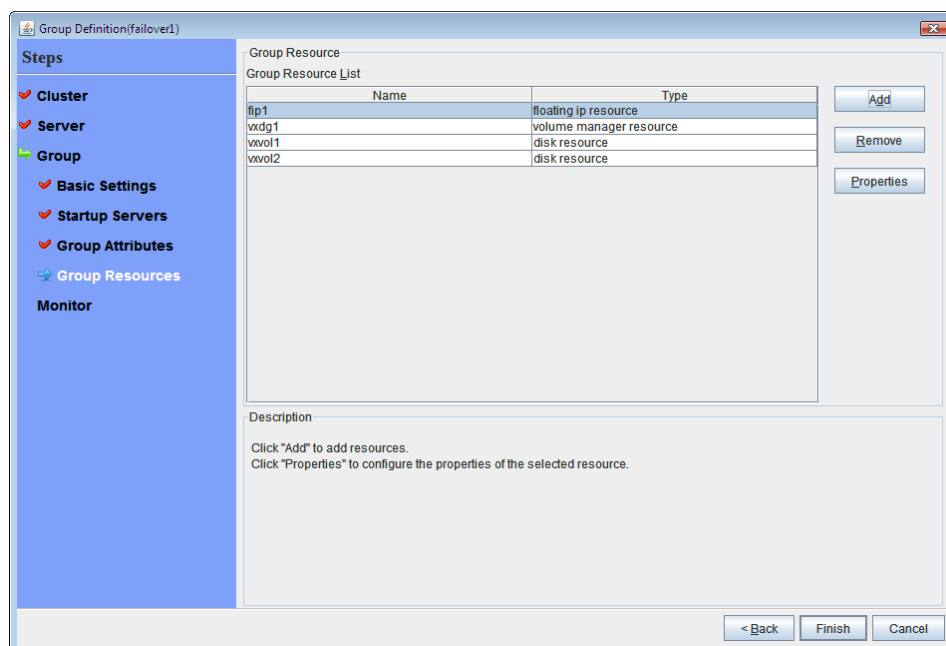
1. In the **Group Resource**, click **Add**.
2. In the **Resource Definition** dialog box, enter the third group resource information. In the **Resource Definition** dialog box, select the group resource type **disk resource** in the **Type** box, and enter the group resource name **vxvol1** in the **Name** 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 the type **vxvm** in the **Disk Type** box and the type **vxfs** in the **File System** box, and enter the device name **/dev/vx/dsk/dg1/vol1**, the raw device name **/dev/vx/rdisk/dg1/vol1**, and the mount point **/mnt/vol1** in their respective boxes. Click **Finish**.

Specify the settings for the following group resources in the same way.

The forth group resources

| Type | disk resource |
|---------------|-----------------------|
| Resource name | vxvol2 |
| Disk type | vxvm |
| File system | vxfs |
| Device | /dev/vx/dsk/dg1/vol2 |
| Raw device | /dev/vx/drsk/dg1/vol2 |
| Mount point | /mnt/vol2 |

The **Group Definitions** list for **failover1** should look similar to the following:



2-5. Add a failover group (second group)

Next, set up a group used as a failover unit when an error occurs.

1. In the **Group** , click **Add**.
2. The **Group Definition** dialog box is displayed. Enter the group name **failover2** 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, check **Failover is possible at all servers** off, select server2 from **Available Servers** list, and click **Add**. Server2 is added to **Available Servers**. Also, add server1 and click **Next**.
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.

2-6. Add a group resource (floating IP address)

1. Click **Add** in the **Group Resource** window.
2. In the **Resource Definition** dialog box, enter the first group resource information. In the **Resource Definition** 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. 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 **10.0.0.13** in the **IP Address** box, and then click **Finish**.

2-7. Add a group resource (volume manager resource)

1. In the **Group Resource**, click **Add**.
2. In the **Resource Definition** dialog box, enter the second group resource information. In the **Resource Definition** dialog box, select the group resource type **volume manager resource** in the **Type** box, and enter the group resource name **vxvg2** 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 **vxvm** in the **Volume Manager** box, enter the disk group name (dg2) in the **Target Name** box, and click **Finish**.

2-8. Add a group resource (disk resource)

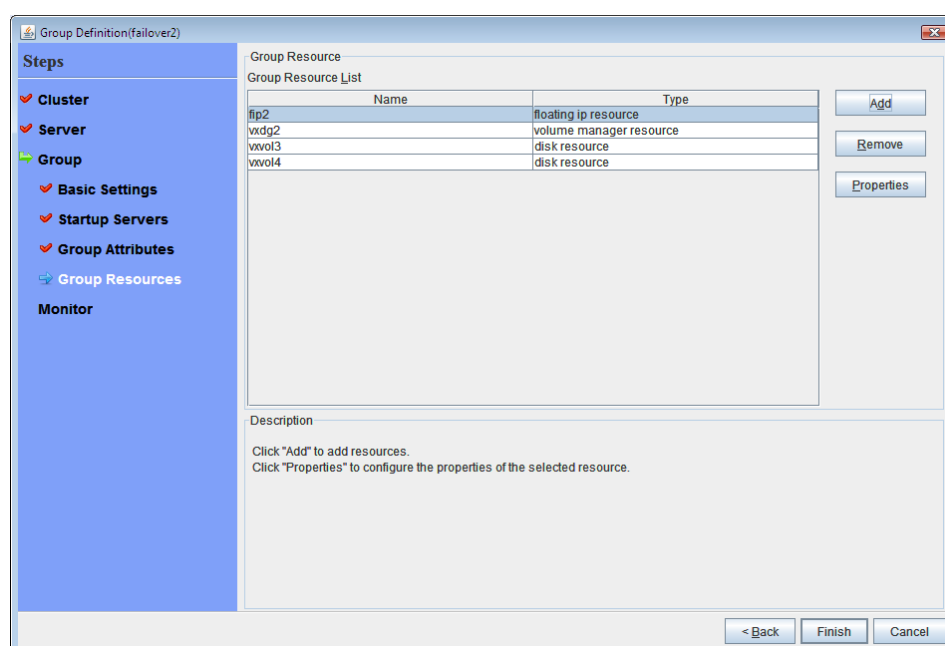
1. In the **Group Resource**, click **Add**.
2. In the **Resource Definition** dialog box, enter the third group resource information. In the **Resource Definition** dialog box, select the group resource type **disk resource** in the **Type** box, and enter the group resource name **vxvol2** in the **Name** 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 the type **vxvm** in the **Disk Type** box and the type **vxfs** in the **File System** box, and enter the device name **/dev/vx/dsk/dg2/vol3**, the raw device name **/dev/vx/rdisk/dg2/vol3**, and the mount point **/mnt/vol3** in their respective boxes. Click **Finish**.

Specify the settings for the following group resources in the same way.

The forth group resources

| | |
|---------------|------------------------|
| Type | disk resource |
| Resource name | vxvol4 |
| Disk Type | vxvm |
| File System | vxfs |
| Device | /dev/vx/dsk/dg2/vol4 |
| RAW device | /dev/vx/rdisk/dg2/vol4 |
| Mount point | /mnt/vol4 |

The **Group Definitions** list for **failover2** should look similar to the following:



3. Creating monitor resources

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

3-1. Configure a monitor resource (volume manager monitor resource)

1. In the **Group** list, click **Next**.
2. The **Monitor Resource Definitions** list is displayed. Select a volume manager monitor resource (volmgrw1), and then click **Properties**.
3. Set the recovery target. Click **Browse**.
4. Click **LocalServer** in the tree view being displayed, click **OK**. **LocalServer** is set to the **Recovery Target**.
5. On the **Recovery Action** tab, check that the recovery target and final action are appropriate, and then click **OK**.

3-2. Add a monitor resource (disk monitor resource)

1. In the **Group**, click **Next**.
2. The **Monitor Resource** is displayed. Click **Add**.
3. Select the monitor resource type **disk monitor** in the **Type** box, and enter the monitor resource name **vxvolw1** in the **Name** box. Click **Next**.
4. Select **Active** in **Monitor Timing**, and then click **Browse**.
5. Select the **vxvol1** icon in the **Selection of Target Resource** box, and then click **OK**.
6. Make sure that **vxvol1** is set to **Target Resource**, and then click **Next**.
7. Select type (READ (VXVM)) in the **Method** and enter the target device (/dev/vx/rdisk/dg1/vol1) to the **Monitor Target RAW Device Name** box, and click **Next**.
8. Set the recovery target. Click **Browse**.
9. Click **LocalServer** in the tree view being displayed, click **OK**. **LocalServer** is set to the **Recovery Target**.
10. Specify **Stop the cluster service and shut down OS** as the final action. Click **Finish**.

Specify the settings for the following group monitor resources in the same way.

Fourth monitor resources

| | |
|---------------------------|--|
| Type | disk monitor |
| Monitor resource name | vxvolw2 |
| Target Resource | vxvol2 |
| Monitor method | READ(VXVM) |
| Monitor target raw device | /dev/vx/rdisk/dg1/vol2 |
| Recovery Target | LocalServer |
| When an error is detected | Stop the cluster service and shut down the OS. |

Fifth monitor resources

| | |
|---------------------------|--|
| Type | disk monitor |
| Monitor resource name | vxvolw3 |
| Target Resource | vxvol3 |
| Monitor method | READ(VXVM) |
| Monitor target raw device | /dev/vx/rdisk/dg2/vol3 |
| Recovery Target | LocalServer |
| When an error is detected | Stop the cluster service and shut down the OS. |

Sixth monitor resources

| | |
|---------------------------|--|
| Type | disk monitor |
| Monitor resource name | vxvolw4 |
| Target Resource | vxvol4 |
| Monitor method | READ(VXVM) |
| Monitor target raw device | /dev/vx/rdisk/dg2/vol4 |
| Recovery Target | LocalServer |
| When an error is detected | Stop the cluster service and shut down the OS. |

3-3. Add a monitor resource (IP monitor resource)

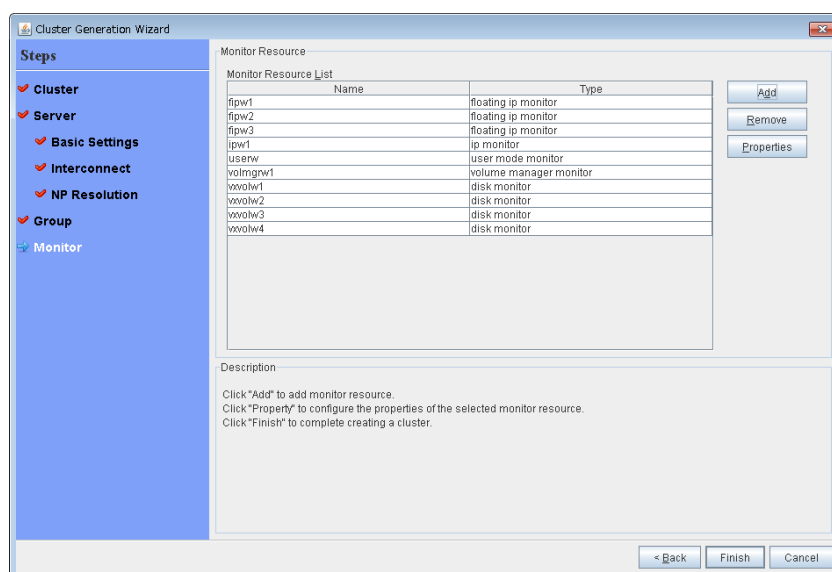
1. In the **Monitor Resource Definitions** list, click **Add**.
2. In the **Monitor Resource Definition** dialog box, enter the tenth monitor resource information. Select the monitor resource type **ip monitor** in the **Type** box, and enter the monitor resource name **ipw1** in the **Name** box. Click **Next**.
3. Set the monitor settings. 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.

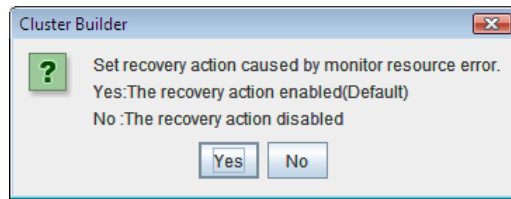
5. The entered IP address is specified in the **IP Addresses** list. Click **Next**.
6. Specify the operation to perform when an error is detected. Click **Browse**.
7. Select **All Groups** in the tree view and Click **OK**. **All Groups** is set to **Recovery Target**.
8. Click **Finish**.

The **Monitor Resource Definitions** list should look similar to the following:



4. Disabling recovery action caused by monitor resource error

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



Clicking **No** disables the recovery operation even if a monitor resource error is detected. When you start a cluster for the first time after creating the cluster configuration information, it is recommended that you disable recovery action to check for setting errors in the cluster configuration information.

Note that this function can be set up by using the **Disable Recovery Action Caused by Monitor Resource Error** on the **Recovery** tab in the **Cluster Properties** window.

Note:

When recovery action was disabled, recovery action caused by monitor resource error is not performed. Even if this function is enabled, recovery from a group resource activation failure and failover upon a server failure will still be performed.

This function is not available on the monitor in user mode.

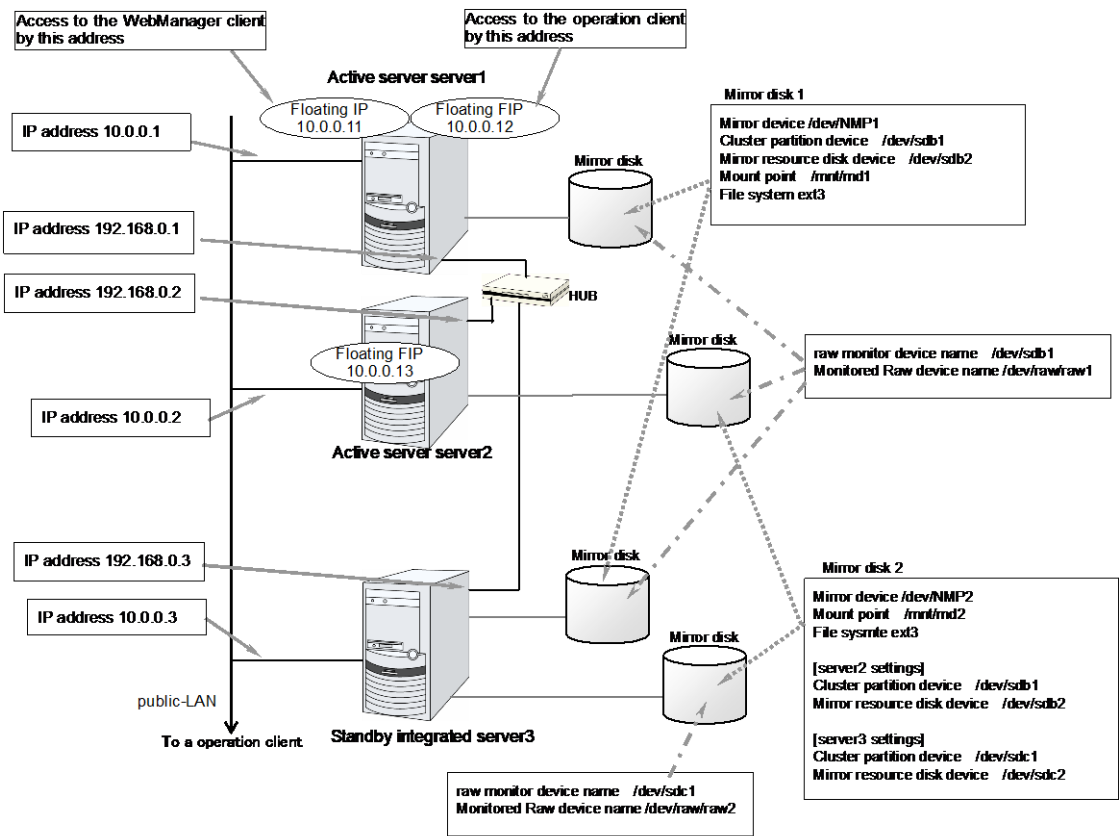
This concludes creating the cluster configuration information.

Proceed to "Creating a cluster" on page 187.

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

Sample cluster environment

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



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 *Referenced 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 LAN heartbeats | 2 |
| | Number of kernel mode LAN heartbeats | 2 |
| First server information (Master server) | Server name*1 | server1 |
| | Interconnect IP address (Dedicated) | 192.168.0.1 |
| | Interconnect IP address (Backup) | 10.0.0.1 |
| | Public IP address | 10.0.0.1 |
| | Mirror disk connect 1 | 192.168.0.1 |
| Second server information | Server name*1 | server2 |
| | Interconnect IP address (Dedicated) | 192.168.0.21 |
| | Interconnect IP address (Backup) | 10.0.0.2 |
| | Public IP address | 10.0.0.2 |
| | Mirror disk connect 1 | 192.168.0.2 |
| Third server information (Standby integrated server) | Server name*1 | server3 |
| | Interconnect IP address (Dedicated) | 192.168.0.3 |
| | Interconnect IP address (Backup) | 10.0.0.3 |
| | Public IP address | 10.0.0.3 |
| | Mirror disk connect 1 | 192.168.0.3 |
| Group resources for management (For the WebManager) | 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 |
| Group resources for operation 1 | Type | failover |
| | Group name | failover1 |

| Target | Parameter | Value |
|---------------------------------|---|----------------------|
| | 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 |
| 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 | /dev/sdb2 |
| | Cluster partition device name | /dev/sdb1 |
| | File system | ext3 |
| | Mirror disk connect | mdc1 |
| Third group resources | Type | exec resource |
| | 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 |
| 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 (server3 individual server setting) | /dev/sdc2 |
| | Cluster partition device name | /dev/sdb1 |
| | Cluster partition device name (server3 individual server setting) | /dev/sdc1 |
| | File system | ext3 |
| | Mirror disk connect | mdc2 |
| Third group resources | Type | execute resource |
| | Group resource name | exec2 |
| | Script | Standard script |
| First monitor | Type | user mode monitor |

| Target | Parameter | Value |
|--|----------------------------------|---|
| resources (Created by default) | Monitor resource name | userw |
| Second monitor resources | Type | disk monitor |
| | Monitor resource name | diskw1 |
| | Device name | /dev/sdb1 |
| | Monitored target raw device name | - |
| | When error is detected | Stop the cluster service and shut down OS |
| Third monitor resources | Type | disk monitor |
| | Monitor resource name | diskw2 |
| | Device name | /dev/sdc1 |
| | Monitored raw device name | - |
| | When error is detected | Stop the cluster service and shut down OS |
| | Startup server | server3 |
| Fourth 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 *3 |
| 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 *3 |
| 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 *3 |
| 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 *3 |
| 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 | Type | mirror disk connect monitor |
| | Monitor resource name | mdnw2 |

| Target | Parameter | Value |
|---|--------------------------------|---------------------|
| (Automatically created after creating mirror disk resource) | 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 |
| 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 |

*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 WebManager. You can access the WebManager 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 Chapter 5, “Monitor resource details” in the *Reference Guide*.

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. Creating a cluster

Create a cluster.

1-1. Add a cluster

Add a cluster you want to construct and enter its name.

1-2. Add a server

Add a server. Make settings such as IP addresses.

1-3. Set up the network configuration

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

1-4. Set up the network partition solution

Set up the network partition resolution resource.

2. Creating a failover group

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

2-1. Add a failover group (group 1)

Add a group used as a unit when a failover occurs.

2-2. Add a group resource (floating IP address)

Add a resource that constitutes a group.

2-3. Add a group resource (mirror disk resource)

Add a resource that constitutes a group.

2-4. Add a group resource (EXEC resource)

Add a resource that constitutes a group.

2-5. Add a failover group (group 2)

Add a group used as a unit when a failover occurs.

2-6. Add a group resource (floating IP address)

Add a resource that constitutes a group.

2-7. Add a group resource (mirror disk resource)

Add a resource that constitutes a group.

2-8. Add a group resource (EXEC resource)

Add a resource that constitutes a group.

3. Creating monitor resources

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

3-1. Add a monitor resource (disk monitor resource)

Add a monitor resource to use.

3-2. Add a monitor resource (disk monitor resource)

Add a monitor resource to use.

3-3. Add a monitor resource (IP monitor resource)

Add a monitor resource to use.

4. Disabling recovery action caused by monitor resource error

Enable or disable the recovery action caused by the monitor resource error.

1. Creating a cluster

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

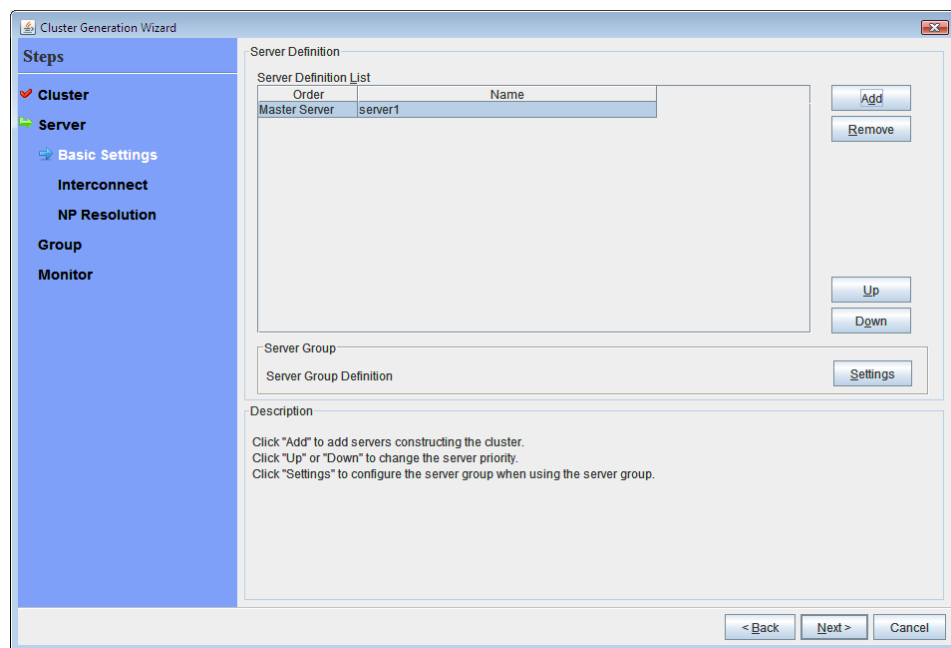
1-1. Add a cluster

1. On the **File** menu of the Builder, 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 / WebManager 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 / WebManager in the **Management IP Address** box. Click **Next**.
The **Servers List** is displayed. The server (`server1`) for which the IP address was specified as the URL when starting up the WebManager is registered in the list.



1-2. 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**.

1-3. Set up the network configuration

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

Cluster Generation Wizard

Steps

- Cluster
- Server
- Basic Settings
- Interconnect
- NP Resolution
- Group
- Monitor

Interconnect

| Priority | Type | MDC | server1 | server2 | server3 |
|----------|-------------|------------|-------------|-------------|-------------|
| 1 | Kernel Mode | mdc1 | 192.168.0.1 | 192.168.0.2 | 192.168.0.3 |
| 2 | Kernel Mode | Do Not Use | 10.0.0.1 | 10.0.0.2 | 10.0.0.3 |

Buttons: Add, Remove, Up, Down

Description

Configure the interconnect among the servers constructing the cluster. Click "Add" to add interconnect and select the type. For "Kernel mode" setting, configure the route which is used for heartbeat. For "Mirror Communication Only" setting, configure the route which is used only for data mirroring communication. For "Kernel mode" setting, more than zero routes are necessary to be configured. Configuring more than one routes is recommended. Click each server column cell to configure IP addresses for each communication routes. Click "Up" or "Down" to configure the priority to preferentially use the LAN only for the communication among the cluster servers. For the communication route which is used for data mirroring communication, select the mirror disk connect name to be allocated to the communication route in MDC column.

Buttons: < Back, Next >, Cancel

1. When the network communication routes between the servers in the cluster can be identified using a network address in the IP address format as in the setup example in this chapter, each communication route is automatically registered in **interconnectList**. If the registered communication routes differ from the actual network configuration, 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.

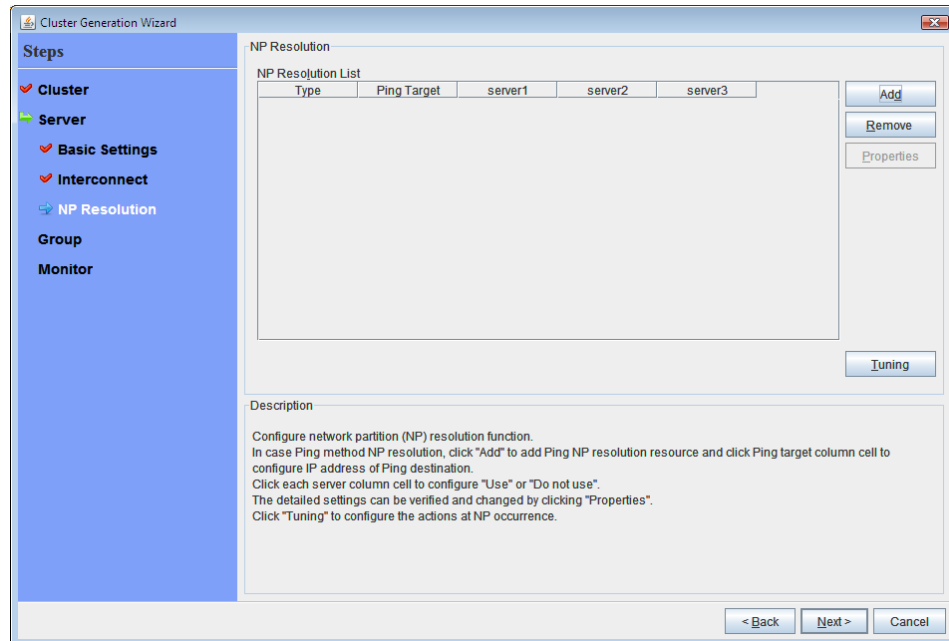
At least one communication route must be specified for the interconnect. Specify as many communication routes for the interconnect as possible.

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 using **Up** or **Down**.

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 BMC heartbeat, click a cell in the **Type** column and then select **BMC**. Then, click the corresponding cell in the server name cell, and enter the IP address of BMC. For a server that does not use BMC heartbeat, leave the cell in the server name column blank.
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**.

1-4. Set up the network partition resolution

Set up the network partition resolution resource.

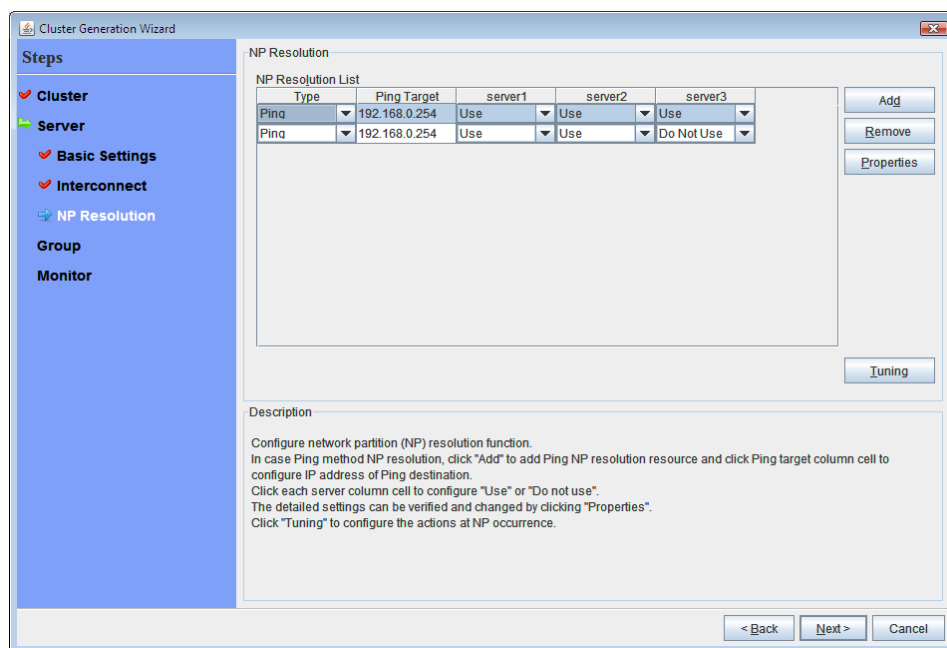


1. To use NP resolution in the PING mode, click **Add** and add a row to **NP Resolution List**, click **Type** and select **Ping**, click the cell of **Ping Target**, and then enter the IP addresses of the ping destination target devices (such as a gateway). When multiple IP addresses separated by commas 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 **Ping Target**.



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

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

- Click **Next**.

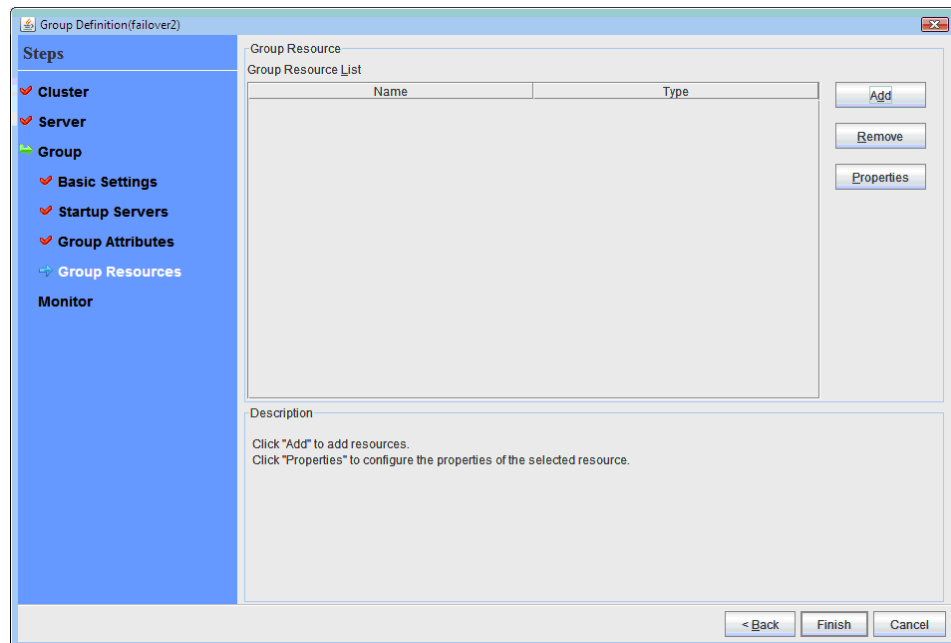
2. Creating a failover group

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

2-1. 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**, 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.



2-2. 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 Step 2-1.

1. Click **Add** in the **Group Resource**.
2. The **Resource Definition** 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**.

2-3. Add a group resource (mirror disk resource)

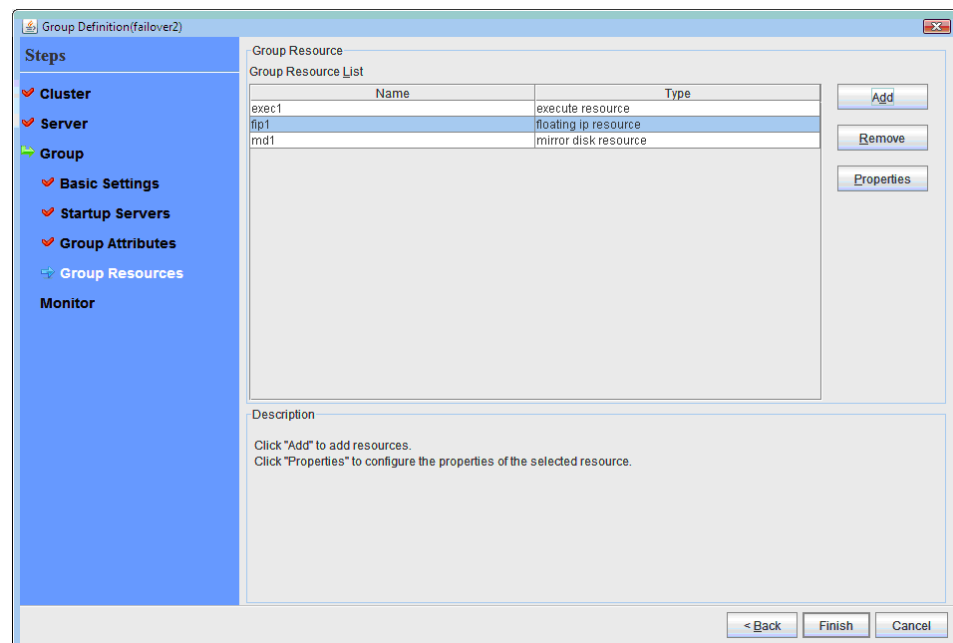
1. In the **Group Resource**, click **Add**.
2. In the **Resource Definition** dialog box, select the group resource type **mirror disk resource** in the **Type** box, and enter the group resource name **md1** in the **Name** box. Click **Next**.
3. The **Dependent Resources** page is displayed. Specify 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/sdb2**, and the cluster partition device name **/dev/sdb1** in the respective box. In the **File System** dialog box, select the file system **ext3**.
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. In **Resource Definition**, click **Finish**.

2-4. 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**, click **Add**.
2. In the **Resource Definition** 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** of the **failover1** should look similar to the following:



6. Click **Finish**.

2-5. 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**, 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.

2-6. 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 Step 2-5.

1. Click **Add** in the **Group Resource**.
2. In the **Resource Definition** 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**.

2-7. Add a group resource (mirror disk resource)

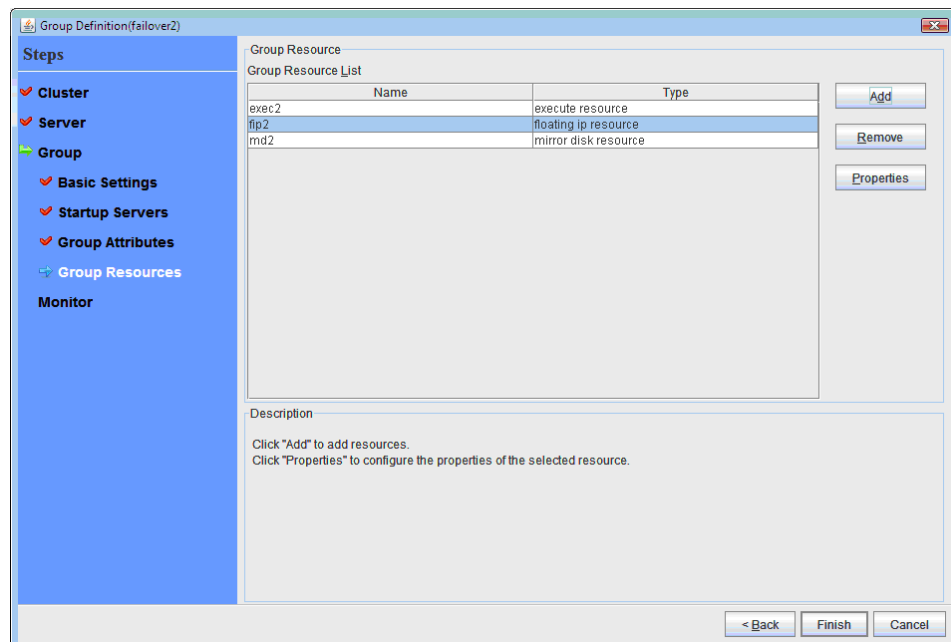
1. Click **Add** in the **Group Resource**.
2. In the **Resource Definition** dialog box, select the group resource type **mirror disk resource** in the **Type** box, and enter the group name **md2** in the **Name** box. Click **Next**.
3. A page for setting up a dependency is displayed. Click **Next**.
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/sdb2`, and the cluster partition device name `/dev/sdb1` in the respective box. In the **File System** dialog box, select the file system **ext3**.
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 **server3** tab in the **Resource Definition of Group** dialog box, and check **Set Up Individually** on. Re-enter data partition device name (`/dev/sdc2`) and cluster partition device name (`/dev/sdc1`).
8. Click **Finish**.

2-8. 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**.
2. In the **Resource Definition** dialog box, select the group resource **execute 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**.

3. Creating monitor resources

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

3-1. 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/sdb1**). Click **Next**.
6. Set **Recovery Target**. Click **Browse**.
7. Select **LocalServer** on the tree view being displayed, and click **OK**. **LocalServer** is set to **Recovery Target**.
8. Select **Stop the cluster service and shut down OS** in the **Final Action** box, and click **Finish**.

3-2. 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 Definitions** 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. Configure the monitor settings. Click **Server**.
4. Select the **Select radio button**. Select **server3** on **Available Servers**. Confirm that **server3** is added to **Servers that can run the Group**. Click **OK**.
5. In the **Monitor Resource Definition** window, click **Next**.
6. Enter **Method** (**READ (O_DIRECT)**) and **Monitor Target** (**/dev/sdb1**). 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**.

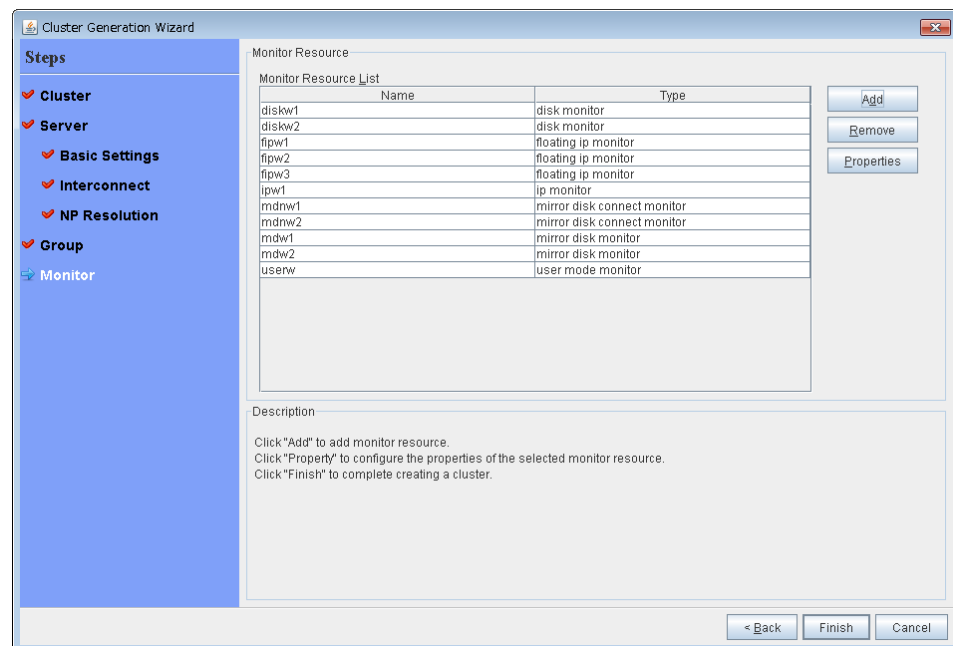
3-3. Add a monitor resource (IP monitor resource)

1. In the **Monitor Resource Definitions** 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.

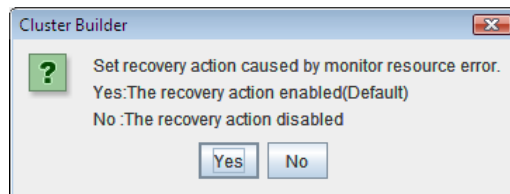
5. The entered IP address is specified in the **IP Addresses** list. Click **Next**.
6. Specify the recovery target. Click **Browse**.
7. Select **All Groups** in the tree view and click **OK**. **All Groups** is set to **Recovery Target**.
8. Click **Finish**

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.



4. Disabling recovery action caused by monitor resource error

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



Clicking **No** disables the recovery operation even if a monitor resource error is detected. When you start a cluster for the first time after creating the cluster configuration information, it is recommended that you disable recovery action to check for setting errors in the cluster configuration information.

Note that this function can be set up by using the **Disable Recovery Action Caused by Monitor Resource Error** on the **Recovery** tab in the **Cluster Properties** window.

Note:

When recovery action was disabled, recovery action caused by monitor resource error is not performed. Even if this function is enabled, recovery from a group resource activation failure and failover upon a server failure will still be performed.

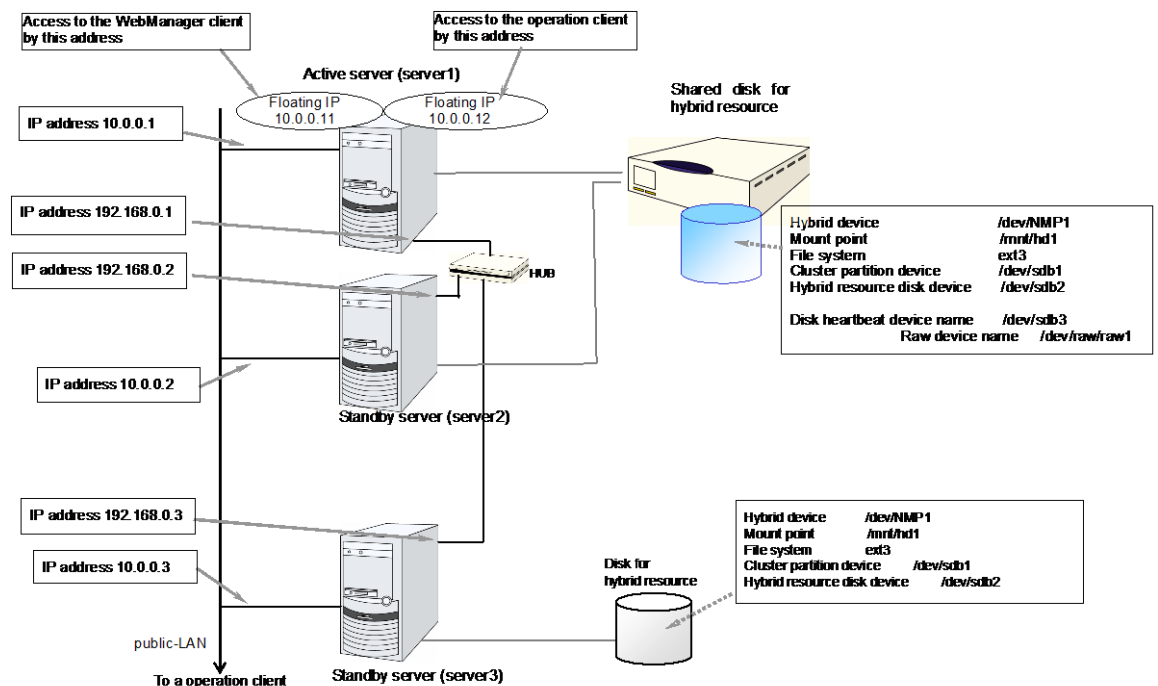
This function is not available on the monitor in user mode.

Creating the cluster configuration data is completed. Proceed to “Creating a cluster” on page 187.

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

Sample cluster environment

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



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 *Referenced 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 LAN heartbeats | 2 |
| | Number of kernel mode LAN heartbeats | 2 |
| | Number of disk heartbeats | 1 |
| 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/sdb3 |
| | Disk heartbeat Raw device | /dev/raw/raw1 |
| | 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/sdb3 |
| | Disk heartbeat Raw device | /dev/raw/raw1 |
| | Mirror disk connect | 192.168.0.2 |

| Target | Parameter | Value |
|--|-------------------------------------|--------------------------------|
| 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 |
| | Disk heartbeat Raw device | Not configured |
| | Mirror disk connect | 192.168.0.3 |
| First server group | Server group name | svg1 |
| | Belonging servers | server1 server2 |
| Second server group | Server group name | svg2 |
| | Belonging servers | server3 |
| Group for management (For the WebManager) | 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 | Type | hybrid disk resource |
| | Group resource name | hd1 |
| | Mirror partition device name | /dev/NMP1 |
| | Mount point | /mnt/hd1 |
| | Data partition device name | /dev/sdb2 |
| | Cluster partition device name | /dev/sdb1 |
| | File system | ext3 |
| | Mirror disk connect | mdc1 |

| Target | Parameter | Value |
|---|--------------------------------|---|
| Third group resources | Type | execute 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/sdb2/ |
| | Monitoring method | READ(O_DIRECT) |
| | 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 |
| Fiith 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 |

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. Creating a cluster

Create a cluster.

1-1. Add a cluster

Add a cluster. Make settings such as IP addresses.

1-2. Add a server

Add a server. Make settings such as IP addresses.

1-3. Create a server group

Create a server group.

1-4. Set up the network configuration

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

1-5. Set up the network partition resolution

Set up the network partition resolution resource.

2. Creating a failover group

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

2-1. Add a failover group

Add a group used as a unit when a failover occurs.

2-2. Add a group resource (floating IP address)

Add a resource that constitutes a group.

2-3. Add a group resource (hybrid disk resource)

Add a resource that constitutes a group.

2-4. Add a group resource (EXEC resource)

Add a resource that constitutes a group.

3. Creating monitor resources

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

3-1. Add a monitor resource (disk monitor resource)

Add a monitor resource to use.

3-2. Add a monitor resource (IP monitor resource)

Add a monitor resource to use.

4. Disabling recovery action caused by monitor resource error

Enable or disable the recovery action caused by the monitor resource error.

5. Modify cluster properties

Modify the settings not to perform server down notification.

1. Creating a cluster

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

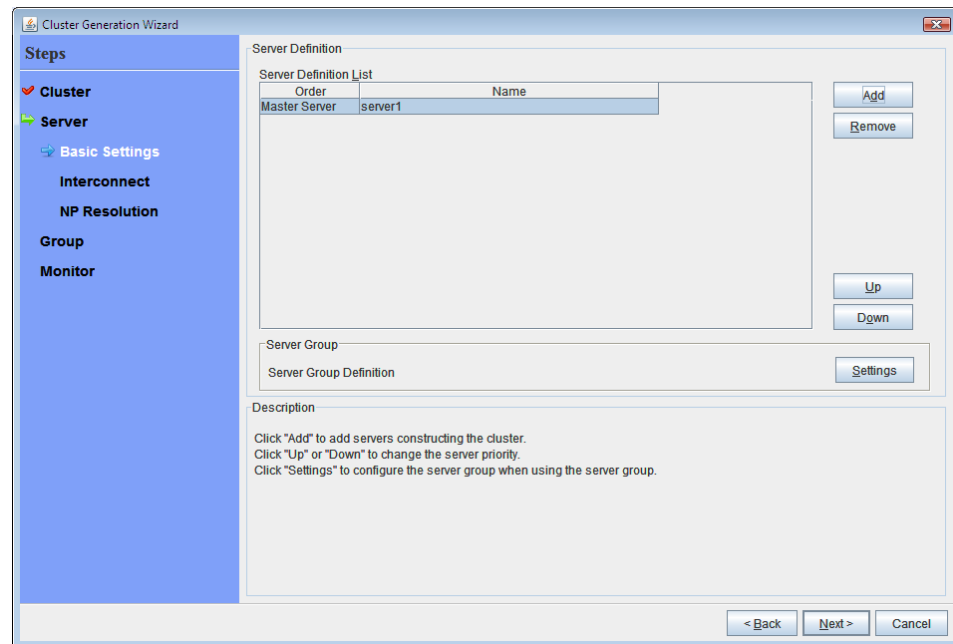
1-1. Add a cluster

1. On the **File** menu of the Builder, 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 / WebManager 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 / WebManager in the **Management IP Address** box. Click **Next**.

The **Servers List** is displayed. The server (`server1`) for which the IP address was specified as the URL when starting up the WebManager is registered in the list.



1-2. Add a server

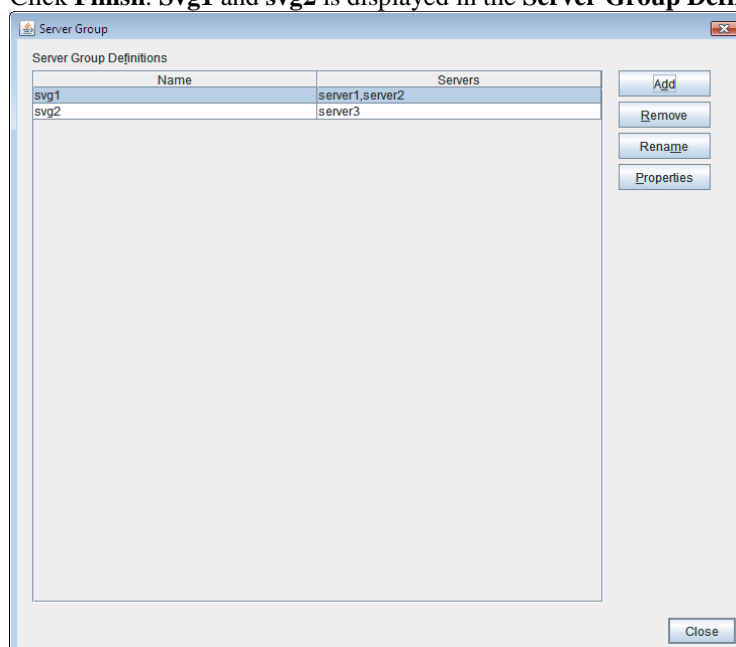
Add the second and subsequent servers to the cluster.

1. In the **Server List**, 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 List**.
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**.

1-3. 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.

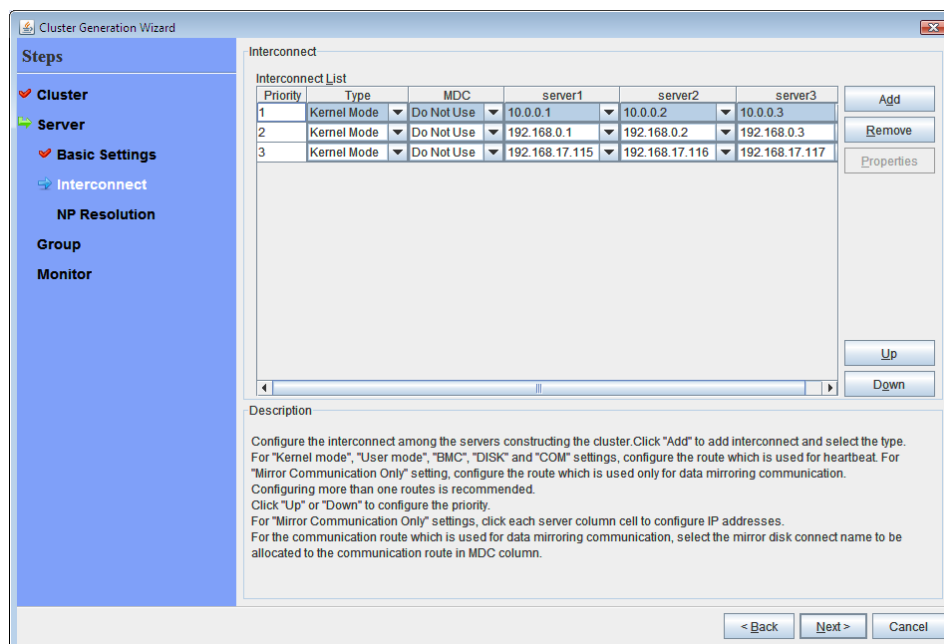
1. In the **Server Group**, click **Settings**.
2. In the **Server Group Definitions**, click **Add**.
3. The **Server Addition** dialog box is displayed. Enter server group name (svg1) in the **Name** box, and then click **Next**.
4. In the **Available Servers**, click **server1**, and click **Add**.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



9. Click **Close**.

1-4. Set up the network configuration

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



1. In the **Server Definition List**, click **Next**. **Interconnect List** is displayed.
2. When the network communication routes between the servers in the cluster can be identified using a network address in the IP address format as in the setup example in this chapter, each communication route is automatically registered in **InterconnectList**. If the registered communication routes differ from the actual network configuration, 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.
3. 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**.

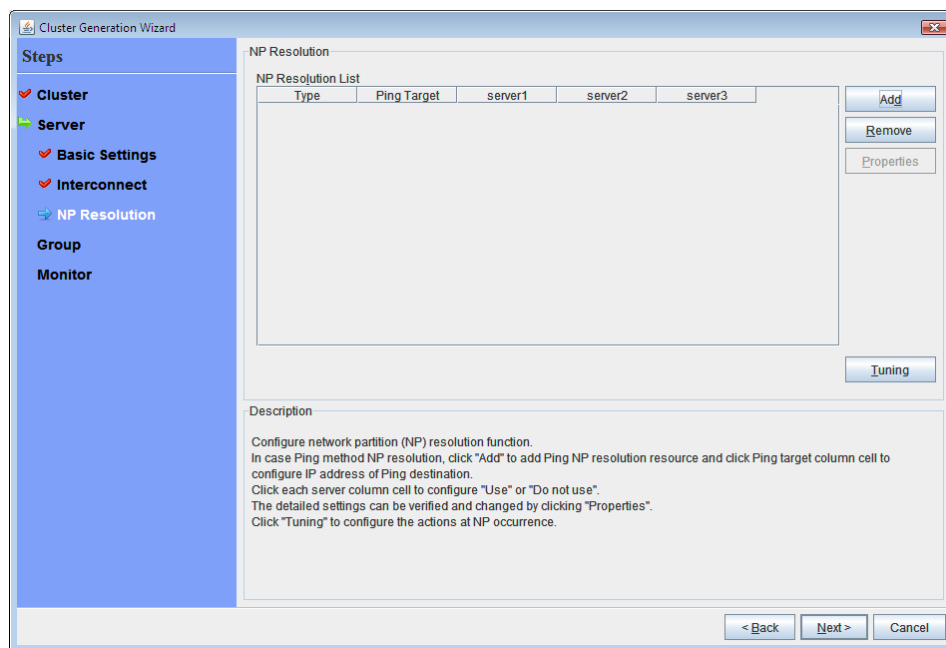
At least one communication route must be specified for the interconnect. Specify as many communication routes for the interconnect as possible.

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 using **Up** or **Down**.

4. When using BMC heartbeat, click a cell in the **Type** column and then select **BMC**. Then, click the corresponding cell in the server name cell, and enter the IP address of BMC. For a server that does not use BMC heartbeat, leave the cell in the server name column blank.
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**.

1-5. Set up the network partition resolution

Set up the network partition resolution resource.

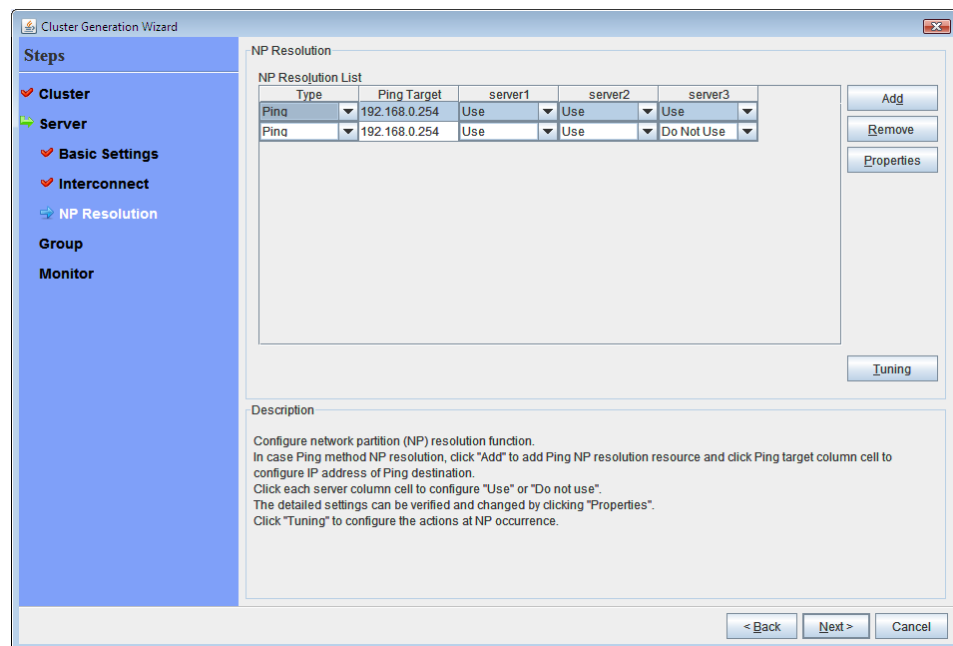


1. To use NP resolution in the PING mode, click **Add** and add a row to **NP Resolution List**, click **Type** and select **Ping**, click the cell of **Ping Target**, and then enter the IP addresses of the ping destination target devices (such as a gateway). When multiple IP addresses separated by commas 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 **Ping Target**.



2. Specify the operation to perform when a network partition is detected. Select **Stop the cluster service** or **Stop the cluster service and shut down OS**.
 For the setup example in this chapter, **Stop the cluster service** is selected.
3. Click **Next**.

2. Creating a failover group

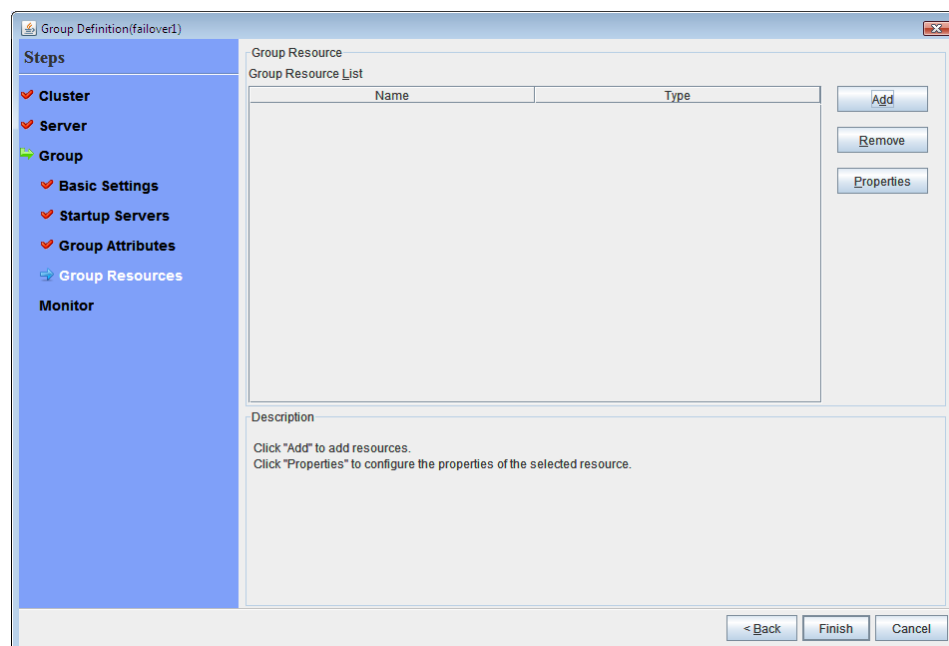
Add a failover group that executes an application to the cluster. (Below, *failover group* is sometimes abbreviated to *group*.)

2-1. 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**, 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 Group** 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.



2-2. 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 Step 2-1.

1. Click **Add** in the **Group Resource**.
2. The **Resource Definition** 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 **fp1** 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**.

2-3. Add a group resource (hybrid disk resource)

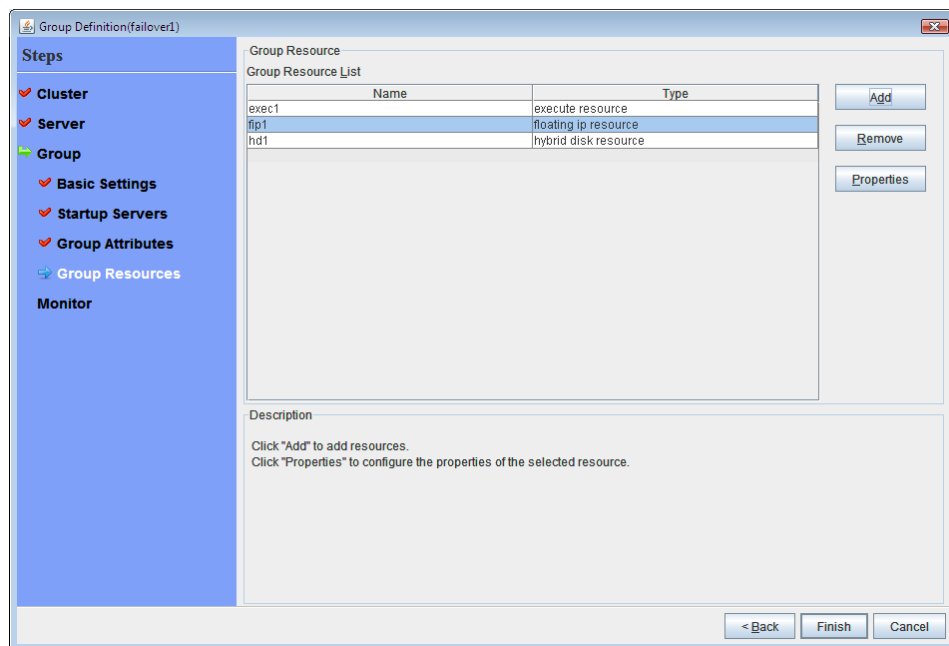
1. In the **Group Resource Definitions** list, click **Add**.
2. In the **Resource Definition** dialog box, select the group resource type **hybrid disk resource** in the **Type** box, and enter the group resource name **hd1** in the **Name** box. Click **Next**.
3. The **Dependent Resources** page is 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/sdb2**, the data partition device name **/dev/sdb2** and the cluster partition device name **/dev/sdb1** in the respective box. In the **File System** dialog box, select the file system **ext3**. Click **Finish**.

2-4. 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 Definitions** list, click **Add**.
2. In the **Resource Definition** dialog box, 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. 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 Definitions** list of the failover1 should look similar to the following:



6. Click **Finish**.

3. Creating monitor resources

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

3-1. 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 Definitions** list, click **Next**.
2. In the **Monitor Resource Definitions** 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. Select **Method** (READ (RAW)) and enter **Monitor Target** (/dev/sdb2). Click **Next**.
6. Set the recovery target. Click **Browse**.
7. Click **LocalServer** in the tree view, click **OK**. **LocalServer** is set to the **Recovery Target**.
8. Select **Stop the cluster service and shut down OS** in the **Final Action** box, and click **Finish**.

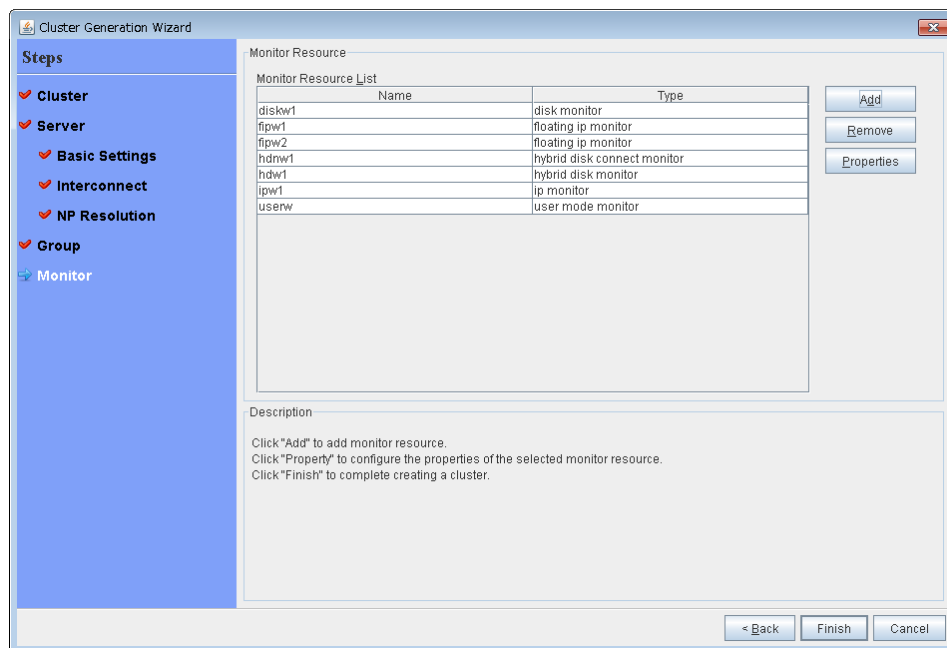
3-2. Add a monitor resource (IP monitor resource)

1. In the **Monitor Resource Definitions** 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.

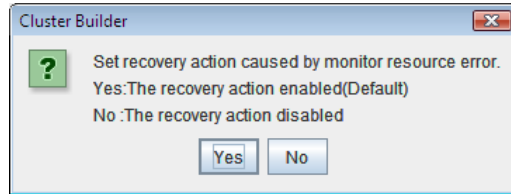
5. The entered IP address is specified in the **IP Addresses** list. Click **Next**.
6. Specify the recovery target. Click **Browse**.
7. Select **All Groups** in the tree view and click **OK**. **All Groups** is set to **Recovery Target**.
8. Click **Finish**.

The **Monitor Resource Definitions** list should look similar to the following:



4. Disabling recovery action caused by monitor resource error

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



Clicking **No** disables the recovery operation even if a monitor resource error is detected. When you start a cluster for the first time after creating the cluster configuration information, it is recommended that you disable recovery action to check for setting errors in the cluster configuration information.

Note that this function can be set up by using the **Disable Recovery Action Caused by Monitor Resource Error** on the **Recovery** tab in the **Cluster Properties** window.

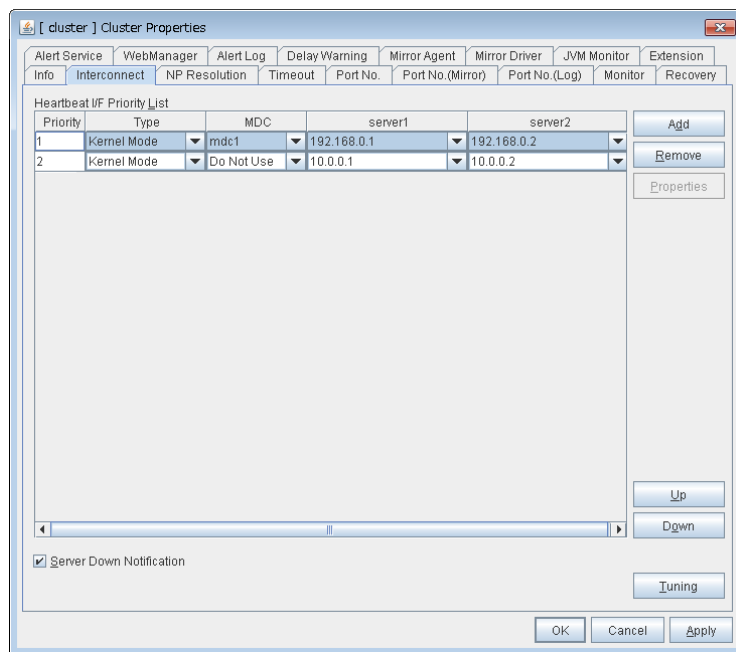
Note:

When recovery action was disabled, recovery action caused by monitor resource error is not performed. Even if this function is enabled, recovery from a group resource activation failure and failover upon a server failure will still be performed.

This function is not available on the monitor in user mode.

5. Modify cluster properties

1. Right-click **Cluster** on the tree view and select **Properties**.
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 “Creating a cluster” on page 187.

Saving the cluster configuration data

The cluster configuration data can be saved to any directory. When starting the Builder on the WebManager, you can apply the saved cluster information to the server machine with the EXPRESSCLUSTER Server installed via the WebManager.

Saving the cluster configuration data (Linux)

Follow the procedures below to save cluster configuration data when using Linux machine.

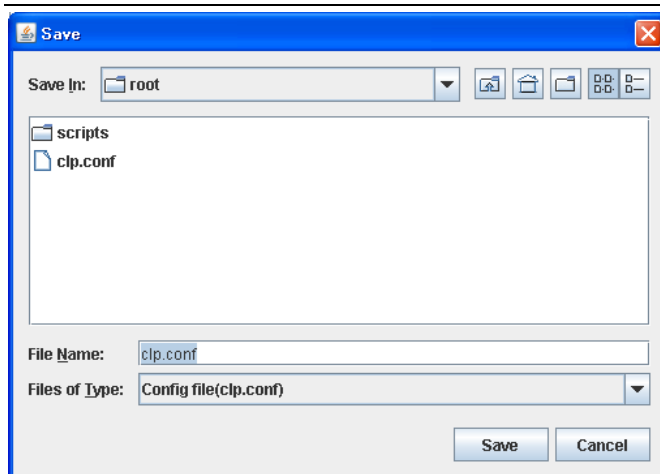
1. Select **Export** on the **File** menu of the Builder, or click the icon  on the tool bar.
2. Select a location to save the data in the following dialog box, and click **Save**. Specify this directory when executing the creation command later.

Note 1:

One file (`clp.conf`) and one directory (`scripts`) are 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 2:


The file and directory can be seen only when **For Windows** or **File System** is selected.

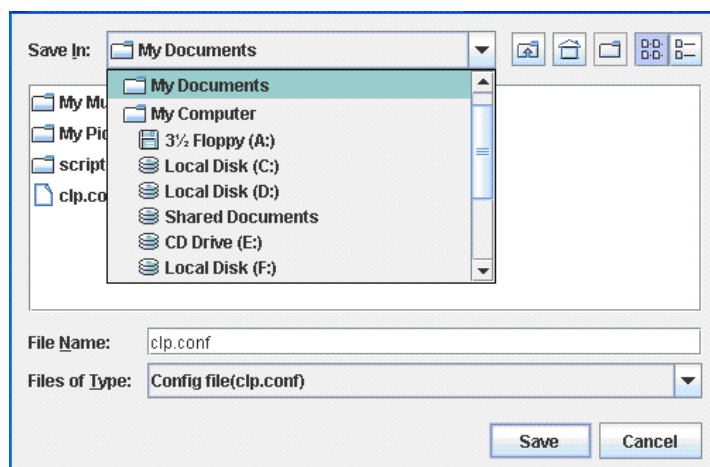


3. Check the directory and verify if the file (`clp.conf`) and the directory (`scripts`) are located in the directory for storing.

Saving the cluster configuration data (Windows)

Follow the procedures below to save the cluster configuration data when using a Windows machine.

1. Select **Export** on the **File** menu of the Builder, or click the icon  on the tool bar.
2. Select a location to save the data in the following dialog box, and click **Save**.



3. Select a location to save the data in the following dialog box, and click **Save**. Specify this directory when executing the creation command later.

Note:

Three files (`clp.conf`, `clp.conf.bak` and `clp.conf.rep`) and one directory (`scripts`) are saved. If any of these are missing, the command to create a cluster does not run successfully. Make sure to treat these three as a set. When new configuration data is edited, `clp.conf.bak` is created in addition to these three.


4. Check the directory and verify if the file (`clp.conf`) and the directory (`scripts`) are located in a directory to be saved.

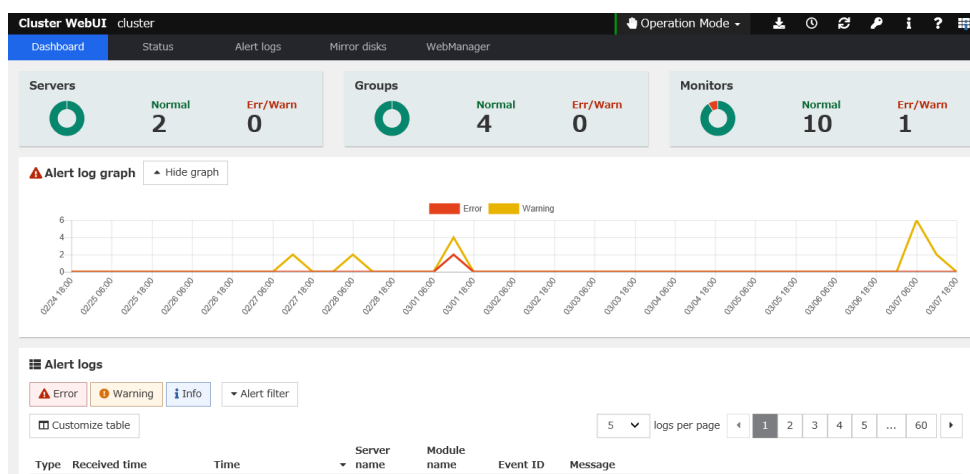
Creating a cluster


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.

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** menu of the Builder, or click the icon  on the tool bar.
If the upload succeeds, the message saying "The application finished successfully."
2. Terminate the Builder.
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 "3. Partition settings for hybrid disk resource (Required for the Replicator DR)" in "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 WebManager.
 - ◆ When using mirror disk resource
 - (1) Restart all servers. After restarting the servers, clustering starts and the status of clustering is displayed on WebManager.
 - ◆ When using neither mirror disk resource nor hybrid disk resource
 - (1) Execute **Restart Manager** from the **Service** menu of WebManager.
 - (2) Execute **Start clustering** from the **Service** menu of WebManager. Clustering starts and the status of clustering is displayed on WebManager.
4. The status of the cluster will be displayed on the 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.

Chapter 6 Verifying a cluster system

This chapter describes how you change the cluster configuration.

This chapter covers:

- Verifying operations using the WebManager..... 190
- Verifying operation by using commands..... 192

Verifying operations using the WebManager

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

Related Information:

For system requirements of the WebManager, refer to Chapter 3, “System requirements for the WebManager” in the *Getting Started Guide*.

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

Related Information:

For details on how to use the WebManager, see Chapter 1, “Functions of the WebManager” in the *Reference Guide*. If any error is detected while verifying the operation, troubleshoot the error by referring to Chapter 11, “Troubleshooting” in the *Reference Guide*.

1. Check heartbeat resources

Verify that the status of each server is online on the WebManager.
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 WebManager.

3. Start up a group

Start a group.
Verify that the status of the group is online on the WebManager.

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 WebManager.

9. Move a group

Move a group to another server.
Verify that the status of the group is online on the WebManager.

EXPRESSCLUSTER X 4.0 for Linux Installation and Configuration Guide

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 WebManager.

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 WebManager.

12. Shut down the cluster

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

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.

Related Information:

For details on how to use commands, see Chapter 3, “EXPRESSCLUSTER command reference” in the *Reference Guide*. If any error is detected while verifying the operation, troubleshoot the error referring to Chapter 11, “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 7 **Modifying the cluster configuration data**

This chapter describes how you modify the cluster configuration data.

This chapter covers:

- Modifying the cluster configuration data 196
- Applying the cluster configuration data 199
- Online version Builder 200

Modifying the cluster configuration data

Before you reconfigure the EXPRESSCLUSTER Server or change its parameters, you must back up the cluster configuration data. Backing up can be done with the `clpcfctrl` command. For details, see Chapter 3, “EXPRESSCLUSTER command reference” in the *Reference Guide*.

Modify the cluster configuration data by using the Builder. For details of the Builder, see Chapter 2, “Functions of the Builder” in the *Reference Guide*.

The following describes procedures and precautions of modifying the cluster configuration data after creating a cluster.

Add the server

Add a server that constitutes a cluster.

1. Click **Servers** on the tree view, and click **Add** on the **Edit** menu.
2. The **Server Definition** dialog box is displayed. Click **Add**.
3. The **Add Server** dialog box is displayed. Enter the server name to the **Server Name or IP Address**, and click **OK**.

Note:

Enter the actual host name of the server. Make sure to type it correctly because the information you enter here is case sensitive.

4. Click **Next**.
5. Configure the interconnect. After configuring, click **Next**.
6. Configure NP resolution. After configuring, click **Finish**.

Add a group

Add a group by which a failover is performed.

1. Click **Groups** in the tree view, and click **Add Group** on the **Edit** menu.
2. The **Group Definition** dialog box is displayed. Select the checkbox when you use **Sever Group Settings**. Enter the group name (`failover1`) in the **Name** box, and click **Next**.
3. **Servers that can run the Group** is displayed. Configure the settings, and then click **Next**.
4. The **Group Attribute Settings** is displayed. Configure the group and click **Next**.
5. The **Group Resource** is displayed. Configure the group and click **Finish**.

Add a group resource

Add a group resource. In this example, a floating IP resource is added.

1. Click the group to which a resource to be added belongs in the tree view. Click **Add Resource** on the **Edit** menu.
2. In the **Resource Definition** 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. A page for setting up a dependency is displayed. Configure the settings, and 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 in the **IP Address** box, and then click **Finish**.

Add a monitor resource

Add monitor resources that monitor IP. In this example, an ip monitor resource is added.

1. Click **Monitors** in the tree view, and click **Add Monitor Resource** on the **Edit** menu.
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. The monitor settings is displayed. Configure the monitor resource and click **Next**.
4. Click **Add**. Enter the IP address to be monitored in the **IP Address** box, and click **OK**.
5. The entered IP address is specified in the **IP Addresses**. Click **Next**.
6. Specify the recovery action. Configure the settings, and click **Finish**.



Modifying the cluster configuration data by using the Builder (online version)

1. Start the WebManager.

Note:

In Java Runtime Environment Version 9.0 or later, WebManager can be launched by using Java Web Start.

Example: `http://10.0.0.11:29003/main.jnlp`.

2. Start the Builder by clicking **Config Mode** from **View** menu of the WebManager or select the **Config Mode** icon  from the drop down menu of the tool bar.
3. Modify the configuration data after the current cluster configuration data is displayed
4. Upload the modified configuration data from **Apply the Configuration File** on **File** menu or click the icon  on the tool bar. 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.

Modifying the cluster configuration data by using the Builder (offline version)

1. Start the Builder.

`<installation path>/clptrek.htm`

Note:

In Java Runtime Environment Version 9.0 or later, WebManager can be launched by using Java Web Start.

Example: `(installation path)/main.jnlp`.

2. Open the saved cluster configuration data.
3. When the cluster configuration data is displayed, modify it.
4. Save the modified configuration data.

5. Upload the configuration data from the server where EXPRESSCLUSTER is saved by using the command prompt.

```
clpcfctrl --push -w -x <path to the directory where configuration data  
is saved>
```

Depending on the data modified, it may become necessary to suspend or stop the cluster, 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.

Applying the 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 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 WebManager | |
| 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. |
| 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 WebManager alert view shows “Module type: pm, Event type: information, Event ID: 2”. For more information on messages, see Chapter 12, “Error Messages” in the *Reference Guide*.

When the WebManager 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.

Online version Builder

Uploading data only

1. Start the Builder, and change the cluster configuration data.
2. Upload the cluster configuration data with the Builder from **Apply the Configuration File** on **File** menu.
3. The following message is displayed if the data has successfully been distributed.
`The application finished successfully.`

Uploading data and restarting the WebManager

For details on how to restart the WebManager, see Chapter 1 “Functions of the WebManager” in the *Reference Guide*.

1. Start the Builder, and change the cluster configuration data.
2. Upload the cluster configuration data with the Builder from **Apply the Configuration File** on **File** menu.
3. The following message is displayed if the data has successfully been distributed.
`Changes applied successfully.`
`Restart the WebManager.`
4. Restart the WebManager.

Uploading data after suspending a cluster

The following explains how to suspend a cluster such as when changing a configuration (adding or deleting a server).

1. Start the Builder, and change the cluster configuration data.
2. On the **Service** menu of the WebManager, click **Suspend Cluster**.
3. Upload the cluster configuration data with the Builder from **Apply the Configuration File** on **File** menu.
4. The following message is displayed if the data has been successfully distributed.
`Changes applied successfully.`
5. On the **Service** menu of the WebManager, click **Resume Cluster**.

Uploading data after stopping a cluster

1. Start the Builder, and change the cluster configuration data.
2. On the **Service** menu of the WebManager, click **Stop Cluster**.
3. Upload the cluster configuration data with the Builder from **Apply the Configuration File** on **File** menu.
4. The following message is displayed if the data has successfully been distributed.
`Changes applied successfully.`
5. On the **Service** menu of the WebManager, click **Start Cluster**.

Shutting down and restarting a cluster after uploading data

1. Start the Builder, and change the cluster configuration data.
2. On the **Service** menu of the WebManager, click **Stop Cluster**.
3. Upload the cluster configuration data with the Builder from **Apply the Configuration File** on **File** menu.
4. The following message is displayed if the data has successfully been distributed.
`Changes applied successfully.
Restart all the servers.`
5. Restart all servers.

Uploading data after stopping mirror agents

1. Start the Builder, and change the cluster configuration data.
2. On the **Service** menu of the WebManager, click **Stop Cluster**.
3. On the **Service** menu of the WebManager, click **Stop Mirror Agent**.
4. Upload the cluster configuration data with the Builder from **Apply the Configuration File** on **File** menu.
5. The following message is displayed if the data has successfully been distributed.
`Changes applied successfully.`
6. On the **Service** menu of the WebManager, click **Start Mirror Agent**.
7. On the **Service** menu of the WebManager, click **Start Cluster**.

Section III Evaluation before operating a cluster system

This section provides information on the evaluation that must be done before starting the operation of EXPRESSCLUSTER. After you have verified the constructed system, check what you need to do before you start operating a cluster system. This section also provides instructions for uninstallation and reinstallation.

- Chapter 8 Verifying operation
- Chapter 9 Preparing to operate a cluster system
- Chapter 10 Uninstalling and reinstalling EXPRESSCLUSTER

Chapter 8 Verifying operation

This chapter provides information on how to run dummy-failure tests to see the behaviors of your cluster system and how to adjust parameters.

This chapter covers:

- Operation tests 206
- Backup procedures 210
- Restoration procedures 212

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 /WebManager or with the `clpmonctrl` command. For details, see Chapter 1, "Functions of the WebManager" or Chapter 3, "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.

Related Information:

For information on how to change each parameter, refer to the *Reference Guide*.

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 | Communication between servers continues using a public LAN Operation continues |
| | | The 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. |
| | | An error is detected in a NIC Link Up/Down monitor resource Failover to the standby server occurs. |
| | | |
| Public LAN | Unplug the LAN cable or power off the HUB | Communication stops, application stalls or an error occurs. =These do not result in failover. |
| | | 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 |

| Device/Resource | Dummy-failure | What happens |
|----------------------|---|---|
| LAN for UPS | Unplug the LAN cable | UPS becomes uncontrollable. Operation continues |
| COM | Unplug the RS-232C cable of the COM heartbeat | COM heartbeat resource becomes offline. A warning is issued to the alert log. Operation continues. |
| 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 | When Disk Type is not raw Start up the group after mounting the disk (Example) # mount /dev/sda2 /mnt/sda2 | A disk resource does not get activated. |
| | When Disk Type is raw Specify the already-used device (the one that is used for the cluster partition) to make it redundant. | The disk resource is not 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 | Start up the group after mounting the disk | A mirror disk resource/hybrid disk resource does not get activated. |
| Hybrid disk resource | (Example) # mount /dev/sda2 /mnt/sda2 | |
| NAS resource | Start up the group after mounting the disk (Example) # mount -t nfs <server-name>:/<share-name> /mnt/nas1 | A NAS resource does not get activated. |
| PID monitor resource | Terminate resident process of monitored exec resource (Example) # kill <process-ID> | Failover to a standby server occurs. |

| Device/Resource | Dummy-failure | What happens |
|---------------------------------|---|--|
| 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. |
| | When Volume Manager is vxvm Stop the VxVM daemon. | An error is detected in the monitor resource. |
| VM resource | Disconnect the shared disk containing the virtual machine image. | The VM resource is not activated. |
| | Start the virtual machine while the VM resource is stopped. | The VM resource is activated. |
| VM monitor resource | Shut down the virtual machine. | The virtual machine is started by restarting the 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 <code>nsupdate</code> 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. |

Related Information:

For information on how to change each parameter, refer to the *Reference Guide*.

Backup procedures

This section explains how to back up and restore the file system. Before you start using your cluster system, make sure to simulate a backup operation. To back up the file system, follow the procedures below.

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 Chapter 3, "EXPRESSCLUSTER command reference" in the *Reference Guide*.

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
```

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” in Chapter 11, “Trouble shooting” in the *Reference Guide*.

Restoration procedures

You also need to simulate restoration operation before starting to use your cluster system. To restore the file system, follow the procedures below.

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.

For an init.d environment:

```
chkconfig --del name
```

For Ubuntu, run `update-rc.d -f name remove`.

For a systemd environment:

```
systemctl disable name
```

For *name*, specify services in the following order:

- clusterpro_alertsync
- clusterpro_webmgr
- clusterpro
- clusterpro_md
- clusterpro_trn
- clusterpro_evt

3. Execute cluster shutdown by using Cluster WebUI / WebManager 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:

EXPRESSCLUSTER X 4.0 for Linux Installation and Configuration Guide

Do not specify options other than the one stated above.

For troubleshooting a problem that occurs when you uninstall the EXPRESSCLUSTER Server, see “Uninstalling the EXPRESSCLUSTER Server” in “Uninstallation”.

7. Install the EXPRESSCLUSTER Server.

For details, see “Setting up the EXPRESSCLUSTER Server” in Chapter 4 of 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 -l -x <path to the directory where
configuration data is saved>
```

```
Command succeeded. (code:0)
```

Verify if the command is successfully displayed and completed.

Related Information:

For details on the cluster creation command, see Chapter 3, “EXPRESSCLUSTER command reference” in the *Reference Guide*.

10. Unmount the external media and then restart the server.

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 “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
```

Related- Information:

For details on the command for adjusting time-out temporarily, see Chapter 3, “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.¹
For example, when the disk resource partition device is `/dev/sdb5`:

```
# clproset -w -d /dev/sdb5
```
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.¹ Do not specify ReadOnly for the device used by a volume manager resource.
For example, when the disk resource partition device is `/dev/sdb5`:

```
# clproset -o -d /dev/sdb5
```
6. Start the EXPRESSCLUSTER daemon.

```
# clpcl -s -a
```

Related Information:

For details on the command for operating a cluster, see Chapter 3, “EXPRESSCLUSTER command reference” in the *Reference Guide*.

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
```

Related Information:

¹ This is necessary only if Disk is specified for Disk Type for the disk resource.

For details on the command for adjusting time-out temporarily, see Chapter 3, “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 9 Preparing to operate a cluster system

This chapter describes what you have to do before you start operating a cluster system, such as how you perform operation simulation, backup, data restoration and log collection.

This chapter covers:

- Operating the cluster system 218
- Suspending EXPRESSCLUSTER 221

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 / WebManager or EXPRESSCLUSTER commands. For details of functions of Cluster WebUI, see the online manual.

The following describes procedures to start up and shut down a cluster and to shut down a server.

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 1:

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 Builder. Note that failover occurs if startup of any server fails to be confirmed within the specified time duration.

Note 2:

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.

Shutting down a cluster and server

To shut down a cluster or server, use EXPRESSCLUSTER commands or shut down through the Cluster WebUI / WebManager.

Note:

When you are using the Replicator, mirror break may occur if you do not use any EXPRESSCLUSTER commands or Cluster WebUI / WebManager to shut down a cluster.

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 / WebManager. By shutting down a cluster, all servers in the cluster can be stopped properly as a cluster system.

Related Information:

For more information on the `clpstdn` command and the WebManager functions, refer to the *Reference Guide*.

Shutting down a server

Shut down a server by running the `clpdown` command or executing server shutdown from the Cluster WebUI / WebManager.

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.

Related Information:

For more information on the `clpdown` command and WebManager functions, refer to the *Reference Guide*.

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 / WebManager 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 cluster status cannot be displayed or operated by Cluster WebUI / WebManager or the `clpstat` command.
- The following commands cannot be used:
 - `clpstat`
 - `clpcl` command options other than `--resume`
 - `clpdown`
 - `clpstdn`
 - `clpgrp`
 - `clptoratio`
 - `clpmonctrl` (except for the `-c` and `-v` options)
 - `clprsc`
 - `clpcpufreq`

How to suspend a cluster

You can suspend a cluster by executing the `clpcl` command or by using Cluster WebUI / WebManager.

Related Information:

For more information on the `clpcl` command and WebManager functions, refer to the *Reference Guide*.

How to resume a cluster

You can resume a cluster by executing the `clpcl` command or by using Cluster WebUI / WebManager.

Related Information:

For more information on the `clpcl` command and WebManager functions, refer to the *Reference Guide*.

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.

Stopping the EXPRESSCLUSTER daemon

To stop only the EXPRESSCLUSTER daemon without shutting down the operating system, use the `clpcl` command.

Related Information:

For more information on the `clpcl` command, see Chapter 3, "EXPRESSCLUSTER command reference" in the *Reference Guide*.

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.

For an `init.d` environment:

`chkconfig --del name`

For Ubuntu, run **`update-rc.d -f name remove`**.

For a `systemd` environment:

`systemctl disable name`

For *name*, specify services in the following order:

- `clusterpro_alertsync`
- `clusterpro_webmgr`
- `clusterpro`
- `clusterpro_md`

2. Restart the server by using the Cluster WebUI, WebManager, or the `clpstdn` command.

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.

For an `init.d` environment:

`chkconfig --add name`

For a `systemd` environment:

`systemctl enable name`

For *name*, specify services in the following order:

- `clusterpro_md`
- `clusterpro`
- `clusterpro_webmgr`

- `clusterpro_alertsync`

For an `init.d` environment on Ubuntu, run the following command.

```
# update-rc.d clusterpro_md defaults 85 6
# update-rc.d clusterpro defaults 90 5
# update-rc.d clusterpro_webmgr defaults 91 4
# update-rc.d clusterpro_alertsync defaults 92 3
```

- 2.** Restart the server.

Chapter 10 Uninstalling and reinstalling EXPRESSCLUSTER

This chapter provides instructions for uninstalling and reinstalling EXPRESSCLUSTER.
This chapter covers:

- Uninstallation 224
- Reinstallation 227

Uninstallation

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 Chapter 3, “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 “Canceling the SNMP linkage function settings”.
 2. Run the following command to disable the following services.
For an `init.d` environment:
chkconfig --del *name*
For Ubuntu, run **update-rc.d -f *name* remove**.
For a `systemd` environment:
systemctl disable *name*
For *name*, specify services in the following order:
 - `clusterpro_alertsync`
 - `clusterpro_webmgr`
 - `clusterpro`
 - `clusterpro_md`
 - `clusterpro_trn`
 - `clusterpro_evt`
 3. Restart the server by using the Cluster WebUI, WebManager, or the `clpdown` command.
 4. Run the **rpm -e expresscls** command.
For Ubuntu, run **dpkg -r expresscls**.
-

Note:

Do not specify other options than the one stated above.

Uninstalling the Builder (Offline version)

For Linux

Note:

You must log on as root user when uninstalling the Builder.

Follow the procedures below to uninstall the Builder:

1. Close all Web browsers.
 2. Run the **`rpm -e expressclsbuilder`** command.
-

Note:

Do not specify other options than the one stated above.

For Windows

To uninstall the Builder, follow the procedures below:

1. Exit from all Web browsers (confirm that the JavaVM icon is no longer in the task tray).
2. Delete the Builder installation folder from Windows Explorer.

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 1:

To cancel the SNMP linkage function settings, you must log in as the root user.

Note 2:

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/libclpmgmtmib.so
dlmod clusterManagementMIB /opt/nec/clusterpro/lib/libclpmgmtmib2.so
```

Note 1:

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

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

Note 2:

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 "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
```

Reinstallation

Reinstalling the EXPRESSCLUSTER Server

To reinstall the EXPRESSCLUSTER Server, you have to prepare the cluster configuration data created by the Builder.

If you do not have the cluster configuration data created by the Builder at hand, you can back up the data with the `clpcfctrl` command. For details, see Chapter 3, “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 “Uninstalling the EXPRESSCLUSTER Server” in “Uninstallation”.
2. Install the EXPRESSCLUSTER Server and recreate the cluster.
For details, see “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 “Uninstalling the EXPRESSCLUSTER Server” in “Uninstallation”.
2. Install the EXPRESSCLUSTER Server RPM.
For details, refer to “Installing the EXPRESSCLUSTER RPM.”

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)

Note:

For troubleshooting problems that occur while you are running the `clpcfctrl` command, see Chapter 3, “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 Chapter 3 “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 “Registering the node license.”

6. Restart the server on which you reinstalled the EXPRESSCLUSTER Server.

Appendix A. Troubleshooting

Errors messages when installing the EXPRESSCLUSTER X Builder

| | Error message | Cause | Action |
|---|--|--------------------------------------|---|
| 1 | 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. |
| 2 | error: package expressclsbuilder-* is already installed | The Builder is already installed. | Uninstall the Builder and reinstall it. |

Error messages when uninstalling the EXPRESSCLUSTER X Builder

| | Error messages | Cause | Action |
|---|--|--------------------------------------|---|
| 1 | 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. |
| 2 | error: Cluster Builder is running | The Builder is active. | Exit from the Web browser. Uninstall it again after waiting for a while. |

Error messages when installing the EXPRESSCLUSTER Server

| | Error message | Cause | Action |
|---|--|--|---|
| 1 | 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. |
| 2 | error: package expresscls-* is already installed | The EXPRESSCLUSTER is already installed. | Uninstall the Builder and reinstall it. |
| 3 | 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. |
| 4 | 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. |
| 5 | 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. |

Error messages when uninstalling the EXPRESSCLUSTER Server

| | Error messages | Cause | Action |
|---|--|--------------------------------------|---|
| 1 | 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. |
| 2 | error: EXPRESSCLUSTER is running | The EXPRESSCLUSTER is active. | Disable Auto Startup of services, restart the server, and uninstall the EXPRESSCLUSTER again. |

Troubleshooting for licensing

| Behavior and Message | Cause | Action |
|---|---|--|
| <p>When the command was executed, the following message appeared in the console:</p> <pre>Log in as root.</pre> | The command was executed by a general user. | Log on as root user or log on again after changing to root user with <code>su -</code> . |
| <p>When the command was executed at the license registration, the following message appeared in the console:</p> <pre>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.</pre> | 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. |
| <p>When the cluster was shut down and rebooted after distribution of the configuration data created by the Builder to all servers, the following message was displayed on the alert log, and the cluster stopped.</p> <pre>The license is not registered. (Product name:%1) %1: Product name</pre> | The cluster has been shut down and rebooted without its license being registered. | Register the license according to Chapter4, "Registering the license". |
| <p>When the cluster was shut down and rebooted after distribution of the configuration data created by the Builder to all servers, the following message appeared on the alert log, but the cluster is working properly.</p> <pre>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</pre> | The number of licenses is insufficient. | Obtain a license and register it. |
| <p>While the cluster was operated on the trial license, the following message appeared and the cluster stopped.</p> <pre>The trial license has expired in %1. (Product name:%2) %1: Trial end date %2: Product name</pre> | The license has already expired. | Ask your sales agent for extension of the trial version license, or obtain and register the product version license. |
| <p>While the cluster was operated on the fixed term license, the following message appeared.</p> <pre>The fixed term license has expired in %1. (Product name:%2) %1: Fixed term end date %2: Product name</pre> | The license has already expired. | Obtain the license for the product version from the vendor, and then register the license. |

Appendix B. 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 / WebManager 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 Builder |
| 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. |

Appendix C. Index

A

- Activating a cluster, 218
- Add a cluster, 113, 135, 155, 173
- Add a failover group, 118, 159, 178
- Add a group, 196
- Add a group resource, 119, 120, 140, 160, 161, 162, 163, 179
- Add a group resource (floating IP address), 196
- Add a monitor resource, 197
- Add a monitor resource (disk monitor resource), 164, 181
- Add a monitor resource (IP monitor), 165, 182
- Add a monitor resources, 181
- Add a server, 114, 135, 155, 173
- Add the server, 196
- Adjustment of the operating system startup time, 44
- applications to be duplicated, 56
- Applying the cluster configuration data, 199

B

- Backing up, 210, 211
- Backup procedures, 210
- Browser, 102
- Browsers supported by the Cluster WebUI, 99

C

- Canceling the SNMP linkage function settings, 226
- Checking system requirements for each EXPRESSCLUSTER module, 30
- Checking the values to be configured, 97, 104, 148, 167
- cluster topology, 53
- Cluster WebUI, 99
- Configuration of VERITAS Volume Manager, 125
- Configuring a cluster system, 52
- Create a failover group, 118, 139, 159, 178
- Create a server group, 174
- Creating a cluster, 113, 135, 155, 173, 187
- Creating configuration information, 133
- Creating monitor resources, 122, 144, 164
- Creating the cluster configuration data, 98, 112, 153
- Creating the configuration data, 171

D

- data mirror type, 21
- disabled, 221
- Disabling, 221
- Disabling recovery action caused by monitor resource error, 124, 147, 166, 183

E

- EXPRESSCLUSTER daemon, 221

F

- failover, 54, 55
- Failover in multi-directional standby cluster, 55

- Failover in uni-directional standby cluster, 54
- file system, 212

G

- group resources, 60

H

- hardware configuration, 31, 33
- heartbeat resources, 63
- How to create a cluster, 187
- hybrid type, 21

I

- installation, 72, 73, 74
- Installing the Builder (Offline version), 74
- Installing the EXPRESSCLUSTER deb package, 73
- Installing the EXPRESSCLUSTER RPM, 72

M

- Modify cluster properties, 184
- Modifying the cluster configuration data, 196, 197
- modules, 20
- monitor resources, 61

N

- network partition resolution resources, 64
- Notes on server applications, 56
- Notes on the fixed term license, 80, 93

O

- Online version Builder, 200
- Operating the cluster system, 218
- Operation tests, 206

P

- Partition settings for hybrid disk resource, 37, 40, 187
- Partition settings for mirror disk resource, 40, 42
- Planning a cluster configuration, 59

R

- Registering the CPU license, 79, 80
- Registering the fixed term license, 93
- Registering the fixed term license by specifying the license file, 95
- Registering the license, 80
- Registering the license by specifying the license file, 80, 81
- Registering the license interactively from the command line, 80, 82
- Registering the node license, 88
- Registering the node license by specifying the license file, 88, 89

- Registering the node license interactively from the command line, 88, 91
- Registering the VM node license, 84
- Reinstallation, 227
- Reinstalling the EXPRESSCLUSTER Server, 227
- Restart, 201
- Restoration procedures, 212
- Restoring the data on the mirror disk or the hybrid disk, 214
- Restoring the data on the shared disk, 213
- Resuming a cluster, 219

S

- Sample cluster environment, 104, 127, 167
- Saving the cluster configuration data, 185
- Server clock synchronization, 50
- Set up the network configuration, 115, 136, 156, 175
- Set up the network partition resolution, 116, 137, 157, 176
- Setting Up Java runtime environment, 102
- Setting up the EXPRESSCLUSTER Server, 71
- Setting up the SNMP linkage function, 76
- Settings after configuring hardware, 34
- Shared disk settings for disk resource, 35, 37
- Shared disk settings for hybrid disk resource, 35, 37, 40, 42
- Shared disk type, 21
- Shutting down a cluster, 218
- Shutting down a server, 218
- Shutting down and restarting a cluster after uploading data, 201
- Shutting down the entire cluster, 218
- Starting the Builder, 75
- Starting the Cluster WebUI, 100
- Starting the WebManager, 102
- Starting up the Cluster WebUI, 99
- Starting up the WebManager, 101

- Steps from Installing EXPRESSCLUSTER to creating a cluster, 70
- Supported browsers, 102
- Suspending, 217, 221
- Suspending a cluster, 219
- system configuration, 21

T

- Troubleshooting, 229

U

- Uninstallation, 224
- Uninstalling the Builder, 225
- Uninstalling the EXPRESSCLUSTER Server, 224
- Uploading data after stopping a cluster, 200
- Uploading data after stopping mirror agents, 201
- Uploading data after suspending a cluster, 200
- Uploading data and restarting the WebManager, 200
- Uploading data only, 200

V

- Verification of the firewall settings, 47
- Verification of the network settings, 46
- Verification of the root file system, 46
- Verifying cluster using the WebManager, 190
- Verifying operation by using commands, 192
- Verifying system requirements for the Cluster WebUI / WebManager, 32

W

- WebManager, 101
- What is EXPRESSCLUSTER, 17, 19