ExpressCluster® X 1.0 *for Linux*

Installation and Configuration Guide

12/12/2006
Second Edition

Revision History

Edition	Revised Date	Description
First	2006/09/08	New manual
Second	2006/12/12	EXPRESSCLUSTER logo has been changed.

© Copyright NEC Corporation 2006. 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® X is a registered trademark of NEC Corporation.
FastSync™ is a trademark of NEC Corporation.
Linux is a registered trademark and trademark of Linus Torvalds in the United State and other countries.
RPM is a trademark of Red Hat, Inc.
Intel, Pentium and Xeon are registered trademarks and trademarks of Intel Corporation.
Microsoft and Windows are registered trademarks of Microsoft Corporation in the United State and other countries.
Turbolinux is a registered trademark of Turbolinux. Inc.
VERITAS, VERITAS Logo and all other VERITAS product names and slogans are trademarks and registered trademarks of VERITAS Software Corporation.
Other product names and slogans written in this manual are trademarks and registered trademarks of their respective companies.

Table of Contents

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 ExpressCluster X 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.

Chapter 3 **Creating the cluster configuration data using the Builder**
Provides instructions for how to create the cluster configuration data with the ExpressCluster X Builder.

Section II **Installing ExpressCluster**
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 4 **Installing ExpressCluster**
Provides instructions for how to install ExpressCluster.

Chapter 5 **Registering the license**
Provides instructions for how to register the license.

Chapter 6 **Starting up a cluster system**
Verify if the cluster system that you have configured operates successfully.

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 7 **Verifying operation**
Run the pseudo-failure test and adjust the parameters.

Chapter 8 **Preparing to operate a cluster system**
Provides information on what you need to consider before actually start operating ExpressCluster.

Chapter 9 **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*.

Administrator's Guide (Add-on product)
This guide is intended for system administrators. The detailed information on each product package is described in this guide. There are five guides for each optional product and topics such as product overview, instruction for setting up are covered:

Alert Service Administrator's Guide
Application Server Agent Administrator's Guide
Database Agent Administrator's Guide
File Server Agent Administrator's Guide
Internet Server Agent Administrator's Guide

Conventions

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.	`clpstat –s[-h host_name]`
#	Prompt to indicate that a Linux user has logged on as root user.	`clpcl -s -a`
Monospace (courier)	Indicates path names, commands, system output (message, prompt, etc), directory, file names, functions and parameters.	`/Linux/1.0/eng/server/`
Monospace bold (courier)	Indicates the value that a user actually enters from a command line.	Enter the following: **`clpcl -s -a`**
Monospace italic (courier)	Indicates that users should replace italicized part with values that they are actually working with.	`rpm –i expressclsbuilder -<version_number>-<release_number>.i686.rpm`

Contacting NEC

For the latest product information, visit our website below:

http://www.ace.comp.nec.co.jp/CLUSTERPRO/global-link.html

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 ExpressCluster X Builder.

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

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)

Step 1 Determining a system configuration (Chapter 1)

Step 2 Configuring a cluster system (Chapter 2)

Step 3 Creating the cluster configuration data using the Builder (Chapter 3)

Installing and configuring ExpressCluster X (Section II)

Step 4 Installing ExpressCluster (Chapter 4)

Step 5 Registering the license (Chapter 5)

Step 6 Starting up a cluster system (Chapter 6)

Evaluation before operating a cluster system (Section III)

Step 7 Verifying operation (Chapter 7)

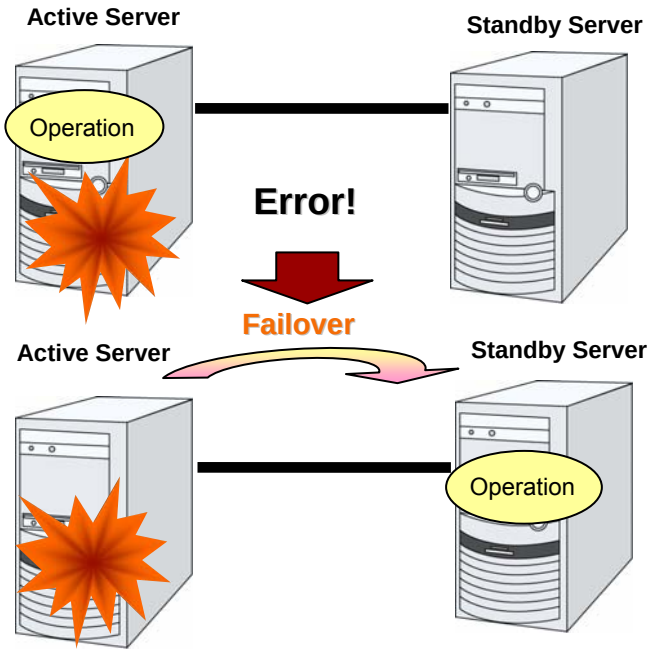
Step 8 Preparing to operate a cluster system (Chapter 8)

Step 9 Uninstalling and reinstalling ExpressCluster (Chapter 9)

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 inherited 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**

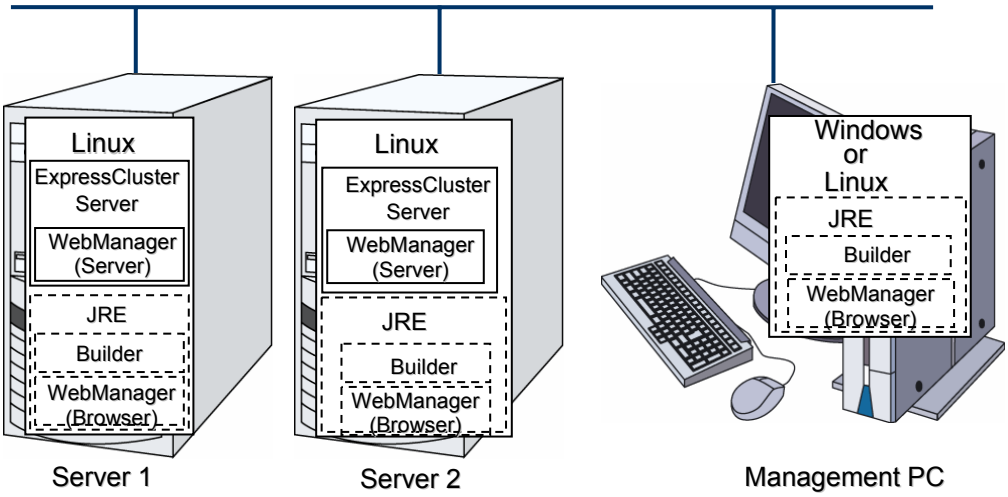
  The main module of ExpressCluster and has all high availability functions of the server. Install this module on each server constituting the cluster.

- **ExpressCluster X 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.

- **ExpressCluster X Builder**

  A tool for editing the cluster configuration data. The Builder also uses a Web browser as a user interface the same way as the WebManager. The Builder needs to be installed separately from the ExpressCluster Server on the machine where you use the Builder.



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

The Builder and the WebManager 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.

- **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.

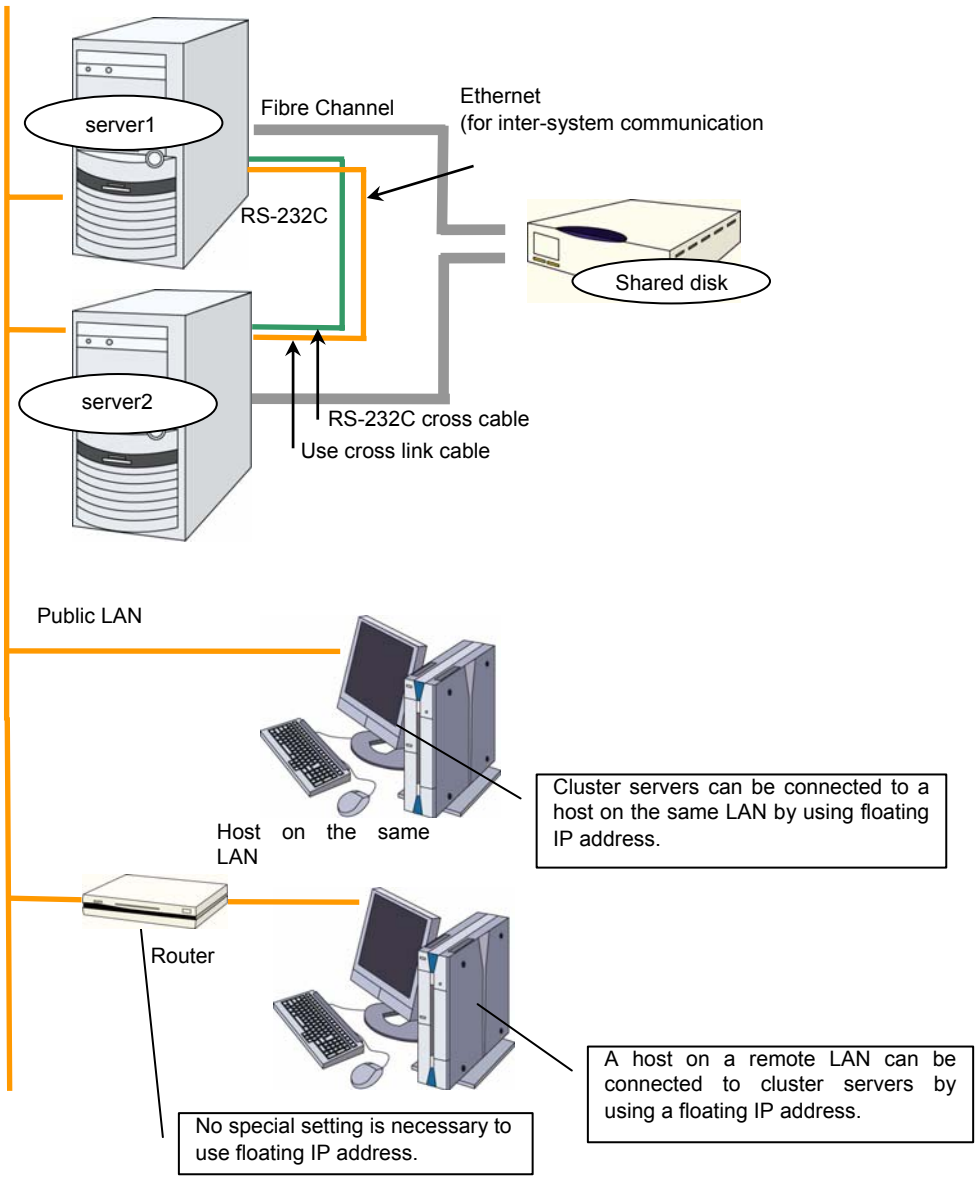
  Performance in writing decreases because data is written on the standby server. However, cost of system can be reduced since no external disk such as a shared disk is necessary, and the cluster can be achieved only by disks on servers.

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

Example 1: configuration using a shared disk with 2 nodes

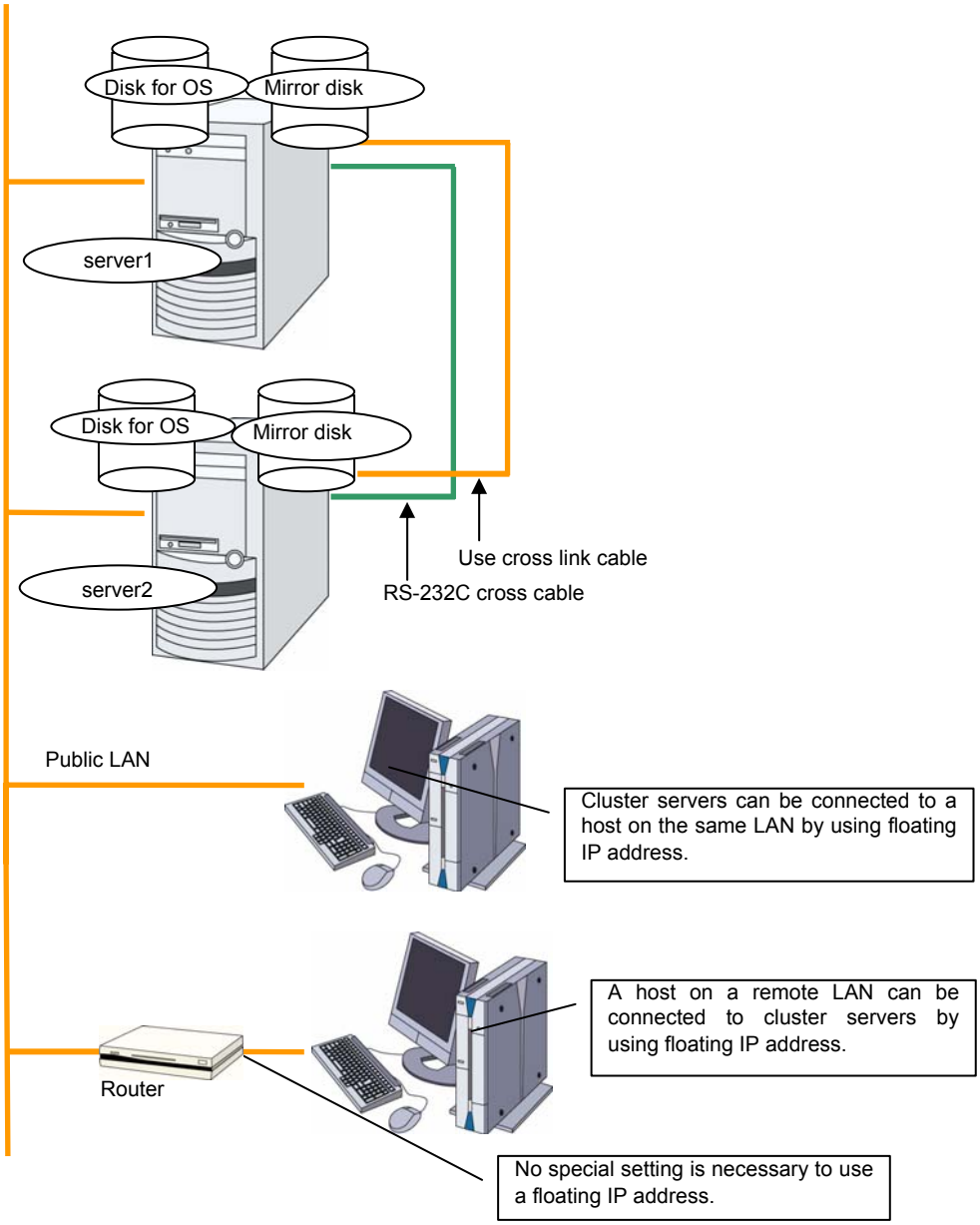
The most the most commonly used system configuration:

- Different models can be used for servers. However, mirroring disk should have the same device name in all servers.
- Servers need to be on the same LAN and have same network address.
- Use cross cables for interconnection. (A dedicated HUB can be used for connection the same way as 4-nodes configuration)
- Connect COM (RS-232C) ports using a cross cable.



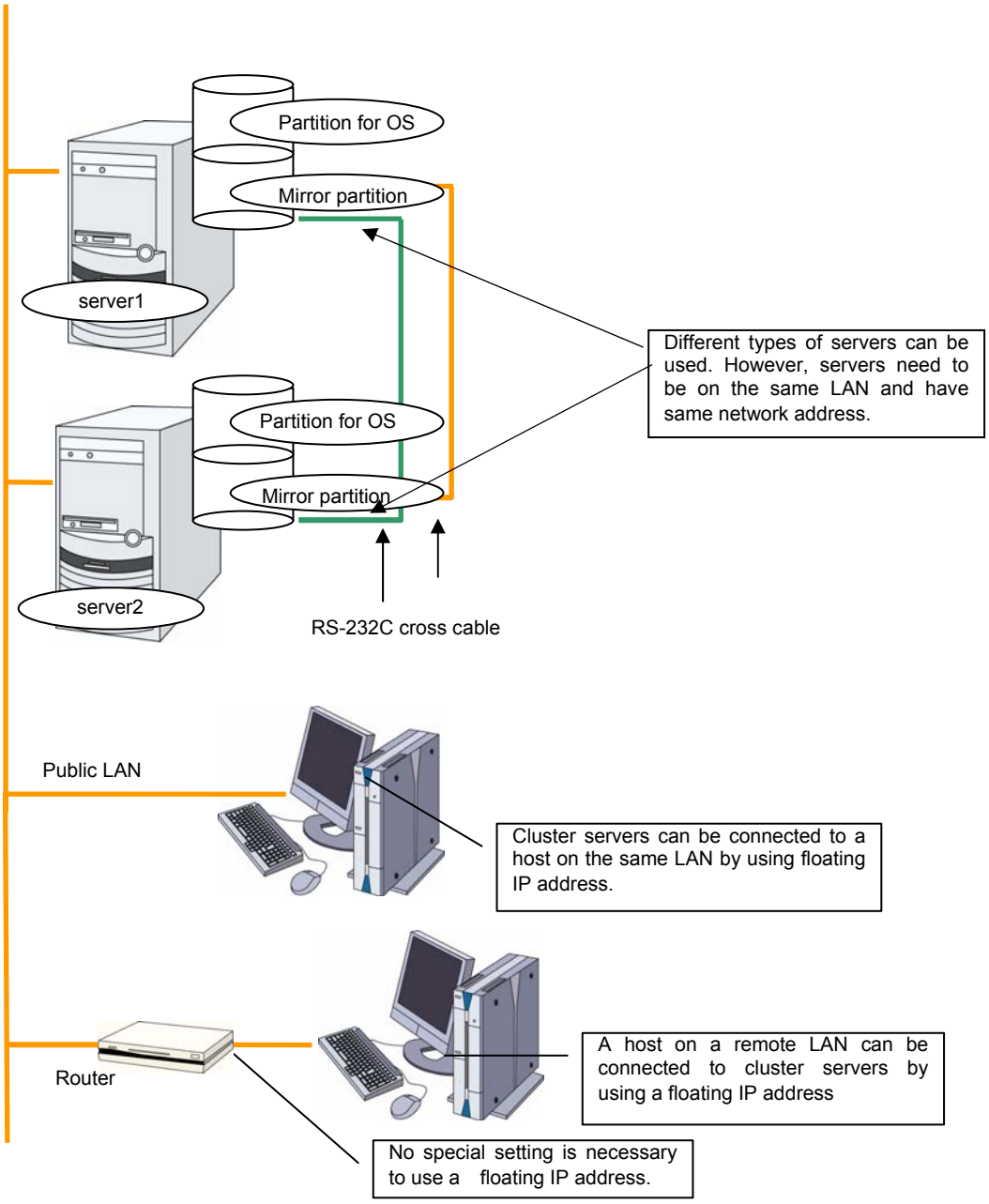
Example 2: configuration using mirror disks with 2 nodes

- Different models can be used for servers. However, the mirror disk should have the same device name in all servers.
- 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 partitions on the disks for OS with 2 nodes

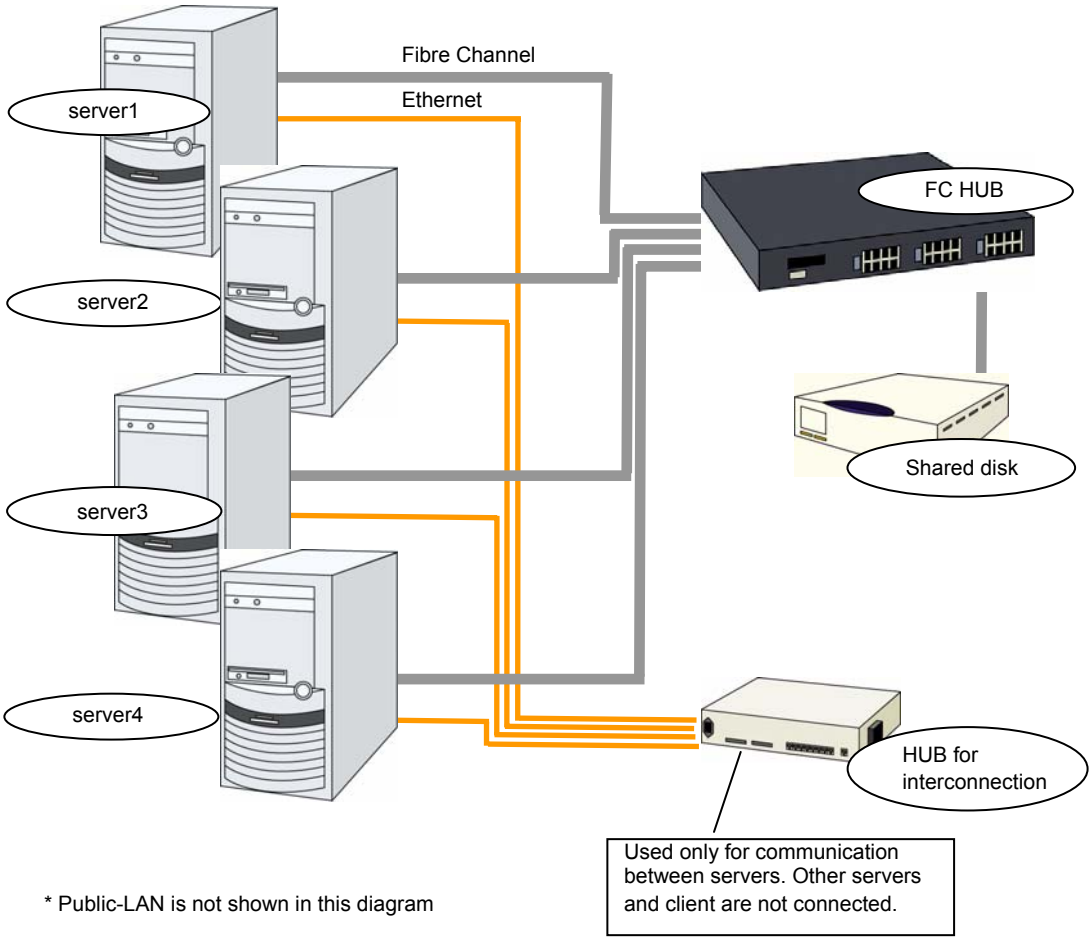
- As shown below, a mirroring partition can be created on the disk used for the OS.
- Mirror partitions and cluster partitions should have the same device names in both servers.



Related Information:
For mirror partition settings, refer to Chapter 4, "Group resource details" in the *Reference Guide*.

Example 4: configuration with 4 nodes

- As is the case for 2 nodes, connect a shared disk. The shared disk should have the same name in all servers.
- Install a dedicated HUB for interconnection.
- It is not necessary to establish connectivity between servers using the connect COM (RS-232C).



Checking system requirements for each ExpressCluster module

ExpressCluster consists of three modules: ExpressCluster Server (main module), ExpressCluster X WebManager, and ExpressCluster X Builder. Check configuration and operation requirements of each machine where these modules will be installed. The following is the basic system requirements for ExpressCluster X 1.0 for Linux:

- It is recommended to use a file system that is capable of journaling for the root file system in the operating system. File systems such as ext3, JFS, ReiserFS, XFS are available for a journaling file system supported by Linux (kernel version 2.6 or later). If a file system that is not capable of journaling is used, run an interactive command (fsck the root file system) when rebooting from server or OS stop (i.e. normal shutdown could not be done.)

Following is the system requirements for each module:

ExpressCluster Server	
Machine on which ExpressCluster Server can be installed	Server that supports one of the following operating systems.
Supported operating systems	**IA-32 version** Turbolinux 10 Server Red Hat Enterprise Linux AS/ES 4 (update3 or later) MIRACLE LINUX V 4.0 Novell SUSE LINUX Enterprise Server 9 (up to SP3) **x86-64 version** Turbolinux 10 Server Red Hat Enterprise Linux AS/ES 4 (update3 or later) MIRACLE LINUX V4.0 Novell SUSE LINUX Enterprise Server 9 (SP3 or later) **IA64 version** Red Hat Enterprise Linux AS/ES 4 (update3 or later) Asianux2.0-based distribution Novell SUSE LINUX Enterprise Server 9 (SP3 or later) **PPC64 version** Asianux2.0-based distribution Red Hat Enterprise Linux AS/ES 4 (update3 or later)

ExpressCluster X Builder	
Machine on which the Builder can be installed	PC that supports one of the following operating systems.
Supported operating systems	Linux (IA-32) Microsoft Windows® XP SP2 (IA-32) Microsoft Windows Server™ 2003 SP1 or later (IA-32)
Supported browsers	Browsers supporting Java 2: Firefox 1.0.6 or later Microsoft internet Explorer 6.0 SP1 or later
Java runtime environment	Sun Microsystems Java(TM) Runtime Environment Version 5.0 Update 6 (1.5.0_06) or later * Java runtime environment is necessary to use the Builder.

ExpressCluster X WebManager	
Machine on which the WebManager can be installed	PC that supports one of the following operating systems.
Supported operating systems	Linux (IA-32) Microsoft Windows® XP SP2 (IA-32) Microsoft Windows Server™ 2003 SP1 (IA-32, X86-64)
Supported browsers	Browsers supporting Java 2: Firefox 1.0.6 or later Microsoft Internet Explorer 6.0 SP1 or later
Java runtime environment	Sun Microsystems Java(TM) Runtime Environment Version 5.0 Update 6 (1.5.0_06) or later * Java runtime environment is necessary to use WebManager.

Related Information:
For details on supported hardware and the latest information on system requirements, refer to the *Getting Started Guide*.

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. ExpressCluster X 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, mirroring disk, or free partition space for mirroring (when mirroring disk is used)
- Floppy disk drive or USB port
- CD-ROM drive

Related Information:
For information on system requirements for supported hardware and OS, refer to the *Getting Started Guide*. Configure and connect the peripheral devices and networks as described in "Example 2: configuration using mirror disks with 2 nodes" in this chapter.

Checking system requirements for the Builder

You can use the Builder by installing it in a management PC of the cluster system that uses ExpressCluster. The operating system of the management PC is Linux or Windows. Following is the supported operating systems:

Supported operating systems

- Linux (IA-32)
- Microsoft Windows® XP SP2 (IA-32)
- Microsoft Windows Server™ 2003 SP1 or later (IA-32)

Note:
The ExpressCluster X Builder does not run on 64bit, x86-64, and PPC64 machines.
Use 32bit OS to create or change the cluster configuration data.

Supported browsers

Java 2 supported browsers:

- Firefox 1.0.6 or later
- Microsoft Internet Explorer 6.0 SP1 or later

Java runtime environment

To use the Builder, you need to have Java runtime environment.

- Sun Microsystems, Java(TM) Runtime Environment, Version 5.0 Update 6 (1.5.0_06) or later

Required memory/disk space

- Required memory size: 32MB or more
- Required disk size: 2MB (excluding space required for Java runtime environment)

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

Verifying system requirements for the WebManager

To monitor a cluster system that uses ExpressCluster, use 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.

Supported operating systems

- Linux (IA-32)
- Microsoft Windows® XP SP2 (IA-32)
- Microsoft Windows Server™ 2003 SP1 or later (IA-32, X86-64)

Note:
The ExpressCluster X WebManager does not run on 64bit, x86-64, and PPC 64 machines. Use a 32-bit OS when operating a cluster on Linux machine.

Supported browsers

Java 2 supported browsers:

- Firefox 1.0.6 or later
- Microsoft Internet Explorer 6.0 SP1 or later

Java runtime environment

To use WebManager, you should have Java runtime environment.

- Sun Microsystems, Java(TM) Runtime Environment, Version 5.0 Update 6 (1.5.0_06) or later

Required memory and disk space

- Required memory size: 40 MB or more
- Required disk size: 300KB (excluding space required for Java runtime environment)

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

Note:
To operate ExpressCluster for Windows by using the Integrated WebManager, make sure to use Windows supported OS and browser

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:

- Configuration of the shared disk settings (Required for shared disk)
- Configuration of the mirror partition settings (Required for the Replicator)
- Adjustment of the operating system startup time (Required)
- Verification of the network settings (Required)
- Verification of the root file system (Required)
- Verification of the firewall settings (Required)
- Synchronization of the server clock (Recommended)

Shared disk settings (Required for shared disk)

Set up the shared disk by following the steps below:

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 partitions for disk heartbeat resource.

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

   Note:
   Typically, only one partition is used for heartbeat resources. However, in addition to the LUN used for heartbeat, you should create another partition used for the disk heartbeat resources in each disk as a spare dummy partition. This is because heartbeat needs to be done in other LUN when the file system gets corrupted and the device name is changed by disk error or other errors. Use the same partition number for partitions for disk heartbeat in all the LUNs.
   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.
   A disk heartbeat partition should be 10MB (10*1024*1024 bites) or larger. It is not necessary to construct any file system for disk heartbeat partitions.

2. Allocate a partition for disk resources.

   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.

3. Create a file system.

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

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

- In principle, the file system used on shared disk does not depend on others. However, an error may occur depending on fsck on 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 in IA-32 and x86-64 machines:
  - ext2
  - ext3
  - xfs
  - reiserfs
  - jfs
  - vxfs
- Following is the currently supported file system in IA-64 and PPC64 machines:
  - ext3

4. Create a mount point.

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

Mirror partition settings (Required for the Replicator)

Set up partitions for mirror disk resource by following the steps below:

Note:
When you continue using the data on a shared disk (for example, when you cluster a single 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 partitions for mirror disk resource.

   Allocate a partition to be used by the mirror driver. The mirror driver uses 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 partition for mirror disk resource should be 10 MB (10*1024*1024 byte) or larger. (The size will be actually larger than 10 MB even if you specify exactly 10 MB because of the disk geometry difference. This will cause no problem.) You do not need to create a file system on this partition.

2. Initialize the mirror disks. (Required only when you continue using mirror disks that were used as ExpressCluster mirror disks)

- Initialization is required since 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, make sure to initialize it.
- Run the following command:

  dd if=/dev/zero of=[*Partition device name to be used as cluster partition*]

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

3. Allocate partitions for mirror disk resource

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

4. It is not necessary to create a file system on partition for mirror disk resources.

- When **Execute initial mkfs** is selected in creating the cluster configuration data with the Builder, ExpressCluster automatically creates a file system. If **Execute initial mkfs** is not selected, file system will not be created.
- A file system used on a shared disk does not depend on other file systems. However, an error may occur depending on fsck on 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 in IA-32 and x86-64 machines:
  - ext2
  - ext3
  - xfs
  - reiserfs
  - jfs

Note:
Do not select **Execute initial mkfs** when you continue using the data on cluster partition. The ExpressCluster controls the file systems on mirror resource. Do not enter the mirror resource or partition for mirror resource into `/etc/fstab` in the operating system.

5. Create a mount point.

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

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

1. Edit /boot/grub/menu.lst.

Specify the time-out <*Startup_time* (in seconds)> option. In the following example, change only the underlined part.

```
---(Example: Startup time: 30 seconds)---
default 0
timeout 30

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

title floppy
   root (fd0)
   chainloader +1
```

When LILO is used for the operating system loader

1. 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: 30 seconds)---
boot=/dev/sda
map=/boot/map
install=/boot/boot.b
prompt
linear
timeout=300
image=/boot/vmlinuz
           label=linux
           root=/dev/sda1
           initrd=/boot/initrd.img
           read-only

---(Example 2: Not output prompt. Startup time: 30 seconds)---
boot=/dev/sda
map=/boot/map
install=/boot/boot.b
#prompt
linear
delay=300
image=/boot/vmlinuz
           label=linux
           root=/dev/sda1
           initrd=/boot/initrd.img
           read-only
```

2. 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.

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 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, JFS, ReiserFS, XFS are available for a journaling file system supported by Linux (version 2.6 or later).

Caution:
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. The following is the list of port numbers used by default in ExpressCluster:

Server to 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	29005/TCP	Communication between mirror drivers
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	icmp	keepalive between mirror drivers

WebManager to Server					
From			**To**		**Used for**
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

[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 resource basis and is set when creating mirror disk resource. A port number 29051 is set by default. When you ad a mirror resource this value is automatically incremented by 1. To change the value, click **Detail** tab of **Mirror Disk Resource Properties** in the Builder. For more information, refer to Chapter 4, "Group resource details" in *Reference Guide*.

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.

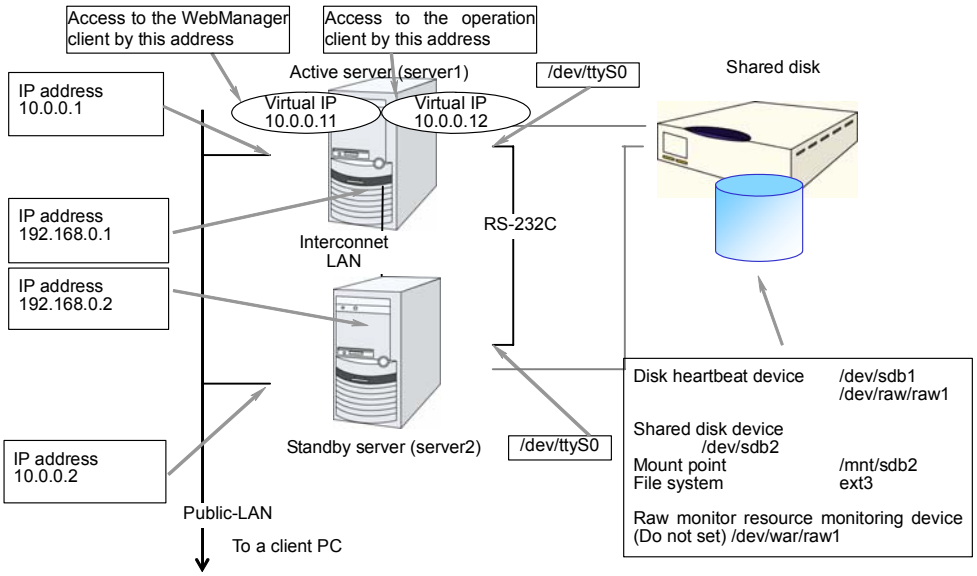
This chapter covers:

Configuring a cluster system

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

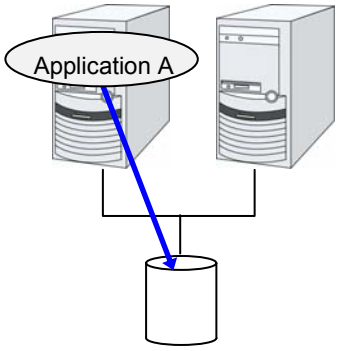
In this guide, explanations are given using a 2-node and uni-directional standby cluster environment as an example.



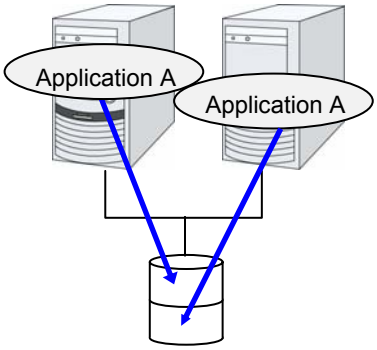
Determining a cluster topology

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.

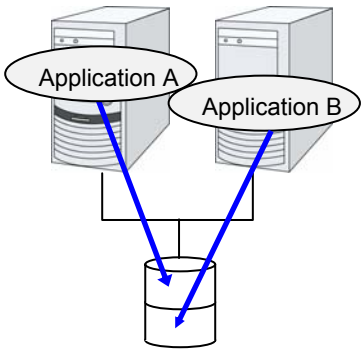
- **Uni-directional standby cluster system**
  In this operation, only one application runs on an entire cluster system. There is no performance deterioration even when a failover occurs. However, resources in a standby server will be wasted.



- **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.

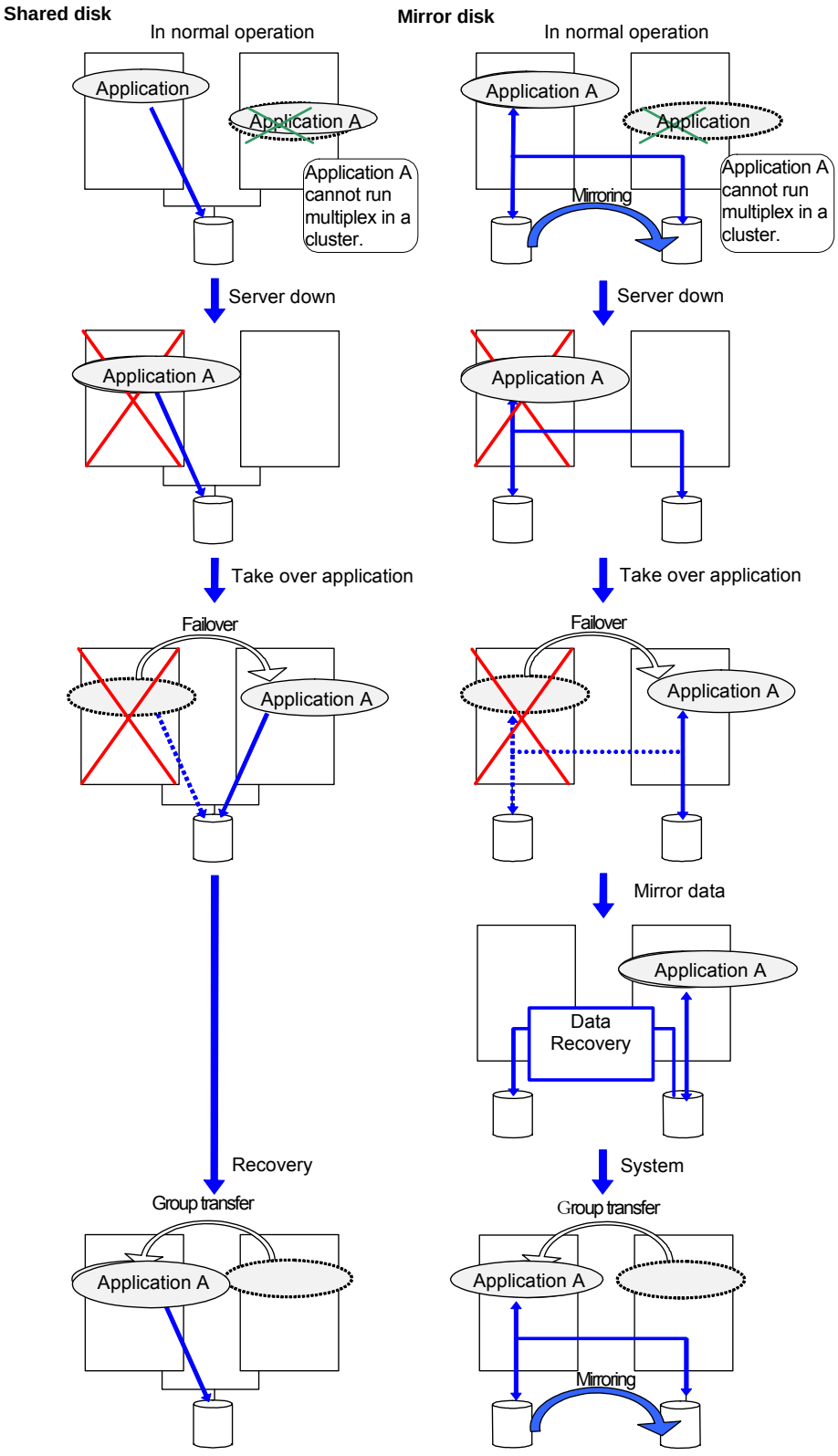


- **Different applications multi-directional standby cluster system**
  In this operation, different applications run on different servers and standby each other. Resources will not be wasted during normal operation; however, two applications run on one server after failing over and system performance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



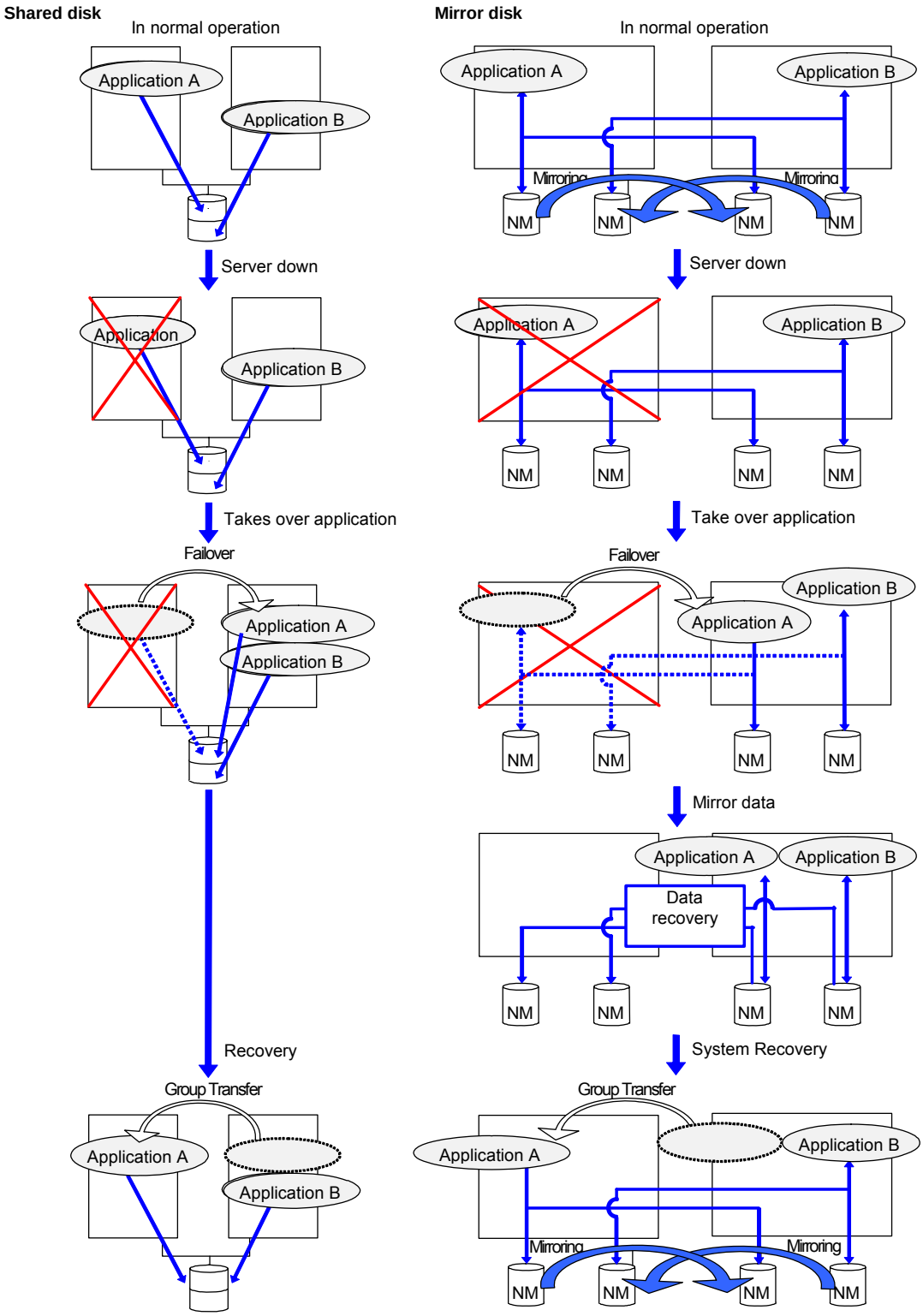
Failover in uni-directional standby cluster

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 pointes 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 is 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 severs:

- 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. .

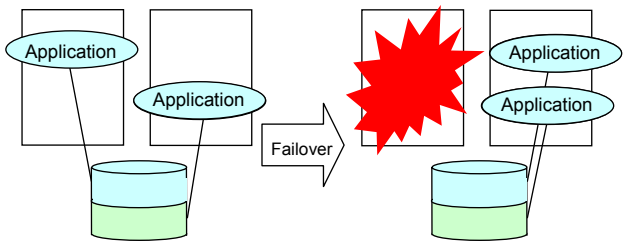
Data type	Example	Where to store
Data to be shared among servers	User data, etc.	On shared disk or mirror disks
Data specific to a server	Programs, configuration data	On server's local disks

Note 4: Multiple application service groups

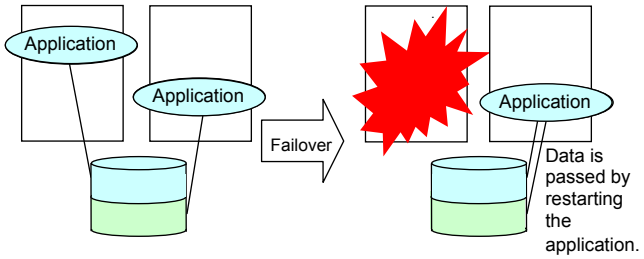
For multi-directional standby operation, you have to assume (in case of degeneration due to a failure) that multiple application groups are run by the same application on a server.

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:

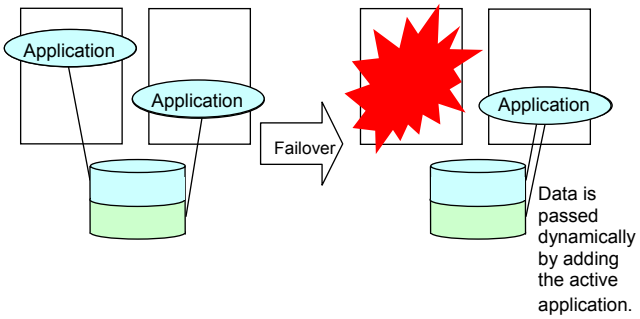
- **Starting up multiple instances**
  This method invokes a new process. More than one application should co-exist and run.



- **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 shared disks are not writable.
  Inactive mirror disks are neither readable nor writable.
  Applications should not make access to an inactive shared disk or mirror disk (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 switchable partition or mirror partition 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 switchable partition or mirror partition 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 shared disk or mirror disk for a certain period of time even after it is stopped.	Execute the sleep command during stop script execution.	Note 2: Application termination
The same application cannot be started more than once on one server.	In multi-directional operation, reboot the application at failover and pass the shared data.	Note 3: Location to store the data

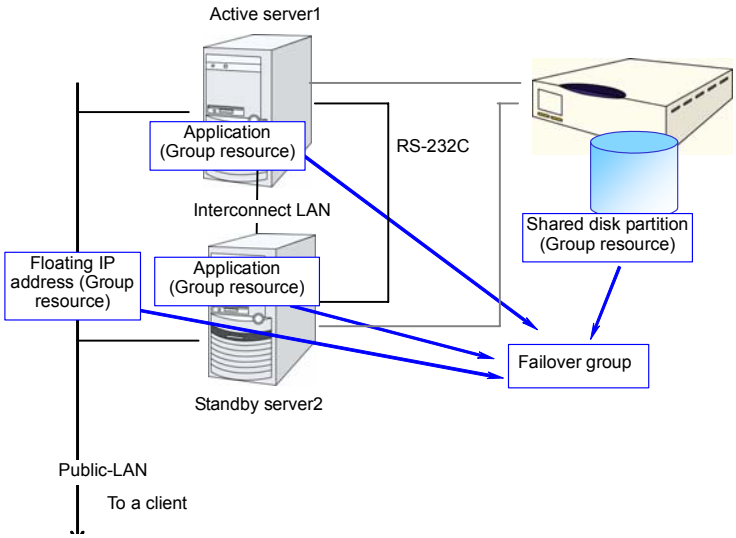
How to determine a cluster topology

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 shared disks or mirror disks

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. 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
Mirror disk resource	md
Raw resource	raw
VxVM disk group resource	vxdg
VxVM volume resource	vxvol
NAS resource	nas

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 times when monitor resources monitor: always monitor and monitor when active.

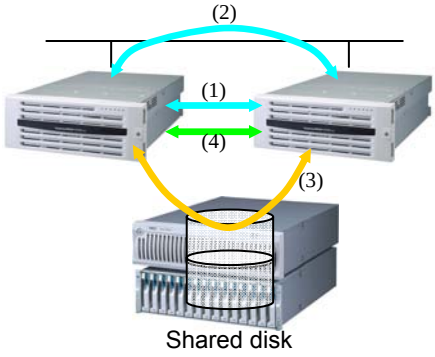
Following is the currently supported monitor resource:

Monitor Resource Name	Abbreviation
Disk monitor resource	diskw
Raw monitor resource	raww
IP monitor resource	ipw
NIC Link Up/Down monitor resource	miiw
Mirror disk connect monitor resource	mdnw
Mirror disk monitor resource	mdw
PID monitor resource	pidw
User space monitor resource	userw
VxVM daemon monitor resource	vxdw
VxVM volume monitor resource	vxvolw
Multi-target Monitoring Resource	mtw

- Always monitor (From cluster startup to cluster stop)
  - Disk monitor resources
  - IP monitor resources
  - User space monitor resources
  - Mirror disk monitor resources
  - Mirror disk connect monitor resources
  - Raw monitor resources
  - VxVM daemon monitor resources
  - NIC Link Up/Down monitor resources
  - Multi-target monitor resources
- Monitor when active (From group activation to group deactivation)
  - PID monitor resources
  - VxVM volume monitor resources

Understanding heartbeat resources

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



(1) LAN heartbeat resource dedicated to interconnect

(1) LAN heartbeat resource dedicated to interconnect (kernel mode)

(2) Public LAN heartbeat

(2) Public LAN heartbeat (kernel mode)

(3) Disk heartbeat

(4) COM heartbeat

Heartbeat Resource Name	Abbreviation	Functional Overview
LAN heartbeat resource (1)(2)	lanhb	Uses a LAN to monitor if servers are active. Used for communication within the cluster as well.
Kernel mode LAN heartbeat resource (1)(2)	lankhb	A kernel mode module uses a LAN to monitor if servers are active. Used for communication within the cluster as well.
Disk heartbeat resource (3)	diskhb	Uses a dedicated partition in the shared disk to monitor if servers are active.
COM heartbeat resource (4)	comhb	Uses a COM cable to connect two servers to monitor if servers are active.

- At least one LAN heartbeat resource needs to be set. Setting up more than two LAN heartbeat resources is recommended. It is also recommended to set both LAN heartbeat resource and kernel mode LAN heartbeat resource.
- 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

Chapter 3 Creating the cluster configuration data using the Builder

In ExpressCluster, data that contains information on how a cluster system is configured is called “cluster configuration data” and it is created with the ExpressCluster Builder. This chapter provides the procedures to create the cluster configuration data using the Builder with a sample cluster configuration.

This chapter covers:

Installing the ExpressCluster X Builder

Before installation

The ExpressCluster X Builder is a tool to create and change the cluster configuration data. You can use it on servers constituting the cluster or on a management PC. To create or change a cluster according to the data being created and changed by the Builder on the management PC, save the cluster configuration data on a removable media such as a floppy disk and run a command to generate clusters on a server in the cluster. If the server does not support any removable media, you can copy the created data by NFS or ftp to a server that constitutes the cluster and run the command on the server. This means you can use the Builder on a PC that cannot communicate with a server in the cluster. The operating system of the management PC can be Linux or Windows.

Check the system requirements before installing the Builder on the management PC. The following are the requirements for the ExpressCluster X Builder to function properly.

Hardware	Models on which Java virtual machine (hereinafter referred to as Java VM) is operable
Operating system	Linux Microsoft Windows® XP SP2 Microsoft Windows Server™ 2003 SP1 or later
Java VM	Sun Microsystems Java™ Runtime Environment Version 5.0 Update 6 (1.5.0_06) or later
Web browser	Java 2 supported browser

Related Information:
For details on supported operating systems and browsers, see Chapter 3, “Installation requirements for ExpressCluster” in the *Getting Started Guide*.

Installing the Builder on a Linux machine

Note:
Log in as root user when installing ExpressCluster Builder on Linux machine.

1. Mount the installation CD-ROM.
2. Navigate to the folder, /Linux/1.0/en/builder, in the CD-ROM and run the following:

```
rpm -i expressclsbuilder-[version #]-[release
#].linux.i686.rpm
```

The installation starts.

Note:
- The Builder will be installed in the following location. You will not be able to uninstall the Builder if you change this directory.
  Installation Directory: **`/opt/nec/clpbuilder`**
- The version number and release number that you need to specify is rpm version number stated in ExpressCluster X Installation CD. When there are multiple versions of rpm, refer to "Supported ExpressCluster versions" in Chapter 3, "Installation requirements for ExpressCluster" in the *Getting Started Guide* and select an appropriate version and release number.

3. When the installation is completed, unmount the CD-ROM.
4. Configure the Java user policy file to grant the Builder (Java applet) the permission to access the platform operating system (outside of Java VM).

The next steps you take are determined by whether the .java.policy file exists or not in your home directory[3]. Check if the .java.policy file already exists in your home directory by running the following command[4]: **`# ls -a`**

Note:
Make sure to close all browsers before continuing to the following steps.

When your home directory *does not* have .java.policy file

The .java.policy file does not exist in your home directory if you are installing ExpressCluster for the first time.

1 Find the .java.policy file in the etc directory (/opt/nec/clpbuilder/etc) in the installation folder of the Builder. Copy it to the home directory.

2 Load the following file by a Web browser and start the Builder:

file:///opt/nec/clpbuilder/clptrek.html

[3] The .java.policy file does not exist in your home directory if you are installing ExpressCluster for the first time.

[4] Because the .java.policy file is a hidden file, add `-a` option to the `ls` command which displays files and directories that are in a current directory to verify whether the .java.policy file exists or not. The .java.policy file is not displayed unless `-a` option is added even if it actually exists.

When your home directory *has* .java.policy file

The .java.policy file exists in your home directory if you have installed ExpressCluster before or if it was created for other Java application.

1. Open the .java.policy file in the home directory using a text editor.
2. Add the following at the end of the file.

```
/* Cluster Builder */
grant codeBase "file:/opt/nec/clpbuilder/clptrek.jar" {
  permission java.security.AllPermission;
};
```

3. Save the change and exit from the editor.
4. Load the following file by a Web browser and start the Builder:

   `file:///opt/nec/clpbuilder/clptrek.html`

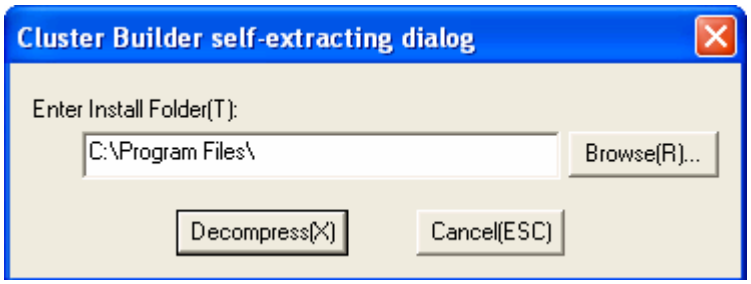
Note:
If the Builder does not start properly, close the browser once and restart, and check the following:
Java Runtime Environment (JRE) is installed in your PC.
JRE is enabled in your browser.
The .java.policy file exists in your home directory and the installation path of the Builder is specified.

Installing the Builder on a Windows machine

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

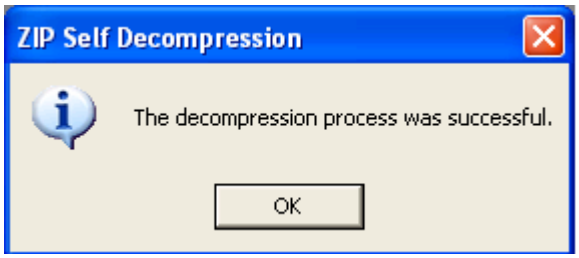
1. Set the Installation CD-ROM in the CD-ROM drive.
2. Navigate to the \Linux\1.0\en\builder\ in the CD-ROM and execute the following:

   expressclsbuilder-[version #]-[release #].linux.i686.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-l” 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-l” directory.

4. Check whether the .java.policy file exists in your home directory, and configure the Java user policy file to allow the Builder (Java applet) to access the platform operating system (outside of Java VM).

   When the operating system is installed in the C drive and you have logged on by USERNAME, the home directory is C:\Documents and Settings\USERNAME (For Windows XP).

   (* It may be different from above depending on your environment.)

When your home directory *does not* have the `.java.policy` file

1. Decompress java_pol.zip in the etc directory (C:\Program Files\CLUSTERPRO\clpbuilder-l\etc) where the Builder is decompressed to save the.java.policy file to your desired directory.
2. Open the .java.policy file by a text editor (Notepad, etc).
3. Change the underlined part in the second line to the directory where the Builder has been decompressed. Delimit the path using "/", not "\".

```
/* Cluster Builder */
grant codeBase "file:/C:/Program
Files/CLUSTERPRO/clpbuilder-l/clptrek.jar" {
   permission java.security.AllPermission;
};
```

4. Save the changes and exit from the editor.
5. Copy the changed .java.policy file to the home directory.
6. Load the file listed below by a Web browser and start the Builder:

   file:///installpath/clptrek.html

When your home directory has the `.java.policy` file

1. Open the .java.policy file by a text editor (Notepad, etc).
2. Change the underlined part in the second line to the directory where the Builder has been decompressed. Delimit the path using "/", not "\".

```
/* Cluster Builder */
grant codeBase "file:/C:/Program
Files/CLUSTERPRO/clpbuilder-l/clptrek.jar" {
   permission java.security.AllPermission;
};
```

3. Save the change and exit from the editor.
4. Load the following file by a Web browser and start the Builder.

   file:///installpath/clptrek.html

Note:
If the Builder does not start properly, close the browser once and restart. Check the following:
Java Runtime Environment (JRE) is installed in your PC.
JRE is effective in your browser.
The .java.policy file exists in your home directory and the installation path of the Builder is specified.

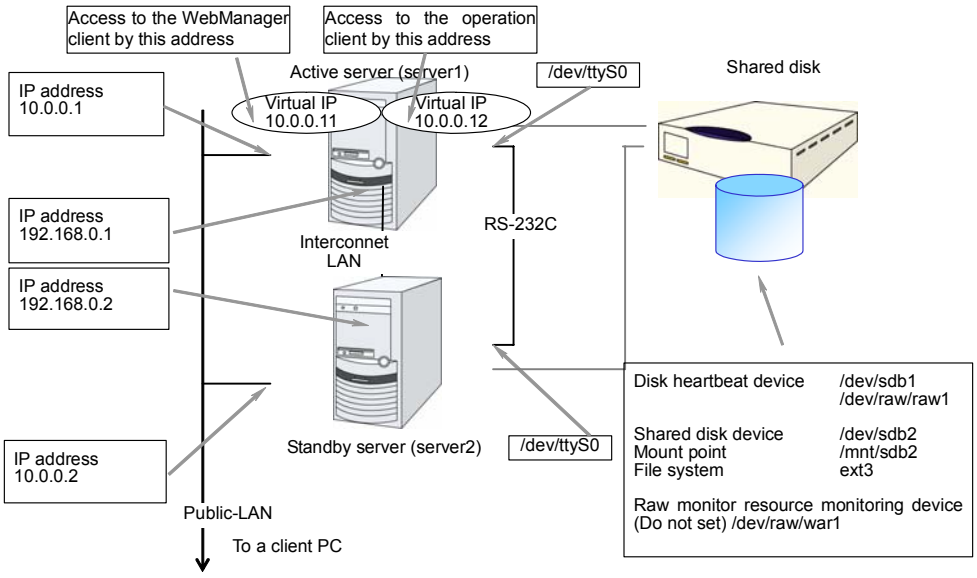
Checking the values to be configured

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

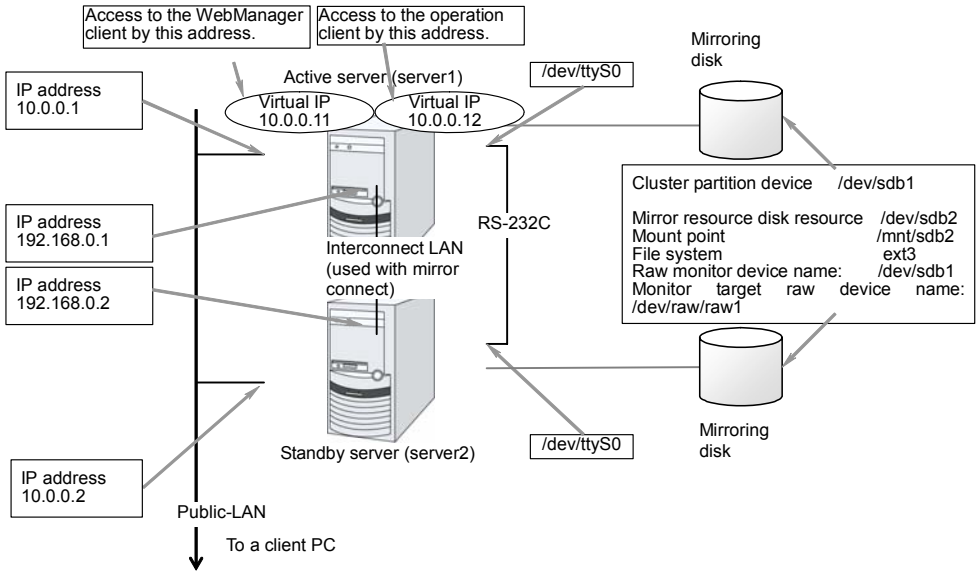
Sample cluster environment

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

When a shared disk is used:



When mirroring disks are 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 2 nodes

Target	Parameter	Value (For shared disk)	Value (For mirroring disk)
Cluster configuration	Cluster name	Cluster	Cluster
	Number of servers	2	2
	Number of failover groups	2	2
	Number of monitor resources	4	6
Heartbeat resources	Number of LAN heartbeats	2	2
	Number of kernel mode LAN heartbeats	2	2
	Number of COM heartbeats	1	1
	Number of disk heartbeats	1	1
First server information (Master server)	Server name	server1	server1
	Interconnect IP address (Dedicated)	192.168.0.1	192.168.0.1
	Interconnect IP address (Backup)	10.0.0.1	10.0.0.1
	Public IP address	10.0.0.1	10.0.0.1
	COM heartbeat device	/dev/ttyS0	/dev/ttyS0
	Disk heartbeat device	/dev/sdb1	--
	Disk heartbeat raw device	dev/raw/raw1	--
	Mirror disk connect	--	192.168.0.1
Second server information	Server name	server2	server2
	Interconnect IP address (Dedicated)	192.168.0.2	192.168.0.21
	Interconnect IP address (Backup)	10.0.0.2	10.0.0.2
	Public IP address	10.0.0.2	10.0.0.2
	COM heartbeat device	/dev/ttyS0	/dev/ttyS0
	Disk heartbeat device	/dev/sdb1	--
	Disk heartbeat raw device	/dev/raw/raw1	--
	Mirror disk connect	--	192.168.0.2
Group resources for management (For the WebManager)	Type	failover	failover
	Group name	WebManager	WebManager
	Startup server	server1 → server2	server1 → server2
	Number of group resources	1	1

Target	Parameter	Value (For shared disk)	Value (For mirroring disk)
Group resources for management *1	Type	floating IP resource	floating IP resource
	Group resource name	WebManager FIP1	WebManager FIP1
	IP address	10.0.0.11	10.0.0.11
Group resources for operation	Type	failover	failover
	Group name	failover1	failover1
	Startup server	server1 → server2	server1 → server2
	Number of group resources	3	3
First group resources	Type	floating IP resource	floating IP resource
	Group resource name	fip1	fip1
	IP address	10.0.0.12	10.0.0.12
Second group resources	Type	disk resource	Mirror disk resource
	Group resource name	disk1	md1
	Device name	/dev/sdb2	
	Mount point	/mnt/sdb2	
	File system	ext3	
	Disk type	disk	
	Mirror partition device name		/dev/NMP1
	Mirror mount point		/mnt/sdb2
	Data partition device name		/dev/sdb2
	Cluster partition device name		/dev/sdb1
	Disk device name		/dev/sdb
	File system		ext3
	Mirror data port number		29051
Third group resources	Type	exec resource	exec resource
	Group resource name	exec1	exec1
	Script	Standard Script	Standard Script
First monitor resources (Created by default)	Type	user mode monitor	user mode monitor
	Monitor resource name	userw	userw
Second monitor resources	Type	raw monitor	raw monitor
	Monitor resource name	raww1	raww1
	Monitored target raw device	/dev/raw/raw1	/dev/raw/raw1
	Device name	--	/dev/sdb1
	When error is detected	Stop the cluster daemon and shut down OS	Stop the cluster daemon and shut down OS

Target	Parameter	Value (For shared disk)	Value (For mirroring disk)
Third monitor resources	Type	ip monitor	ip monitor
	Monitor resource name	ipw1	ipw1
	Monitored IP address	10.0.0.254 (Gateway)	10.0.0.254 (Gateway)
	When error is detected	"WebManager" group's failover *2	"WebManager" group's failover *2
Fourth monitor resources	Type	ip monitor	ip monitor
	Monitor resource name	ipw2	ipw2
	Monitored IP address	10.0.0.254 (Gateway)	10.0.0.254 (Gateway)
	When error is detected	"failover1" group's Failover *2	"failover1" group's Failover *2
Fifth monitor resource (Automatically created after creating mirror disk resource)	Type		mirror disk connect monitor
	Monitor resource name		mdnw1
	Monitored mirror disk connect		No.1
	When error is detected		No Operation
Sixth 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

*1: 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.

*2: For the settings to execute a failover when all interconnect LANs are disconnected, see Chapter 6, "Monitor resource details" in the *Reference Guide*.

Creating the cluster configuration data

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. Create a cluster

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

1-1. Add a cluster

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

1-2. Add the first server

Add a server that constitutes the cluster. If the cluster consists of two nodes, add both servers and make settings such as IP addresses.

1-3. Add the second server

Add a server that constitutes the cluster. If the cluster consists of two nodes, add both servers and make settings such as IP addresses.

1-4. Set a server priority

Specify the server that serves as an active server and the server that serves as a standby server.

1-5. Set a heartbeat priority

Specify the priority of heartbeats to detect hardware error.

2. Create a failover group

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

2-1. Add a group for the WebManager

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

2-2. Add a group for operation

Add a resource that constitutes a group.

2-3. Add a group resource (floating IP address)

Add a resource that constitutes a group.

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

Add a resource that constitutes a group.

2-5. Add a group resource (EXEC resource)

Add a resource that constitutes a group.

3. Create monitor resources

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

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

Add a monitor resource to use.

3-2. Add a monitor resource (ip monitor resource for the WebManager)

Add a monitor resource to use.

3-3. Add a monitor resource (ip monitor resource for failover group)

Add a monitor resource to use.

Starting up the ExpressCluster X Builder

Create the cluster configuration data using the Builder. You need to start the Builder before creating the data.

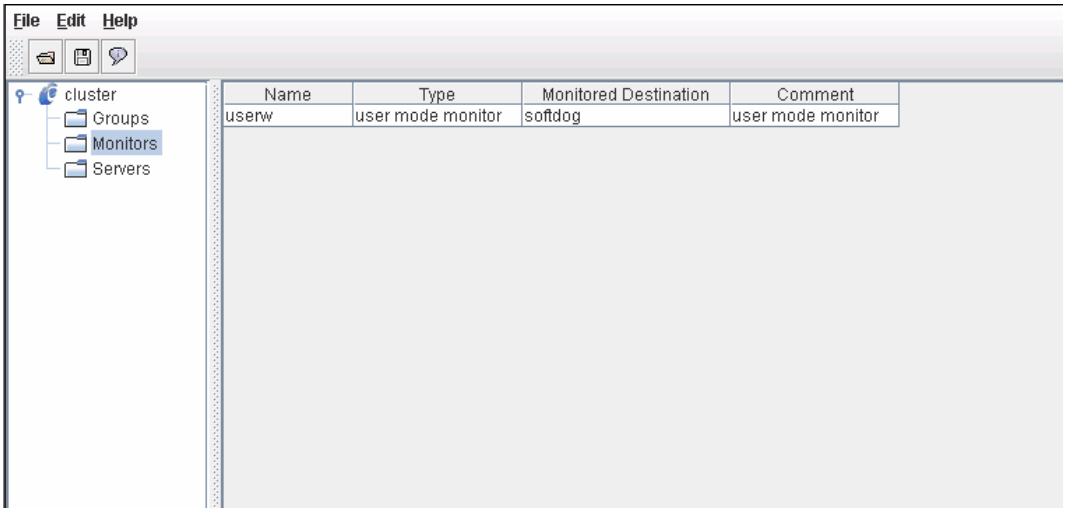
- Load the html file of the Builder through your Web browser and start the Builder.
  - For Linux: file:///opt/nec/clpbuilder/clptrek.html
  - For Windows: file:///Installation path/clptrek.html

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 **Edit** menu, click **Add**.
2. In the **Cluster Definition** dialog box, type the cluster name (cluster) in the **Name** box, and then click **OK**.
3. Click **Monitors** on the tree view. The tree view should look similar to the following. When the cluster name is defined, “user mode monitor” is defined.

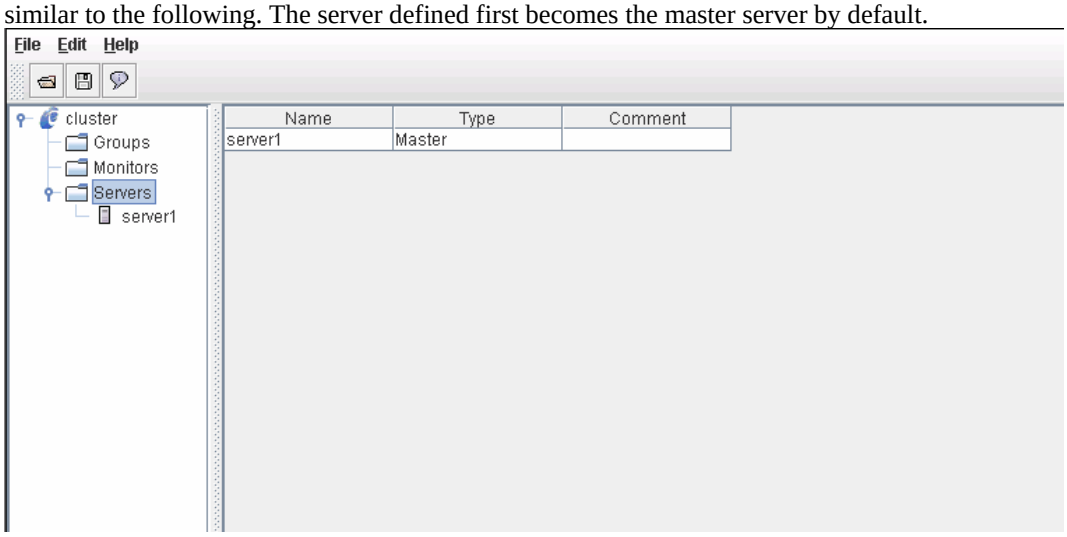


1-2. Add the first server

Add information of each server that constitutes a cluster.

1. Click **Servers** on the tree view, and click **Add** on the **Edit** menu.
2. In the **Server Definition** dialog box, enter the data of the first server.
   Enter the server name **server1** in the **Name** box, and then click **Next**. Enter the actual host name of the server. Make sure to type it correctly because the information you enter here is case sensitive.
3. Set up an interconnect LAN. Click **Add** and enter the interconnect IP address (dedicated) **192.168.0.1** in the **IP Address** box. Click **OK**.
4. The IP address you have entered is displayed in **Interconnect LAN I/F**. Enter the interconnect LAN IP address (backup) **10.0.0.1**. Click **Next**.
5. Click **Add** and enter the IP address of the public LAN **10.0.0.1** in the **IP Address** box. Click **OK**.
6. The IP address you have entered is set in **Public LAN I/F**. Click **Next**.
7. To send a heartbeat using RS-232C, click **Add** and enter COM heartbeat device name in the **Device Name** box. (Typically, leave the default name as it is.) Click **OK**.
8. The device name you have entered is set in the **COM I/F.** Click **Next**.
9. When a cluster system is not a data mirror type or when a shared disk is not used, nothing needs to be configured. Click **Next** and proceed to Step 11. When a shared disk used, click **Add** and enter the actual device name **/dev/sdb1** in the **Device Name** box and the device name for raw access **/dev/raw/raw1** in the **Raw Device** box. Click **OK**.

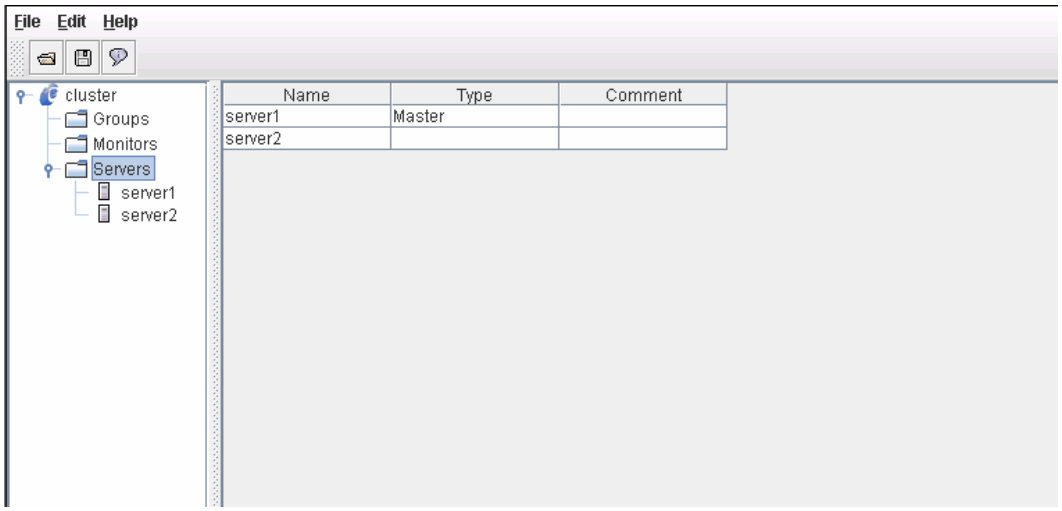
   Note:
   The raw device specified here is used for the heartbeat. Note that it is not a value for a raw monitor resource.
10. The devices entered are set in the **Disk I/F**. Click **Next**.
11. When a cluster system is not a data mirror type, nothing needs to be configured. Click **Next** and proceed to Step 13. When a cluster system is a data mirror type, enter the IP address of the mirror disk connect **192.168.0.1** in **IP Address**. Click **OK**.
12. The IP address entered is registered to **Mirror Disk Connect I/F**. If a cluster system is using a shared disk, nothing is registered. Click **Next**.
13. Nothing needs to be selected in **Warning Light**. Click **Finish.** The tree view should look similar to the following. The server defined first becomes the master server by default.



1-3. Add the second server

Enter the second server information after the first server information.

1. Click **Servers** on the tree view, and click **Add** on the **Edit** menu.
2. In the **Server Definition** dialog box, enter the data of the second server.
   Enter the server name **server2** in the **Name** box, and then click **Next**. Enter the actual host name of the server. The information you enter here is case sensitive.
3. When you define the second server and rest of servers, you will see I/Fs in definition as many as you find in the master server. The IP address is blank by default. Set the IP address corresponding to the I/F number registered in other servers. Click **Edit** and enter the interconnect LAN IP address (dedicated) **192.168.0.2** in the **IP Address** box. Click **OK**.
4. The IP address you have entered is set in **Interconnect LAN I/F**. Likewise, select **[2]** of **I/F No.**, click **Edit**, and enter the LAN IP address (Backup) **10.0.0.2**. Click **Next**.
5. Click **Edit** and enter the public IP address **10.0.0.2** in the **IP Address** box. Click **OK**.
6. Check to see the IP address you have entered in the **Public LAN I/F** is set. Click **Next**.
7. When a heartbeat using RS-232C is sent, the device name is displayed in **COM I/F**. The number of interfaces as many as you see in the master server is displayed. The COM heartbeat device name of the master server is set by default. Click **Next** without changing the settings.
8. When a cluster system is not a data mirror type or when a shared disk is not used, nothing needs to be configured. Click **Next** and proceed to Step 9. When a shared disk used, **Disk I/F** is displayed. The number of interfaces in the master server is displayed. The disk device name and raw device name are set by default. Click **Next** without changing the settings.
9. If a cluster system is not a data mirror type, nothing needs to be configured. Click **Next** and proceed to Step 10. In server definition after the second server, the same number of I/F as the master server I/F is displayed. Configure an IP address corresponding to I/F number registered to other servers. Verify that the IP address entered is registered to **Mirror Disk Connect I/F**, and click **Next**.
10. Nothing needs to be selected in **Warning Light**. Click **Finish.** The tree view should look similar to the following:



1-4. Set a server priority

Specify a priority to the servers that constitute the cluster.

1. Click a cluster name (cluster) in the tree view, and select **Properties** on the **Edit** menu.
2. In the **Cluster Properties** dialog box, click the **Master Server** tab.
3. Check that the master server is set to “server1” in the **Server Priority**. When it is not set, click **Up** and **Down** and set the server to “server1”.

1-5. Set a heartbeat priority

Specify a priority of the heartbeat that monitors communication failure between the servers. In general, specify it in order as described below:

1. In the **Cluster Properties** dialog box, click the **Heartbeat I/F** tab (see Step 1-4).
2. Click **LAN1** in the **Available I/F**, and click **Add**. LAN1 is added to the **Heartbeat I/F Priority**.
3. Add in the order of **LAN2** (public LAN), **KLAN1** (interconnect LAN), **KLAN2** (public LAN), **COM1** (RS232-C cross cable), and **DISK1** (shared disk).
4. Verify that the settings are made in the order of **LAN 1**, **LAN 2**, **KLAN1**, **KLAN2**, **COM1** and **DISK1** in the **Heartbeat I/F Priority**. Click **OK**.

2. Creating a failover group

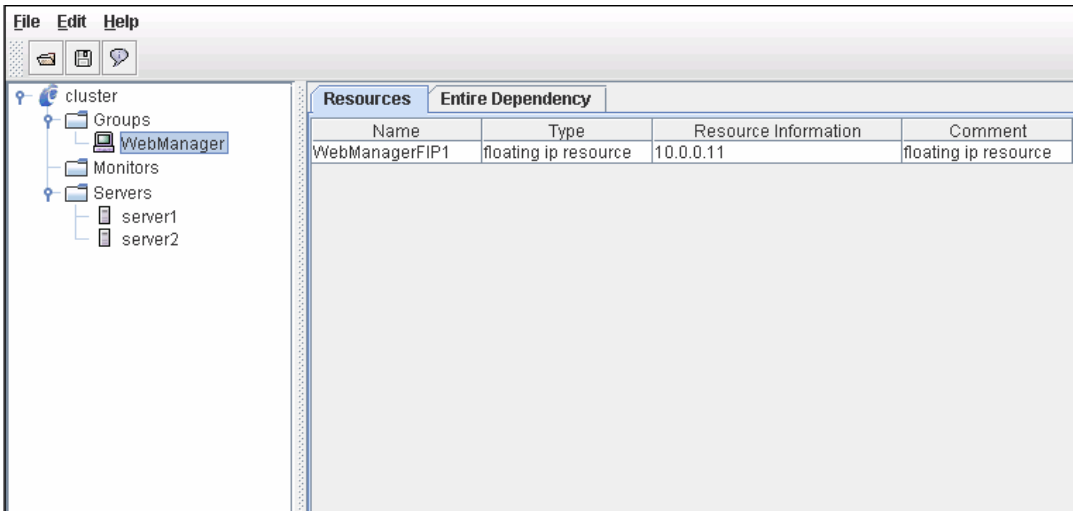
Add a failover group to the cluster. First, create a failover group for the WebManager and then add a failover group that executes an application.

2-1. Add a group for the WebManager

When you add a group to a failover group, first create a group for the WebManager. This group uses a floating IP and accesses servers in the cluster from a management PC. This allows access from the WebManager to a server that has failed over even if one of the servers goes down and failover occurs.

1. Click **Groups** in the tree view, and select the **Add WebManager Group** on the **Edit** menu.
2. Enter the floating IP address **10.0.0.11** in the **IP Address** box. Click **OK**.

A group for the WebManager is added. The tree view should look similar to the following:

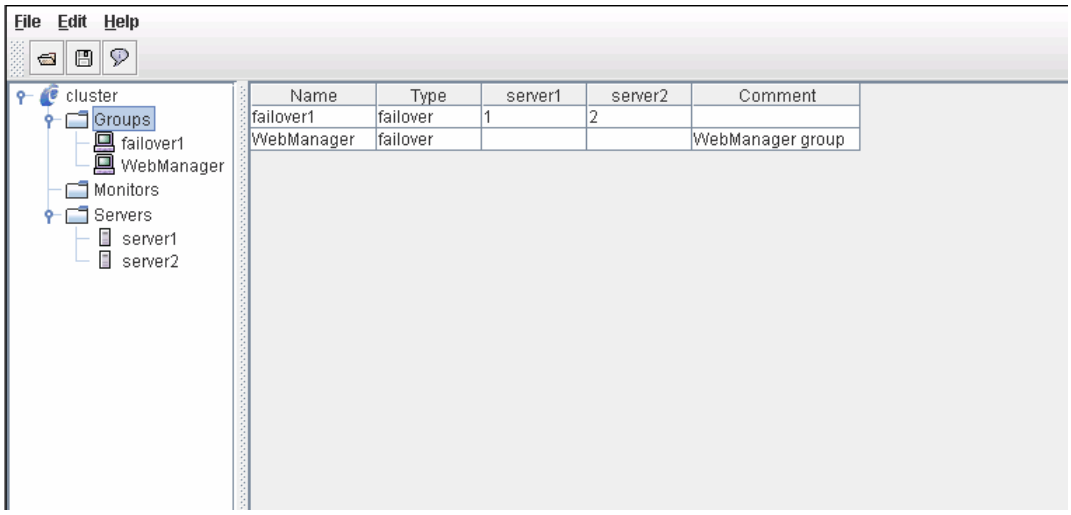


2-2. Add a group for operation

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

1. Click **Groups** in the tree view, and click **Add** on the **Edit** menu.
2. In the **Group Definition** dialog box, enter the group name (failover1) in the **Name** box, and click **Next**.
3. Click **server1** in the **Available Servers** and click **Add**. **server1** is added to the **Servers that can run the Group**. Add **server2**.
4. Verify that **server1** and **server2** are set in this order to the **Servers that can run the Group,** and then click **Finish**.

A failover group is added. The tree view should look similar to the following:



2-3. 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 2-2.

1. Click **failover1** in the tree view, and click **Add** 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. Enter the IP Address **10.0.0.12** in the **IP Address** box. Click **Next**.
4. **Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** are displayed. Click **Next**.
5. A page for setting up a dependency is displayed. 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. Click **failover1** in the tree view, and click **Add** on the **Edit** menu.
2. In the **Resource Definition** dialog box, select the group resource type **disk resource** in the **Type** box, and enter the group name **disk1** in the **Name** box. Click **Next**.
3. Enter the device name **/dev/sdb2**, mount point **/mnt/sdb2** to their corresponding boxes. Select the file system **ext3** from the **File System** box and the disk type **Disk** from the **Disk Type** box. Click **Next**.
4. **Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** are displayed. Click **Next**.
5. A page for setting up a dependency is displayed. 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.

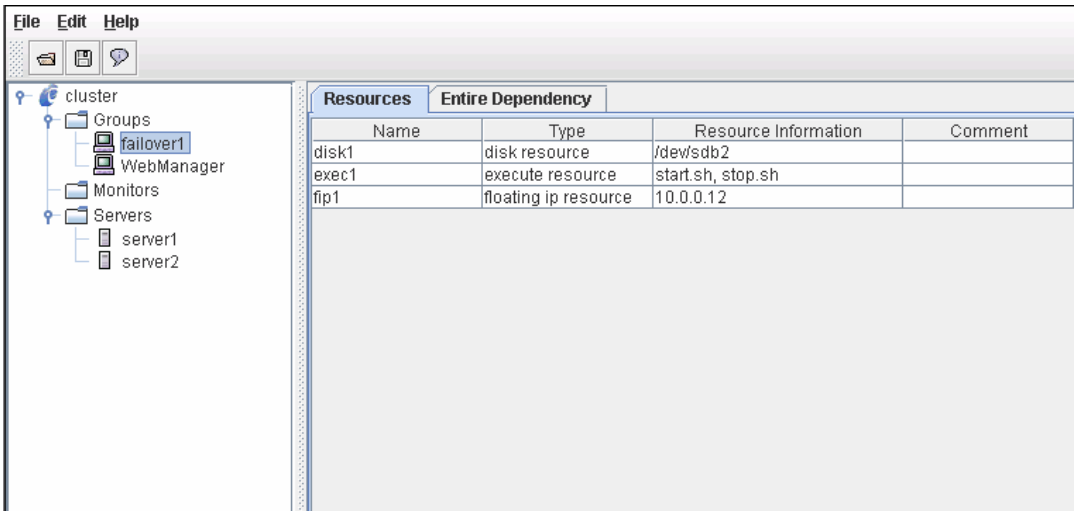
1. Click **failover1** in the tree view, and click **Add** on the **Edit** menu.
2. In the **Resource Definition** dialog box, select the group resource type **mirror disk resource** in the **Type** box, and enter the group name **md1** in the **Name** box. Click **Next**.
3. Select the mirror partition device name **/dev/NMP1** in Mirror Partition Device Name
4. In the **Mirror Partition Device Name** dialog box, select the mirror partition device name **/dev/NMP1**. Enter the mirror mount point **/mnt/sdb2**, the data partition device name **/dev/sdb2**, the cluster partition device name **/dev/sdb1**, and the disk device name **/mnt/sdb** in the respective box. In the **File System** dialog box, select the file system **ext3**. Verify that the mirror data port number **29051** is entered by default. Click **Next**.
5. **Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** are displayed. Click **Next**.
6. A page for setting up a dependency is displayed. Click **Finish**.

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

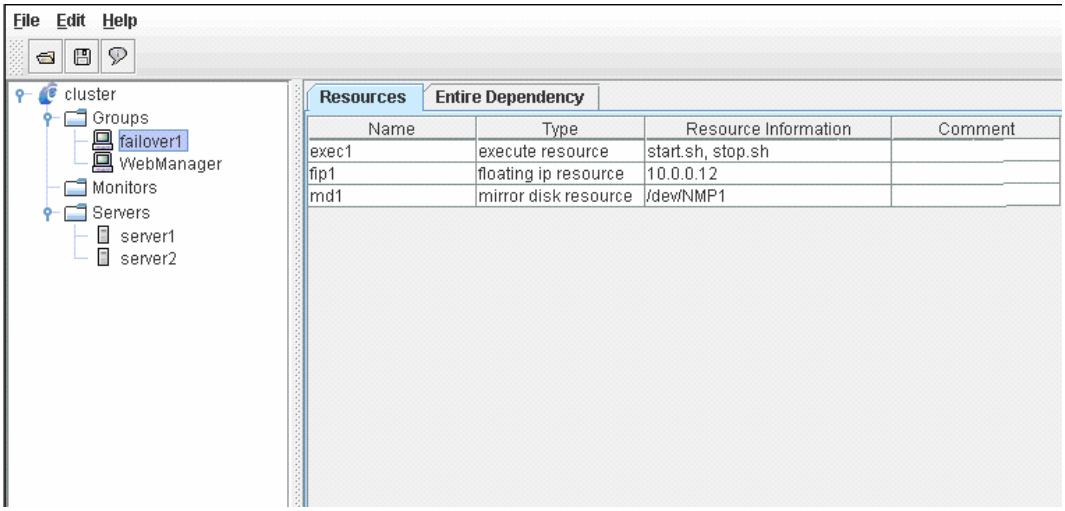
Add an exec resource that can start and stop the application from a script.

1. Click **failover1** in the tree view, and click **Add** on the **Edit** menu.
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. 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**.
4. **Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** are displayed. Click **Next**.
5. A page for setting up a dependency is displayed. Click **Finish**.

When a shared disk is used in a cluster system, the table view of the failover1 should look similar to the following:



When a cluster system is a data mirror type, the table view of the failover1 should look similar to the following:



3. Creating monitor resources

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

3.1 Add a monitor resource (raw monitor resource)

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

1. Click **Monitors** in the tree view, and click **Add** on the **Edit** menu.
2. In the **Monitor Resource Definition** dialog box, the first monitor resource information is created by default when the cluster name is defined. Select the monitor resource type **raw monitor** in the **Type** box, and enter the monitor resource name **raww1** in the **Name** box. Click **Next**.
3. When a shared disk is used, enter the target monitor disk and raw device name (**/dev/raw/raw1**). Nothing needs to be entered in **Device Name**. When mirroring disks are used, enter the target monitor disk and raw device name (**/dev/raw/raw1**). Enter the device name (/dev/sdb1) in **Device Name**. Click **Next**.
4. Configure the monitor settings. Do not change the default value and click **Next**.
5. Specify the recovery target. Click **Browse**.
6. Click **cluster** in the tree view shown. Click **OK**.
7. Select **Stop the cluster daemon and shut down OS** in the **Final Action** box, and click **Finish**.

3-2. Add a monitor resource (IP monitor resource for the WebManager)

Add monitor resources that monitor IP. IP monitor needs to be created on a failover group basis. Because the example used here has two groups, a group for WebManager and a group for an application. An IP monitor is created for each group.

1. Click **Monitors** in the tree view, and click **Add** 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. Click **Add**. Enter the IP address to be monitored **10.0.0.254** in the **IP Address** box, and click **OK**.

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

4. The IP address you have entered is set in the **IP Addresses**. Click **Next**.
5. Configure the monitor settings. Do not change the default value. Click **Next**.
6. Specify the recovery target. Click **Browse**.
7. Click **WebManager** in the tree view and click **OK**. “WebManager” is set in the **Recovery Target**.
8. Set **1** in the **Reactivation Threshold** box. Click **Finish**.

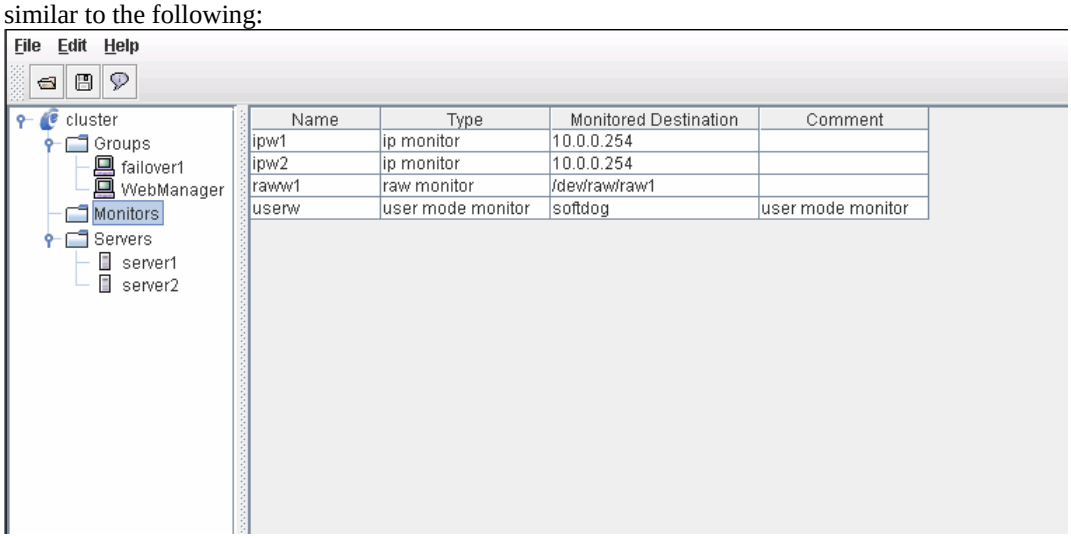
3-3. Add a monitor resource (IP monitor resource for failover group)

1. Click **Monitors** in the tree view, and click **Add** 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 **ipw2** in the **Name** box. Click **Next**.
3. Click **Add**. Enter the IP address to be monitored **10.0.0.254** in the **IP Address** box, and click **OK**.

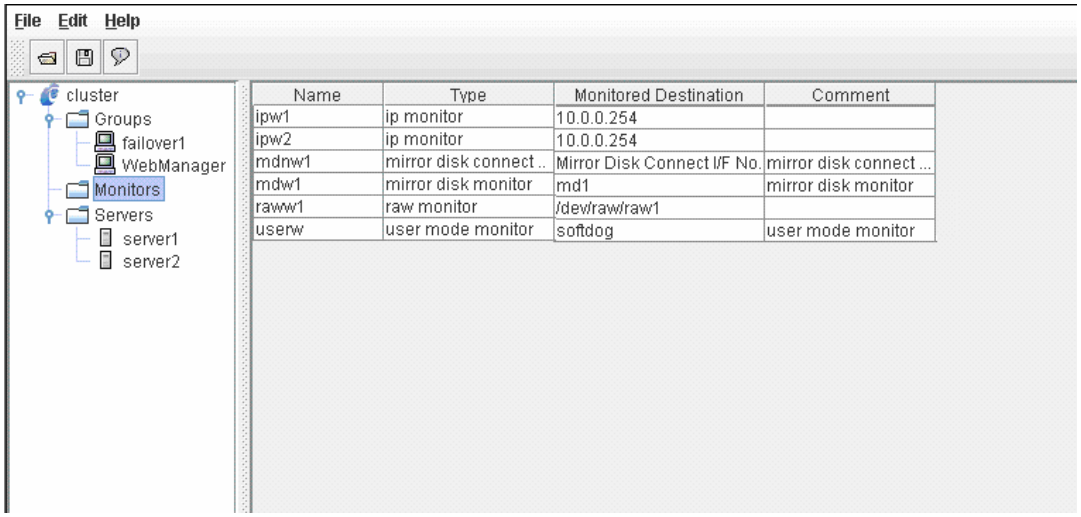
   Note:
   For monitoring target of the IP monitor resource, specify an IP address of the device (i.e. gateway) that is assumed to be always active on public LAN

4. The IP address entered is set in the **IP Addresses**. Click **Next**.
5. Configure the monitor settings. Click **Next**.
6. Specify the recovery target. Click **Browse**.
7. Click **failover1** in the tree view. Click **OK**. “failover1” is set in the **Recovery Target**.
8. Set **0** in the **Reactivation Threshold** box. Click **Finish**.

When a shared disk is used in a cluster system, the table view of the Monitors should look similar to the following:



When data mirror is used in a cluster system, the table view of the Monitors should look similar to the following:



Creating the cluster configuration data is completed. Proceed to the next section “Saving the cluster configuration data.”

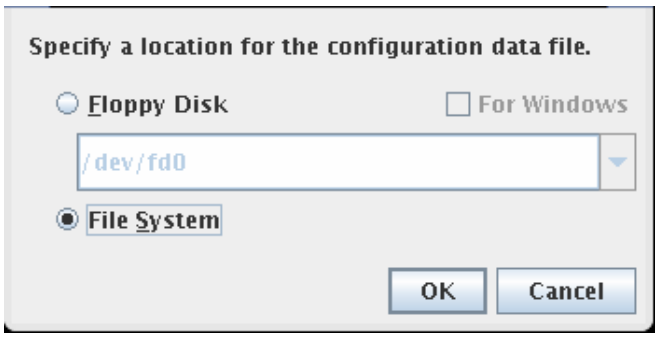
Saving the cluster configuration data

The cluster configuration data can be saved in a file system or in media such as a floppy disk. In an environment where you can use media, create a cluster by hand-carrying the cluster configuration data to the master server. When media cannot be used, it is necessary to save the data to the location where the master server can access.

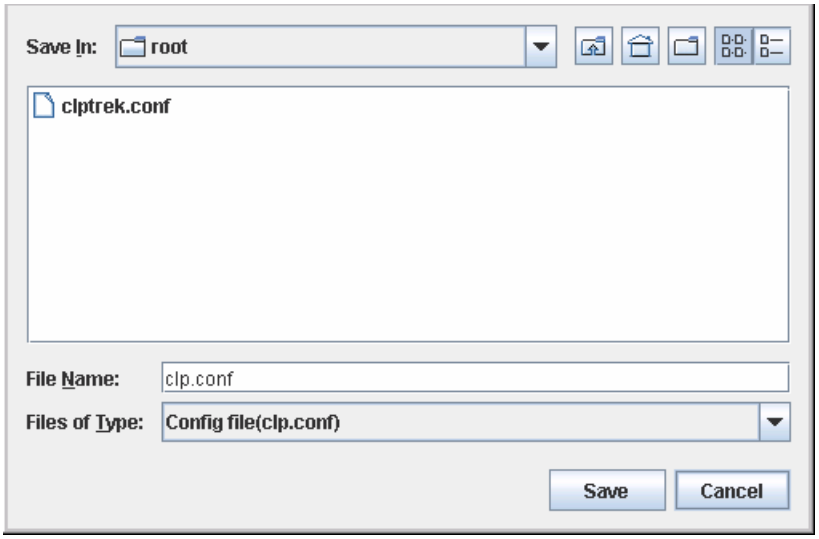
Saving the cluster configuration data in the file system (Linux)

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

1. Select **Save** on the **File** menu of the Builder.
2. Click **File System** in the following dialog box, and click **OK**.

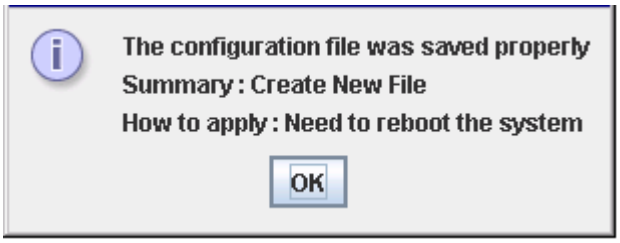


3. Select a location to save the data in the following dialog box, and click **Save**. Specify this directory when executing the creation command later.



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

When the cluster configuration data is saved, the following message is displayed.

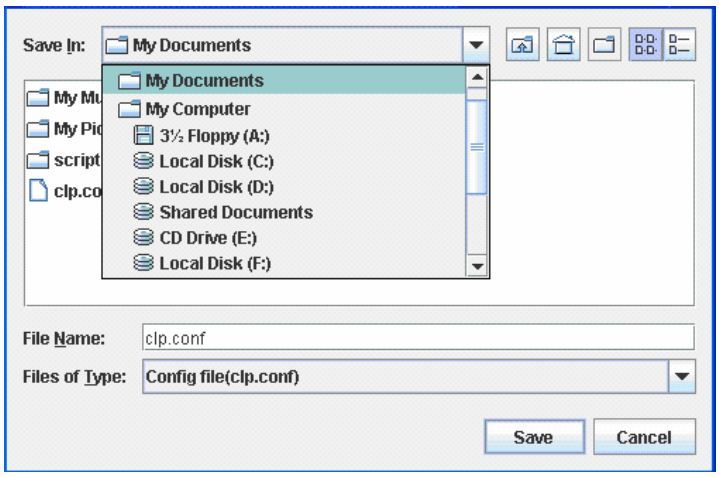


4. Check the file system and verify if the two files (clp.conf and clp.conf.rep) and the directory (scripts) are located in the directory for storing.

Saving the cluster configuration data in the file system (Windows)

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

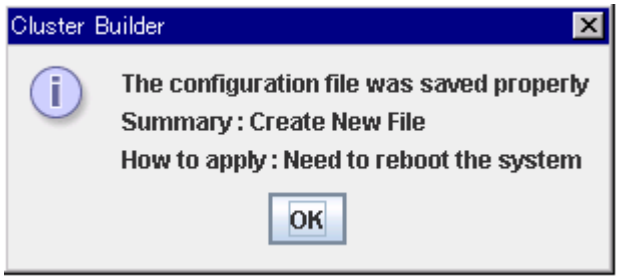
1. Select **Save** on the **File** menu of the Builder.
2. Select a location to save the data in the following dialog box, and click **Save**.



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.

When the cluster configuration data is saved, the following message is displayed.

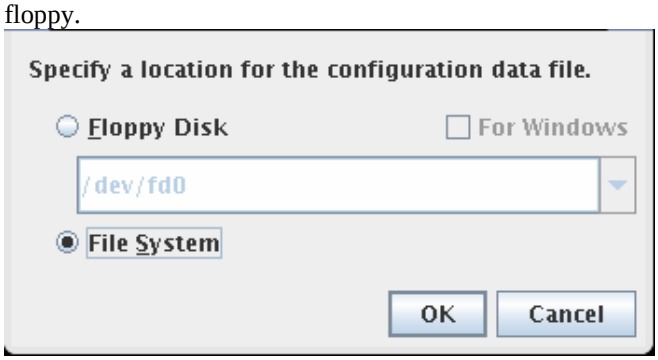


4. Check the file system and verify if the two files (clp.conf and clp.conf.rep) and the directory (scripts) are located in a directory to be saved.

Saving the cluster configuration data on a floppy disk (Linux)

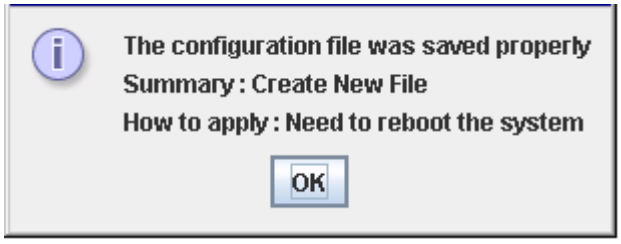
Follow the procedures below to save the cluster configuration data created with the Builder on Linux machine to a floppy disk.

1. Insert a floppy disk into the floppy disk drive. Click **Save** on the **File** menu.
2. The following dialog box is displayed. Select the floppy disk drive name and click **OK**. You can save the data directly in the floppy disk without creating any directory in the floppy.



Note:
If you want to edit the cluster configuration data in the Builder that runs on the Windows browser, select **For Windows**. In this case, you need to prepare a Windows FAT (VFAT) formatted 1.44-MB floppy disk.
Two files (clp.conf 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.

When the cluster configuration data is saved, the following message is displayed.

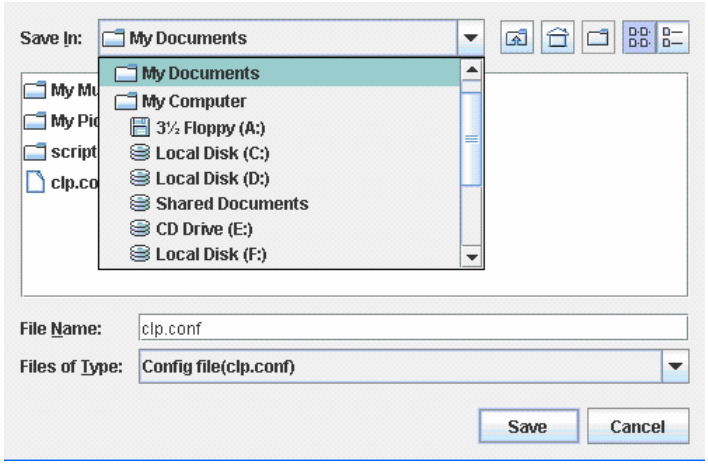


3. Check the floppy disk and verify if two files (clp.conf, clp.conf.rep) and one directory (scripts) are saved directly to the floppy disk.

Saving the cluster configuration data on a floppy disk (Windows)

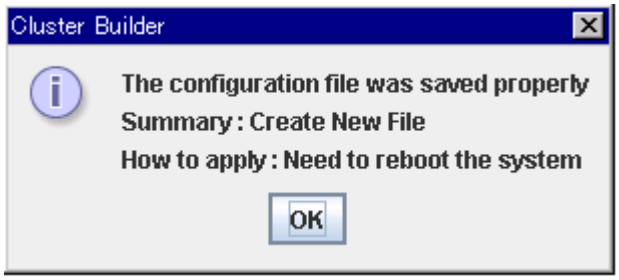
Follow the procedures below to save the cluster configuration data created with the Builder on Windows machine to a floppy disk.

1. Prepare a formatted 1.44-MB floppy disk.
2. Insert the floppy disk into the floppy disk drive. Click **Save** on the **File** menu.
3. The following dialog box is displayed. Select the floppy disk drive in the **Save** box and click **Save**.



Note:
If you want to edit the cluster configuration data in the Builder that runs on the Windows browser, select **For Windows**. In this case, you need to prepare a Windows FAT (VFAT) formatted 1.44-MB floppy disk. For more details, see the *Reference Guide*.
Two files (clp.conf 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.

When the cluster configuration data is saved, the following message is displayed:



4. Check the floppy disk and verify if two files (clp.conf, clp.conf.rep) and one directory (scripts) are saved directly to the floppy disk.

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 4 Installing ExpressCluster
- Chapter 5 Registering the license
- Chapter 6 Starting up a cluster system

Chapter 4 Installing ExpressCluster

This chapter provides instructions for installing ExpressCluster. Installation of the ExpressCluster consists of two components: installation of ExpressCluster X Builder, which is a tool for editing the cluster configuration data, and ExpressCluster Server which is the core component of ExpressCluster. A management tool, ExpressCluster X WebManager, will be automatically installed when accessing the ExpressCluster Server from the browser on the management PC. It is not necessary to install the ExpressCluster X WebManager separately.

This chapter covers:

Steps from Installing ExpressCluster to creating a cluster

The following describes the steps from installing ExpressCluster to creating a cluster.

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 4, “Installing ExpressCluster.”)

Reboot the server

2. Create a cluster

Create a cluster by applying the cluster configuration data created with the Builder to servers using the clpcfctrl command. (See Chapter 3, “Creating the cluster configuration data using the Builder.”)

3. Register the license

Register the license by running the clplcnsc command. (See Chapter 5, “Registering the license.”)

Reboot the server

4. Verify the cluster status using the WebManager

Verify the status of a cluster that you have created using the WebManager. (See Chapter 6, “Starting up a cluster system.”)

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.

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 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/1.0/en/server, in the CD-ROM and run the following:

   ```
   rpm –i expresscls-[version].[architecture].rpm –nodeps
   ```

   There are I686, x86-64, IA-64, and PPC64 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 and reboot the server.

Creating a cluster

Use the cluster configuration data created with the Builder to create a cluster. How you create a cluster is determined by where the data is saved; in the floppy disk or in the file system. It is also necessary to register the license to complete creating the cluster. Follow the steps below and register the license.

Creating a cluster by using the data in a floppy disk

To create a cluster using the cluster configuration data saved on a floppy disk, follow the procedures below.

Note:
You have to restart all servers after installing the ExpressCluster RPM.
The server used to create a cluster is the one specified as a master server at the time creating the cluster configuration data.

1. Insert the floppy disk that contains the cluster configuration data into the floppy disk drive of the server specified as a master server.

Note:
In the clpcfctrl command, /dev/fd0 is used as the floppy disk device, and /mnt/floppy as the mount point by default. If your environment is different from these default values, specify them using the option. For details on option, refer to the *Reference Guide*.

2. Distribute the configuration data saved in the floppy disk to all servers that configure the cluster.

   - To use the floppy disk that contains the data saved on Linux is used, run the following command: **`clpcfctrl --push –l`**
   - To use the floppy disk (1.44-MB formatted) that contains the data saved on Windows, or to use the Windows-formatted floppy disk that contains the data on Linux, run the following command: **`clpcfctrl --push –w`**

Note:
If two files (clp.conf and clp.conf.rep) and one directory (scripts) that are necessary to create a cluster are saved directly in the floppy disk, you do not need to specify any directory.

The following message is displayed:

```
Need to shutdown system and reboot
please shutdown system after push. (hit return) :
```

3. Click **ENTER**. When creating the cluster is successfully completed, the following message is displayed:

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

Related information:
For troubleshooting of the clpcfctrl command, refer to the *Reference Guide*.

To complete creating the cluster, you need to register the license, take out the floppy disk from the drive, and restart all servers. Proceed to Chapter 5, “Registering the license” and register the license.

Creating a cluster from the file system (when a floppy disk is not available)

To create a cluster using the cluster configuration data saved in the file system, follow the procedures below.

Note:
You have to restart all servers after installing the ExpressCluster Server RPM.
The server used to create a cluster is the one specified as a master server at the time creating the cluster configuration data.

1. Allow access to the cluster configuration data saved in the file system or floppy disk from the server specified as the master server by using FTP or other means.
2. Distribute the cluster configuration data in the file system to the servers. For the directory path, specify the full path to the directory that has the cluster configuration data.

Note:
If two files (clp.conf and clp.conf.rep) and one directory (scripts) that are necessary to create a cluster are saved directly in the floppy disk, you do not need to specify any directory.

- To use the cluster configuration data saved on Linux, run the following command:
  clpcfctrl --push –l -x <*directory_path*>
- To use the cluster configuration data saved on Windows, or to use the cluster configuration data for Windows saved on Linux, run the following command: clpcfctrl
  --push –w -x <*directory_path*>

The following message is displayed.

```
Need to shutdown system and reboot
please shutdown system after push. (hit return) :
```

3. Click **ENTER**. When creating the cluster is successfully completed, the following message is displayed:

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

Related information:
For troubleshooting of the clpcfctrl command, refer to the *Reference Guide*.

To complete creating the cluster, you need to register the license, take out the floppy disk from the drive, and restart all servers. Proceed to Chapter 5, “Registering the license” and register the license.

Chapter 5 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

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

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 73, “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 74, “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 73, “Registering the license by specifying the license file (for both product version and trial version).”

Before registering the license, make sure that the procedures described in Chapter 3, “Creating the cluster configuration data using the Builder” in are executed on all servers.

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.

Before you register the license, make sure to:

- Run the command to create the cluster. If you have not run the command yet, see "Creating a cluster" in Chapter 4 and run the command.
- Allow logon as root user to the server that will be set as a master server among servers that configures a cluster system.
- Store the license file in the server that will be set as a master server among servers that constitute the cluster system.

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

```
# clplcnsc -i <filepath> -p <PRODUCT-ID>
```

Specify the path to the license file for ***filepath*** specified by the -i option. Specify the product ID for ***PRODUCT-ID*** specified by the -p option. Enter the product ID that corresponds to the version you are using. The product ID is listed below:

Licensed Product Name	Product ID
ExpressCluster X 1.0 for Linux	BASE10

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 4, "ExpressCluster command reference" in the *Reference Guide*.

2. Run the following command to verify the licenses registered. In PRODUCT-ID, enter the product ID specified in Step 2 in "Registering the license interactively from the command line (Product version)." in this chapter.

```
# clplcnsc -l -p <PRODUCT-ID>
```

3. When an optional product is used, refer to page 76, "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 6, "Starting up a cluster system" and follow the steps.

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.
- Run the command to create the cluster. If you have not run the command yet, see "Creating a cluster" in Chapter 4 and run the command.
- 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 clplcnsc command is used in the following procedures. For more information on how to use the clplcnsc command, see Chapter 4, "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 1.0 for Linux**
License information:	
Type	Product Version
License Key	A1234567- B1234567- C1234567- D1234567
Serial Number	AAA0000000
Number Of Licensed CPUs	2

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

```
# clplcnsc -i -p PRODUCT-ID
```

   Specify the product ID for ***PRODUCT-ID*** specified by the -p option. Enter the product ID that corresponds to the version you are using. The product ID is listed below:

Licensed Product Name	Product ID
ExpressCluster X 1.0 for Linux	BASE10

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

```
Selection of License Version.
1. Product version
2. Trial version
Select License Version [1 or 2 ] …1
```

4. The text that prompts you to enter the number of licenses is displayed. The default value 2 is set for the number of licenses. If the number written in your license sheet is 2, simply press ENTER without entering any value. When the value written in your license sheet is other than 2, enter the correct value and press ENTER.

```
Enter the number of license [1 to 99 (default:2)] ... 2
```

5. 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. XXX0000000] ... AAA0000000
```

6. 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 4, "ExpressCluster command reference" in the *Reference Guide*.

7. Run the following command to verify the licenses registered. In PRODUCT-ID, enter the product ID specified in Step 2.

```
# clplcnsc -l -p PRODUCT-ID
```

8. When an optional product is used, refer to page 76, "Registering the node license" in this chapter.

9. 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 6, "Starting up a cluster system" and follow the steps.

Registering the node license

It is required to register the node license for the GAIA X 1.0 Replicator, GAIA X 1.0 Agent products, and GAIA 1.0 X Alert Service (hereafter referred to as “optional product”) to operate on the configured cluster system.

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

- Register the license by running the license management command and interactively entering the license information that comes with the licensed product. Refer to page 78, “Registering the node license interactively from the command line (Product version).”
- Specify the license file as the parameter of the license management command. Refer to page 77, “Registering the node license by specifying the license file (for both product version and trial version).”

Trial version

- Specify the license file as the parameter of the license management command. Refer to page 77, “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:

- Run the command to create the cluster. If you have not run the command yet, see "Creating a cluster" in Chapter 3 and run the command.
- Allow log on as root user to the server for which you use an optional product.

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

```
# clplcnsc -i filepath -p PRODUCT-ID
```

   Specify the path to the license file for ***filepath*** specified by the –i option. Specify the product ID for ***PRODUCT-ID*** specified by the -p option. For details on product ID, refer to the *Reference Guide*.

   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 4, "ExpressCluster command reference" in the *Reference Guide*.

2. Run the following command to verify the licenses registered. In ***PRODUCT-ID***, enter the product ID specified in Step 2 in page 78, "Registering the node license interactively from the command line (Product version)."

```
# clplcnsc -l -p PRODUCT-ID
```

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 to both servers.
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 6, "Starting up a cluster system" and follow the steps.

   When the license for the Replicator is registered after you have started using the cluster, shut down and reboot the cluster. The Replicator becomes available after rebooting the cluster.

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.
- Run the command to create the cluster. If you have not run the command, see "Creating a cluster" in Chapter 4 and run the command.
- 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 clplcnsc command is used in the following procedures. For more information on how to use the clplcnsc command, see Chapter 4, "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 1.0 for Linux**
License information:	
Type	Product Version
License Key	A1234567- B1234567- C1234567- D1234567
Serial Number	AAA0000000
Number of Nodes	1

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

```
# clplcnsc -i -p PRODUCT-ID
```

   Specify the product ID for ***PRODUCT-ID*** specified by the -p option. Enter the product ID that corresponds to the version you are using. The product ID is listed below:

Licensed Product Name	Product ID
ExpressCluster X Replicator 1.0 for Linux	REPL10
ExpressCluster X Database Agent 1.0 for Linux	DBAG10
ExpressCluster X Internet Server Agent 1.0 for Linux	ISAG10
ExpressCluster X File Server Agent 1.0 for Linux	FSAG10
ExpressCluster X Application Server Agent 1.0 for Linux	ASAG10
ExpressCluster X Alert Service 1.0 for Linux	ALRT10

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

```
Selection of License Version.
1. Product Version
2. Trial Version
Select License Version [1 or 2 ]…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. XXX0000000]... AAA0000000
```

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 4, "ExpressCluster command reference" in the *Reference Guide*.

6. Run the following command to verify the licenses registered. In ***PRODUCT-ID***, enter the product ID specified in the Step 2.

```
# clplcnsc -l -p PRODUCT-ID
```

7. If there is any other server in the cluster that uses an optional product, register the node license by repeating the same steps.

8. 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 6, "Starting up a cluster system" and follow the steps.

When the license for the Replicator is registered after you have started using the cluster, shut down and reboot the cluster. The Replicator becomes available after rebooting the cluster.

Chapter 6 Starting up a cluster system

This chapter describes how you verify that the created cluster system runs normally.

This chapter covers:

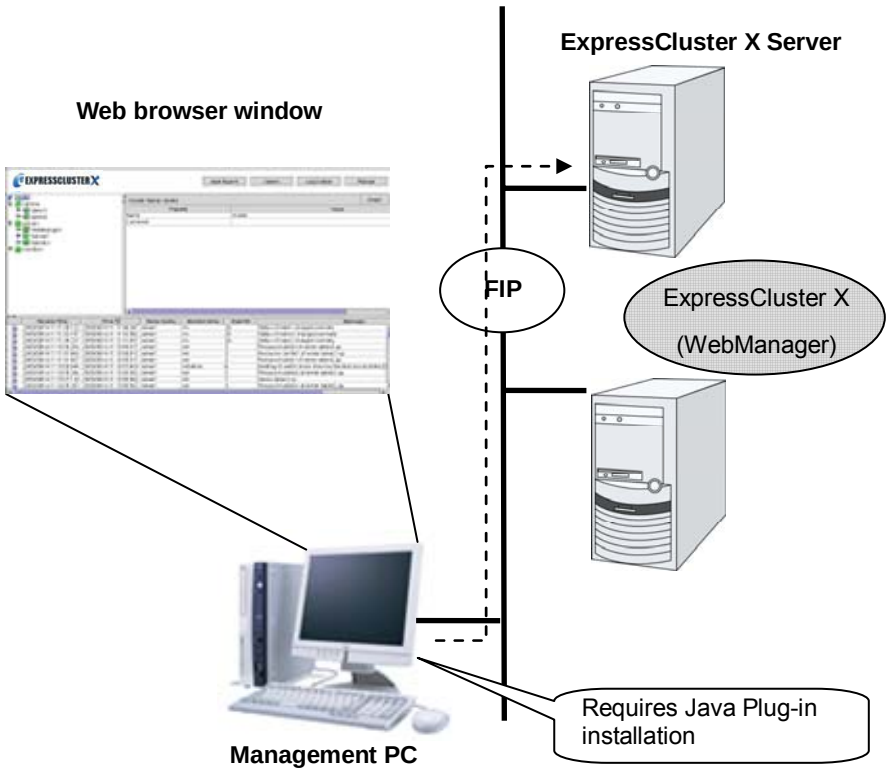
Verifying cluster using the WebManager

The cluster system you have set up can be verified by using the WebManager or the command line. 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*.

What is ExpressCluster X WebManager

Using the WebManager allows you to monitor the cluster status and startup and stop of servers and groups, and collect cluster operation logs from a management PC. A commonly used Web browser (hereafter a browser) is used to access the WebManager from a management PC.



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

Related Information:
You can make settings to manually start WebManager by using the Builder. Open the configuration data, right-click the cluster icon, and clear the **Enable WebManager Server** check box.

Browsers supported by the WebManager

Use the following browsers to access the WebManager:

- Microsoft® Internet Explorer 6.0 SP1 or later
- Firefox 1.0.6 or later

Note that a browser must have Java™ 2 Runtime Environment, Version 5.0 Update 6 (1.5.0_06) or later in it.

Related Information:
For information on combinations of a browser and operating system that have been tested and verified, see Chapter 3, "Installation requirements for ExpressCluster" in the *Getting Started Guide*.

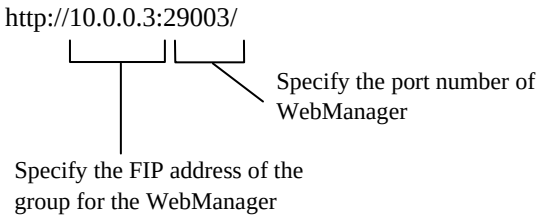
Setting Up JAVA runtime environment

In order to access the WebManager, a Java Plug-in must be installed on a browser on a management PC.

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

Access to the WebManager

Specify the following as the URL to access the WebManager from a browser on your management PC.



Specify the floating IP address of a group for the WebManager for the IP address of the destination.

A connection will switch from the original access destination server to other active server when the server goes down if a floating IP address is specified.

Specify the port number that has been configured in **WebManager HTTP Port Number**. To configure a port number, select **Cluster Properties** in **ExpressCluster X Builder**, and then click **Port No.**

Starting the WebManager

1. Start your browser.
2. Enter the IP address and port number of the ExpressCluster Server in the Address bar of the browser.

   http://10.0.0.11:29003/

   For IP address, use the FIP address specified in the failover group for the WebManager. By doing so, you can access the WebManager when a failover occurs.

   Make sure to enter the same port number as the WebManager HTTP port number specified by the Builder. To verify, open the configuration data file by the Builder. Right-click the name of the cluster, click **Properties**, and then click **Port Number**.

Verifying operation by using the WebManager

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 referring to Chapter 9, "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 floating IP resource**

   Verify that you can ping a floating IP address while the group having the floating IP resource is active.

6. **Check an exec resource**

   Verify that an application is working on the server where the group having an exec resource is active.

7. **Stop a group**

   Stop a group.
   Verify that the status of the group is offline on the WebManager.

8. **Move a group**

   Move a group to another server.
   Verify that the status of the group is online on the WebManager.
   Move the group to all servers in the failover policy and verify that the status changes to online on each server.

9. **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.

10. **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.

11. **Check mail report**

    When the mail report is set, verify that a mail message is sent at failover.

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 4, "ExpressCluster command reference" in the *Reference Guide*. If any error is detected while verifying the operation, troubleshoot the error referring to Chapter 9, "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 floating IP resource**

   Verify that you can ping a floating IP address while the group having a 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. **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.

9. **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.

10. **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.

11. **Check mail report**

    When the mail report is set, verify that a mail message is sent at failover.

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.

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 7 Verifying operation
- Chapter 8 Preparing to operate a cluster system
- Chapter 9 Uninstalling and reinstalling ExpressCluster

Chapter 7 Verifying operation

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

This chapter covers:

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. **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 disk monitoring, raw monitoring, adjust the time-out value of each monitor resources.

2. **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 disk monitoring or raw monitoring, adjust the time-out value of each monitor resources.

3. **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 WebManager terminal. = Operation continues.
		Disk monitor resources detect an error
	For FC, power off the FC-HUB	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 WebManager terminal. = 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 WebManager terminal. = 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 WebManager terminal. 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 WebManager terminal (mirroring stops) Operation continues, but a switch to a standby server becomes impossible.
		An error is detected in mirror disk monitor resource Operation continues
Disk resource	Start up the group after mounting the disk (Example) # mount /dev/sda2 /mnt/sda2	A disk resource does not get activated. Failover to a standby server occurs.
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.
Mirror disk resource	Start up the group after mounting the disk (Example) # mount /dev/sda2 /mnt/sda2	A mirror disk resource does not get activated.
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.
Raw resource	Specify the already-used device (the one that is used for cluster partition) to make it overlapped	A raw resource does not get activated.
VxVM volume resource	Start up the group after mounting the disk (Example) # mount -t vxfs /dev/sda3 /mnt/sda3	A VxVM volume resource does not get activated.

Device/Resource	Dummy-failure	What happens
	Unplug the VxVM disk cable	An error is detected in a VxVM volume monitor resource Operation continues
PID monitor resource	Terminate resident process of exec resource (Example) # kill process ID	Failover to a standby server occurs.
VxVM daemon monitor resource	Stop the VxVM daemon	Failover to a standby server occurs.

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 or mirrored 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, the mirror 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.

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 adjusts time-out temporarily, refer to 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 ~

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 9, “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. Insert a floppy disk into the floppy disk drive of a server normally running in the cluster, and back up the cluster configuration data.

   ```
   # clpcfctrl --pull –l
   ```

   After backing up the data, remove the floppy disk from the floppy disk drive.

   Note:
   Perform the subsequent procedure on the server to be restored.

2. Run **chkconfig --del *name*** in the following order to disable services on the server to be restored.
   - clusterpro_alertsync
   - clusterpro_webmgr
   - clusterpro
   - clusterpro_md (only for Replicator)
   - clusterpro_trn
   - clusterpro_evt
3. 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
   ```

   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
   ```

   Note:
   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.”
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. Insert the cluster configuration data floppy disk 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

  Command succeeded.(code:0)
```

Verify if the command is successfully displayed and completed.

Related Information:
For details on the cluster creation command, see Chapter 4, "ExpressCluster command reference" in the *Reference Guide*.

10. Remove the floppy disk from the floppy disk drive and restart the server.

Restoring the shared disk

The following describes how to restore the data on the shared 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 4, "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 following command to set the disk resource partition to Read/Write.

   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 following command to set the disk resource partition to ReadOnly.

   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 4, "ExpressCluster command reference" in the *Reference Guide*.

.

Restoring a mirror disk

The following describes how to restore the data on the mirrored 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 mirrored disk.

   Mirror 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:
For details on the command for adjusting time-out temporarily, see Chapter 4, "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 8 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

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 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:
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.
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. For more information, see “Shared disk settings (Required for shared disk)” on page 17.

Shutting down a cluster and server

To shut down a cluster or server, use ExpressCluster commands or shut down through the WebManager.

Note:
When you are using the Replicator, mirror break may occur if you do not use any ExpressCluster commands or 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 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 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 clpstdn command and the 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, refer to 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 chkconfig command. The following describes how to disable the ExpressCluster daemon. To disable the ExpressCluster daemon, you also have to disable the ExpressCluster X WebManager.

Follow the procedures below to disable the ExpressCluster daemon:

1. Run **`chkconfig --del name`** in the following order to disable services on the server where you want to disable the ExpressCluster daemon.
   - `clusterpro_alertsync`
   - `clusterpro_webmgr`
   - `clusterpro`
   - `clusterpro_md`
2. Restart the server.

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 **`chkconfig --add name`** in the following order to enable services.
   - `clusterpro_md`
   - `clusterpro`
   - `clusterpro_webmgr`
   - `clusterpro_alertsync`
2. Restart the server.

Modifying the cluster configuration data

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

Modifying the cluster configuration data using a floppy disk

In general, the cluster configuration data should be modified using a floppy disk. Use the file system only when floppy disk cannot be used. The following describes notes for using a floppy disk.

Notes for changing cluster configuration data using a floppy disk

- Floppy disk device name and mount point

  The clpcfctrl command uses /dev/fd0 as a floppy disk device, and /mnt/floppy as a mount point.

  This document assumes that the device above and mount point are available. However, the floppy disk device and mount point may be different depending on your environment, in which case, you need to specify the device and mount point with the clpcfctrl command option.

  In clpcfctrl command samples provided below, substitute the /dev/fd0 and /mnt/floppy with those in your environment.

- Manually mounting a floppy disk

  Run the following command to view the data that is saved on the floppy disk using the Builder for Windows on Linux.

  The example below assumes that the floppy disk deice is /dev/fd0 and the mount point is /mnt/floppy:

  `mount -w -t vfat -o shortname=mixed /dev/fd0 /mnt/floppy`

- The supermount service

  In some environments, the supermount service is enabled. If the settings are configured to use /mnt/floppy as a floppy disk mount point for supermount service, the clpcfctrl command to mount the floppy disk will fail.

  In such a case, suspend the supermount service or us a different mount point.

  To use a different mount point, use the –m option of the clpcfctrl command.

Related Information:
For details on options, see Chapter 4, "ExpressCluster command reference" in the *Reference Guide*.

Uploading the cluster configuration data using a floppy disk

Do either (1) or (2) below depending on the operating system on which you use the Builder. The following is an example when the floppy disk device is /dev/hda and mount point is /mnt.

1. To use the data saved in the floppy disk by the Builder on Linux, run the following command:

   clpcfctrl --push -l -d /dev/hda -m /mnt

2. To use the data saved on the floppy disk (1.44-MB, formatted) by the Builder on Windows or has the data for Windows saved by the Builder on Linux, run the following command:

   clpcfctrl --push -w -d /dev/hda -m /mnt

Related Information:
For details on the clpcfctrl command options, see Chapter 4, "ExpressCluster command reference" in the *Reference Guide*.

Backing up the cluster configuration data using a floppy disk

Do either (1) or (2) depending on the operating system on which you use the Builder. The following is an example when floppy disk device is `/dev/hda` and mount point is `/mnt`.

1. To back up data in the floppy disk for the Builder working on Linux Web browser, run the following command:

   clpcfctrl --pull -l -d /dev/hda -m /mnt

2. To back up data in a floppy disk for the Builder working on Windows Web browser, run the following command:

   clpcfctrl --pull -w -d /dev/hda -m /mnt

Related Information:
For details on the clpcfctrl command options, see Chapter 4, "ExpressCluster command reference" in the *Reference Guide*.

Modifying the cluster configuration data without using a floppy disk

To upload or back up cluster configuration data, a floppy disk needs to be used.

This document assumes that you can use a floppy disk in your environment. However, if a floppy disk is not available for use, you have to use a file system to upload and back up your cluster configuration data.

In clpcfctrl command samples provided below, substitute corresponding parameters with your environment.

Uploading the cluster configuration data when a floppy disk is not available for use

You can access the cluster configuration data saved on the file system from the server you are uploading data. Access the cluster configuration data from the master server by using FTP.

Do either (1) or (2) depending on the operating system on which you use the Builder. The following example assumes that the cluster configuration data is in the /tmp/upload directory.

1. If you use the cluster configuration data saved by the Builder on Linux, run the following command:

   ```
   clpcfctrl --push -l -x /tmp/upload
   ```

2. If you use the cluster configuration data saved by the Builder on Windows, run the following command:

   ```
   clpcfctrl --push -w -x /tmp/upload
   ```

Related Information:
For details on the clpcfctrl command options, see Chapter 4, “ExpressCluster command reference” in the *Reference Guide*.

Backing up the cluster configuration data when a floppy disk is not available for use

Do either (1) or (2) depending on the operating system on which you use the Builder. The following example assumes that data is backed up in the /tmp/backup directory.

1. To back up the cluster configuration data for the Builder working on Linux Web browser, run the following command:

   ```
   clpcfctrl --pull -l -x /tmp/backup
   ```

2. To back up the cluster configuration data for the Builder working on Windows Web browser, run the following command:

   ```
   clpcfctrl --pull -w -x /tmp/backup
   ```

Related Information:
For details on the clpcfctrl command options, see Chapter 4, “ExpressCluster command reference” in the *Reference Guide*.

Changing the cluster configuration data

Before you reconfigure the ExpressCluster Server or change its parameters, you must back up the cluster configuration data in a floppy disk. Backing up can be done with the clpcfctrl command. For details, see Chapter 4, “ExpressCluster command reference” in the *Reference Guide*.

Modify the data in the floppy disk by using the ExpressCluster X Builder. For details of the ExpressCluster X Builder, see Chapter 3, “Functions of the Builder” in the *Reference Guide*.

Reflect the changes in the floppy disk on the ExpressCluster Server environment. The way to reflect them varies depending on the nature of the changes. For details on how to change parameters and how to reflect them, refer to the *Reference Guide*.

The way you reflect changed parameters may affect behavior of the ExpressCluster X. For details, see the table below:

#	The way to reflect changes	Effect
1	Upload Only	The operation of the ExpressCluster Server is not affected. Heartbeat resources, group resources or resource monitor does not stop.
2	Suspending and resuming the ExpressCluster daemon	The operation of the ExpressCluster Server partly stops. While the ExpressCluster daemon is suspended, heartbeat resources and resource monitoring stop. Group resources do not stop.
3	Stopping and restarting the ExpressCluster daemon Shutting down and restarting the cluster	All operations of the ExpressCluster Server stop. While the ExpressCluster daemon is stopped, heartbeat resources, group resources and resource monitoring stop.

Note:
If the ExpressCluster daemon needs to be suspended or stopped to reflect the modified data, ensure it is suspended or stopped before reflecting the data in a floppy disk.
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 Section III 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” are reported.

Uploading the data

1. Insert the floppy disk in the server specified as the master server by the Builder.
2. Distribute the configuration data in the floppy disk to all the servers registered in the cluster configuration information. Do either (A) or (B) depending on the floppy disk type you used to save the data by the Builder:

   (A) If you created the configuration data on a Linux computer, run the following command with the –l option:

   ```
   clpcfctrl --push -l
   ```

   (B) If you created the configuration data on a Windows computer (on 1.44-MB formatted floppy disk), or created the configuration data as a Windows file on Linux, run the following command with the –w option:

   ```
   clpcfctrl --push -w
   ```

3. The following message is displayed if the data has successfully been distributed.

   Command succeeded.(code:0)

   For troubleshooting while running clpcfctrl, see Chapter 4, “ExpressCluster command reference” in the *Reference Guide*.

4. Remove the floppy disk from the floppy disk drive.

Stopping and restarting ExpressCluster X alert synchronization

For information on how to stop and restart ExpressCluster X Alert Synchronization, see Chapter 1, "Functions of the WebManager” in the *Reference Guide*.

Stopping and restarting the ExpressCluster X WebManager

For information on how to stop/restart ExpressCluster X WebManager, see Chapter 1, "Functions of the WebManager” in the *Reference Guide*.

Suspending and resuming the ExpressCluster daemon

If you want to reconfigure the cluster by adding or deleting a server, follow the steps below and suspend the ExpressCluster daemon.

1. Run clpcl –suspend to suspend the ExpressCluster daemon.
2. Insert the floppy disk in the server specified as the master server by the Builder.
3. Distribute the configuration data in the floppy disk to all the servers registered in the cluster configuration information. Do either (A) or (B) depending on the floppy disk type you used to save the data by the Builder:

   (A) If you created the configuration data on a Linux computer, run the following command with the –l option:

   `clpcfctrl --push -l`

   (B) If you created the configuration data on a Windows computer (on 1.44-MB formatted floppy disk), or created the configuration data as a Windows file on Linux, run the following command with the –w option:

   `clpcfctrl --push -w`

4. After executing the command, the message below is displayed. Press **Y** and the **RETURN** key.

   ```
   Need to suspend cluster and resume
   Already suspended? (y/n) :
   ```

5. After clicking the **RETURN** key, the following message is displayed if the data has successfully been distributed.

   Command succeeded.(code:0)

   For troubleshooting while running clpcfctrl, see Chapter 4, “ExpressCluster command reference” in the *Reference Guide*.

6. Remove the floppy disk from the floppy disk drive.
7. Run the **`clpcl –resume`** to resume the ExpressCluster daemon.

Stopping and restarting the ExpressCluster daemon

1. Run the **clpcl -t -a** to stop the ExpressCluster daemon.
2. Insert the floppy disk in the server specified as the master server by the Builder.
3. Distribute the configuration data in the floppy disk to all the servers registered in the cluster configuration information. Do either (A) or (B) depending on the floppy disk type you used to save the data by the Builder:

   (A) If you created the configuration data on a Linux computer, run the following command with the –l option:

   clpcfctrl --push -l

   (B) If you created the configuration data on a Windows computer (on 1.44-MB formatted floppy disk), or created the configuration data as a Windows file on Linux, run the following command with the –w option:

   clpcfctrl --push -w

   The following message is displayed if the data has successfully been distributed.

   ```
   Need to stop cluster and restart
   Already stopped? (y/n) :
   ```

   After clicking the **RETURN** key, the following message is displayed if the data has successfully been distributed.

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

   For troubleshooting while running clpcfctrl, see Chapter 4, “ExpressCluster command reference” in the *Reference Guide*.
4. Remove the floppy disk from the floppy disk drive.
5. Run the **clpcl -s -a** to restart the ExpressCluster daemon.

Shutting down and restarting a cluster

1. Run **clpcl -t -a** to stop the ExpressCluster daemon.
2. Insert the floppy disk in the server specified as the master server when you created the configuration data by using the Builder.
3. Distribute the configuration data in the floppy disk to all the servers registered in the cluster configuration information. Do either (A) or (B) depending on the floppy disk type you used to save the data by the Builder:

   (A) If you created the configuration data on a Linux computer, run the following command with the –l option:

   clpcfctrl --push -l

   (B) If you created the configuration data on a Windows computer (on 1.44-MB formatted floppy disk), or created the configuration data as a Windows file on Linux, run the following command with the –w option:

   clpcfctrl --push -w

   After executing the command, the message below is displayed. Click the **RETURN** key.

   ```
   Need to shutdown system and reboot
   please shutdown system after push. (hit return) :
   ```

   After clicking the **RETURN** key, the following message is displayed if the data has successfully been distributed.

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

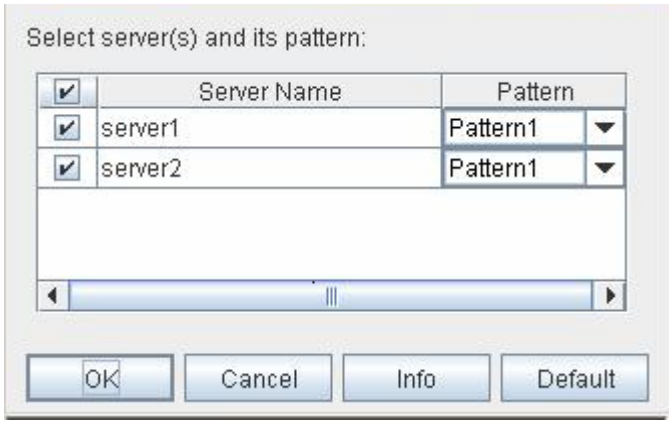
   For troubleshooting while running clpcfctrl, refer to Chapter 3, “Function of the Builder” in the *Reference Guide*.
4. Remove the floppy disk from the floppy disk drive.
5. Restart all servers.

Checking the log collecting procedure

The following describes how to collect logs by using the WebManager.

Collecting logs by using the WebManager

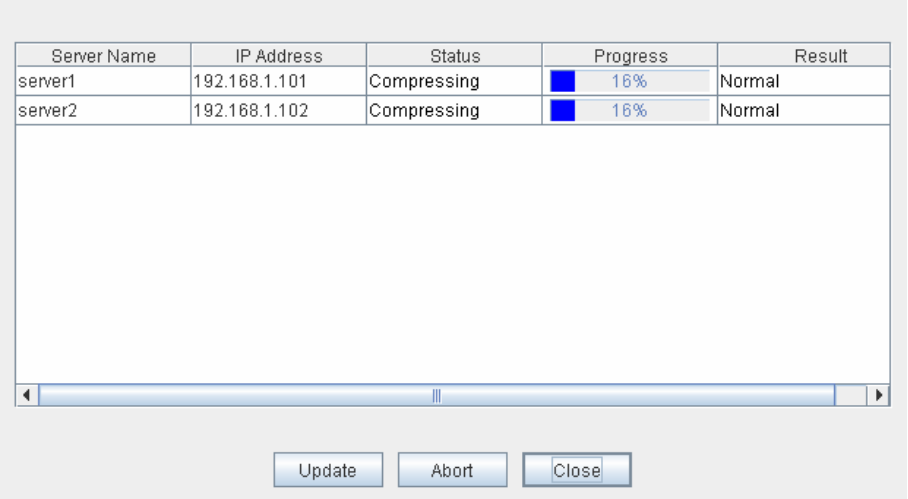
1. Start the WebManager (http://*Floating_IP_address_of_WebManager_group*:*port_number* (default: 29003).
2. In the title view, click **Collect Logs**. The log collection dialog box will open.



3. Select the check box of the servers for collecting log and select a log collection pattern.

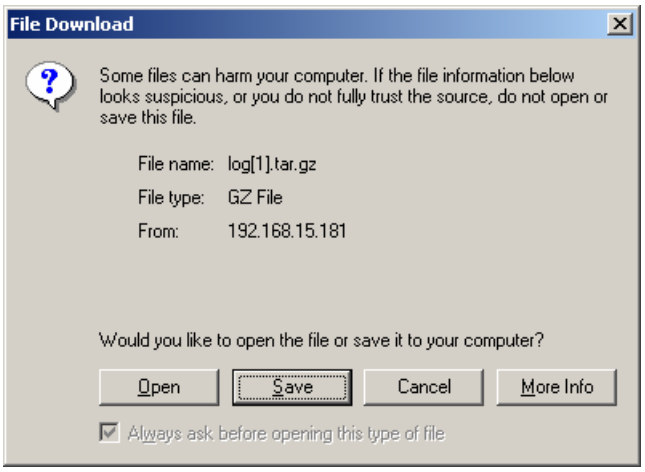
   To view details of the pattern, click the **Info** button. To reset the settings, click the **Default** button.

4. Click **OK**. Log collection will start and the dialog box that shows the progress of log collection will open.



   The progress is displayed in the **Progress** column. To view the latest status, click the **Update** button.

5. When log collection is completed, a file saving dialog box of the browser is displayed. Specify a location to store the file and down load the logs.



Note:
Logs may not be downloaded properly if nothing is changed for more than 10 minutes.

When you collect logs, the following message may be displayed in the server console. However, this will not affect log collection. Ignore this message.

```
hda: bad special flag: 0x03
ip_tables: (C) 2000-2002 Netfilter core team
```

Note:
If other modal dialog is displayed while collecting logs, the file saving dialog box for the log collection will not be displayed. To display the file saving dialog box, terminate the modal dialog.

Chapter 9 Uninstalling and reinstalling ExpressCluster

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

Uninstallation

Uninstalling the ExpressCluster Server

Note:
You must log on as root user when uninstalling the ExpressCluster Server.

Follow the procedures below to uninstall the ExpressCluster Server:

1. Run the **`chkconfig --del name`** to disable the following services in this order.
   - `clusterpro_alertsync`
   - `clusterpro_webmgr`
   - `clusterpro`
   - `clusterpro_md`
   - `clusterpro_trn`
   - `clusterpro_evt`
2. Restart the server.
3. Run the **`rpm -e expresscls`** command.

Note:
Do not specify other options than the one stated above.

Uninstalling the ExpressCluster X Builder

For Linux

Note:
You must log on as root user when uninstalling the ExpressCluster X Builder.

Follow the procedures below to uninstall the ExpressCluster X Builder:

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

Note:
Do not specify other options than the one stated above.

3. Delete Java user policy file settings.
   Delete the ExpressCluster X Builder settings, which were added at installation, from .the java.policy file in the home directory. For details on the ExpressCluster X Builder settings, see “Installing the ExpressCluster X Builder” in Chapter 3.

For Windows

To uninstall the ExpressCluster X 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 ExpressCluster X Builder installation folder from Windows Explorer.
3. Delete Java user policy file settings.
   Delete ExpressCluster X Builder settings, which were added at installation, from the .java.policy file in the home directory. For details on ExpressCluster X Builder settings, refer to Chapter 3, “Functions of the Builder” in the *Reference Guide*.

Reinstallation

Reinstalling the ExpressCluster Server

To reinstall the ExpressCluster Server, you have to prepare the cluster configuration data floppy disk (or the latest data floppy disk if you reconfigured the cluster) created by the Builder.

If you do not have the cluster configuration data floppy disk (or the latest data floppy disk if you reconfigured the cluster) created by the Builder at hand, you can back up the data with the clpcfctrl command. For details, see Chapter 4, “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.”
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, refer to “Uninstalling the ExpressCluster Server.”
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 clpcfctrl, refer to the *Reference Guide*.

4. 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.”
5. 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 ExpressCluster X 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 ExpressCluster X 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.

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 services by using the chkconfig command, restart the server, and uninstall the ExpressCluster again.

Troubleshooting for licensing

Behavior and Message	Cause	Action
When the command was executed, the following message appeared in the console: "Log in as root."	The command was executed by a general user.	Log on as root user or log on again after changing to root user with su -.
When the command was executed at the license registration, the following message appeared in the console: "Command succeeded. But the license was not applied to all the servers in the cluster because there are one or more servers that are not started up."	The transaction server may not be active, or the cluster configuration data may be yet to be distributed.	Check again whether the transaction server is activated and the cluster configuration data is distributed on all servers. If either of them is not done yet, complete the task and register the license again.
When the cluster was shut down and rebooted after distribution of the configuration data created by the Builder to all servers, the following message was displayed on the WebManager's alert view, and the cluster stopped. "The license is not registered. (%1)" %1: Product ID	The cluster has been shut down and rebooted without its license being registered.	Register the license from one of the servers in the cluster.
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 WebManager's alert view, but the cluster is working properly. "The license is insufficient. The number of insufficient is %1. (%2)" %1: The number of licenses in short of supply %2: Product ID	The number of licenses is insufficient.	Obtain a license and register it.
While the cluster was operated on the trial license, the following message appeared and the cluster stopped. "The license of trial expired by %1. (%2)" %1: Trial end date %2: Product ID	The license has already expired.	Ask your sales agent for extension of the trial version license, or obtain and register the product version 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[5]	IP address used to configure a remote cluster.
Management client	Any machine that uses the 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. (Related term: Cluster partition)
Network partition	All heartbeat is lost and the network between servers is partitioned. (Related terms: Interconnect, Heartbeat)

[5] This applies only for Windows version.

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 on top of the **Master Server** in **Cluster Properties** in the Builder.
Mirror connect	LAN used for data mirroring in a data mirror type cluster. 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

S

T

U

V

W