ExpressCluster® X 3.2 *for Linux*

Getting Started Guide

Revision History

Edition	Revised Date	Description
1st	2/19/2014	New manual
2nd	5/23/2014	Corresponds to the internal version 3.2.1-1.

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Table of Contents

Preface

Who Should Use This Guide

ExpressCluster Getting Started Guide is intended for first-time users of the ExpressCluster. The guide covers topics such as product overview of the ExpressCluster, how the cluster system is installed, and the summary of other available guides. In addition, latest system requirements and restrictions are described.

How This Guide is Organized

Section I   **Introducing ExpressCluster**

Chapter 1   **What is a cluster system?**
Helps you to understand the overview of the cluster system and ExpressCluster.
Chapter 2   **Using ExpressCluster**
Provides instructions on how to use a cluster system and other related-information.

Section II   **Installing ExpressCluster**

Chapter 3   **Installation requirements for ExpressCluster**
Provides the latest information that needs to be verified before starting to use ExpressCluster.
Chapter 4   **Latest version information**
Provides information on latest version of the ExpressCluster.
Chapter 5   **Notes and Restrictions**
Provides information on known problems and restrictions.
Chapter 6   **Upgrading ExpressCluster**
Provides instructions on how to update the ExpressCluster.

Appendix

Appendix A   **Glossary**

Appendix B   **Index**

ExpressCluster X Documentation Set

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

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

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

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

ExpressCluster X Integrated WebManager Administrator's Guide
This guide is intended for system administrators who manage cluster systems using ExpressCluster with Integrated WebManager, and also intended for system engineers who introduce Integrated WebManager. This guide describes detailed issues necessary for introducing Integrated WebManager in the actual procedures.

ExpressCluster X WebManager Mobile Administrator's Guide
This guide is intended for system administrators who manage cluster systems using ExpressCluster with ExpressCluster WebManager Mobile and for system engineers who are installing the WebManager Mobile. In this guide, details on those items required for installing the cluster system using the WebManager Mobile are explained in accordance with the actual procedures.

Conventions

In this guide, **Note**, **Important**, **Related Information** are used as follows:

Note:

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

Important:

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

Related Information:

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

The following conventions are used in this guide.

Convention	Usage	Example
Bold	Indicates graphical objects, such as fields, list boxes, menu selections, buttons, labels, icons, etc.	In **User Name**, type your name. On the **File** menu, click **Open Database**.
Angled bracket within the command line	Indicates that the value specified inside of the angled bracket can be omitted.	`clpstat –s[-h host_name]`
#	Prompt to indicate that a Linux user has logged in as root user.	`# clpcl -s -a`
Monospace (courier)	Indicates path names, commands, system output (message, prompt, etc.), directory, file names, functions and parameters.	`/Linux/3.0/en/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.nec.com/global/prod/expresscluster/

Section I Introducing ExpressCluster

This section helps you to understand the overview of ExpressCluster and its system requirements. This section covers:

- Chapter 1   What is a cluster system?
- Chapter 2   Using ExpressCluster

Chapter 1   What is a cluster system?

This chapter describes overview of the cluster system.
This chapter covers:

Overview of the cluster system

A key to success in today's computerized world is to provide services without them stopping. A single machine down due to a failure or overload can stop entire services you provide with customers. This will not only result in enormous damage but also in loss of credibility you once enjoyed.

A cluster system is a solution to tackle such a disaster. Introducing a cluster system allows you to minimize the period during which operation of your system stops (down time) or to avoid system-down by load distribution.

As the word "cluster" represents, a cluster system is a system aiming to increase reliability and performance by clustering a group (or groups) of multiple computers. There are various types of cluster systems, which can be classified into the following three listed below. ExpressCluster is categorized as a high availability cluster.

High Availability (HA) Cluster

In this cluster configuration, one server operates as an active server. When the active server fails, a standby server takes over the operation. This cluster configuration aims for high-availability and allows data to be inherited as well. The high availability cluster is available in the shared disk type, data mirror type or remote cluster type.

Load Distribution Cluster

This is a cluster configuration where requests from clients are allocated to load-distribution hosts according to appropriate load distribution rules. This cluster configuration aims for high scalability. Generally, data cannot be taken over. The load distribution cluster is available in a load balance type or parallel database type.

High Performance Computing (HPC) Cluster

This is a cluster configuration where CPUs of all nodes are used to perform a single operation. This cluster configuration aims for high performance but does not provide general versatility. Grid computing, which is one of the types of high performance computing that clusters a wider range of nodes and computing clusters, is a hot topic these days.

High Availability (HA) cluster

To enhance the availability of a system, it is generally considered that having redundancy for components of the system and eliminating a single point of failure is important. "Single point of failure" is a weakness of having a single computer component (hardware component) in the system. If the component fails, it will cause interruption of services. The high availability (HA) cluster is a cluster system that minimizes the time during which the system is stopped and increases operational availability by establishing redundancy with multiple servers.

The HA cluster is called for in mission-critical systems where downtime is fatal. The HA cluster can be divided into two types: shared disk type and data mirror type. The explanation for each type is provided below.

Shared disk type

Data must be inherited from one server to another in cluster systems. A cluster topology where data is stored in a shared disk with two or more servers using the data is called shared disk type.

| Shared Disk Type | Data Mirror Type |

- Expensive since a shared disk is necessary.
- Ideal for the system that handles large data

- Cheap since a shared disk is unnecessary.
- Ideal for the system with less data volume because of mirroring.
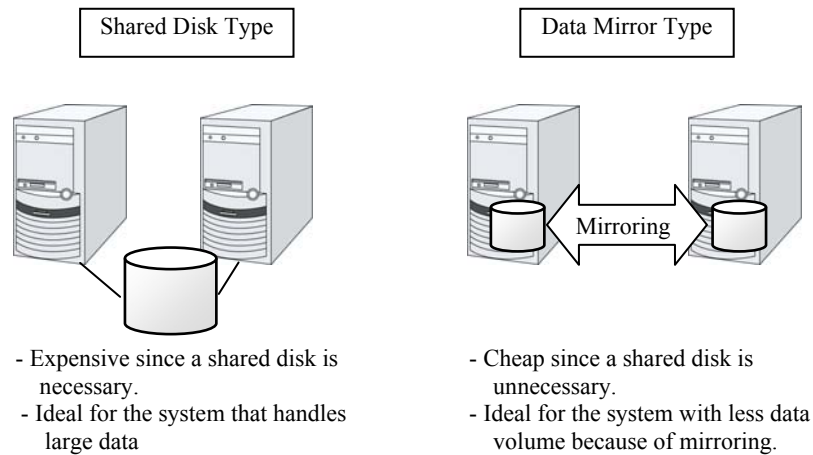
Figure 1-1: HA cluster configuration

If a failure occurs on a server where applications are running (active server), the cluster system detects the failure and applications are automatically started in a standby server to take over operations. This mechanism is called failover. Operations to be inherited in the cluster system consist of resources including disk, IP address and application.

In a non-clustered system, a client needs to access a different IP address if an application is restarted on a server other than the server where the application was originally running. In contrast, many cluster systems allocate a virtual IP address on an operational basis. A server where the operation is running, be it an active or a standby server, remains transparent to a client. The operation is continued as if it has been running on the same server.

File system consistency must be checked to inherit data. A check command (for example, fsck or chkdsk in Linux) is generally run to check file system consistency. However, the larger the file system is, the more time spent for checking. While checking is in process, operations are stopped. For this problem, journaling file system is introduced to reduce the time required for failover.

Logic of the data to be inherited must be checked for applications. For example, roll-back or roll-forward is necessary for databases. With these actions, a client can continue operation only by re-executing the SQL statement that has not been committed yet.

A server with the failure can return to the cluster system as a standby server if it is physically separated from the system, fixed, and then succeeds to connect the system. Such returning is acceptable in production environments where continuity of operations is important.
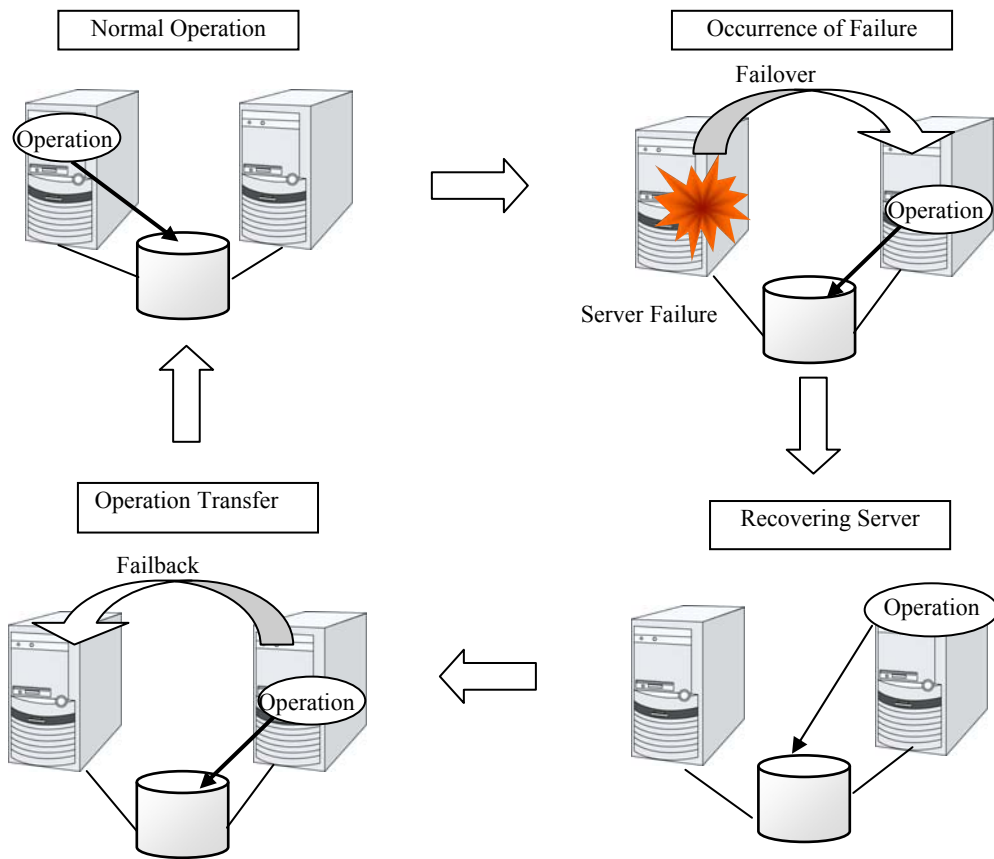
Figure 1-2: From occurrence of a failure to recovery

When the specification of the failover destination server does not meet the system requirements or overload occurs due to multi-directional standby, operations on the original server are preferred. In such a case, a failback takes place to resume operations on the original server.

A standby mode where there is one operation and no operation is active on the standby server, as shown in Figure 1-3, is referred to as uni-directional standby. A standby mode where there are two or more operations with each server of the cluster serving as both active and standby servers is referred to as multi-directional standby.
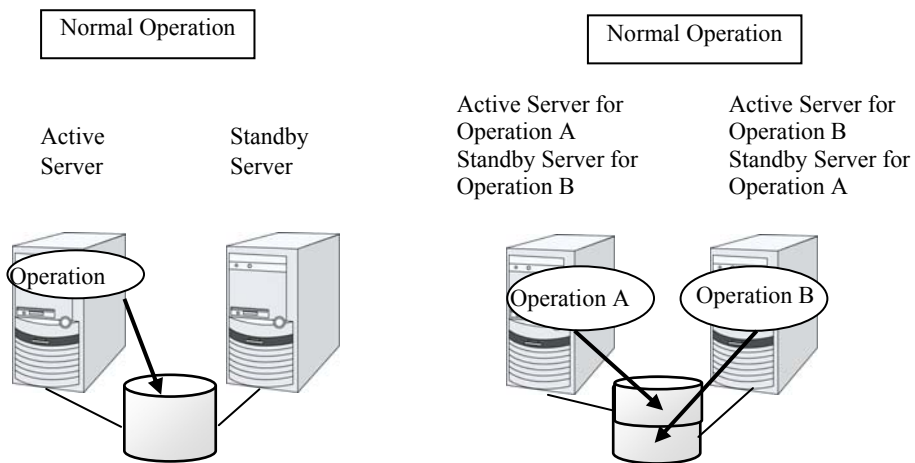
Figure 1-3: HA cluster topology

Data mirror type

The shared disk type cluster system is good for large-scale systems. However, creating a system with this type can be costly because shared disks are generally expensive. The data mirror type cluster system provides the same functions as the shared disk type with smaller cost through mirroring of server disks.

The data mirror type is not recommended for large-scale systems that handle a large volume of data since data needs to be mirrored between servers.

When a write request is made by an application, the data mirror engine not only writes data in the local disk but sends the write request to the standby server via the interconnect. Interconnect is a network connecting servers. It is used to monitor whether or not the server is activated in the cluster system. In addition to this purpose, interconnect is sometimes used to transfer data in the data mirror type cluster system. The data mirror engine on the standby server achieves data synchronization between standby and active servers by writing the data into the local disk of the standby server.

For read requests from an application, data is simply read from the disk on the active server.
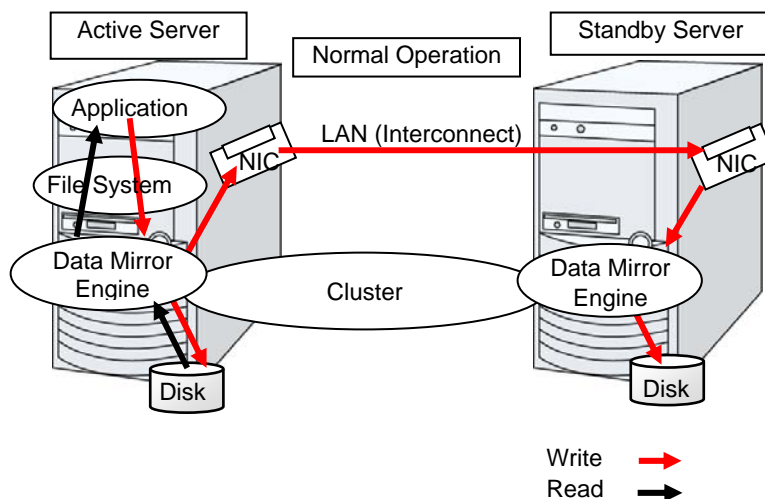
Figure 1-4: Data mirror mechanism

Snapshot backup is applied usage of data mirroring. Because the data mirror type cluster system has shared data in two locations, you can keep the disk of the standby server as snapshot backup without spending time for backup by simply separating the server from the cluster.

Failover mechanism and its problems

There are various cluster systems such as failover clusters, load distribution clusters, and high performance computing (HPC) clusters. The failover cluster is one of the high availability (HA) cluster systems that aim to increase operational availability through establishing server redundancy and passing operations being executed to another server when a failure occurs.

Error detection mechanism

Cluster software executes failover (for example, passing operations) when a failure that can impact continued operation is detected. The following section gives you a quick view of how the cluster software detects a failure.

Heartbeat and detection of server failures

Failures that must be detected in a cluster system are failures that can cause all servers in the cluster to stop. Server failures include hardware failures such as power supply and memory failures, and OS panic. To detect such failures, heartbeat is employed to monitor whether or not the server is active.

Some cluster software programs use heartbeat not only for checking whether or not the target is active through ping response, but for sending status information on the local server. Such cluster software programs begin failover if no heartbeat response is received in heartbeat transmission, determining no response as server failure. However, grace time should be given before determining failure, since a highly loaded server can cause delay of response. Allowing grace period results in a time lag between the moment when a failure occurred and the moment when the failure is detected by the cluster software.

Detection of resource failures

Factors causing stop of operations are not limited to stop of all servers in the cluster. Failure in disks used by applications, NIC failure, and failure in applications themselves are also factors that can cause the stop of operations. These resource failures need to be detected as well to execute failover for improved availability.

Accessing a target resource is a way employed to detect resource failures if the target is a physical device. For monitoring applications, trying to service ports within the range not impacting operation is a way of detecting an error in addition to monitoring whether or not application processes are activated.

Problems with shared disk type

In a failover cluster system of the shared disk type, multiple servers physically share the disk device. Typically, a file system enjoys I/O performance greater than the physical disk I/O performance by keeping data caches in a server.

What if a file system is accessed by multiple servers simultaneously?

Because a general file system assumes no server other than the local updates data on the disk, inconsistency between caches and the data on the disk arises. Ultimately the data will be corrupted. The failover cluster system locks the disk device to prevent multiple servers from mounting a file system, simultaneously caused by a network partition.
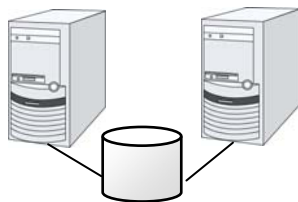
Figure 1-5: Cluster configuration with a shared disk

Network partition (split-brain-syndrome)

When all interconnects between servers are disconnected, failover takes place because the servers assume other server(s) are down. To monitor whether the server is activated, a heartbeat communication is used. As a result, multiple servers mount a file system simultaneously causing data corruption. This explains the importance of appropriate failover behavior in a cluster system at the time of failure occurrence.
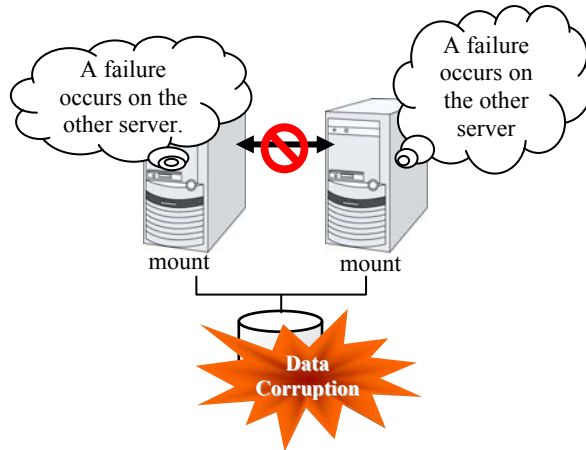
Figure 1-6: Network partition problem

The problem explained in the section above is referred to as "network partition" or "split-brain syndrome." The failover cluster system is equipped with various mechanisms to ensure shared disk lock at the time when all interconnects are disconnected.

Taking over cluster resources

As mentioned earlier, resources to be managed by a cluster include disks, IP addresses, and applications. The functions used in the failover cluster system to inherit these resources are described below.

Taking over the data

Data to be passed from a server to another in a cluster system is stored in a partition on the shared disk. This means data is re-mounting the file system of files that the application uses on a healthy server. What the cluster software should do is simply mount the file system because the shared disk is physically connected to a server that inherits data.
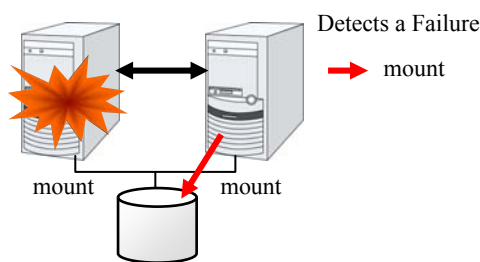
Figure 1-7: Taking over data

Figure 1-7 may look simple, but consider the following issues in designing and creating a cluster system.

One issue to consider is recovery time for a file system. A file system to be inherited may have been used by another server or being updated just before the failure occurred and requires a file system consistency check. When the file system is large, the time spent for checking consistency will be enormous. It may take a few hours to complete the check and the time is wholly added to the time for failover (time to take over operation), and this will reduce system availability.

Another issue you should consider is writing assurance. When an application writes important data into a file, it tries to ensure the data to be written into a disk by using a function such as synchronized writing. The data that the application assumes to have been written is expected to be inherited after failover. For example, a mail server reports the completion of mail receiving to other mail servers or clients after it has securely written mails it received in a spool. This will allow the spooled mail to be distributed again after the server is restarted. Likewise, a cluster system should ensure mails written into spool by a server to become readable by another server.

Taking over the applications

The last to come in inheritance of operation by cluster software is inheritance of applications. Unlike fault tolerant computers (FTC), no process status such as contents of memory is inherited in typical failover cluster systems. The applications running on a failed server are inherited by rerunning them on a healthy server.

For example, when instances of a database management system (DBMS) are inherited, the database is automatically recovered (roll-forward/roll-back) by startup of the instances. The time needed for this database recovery is typically a few minutes though it can be controlled by configuring the interval of DBMS checkpoint to a certain extent.

Many applications can restart operations by re-execution. Some applications, however, require going through procedures for recovery if a failure occurs. For these applications, cluster software allows to start up scripts instead of applications so that recovery process can be written. In a script, the recovery process, including cleanup of files half updated, is written as necessary according to factors for executing the script and information on the execution server.

Summary of failover

To summarize the behavior of cluster software:

◆   Detects a failure (heartbeat/resource monitoring)

◆   Resolves a network partition (NP resolution)

◆   Switches cluster resources

   •   Pass data

   •   Pass IP address

   •   Application Taking over
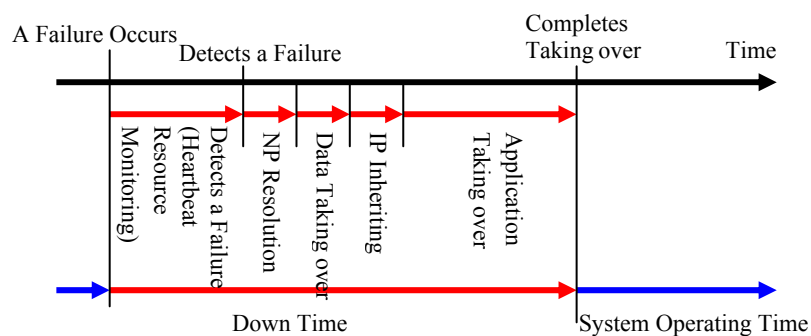
Figure 1-8: Failover time chart

Cluster software is required to complete each task quickly and reliably (see Figure 1-8). Cluster software achieves high availability with due consideration on what has been described so far.

Eliminating single point of failure

Having a clear picture of the availability level required or aimed is important in building a high availability system. This means when you design a system, you need to study cost effectiveness of countermeasures, such as establishing a redundant configuration to continue operations and recovering operations within a short period of time, against various failures that can disturb system operations.

Single point of failure (SPOF), as described previously, is a component where failure can lead to stop of the system. In a cluster system, you can eliminate the system's SPOF by establishing server redundancy. However, components shared among servers, such as shared disk may become a SPOF. The key in designing a high availability system is to duplicate or eliminate this shared component.

A cluster system can improve availability but failover will take a few minutes for switching systems. That means time for failover is a factor that reduces availability. Solutions for the following three, which are likely to become SPOF, will be discussed hereafter although technical issues that improve availability of a single server such as ECC memory and redundant power supply are important.

◆ Shared disk

◆ Access path to the shared disk

◆ LAN

Shared disk

Typically a shared disk uses a disk array for RAID. Because of this, the bare drive of the disk does not become SPOF. The problem is the RAID controller is incorporated. Shared disks commonly used in many cluster systems allow controller redundancy.

In general, access paths to the shared disk must be duplicated to benefit from redundant RAID controller. There are still things to be done to use redundant access paths in Linux (described later in this chapter). If the shared disk has configuration to access the same logical disk unit (LUN) from duplicated multiple controllers simultaneously, and each controller is connected to one server, you can achieve high availability by failover between nodes when an error occurs in one of the controllers.
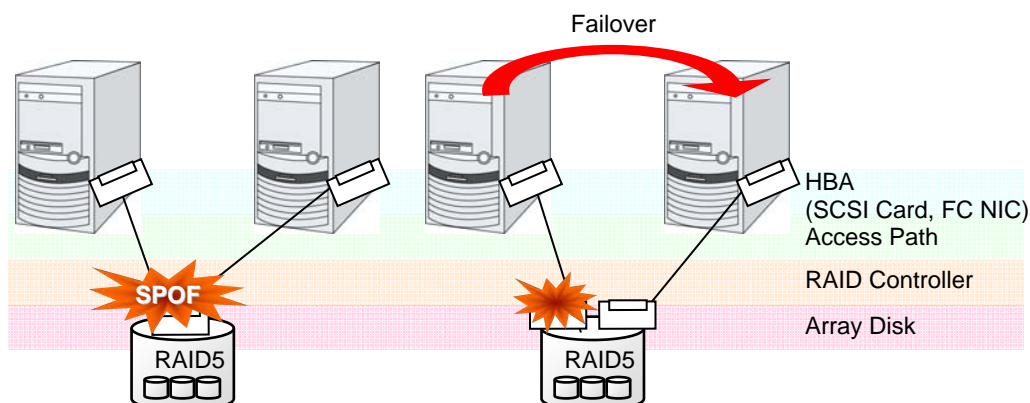
Figure 1-9: Example of the shared disk RAID controller and access paths being SPOF (left) and an access path connected to a RAID controller

With a failover cluster system of data mirror type, where no shared disk is used, you can create an ideal system having no SPOF because all data is mirrored to the disk in the other server. However you should consider the following issues:

◆ Disk I/O performance in mirroring data over the network (especially writing performance)

◆ System performance during mirror resynchronization in recovery from server failure (mirror copy is done in the background)

◆ Time for mirror resynchronization (clustering cannot be done until mirror resynchronization is completed)

In a system with frequent data viewing and a relatively small volume of data, choosing the data mirror type for clustering is a key to increase availability.

Access path to the shared disk

In a typical configuration of the shared disk type cluster system, the access path to the shared disk is shared among servers in the cluster. To take SCSI as an example, two servers and a shared disk are connected to a single SCSI bus. A failure in the access path to the shared disk can stop the entire system.

What you can do for this is to have a redundant configuration by providing multiple access paths to the shared disk and make them look as one path for applications. The device driver allowing such is called a path failover driver. Path failover drivers are often developed and released by shared disk vendors. Path failover drivers in Linux are still under development. For the time being, as discussed earlier, offering access paths to the shared disk by connecting a server on an array controller on the shared disk basis is the way to ensure availability in Linux cluster systems.
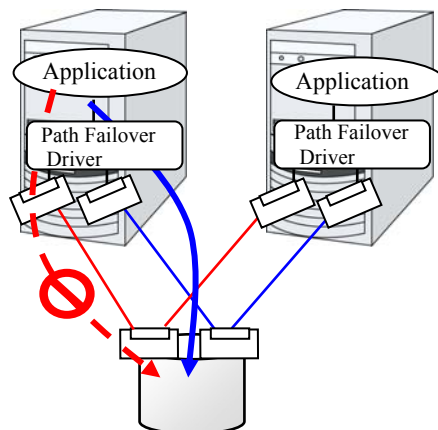
Figure 1-10: Path failover driver

LAN

In any systems that run services on a network, a LAN failure is a major factor that disturbs operations of the system. If appropriate settings are made, availability of cluster system can be increased through failover between nodes at NIC failures. However, a failure in a network device that resides outside the cluster system disturbs operation of the system.
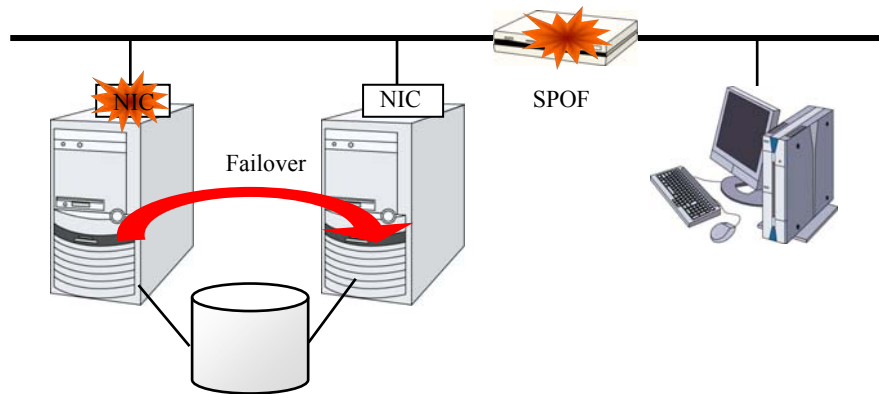
Figure 1-11: Example of router becoming SPOF

LAN redundancy is a solution to tackle device failure outside the cluster system and to improve availability. You can apply ways used for a single server to increase LAN availability. For example, choose a primitive way to have a spare network device with its power off, and manually replace a failed device with this spare device. Choose to have a multiplex network path through a redundant configuration of high-performance network devices, and switch paths automatically. Another option is to use a driver that supports NIC redundant configuration such as Intel's ANS driver.

Load balancing appliances and firewall appliances are also network devices that are likely to become SPOF. Typically they allow failover configurations through standard or optional software. Having redundant configuration for these devices should be regarded as requisite since they play important roles in the entire system.

Operation for availability

Evaluation before staring operation

Given many of factors causing system troubles are said to be the product of incorrect settings or poor maintenance, evaluation before actual operation is important to realize a high availability system and its stabilized operation. Exercising the following for actual operation of the system is a key in improving availability:

◆ Clarify and list failures, study actions to be taken against them, and verify effectiveness of the actions by creating dummy failures.

◆ Conduct an evaluation according to the cluster life cycle and verify performance (such as at degenerated mode)

◆ Arrange a guide for system operation and troubleshooting based on the evaluation mentioned above.

Having a simple design for a cluster system contributes to simplifying verification and improvement of system availability.

Failure monitoring

Despite the above efforts, failures still occur. If you use the system for long time, you cannot escape from failures: hardware suffers from aging deterioration and software produces failures and errors through memory leaks or operation beyond the originally intended capacity. Improving availability of hardware and software is important yet monitoring for failure and troubleshooting problems is more important. For example, in a cluster system, you can continue running the system by spending a few minutes for switching even if a server fails. However, if you leave the failed server as it is, the system no longer has redundancy and the cluster system becomes meaningless should the next failure occur.

If a failure occurs, the system administrator must immediately take actions such as removing a newly emerged SPOF to prevent another failure. Functions for remote maintenance and reporting failures are very important in supporting services for system administration. Linux is known for providing good remote maintenance functions. Mechanism for reporting failures are coming in place. To achieve high availability with a cluster system, you should:

◆ Remove or have complete control on single point of failure.

◆ Have a simple design that has tolerance and resistance for failures, and be equipped with a guide for operation and troubleshooting.

◆ Detect a failure quickly and take appropriate action against it.

Chapter 2 Using ExpressCluster

This chapter explains the components of ExpressCluster, how to design a cluster system, and how to use ExpressCluster.

This chapter covers:

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 a standby server when an error occurs in the active server.

ExpressCluster modules

ExpressCluster consists of following three modules:

ExpressCluster Server

A core component of ExpressCluster. Includes all high availability function of the server. The server function of the WebManager is also included.

ExpressCluster X WebManager (WebManager)

A tool to manage ExpressCluster operations. 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 from the Web browser on the management PC.

ExpressCluster X Builder (Builder)

A tool for editing the cluster configuration data. The Builder also uses Web browser as a user interface. The following two versions of Builder are provided: the offline version, which is installed on your terminal as software independent of ExpressCluster Server, and the online version, which is opened by clicking the setup mode icon on the WebManager screen toolbar or Setup Mode on the View menu. The Builder needs to be installed separately from the ExpressCluster Server on the machine where you use the Builder.

Software configuration of ExpressCluster

The software configuration of ExpressCluster should look similar to the figure below. Install the ExpressCluster Server (software) on a Linux server, and the Builder on a management PC or a server. Because the main functions of WebManager and Builder are included in ExpressCluster Server, it is not necessary to separately install them. However, to use the Builder in an environment where ExpressCluster Server is not accessible, the offline version of Builder must be installed on the PC. The WebManager or Builder can be used through the Web browser on the management PC or on each server in the cluster.
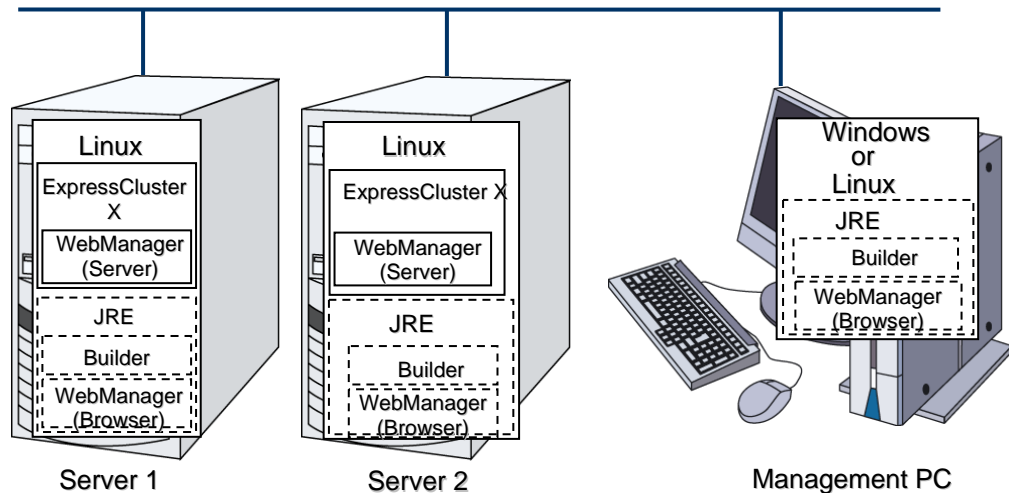
Figure 2-1 Software configuration of ExpressCluster

How an error is detected in ExpressCluster

There are three kinds of monitoring in ExpressCluster: (1) server monitoring, (2) application monitoring, and (3) internal monitoring. These monitoring functions let you detect an error quickly and reliably. The details of the monitoring functions are described below.

What is server monitoring?

Server monitoring is the most basic function of the failover-type cluster system. It monitors if a server that constitutes a cluster is properly working.

ExpressCluster regularly checks whether other servers are properly working in the cluster system. This way of verification is called "heartbeat communication." The heartbeat communication uses the following communication paths:

Primary Interconnect

Uses an Ethernet NIC in communication path dedicated to the failover-type cluster system. This is used to exchange information between the servers as well as to perform heartbeat communication.

Secondary Interconnect

Uses a communication path used for communication with client machine as an alternative interconnect. Any Ethernet NIC can be used as long as TCP/IP can be used. This is also used to exchange information between the servers and to perform heartbeat communication.

1. Primary Interconnect
2. Secondary Interconnect
3. Shared disk
4. COM port
5. BMC
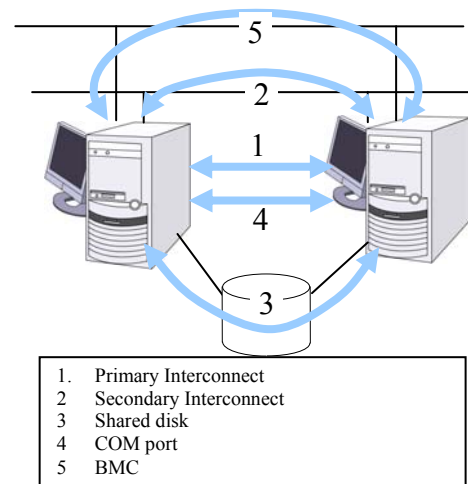
Figure 2-2 Server monitoring

Shared disk

Creates an ExpressCluster-dedicated partition (ExpressCluster partition) on the disk that is connected to all servers that constitute the failover-type cluster system, and performs heartbeat communication on the ExpressCluster partition.

COM port

Performs heartbeat communication between the servers that constitute the failover-type cluster system through a COM port, and checks whether other servers are working properly.

BMC

Performs heartbeat communication between the servers that constitute the failover-type cluster system through the BMC, and checks whether other servers are working properly.

Having these communication paths dramatically improves the reliability of the communication between the servers, and prevents the occurrence of network partition.

Note:
Network partition (also known as "split-brain syndrome") refers to a condition when a network gets split by having a problem in all communication paths of the servers in a cluster. In a cluster system that is not capable of handling a network partition, a problem occurred in a communication path and a server cannot be distinguished. As a result, multiple servers may access the same resource and cause the data in a cluster system to be corrupted.

What is application monitoring?

Application monitoring is a function that monitors applications and factors that cause a situation where an application cannot run.

Activation status of application monitoring

An error can be detected by starting up an application from an exec resource in ExpressCluster and regularly checking whether a process is active or not by using the pid monitor resource. It is effective when the factor for application to stop is due to error termination of an application.

Note:

An error in resident process cannot be detected in an application started up by ExpressCluster. When the monitoring target application starts and stops a resident process, an internal application error (such as application stalling, result error) cannot be detected.

Resource monitoring

An error can be detected by monitoring the cluster resources (such as disk partition and IP address) and public LAN using the monitor resources of the ExpressCluster. It is effective when the factor for application to stop is due to an error of a resource which is necessary for an application to operate.

What is internal monitoring?

Internal monitoring refers to an inter-monitoring of modules within ExpressCluster. It monitors whether each monitoring function of ExpressCluster is properly working. Activation status of ExpressCluster process monitoring is performed within ExpressCluster.

◆ Critical monitoring of ExpressCluster process

Monitorable and non-monitorable errors

There are monitorable and non-monitorable errors in ExpressCluster. It is important to know what can or cannot be monitored when building and operating a cluster system.

Detectable and non-detectable errors by server monitoring

Monitoring condition: A heartbeat from a server with an error is stopped

Example of errors that can be monitored:

◆ Hardware failure (of which OS cannot continue operating)

◆ System panic

Example of error that cannot be monitored:

◆ Partial failure on OS (for example, only a mouse or keyboard does not function)

Detectable and non-detectable errors by application monitoring

Monitoring conditions: Termination of applications with errors, continuous resource errors, and disconnection of a path to the network devices.

Example of errors that can be monitored:

◆ Abnormal termination of an application

◆ Failure to access the shared disk (such as HBA[1] failure)

◆ Public LAN NIC problem

Example of errors that cannot be monitored:

◆ Application stalling and resulting in error. ExpressCluster cannot monitor application stalling and error results. However, it is possible to perform failover by creating a program that monitors applications and terminates itself when an error is detected, starting the program using the exec resource, and monitoring application using the PID monitor resource.

---

[1] HBA is an abbreviation for host bus adapter. This adapter is not for the shared disk, but for the server.

Network partition resolution

When the stop of a heartbeat is detected from a server, ExpressCluster determines whether it is an error in a server or a network partition. If it is judged as a server failure, failover (activate resources and start applications on a healthy server) is performed. If it is judged as network partition, protecting data is given priority over Taking over operations, so processing such as emergency shutdown is performed.

The following is the network partition resolution method:

◆ ping method

Related Information:

For the details on the network partition resolution method, see Chapter 7, "Details on network partition resolution resources" of the Reference Guide.

Failover mechanism

When an error is detected, ExpressCluster determines whether an error detected before failing over is an error in a server or a network partition. Then a failover is performed by activating various resources and starting up applications on a properly working server.

The group of resources which fail over at the same time is called a "failover group." From a user's point of view, a failover group appears as a virtual computer.

Note:

In a cluster system, a failover is performed by restarting the application from a properly working node. Therefore, what is saved in an application memory cannot be failed over.

From occurrence of error to completion of failover takes a few minutes. See the figure 2-3 below:
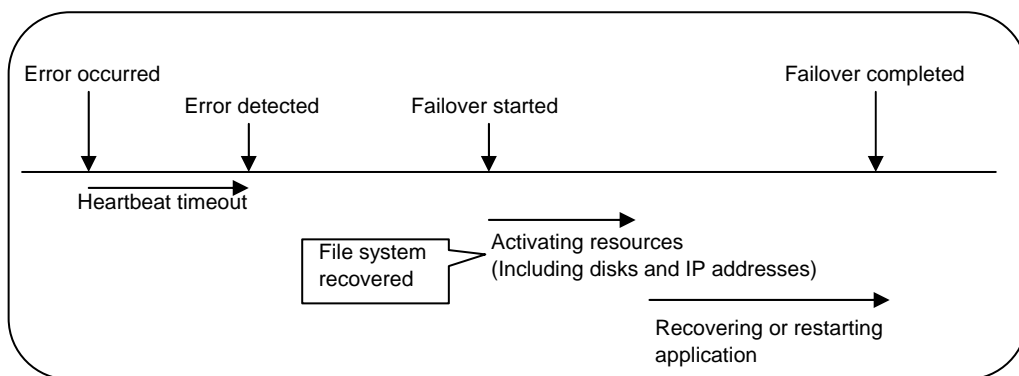
Figure 2-3 Failover time chart

Heartbeat timeout

◆ The time for a standby server to detect an error after that error occurred on the active server.

◆ The setting values of the cluster properties should be adjusted depending on the application load. (The default value is 90 seconds.)

Activating various resources

◆ The time to activate the resources necessary for operating an application.

◆ The resources can be activated in a few seconds in ordinary settings, but the required time changes depending on the type and the number of resources registered to the failover group. For more information, refer to the *Installation and Configuration Guide*.

Start script execution time

◆ The data recovery time for a roll-back or roll-forward of the database and the startup time of the application to be used in operation.

◆ The time for roll-back or roll-forward can be predicted by adjusting the check point interval. For more information, refer to the document that comes with each software product.

Failover resources

ExpressCluster can fail over the following resources:

Switchable partition

◆ Resources such as disk resource, mirror disk resource and hybrid disk resource.

◆ A disk partition to store the data that the application takes over.

Floating IP Address

◆ By connecting an application using the floating IP address, a client does not have to be conscious about switching the servers due to failover processing.

◆ It is achieved by dynamic IP address allocation to the public LAN adapter and sending ARP packet. Connection by floating IP address is possible from most of the network devices.

Script (exec resource)

◆ In ExpressCluster, applications are started up from the scripts.

◆ The file failed over on the shared disk may not be complete as data even if it is properly working as a file system. Write the recovery processing specific to an application at the time of failover in addition to the startup of an application in the scripts.

Note:

In a cluster system, failover is performed by restarting the application from a properly working node. Therefore, what is saved in an application memory cannot be failed over.

System configuration of the failover type cluster

In a failover-type cluster, a disk array device is shared between the servers in a cluster. When an error occurs on a server, the standby server takes over the applications using the data on the shared disk.
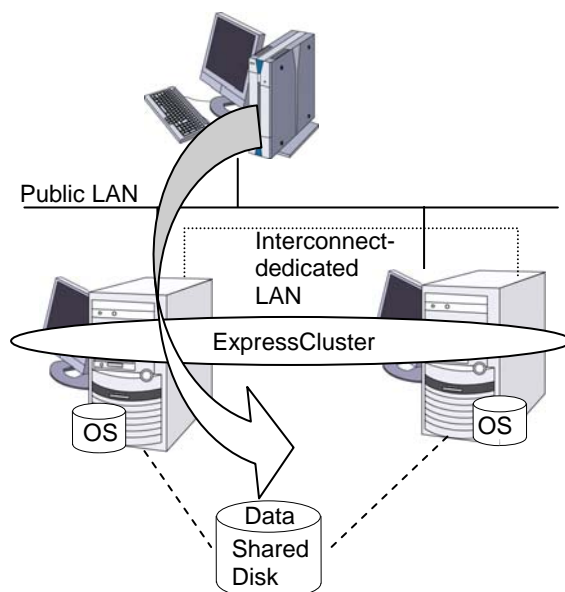
Figure 2-4 System configuration

A failover-type cluster can be divided into the following categories depending on the cluster topologies:

Uni-Directional Standby Cluster System

In the uni-directional standby cluster system, the active server runs applications while the other server, the standby server, does not. This is the simplest cluster topology and you can build a high-availability system without performance degradation after failing over.
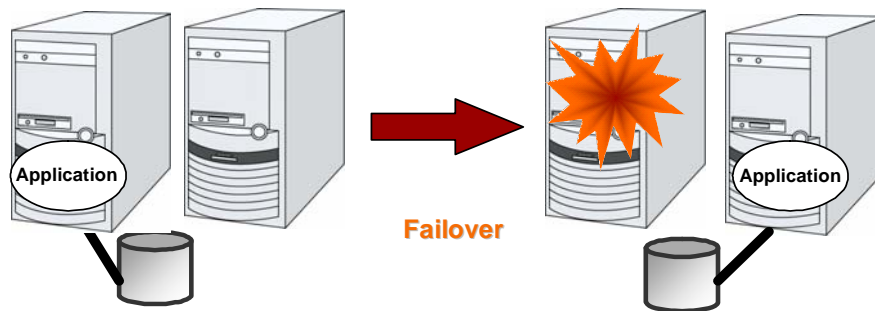
Figure 2-5 Uni-directional standby cluster system

Same Application Multi Directional Standby Cluster System

In the same application multi-directional standby cluster system, the same applications are activated on multiple servers. These servers also operate as standby servers. The applications must support multi-directional standby operation. When the application data can be split into multiple data, depending on the data to be accessed, you can build a load distribution system per data partitioning basis by changing the client's connecting server.
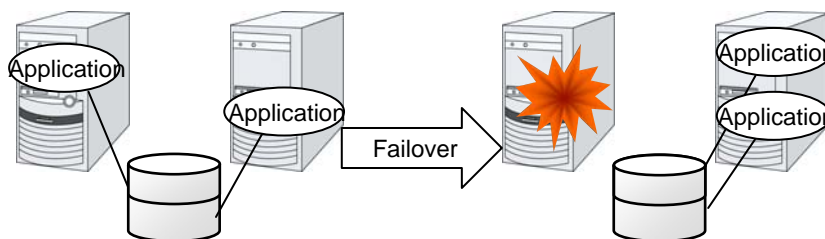
- The applications in the diagram are the same application.
- Multiple application instances are run on a single server after failover.

Figure 2-6 Same application multi directional standby cluster system

Different Application – Multi Directional Standby Cluster System

In the different application multi-directional standby cluster system, different applications are activated on multiple servers and these servers also operate as standby servers. The applications do not have to support multi-directional standby operation. A load distribution system can be built per application unit basis.

- Operation 1 and operation 2 use different applications.
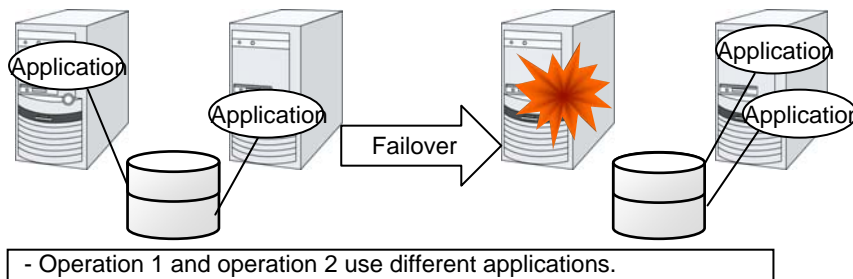
Figure 2-7 Different application multi directional standby cluster system

Node to Node Configuration

The configuration can be expanded with more nodes by applying the configurations introduced thus far. In a node to node configuration described below, three different applications are run on three servers and one standby server takes over the application if any problem occurs. In a uni-directional standby cluster system, one of the two servers functions as a standby server. However, in a node to node configuration, only one of the four server functions as a standby server and performance deterioration is not anticipated if an error occurs only on one server.
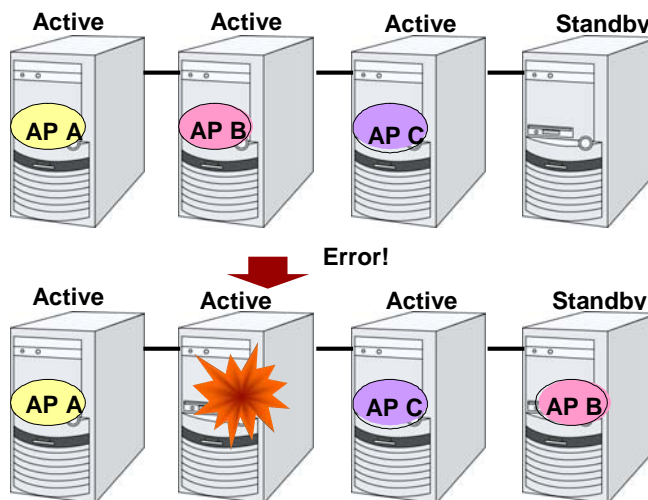
Figure 2-8 Node to Node configuration

Hardware configuration of the shared disk type cluster

The hardware configuration of the shared disk in ExpressCluster is described below. In general, the following is used for communication between the servers in a cluster system:

◆ Two NIC cards (one for external communication, one for ExpressCluster)

◆ COM port connected by RS232C cross cable

◆ Specific space of a shared disk

SCSI or FibreChannel can be used for communication interface to a shared disk; however, recently FibreChannel is more commonly used.
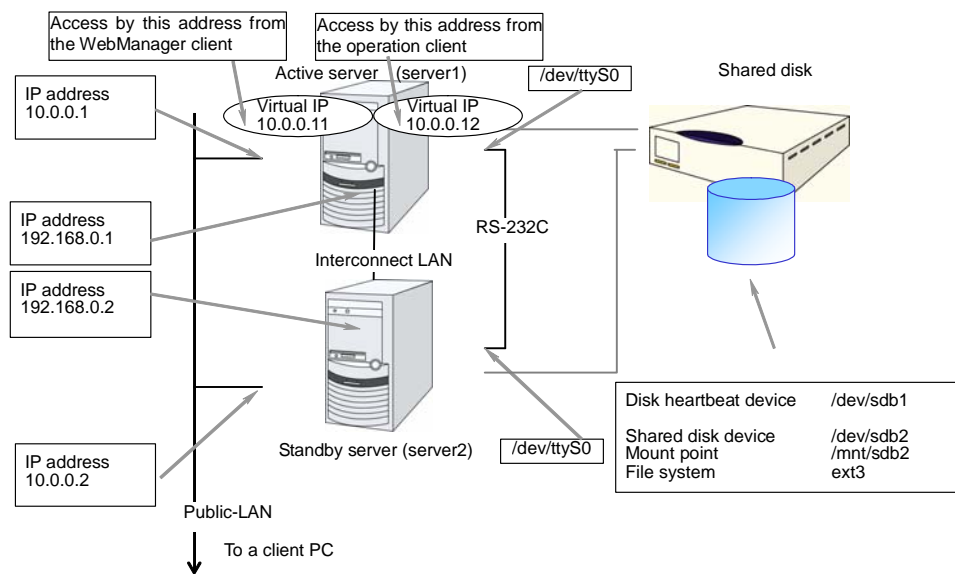
Figure 2-9 Sample of cluster environment when a shared disk is used

Hardware configuration of the mirror disk type cluster

The hardware configuration of the mirror disk in ExpressCluster is described below.

Unlike the shared disk type, a network to copy the mirror disk data is necessary. In general, a network is used with NIC for internal communication in ExpressCluster.

Mirror disks need to be separated from the operating system; however, they do not depend on a connection interface (IDE or SCSI.)
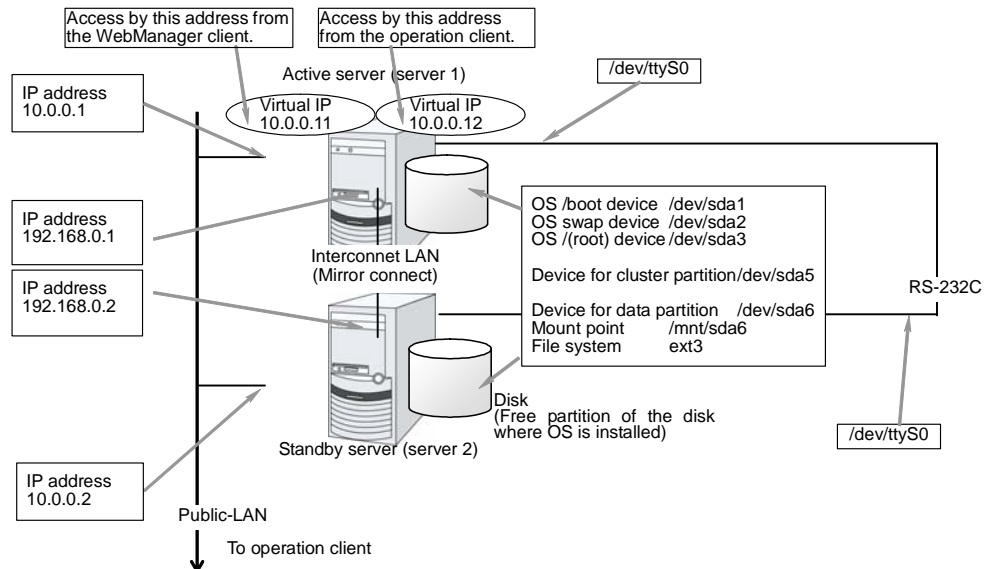
Figure 2-10 Sample of cluster environment when mirror disks are used (when allocating cluster partition and data partition to the disk where OS is installed):
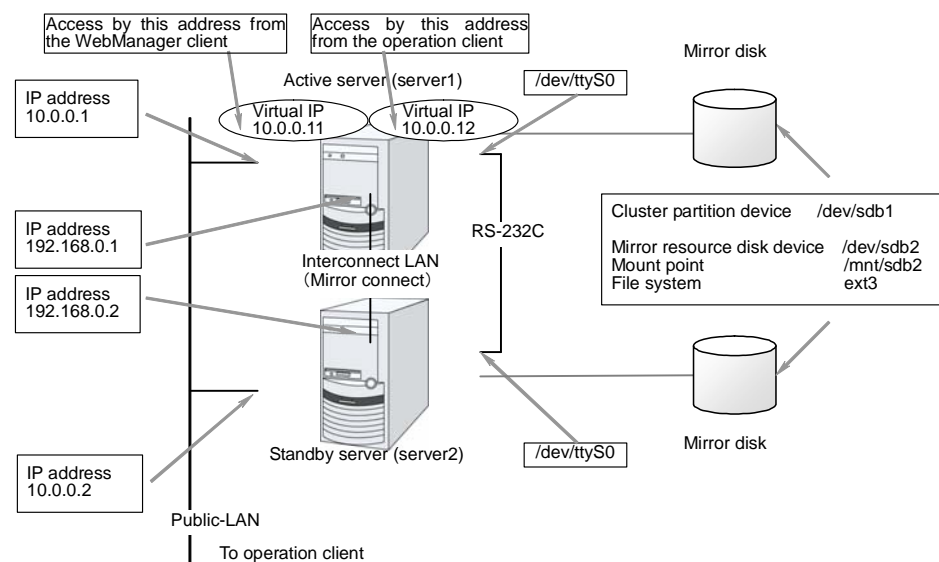
Figure 2-11 Sample of cluster environment when mirror disks are used (when disks for cluster partition and data partition are prepared):

Hardware configuration of the hybrid disk type cluster

The hardware configuration of the hybrid disk in ExpressCluster is described below.

Unlike the shared disk type, a network to copy the data is necessary. In general, NIC for internal communication in ExpressCluster is used to meet this purpose.

Disks do not depend on a connection interface (IDE or SCSI).
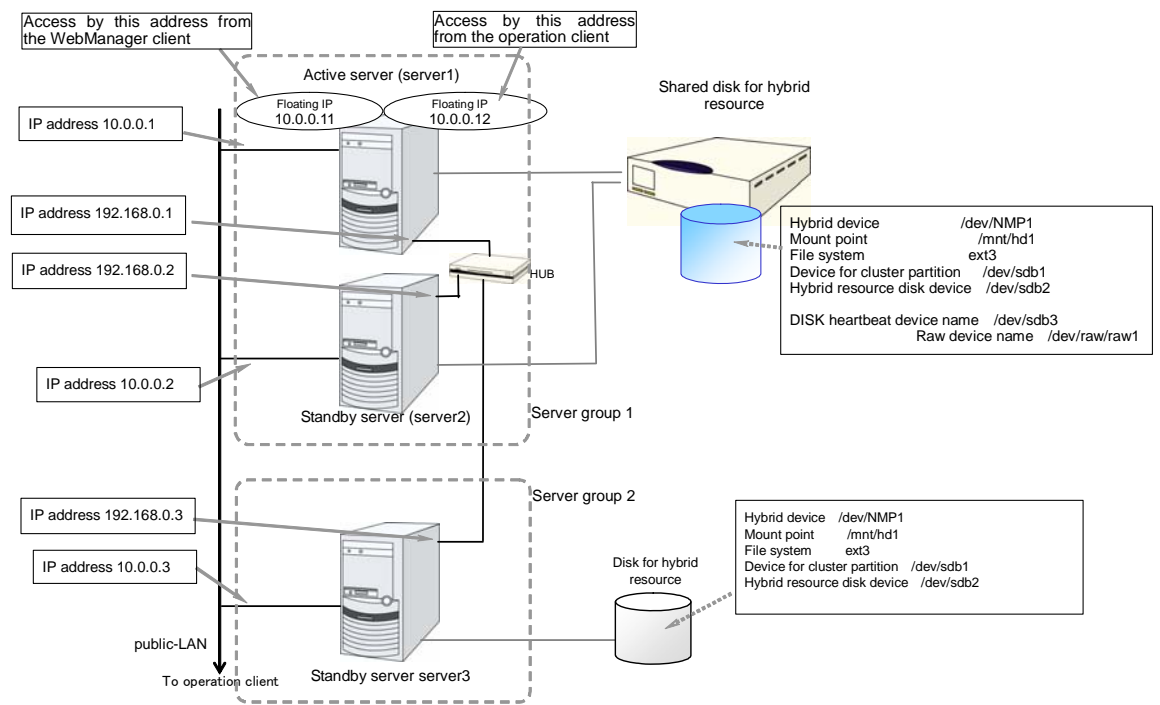
Figure 2-12: Sample of cluster environment where hybrid disks are used (two servers use a shared disk and the third server's general disk are used for mirroring)

What is cluster object?

In ExpressCluster, the various resources are managed as the following groups:

Cluster object
Configuration unit of a cluster.

Server object
Indicates the physical server and belongs to the cluster object.

Server group object
Groups the servers and belongs to the cluster object.

Heartbeat resource object
Indicates the network part of the physical server and belongs to the server object.

Network partition resolution resource object
Indicates the network partition resolution mechanism and belongs to the server object.

Group object
Indicates a virtual server and belongs to the cluster object.

Group resource object
Indicates resources (network, disk) of the virtual server and belongs to the group object.

Monitor resource object
Indicates monitoring mechanism and belongs to the cluster object.

What is a resource?

In ExpressCluster, a group used for monitoring the target is called "resources." There are four types of resources and are managed separately. Having resources allows distinguishing what is monitoring and what is being monitored more clearly. It also makes building a cluster and handling an error easy. The resources can be divided into heartbeat resources, network partition resolution resources, group resources, and monitor resources.

Heartbeat resources

Heartbeat resources are used for verifying whether the other server is working properly between servers. The following heartbeat resources are currently supported:

LAN heartbeat resource
Uses Ethernet for communication.

Kernel mode LAN heartbeat resource
Uses Ethernet for communication.

COM heartbeat resource
Uses RS232C (COM) for communication.

Disk heartbeat resource
Uses a specific partition (cluster partition for disk heartbeat) on the shared disk for communication. It can be used only on a shared disk configuration.

BMC heartbeat resource

Uses Ethernet for communication via the BMC. This resource can be used only when the BMC hardware and firmware support the communication.

Network partition resolution resources

The resource used for solving the network partition is shown below:

PING network partition resolution resource
This is a network partition resolution resource by the PING method.

Group resources

A group resource constitutes a unit when a failover occurs. The following group resources are currently supported:

Floating IP resource (fip)
Provides a virtual IP address. A client can access virtual IP address the same way as the regular IP address.

EXEC resource (exec)
Provides a mechanism for starting and stopping the applications such as DB and httpd.

Disk resource (disk)
Provides a specified partition on the shared disk. It can be used only on a shared disk configuration.

Mirror disk resource (md)
Provides a specified partition on the mirror disk. It can be used only on a mirror disk configuration.

Hybrid disk resource (hd)
Provides a specified partition on a shared disk or a disk. It can be used only for hybrid configuration.

Volume manager resource (volmgr)
Handles multiple storage devices and disks as a single logical disk.

ExpressCluster X 3.2 for Linux Getting Started Guide

NAS resource (nas)
Connect to the shared resources on NAS server. Note that it is not a resource that the cluster server behaves as NAS server.

Virtual IP resource (vip)
Provides a virtual IP address. This can be accessed from a client in the same way as a general IP address. This can be used in the remote cluster configuration among different network addresses.

VM resource (vm)
Starts, stops, or migrates the virtual machine.

Dynamic DNS resource (ddns)
Registers the virtual host name and the IP address of the active server to the dynamic DNS server.

Monitor resources

A monitor resource monitors a cluster system. The following monitor resources are currently supported:

Floating IP monitor resource (fipw)
Provides a monitoring mechanism of an IP address started up by a floating IP resource.

IP monitor resource (ipw)
Provides a monitoring mechanism of an external IP address.

Disk monitor resource (diskw)
Provides a monitoring mechanism of the disk. It also monitors the shared disk.

Mirror disk monitor resource (mdw)
Provides a monitoring mechanism of the mirroring disks.

Mirror disk connect monitor resource (mdnw)
Provides a monitoring mechanism of the mirror disk connect.

Hybrid disk monitor resource (hdw)
Provides a monitoring mechanism of the hybrid disk.

Hybrid disk connect monitor resource (hdnw)
Provides a monitoring mechanism of the hybrid disk connect.

PID monitor resource (pidw)
Provides a monitoring mechanism to check whether a process started up by exec resource is active or not.

User mode monitor resource (userw)
Provides a monitoring mechanism for a stalling problem in the user space.

NIC Link Up/Down monitor resource (miiw)

Provides a monitoring mechanism for link status of LAN cable.

Volume manager monitor resource (volmgrw)
Provides a monitoring mechanism for multiple storage devices and disks.

Multi target monitor resource (mtw)

Provides a status with multiple monitor resources.

Virtual IP monitor resource (vipw)

Provides a mechanism for sending RIP packets of a virtual IP resource.

ARP monitor resource (arpw)

Provides a mechanism for sending ARP packets of a floating IP resource or a virtual IP resource.

Custom monitor resource (genw)

Provides a monitoring mechanism to monitor the system by the operation result of commands or scripts which perform monitoring, if any.

VM monitor resource (vmw)
Checks whether the virtual machine is alive.

Message receive monitor resource (mrw)
Specifies the action to take when an error message is received and how the message is displayed on the WebManager.

Dynamic DNS monitor resource (ddnsw)

Periodically registers the virtual host name and the IP address of the active server to the dynamic DNS server.

Process name monitor resource (psw)

Provides a monitoring mechanism for checking whether a process specified by a process name is active.

BMC monitor resource (bmcw)

Provides a monitoring mechanism for checking whether a BMC is active.

DB2 monitor resource (db2w)

Provides a monitoring mechanism for IBM DB2 database.

ftp monitor resource (ftpw)

Provides a monitoring mechanism for FTP server.

http monitor resource (httpw)

Provides a monitoring mechanism for HTTP server.

imap4 monitor resource (imap4w)

Provides a monitoring mechanism for IMAP4 server.

MySQL monitor resource (mysqlw)

Provides a monitoring mechanism for MySQL database.

nfs monitor resource (nfsw)

Provides a monitoring mechanism for nfs file server.

Oracle monitor resource (oraclew)

Provides a monitoring mechanism for Oracle database.

OracleAS monitor resource (oracleasw)

Provides a monitoring mechanism for Oracle application.

Oracle Clusterware Synchronization Management monitor resource (osmw)

Provides a monitoring mechanism for Oracle Clusterware process linked ExpressCluster.

pop3 monitor resource (pop3w)

Provides a monitoring mechanism for POP3 server.

PostgreSQL monitor resource (psqlw)

Provides a monitoring mechanism for PostgreSQL database.

samba monitor resource (sambaw)

Provides a monitoring mechanism for samba file server.

smtp monitor resource (smtpw)

Provides a monitoring mechanism for SMTP server.

Sybase monitor resource (sybasew)

Provides a monitoring mechanism for Sybase database.

Tuxedo monitor resource (tuxw)

Provides a monitoring mechanism for Tuxedo application server.

Websphere monitor resource (wasw)

Provides a monitoring mechanism for Websphere application server.

Weblogic monitor resource (wlsw)

Provides a monitoring mechanism for Weblogic application server.

WebOTX monitor resource (otxsw)

Provides a monitoring mechanism for WebOTX application server.

JVM monitor resource (jraw)

Provides a monitoring mechanism for Java VM.

System monitor resource (sraw)

Provides a monitoring mechanism for the resources specific to individual processes or those of the whole system.

Getting started with ExpressCluster

Refer to the following guides when building a cluster system with ExpressCluster:

Latest information

Refer to Section II, "Installing ExpressCluster" in this guide.

Designing a cluster system

Refer to Section I, "Configuring a cluster system" in the *Installation and Configuration Guide* and Section II, "Resource details" in the *Reference Guide*.

Configuring a cluster system

Refer to the *Installation and Configuration Guide.*

Troubleshooting the problem

Refer to Section III, "Maintenance information" in the *Reference Guide*.

Section II   Installing ExpressCluster

This section provides the latest information on the ExpressCluster. The latest information on the supported hardware and software is described in detail. Topics such as restrictions, known problems, and how to troubleshoot the problem are covered.

Chapter 3 Installation requirements for ExpressCluster

This chapter provides information on system requirements for ExpressCluster.
This chapter covers:

Hardware

ExpressCluster operates on the following server architectures:

◆ IA-32

◆ x86_64

◆ IBM POWER (Replicator, Replicator DR, Agents except Database Agent are not supported)

General server requirements

Required specifications for ExpressCluster Server are the following:

◆ RS-232C port   1 port (not necessary when configuring a cluster with 3 or more nodes)

◆ Ethernet port   2 or more ports

◆ Shared disk

◆ Mirror disk or empty partition for mirror

◆ CD-ROM drive

When using the off-line Builder upon constructing and changing the existing configuration, one of the following is required for communication between the off-line Builder and servers:

◆ Removable media (for example, floppy disk drive or USB flash drive)

◆ A machine to operate the off-line Builder and a way to share files

Supported disk interfaces

Disk types that are supported as mirror disks or hybrid disk (non-shared disk) of Replicator DR are as follows:

Disk type	Host side driver	Remarks
IDE	ide	Supported up to 120GB
SCSI	aic7xxx	
SCSI	aic79xx	
SCSI	sym53c8xx	
SCSI	mptbase,mptscsih	
SCSI	mptsas	
RAID	Megaraid (SCSI type)	
RAID	megaraid (IDE type)	Supported up to 275GB
S-ATA	sata-nv	Supported up to 80GB
S-ATA	ata-piix	Supported up to 120GB

Supported network interfaces

The following are the network boards that are supported as a mirror disk connect for the mirror disk and hybrid disk of the Replicator and the Replicator DR:

Chip	Driver
Intel 82540EM	e1000
Intel 82544EI	
Intel 82546EB	
Intel 82546GB	
Intel 82573L	
Intel 80003ES2LAN	
Intel 631xESB/632xESB	
Broadcom BCM5701	bcm5700
Broadcom BCM5703	
Broadcom BCM5721	
Broadcom BCM5721	tg3

Only typical examples are listed above and other products can also be used.

Servers supporting BMC-related functions

The table below lists the supported servers that can use the function to forcibly stop a physical machine and the chassis identify function. These are typical examples, and also some other servers can use these functions.

Server	Remarks
Express5800/120Rg-1	
Express5800/120Rf-1	
Express5800/120Rg-2	

Servers supporting NX7700x/A2010M and NX7700x/A2010L series linkage

The table below lists the supported servers that can use the NX7700x/A2010M and NX7700x/A2010L series linkage function of the BMC heartbeat resources and message receive monitor resources. This function cannot be used by servers other than the following.

Server	Remarks
NX7700x/A2010M	Update to the latest firmware.
NX7700x/A2010L	Update to the latest firmware.

Servers supporting Express5800/A1080a and Express5800/A1040a series linkage

The table below lists the supported servers that can use the Express5800/A1080a and Express5800/A1040a series linkage function of the BMC heartbeat resources and message receive monitor resources. This function cannot be used by servers other than the following.

Serve	Remarks
Express5800/A1080a-E	Update to the latest firmware.
Express5800/A1080a-D	Update to the latest firmware.
Express5800/A1080a-S	Update to the latest firmware.
Express5800/A1040a	Update to the latest firmware.

Software

System requirements for ExpressCluster Server

Supported distributions and kernel versions

The environment where ExpressCluster Server can operate depends on kernel module versions because there are kernel modules unique to ExpressCluster.

There are the following driver modules unique to ExpressCluster.

Driver module unique to ExpressCluster	Description
Kernel mode LAN heartbeat driver	Used with kernel mode LAN heartbeat resources.
Keepalive driver	Used if keepalive is selected as the monitoring method for user space monitor resources. Used if keepalive is selected as the monitoring method for shutdown monitoring.
Mirror driver	Used with mirror disk resources.

Kernel versions which has been verified are listed below.

IA-32

Distribution	Kernel version	Replicator Replicator DR support	Run clpka and clpkhb support	Express Cluster Version	Remarks
Turbolinux 11 Server (SP1)	2.6.23-10 2.6.23-10smp64G	Yes	Yes	3.0.0-1 or later	
	2.6.23-12 2.6.23-12smp64G	Yes	Yes	3.0.0-1 or later	
	2.6.23-15 2.6.23-15smp64G	Yes	Yes	3.2.0-1 or later	
Turbolinux Appliance Server 3.0 (SP1)	2.6.23-10 2.6.23-10smp64G	Yes	Yes	3.0.0-1 or later	
	2.6.23-12 2.6.23-12smp64G	Yes	Yes	3.0.0-1 or later	
	2.6.23-15 2.6.23-15smp64G	Yes	Yes	3.2.0-1 or later	
Red Hat Enterprise Linux 5 (update4)	2.6.18-164.el5 2.6.18-164.el5PAE 2.6.18-164.el5xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-164.6.1.el5 2.6.18-164.6.1.el5PAE 2.6.18-164.6.1.el5xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-164.9.1.el5 2.6.18-164.9.1.el5PAE 2.6.18-164.9.1.el5xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-164.11.1.el5 2.6.18-164.11.1.el5PAE 2.6.18-164.11.1.el5xen	Yes	Yes	3.0.0-1 or later	

Distribution	Kernel version	Replicator Replicator DR support	Run clpka and clpkhb support	Express Cluster Version	Remarks
	2.6.18-164.15.1.el5 2.6.18-164.15.1.el5PAE 2.6.18-164.15.1.el5xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-164.38.1.el5 2.6.18-164.38.1.el5PAE 2.6.18-164.38.1.el5xen	Yes	Yes	3.1.4-1 or later	
Red Hat Enterprise Linux 5 (update5)	2.6.18-194.el5 2.6.18-194.el5PAE 2.6.18-194.el5xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-194.8.1.el5 2.6.18-194.8.1.el5PAE 2.6.18-194 8.1.el5xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-194.11.4.el5 2.6.18-194.11.4.el5PAE 2.6.18-194.11.4.el5xen	Yes	Yes	3.0.1-1 or later	
	2.6.18-194.17.1.el5 2.6.18-194.17.1.el5PAE 2.6.18-194.17.1.el5xen	Yes	Yes	3.0.1-1 or later	
	2.6.18-194.32.1.el5 2.6.18-194.32.1.el5PAE 2.6.18-194.32.1.el5xen	Yes	Yes	3.0.3-1 or later	
Red Hat Enterprise Linux 5 (update6)	2.6.18-238.el5 2.6.18-238.el5PAE 2.6.18-238.el5xen	Yes	Yes	3.0.3-1 or later	
	2.6.18-238.1.1.el5 2.6.18-238.1.1.el5PAE 2.6.18-238.1.1.el5xen	Yes	Yes	3.0.3-1 or later	
	2.6.18-238.9.1.el5 2.6.18-238.9.1.el5PAE 2.6.18-238.9.1.el5xen	Yes	Yes	3.1.0-1 or later	
	2.6.18-238.37.1.el5 2.6.18-238.37.1.el5PAE 2.6.18-238.37.1.el5xen	Yes	Yes	3.1.4-1 or later	
Red Hat Enterprise Linux 5 (update7)	2.6.18-274.el5 2.6.18-274.el5PAE 2.6.18-274.el5xen	Yes	Yes	3.1.0-1 or later	
	2.6.18-274.18.1.el5 2.6.18-274.18.1.el5PAE 2.6.18-274.18.1.el5xen	Yes	Yes	3.1.3-1 or later	
Red Hat Enterprise Linux 5 (update8)	2.6.18-308.el5 2.6.18-308.el5PAE 2.6.18-308.el5xen	Yes	Yes	3.1.4-1 or later	
	2.6.18-308.4.1.el5 2.6.18-308.4.1.el5PAE 2.6.18-308.4.1.el5xen	Yes	Yes	3.1.4-1 or later	
	2.6.18-308.11.1.el5 2.6.18-308.11.1.el5PAE 2.6.18-308.11.1.el5xen	Yes	Yes	3.1.5-1 or later	

Distribution	Kernel version	Replicator Replicator DR support	Run clpka and clpkhb support	Express Cluster Version	Remarks
	2.6.18-308.24.1.el5 2.6.18-308.24.1.el5PAE 2.6.18-308.24.1.el5xen	Yes	Yes	3.1.8-2 or later	
Red Hat Enterprise Linux 5 (update9)	2.6.18-348.el5 2.6.18-348.el5PAE 2.6.18-348.el5xen	Yes	Yes	3.1.8-1 or later	
	2.6.18-348.4.1.el5 2.6.18-348.4.1.el5PAE 2.6.18-348.4.1.el5xen	Yes	Yes	3.1.10-1 or later	
	2.6.18-348.6.1.el5 2.6.18-348.6.1.el5PAE 2.6.18-348.6.1.el5xen	Yes	Yes	3.1.10-1 or later	
	2.6.18-348.12.1.el5 2.6.18-348.12.1.el5PAE 2.6.18-348.12.1.el5xen	Yes	Yes	3.1.10-1 or later	
	2.6.18-348.18.1.el5 2.6.18-348.18.1.el5PAE 2.6.18-348.18.1.el5xen	Yes	Yes	3.1.10-1 or later	
Red Hat Enterprise Linux 5 (update10)	2.6.18-371.el5 2.6.18-371.el5PAE 2.6.18-371.el5xen	Yes	Yes	3.2.0-1 or later	
	2.6.18-371.3.1.el5 2.6.18-371.3.1.el5PAE 2.6.18-371.3.1.el5xen	Yes	Yes	3.2.0-1 or later	
Red Hat Enterprise Linux 6	2.6.32-71.el6.i686	Yes	Yes	3.0.2-1 or later	
	2.6.32-71.7.1.el6.i686	Yes	Yes	3.0.3-1 or later	
	2.6.32-71.14.1.el6.i686	Yes	Yes	3.0.3-1 or later	
	2.6.32-71.18.1.el6.i686	Yes	Yes	3.0.3-1 or later	
	2.6.32-71.40.1.el6.i686	Yes	Yes	3.1.10-1 or later	
Red Hat Enterprise Linux 6 (update1)	2.6.32-131.0.15.el6.i686	Yes	Yes	3.0.4-1 or later	
	2.6.32-131.21.1.el6.i686	Yes	Yes	3.1.3-1 or later	
	2.6.32-131.39.1.el6.i686	Yes	Yes	3.1.10-1 or later	
Red Hat Enterprise Linux 6 (update2)	2.6.32-220.el6.i686	Yes	Yes	3.1.3-1 or later	
	2.6.32-220.4.2.el6.i686	Yes	Yes	3.1.3-1 or later	
	2.6.32-220.17.1.el6.i686	Yes	Yes	3.1.4-1 or later	
	2.6.32-220.23.1.el6.i686	Yes	Yes	3.1.5-1 or later	
	2.6.32-220.39.1.el6.i686	Yes	Yes	3.1.10-1 or later	
	2.6.32-220.45.1.el6.i686	Yes	Yes	3.1.10-1 or later	
Red Hat Enterprise Linux 6 (update3)	2.6.32-279.el6.i686	Yes	Yes	3.1.4-1 or later	
	2.6.32-279.2.1.el6.i686	Yes	Yes	3.1.5-1 or later	
	2.6.32-279.11.1.el6.i686	Yes	Yes	3.1.7-2 or later	
	2.6.32-279.14.1.el6.i686	Yes	Yes	3.1.7-2 or later	

Section II Installing ExpressCluster

Distribution	Kernel version	Replicator Replicator DR support	Run clpka and clpkhb support	Express Cluster Version	Remarks
	2.6.32-279.19.1.el6.i686	Yes	Yes	3.1.8-1 or later	
	2.6.32-279.31.1.el6.i686	Yes	Yes	3.1.10-1 or later	
	2.6.32-279.33.1.el6.i686	Yes	Yes	3.1.10-1 or later	
	2.6.32-279.37.2.el6.i686	Yes	Yes	3.1.10-1 or later	
	2.6.32-279.41.1.el6.i686	Yes	Yes	3.2.0-1 or later	
Red Hat Enterprise Linux 6 (update4)	2.6.32-358.el6.i686	Yes	Yes	3.1.8-1 or later	
	2.6.32-358.0.1.el6.i686	Yes	Yes	3.1.8-1 or later	
	2.6.32-358.2.1.el6.i686	Yes	Yes	3.1.8-1 or later	
	2.6.32-358.6.1.el6.i686	Yes	Yes	3.1.10-1 or later	
	2.6.32-358.6.2.el6.i686	Yes	Yes	3.1.8-2 or later	
	2.6.32-358.11.1.el6.i686	Yes	Yes	3.1.8-2 or later	
	2.6.32-358.14.1.el6.i686	Yes	Yes	3.1.8-1 or later	
	2.6.32-358.18.1.el6.i686	Yes	Yes	3.2.0-1 or later	
	2.6.32-358.23.2.el6.i686	Yes	Yes	3.1.10-1 or later	
Red Hat Enterprise Linux 6 (update5)	2.6.32-431.el6.i686	Yes	Yes	3.2.0-1 or later	
	2.6.32-431.1.2.el6.i686	Yes	Yes	3.2.0-1 or later	
	2.6.32-431.3.1.el6.i686	Yes	Yes	3.2.0-1 or later	
	2.6.32-431.5.1.el6.i686	Yes	Yes	3.2.0-1 or later	
	2.6.32-431.11.2.el6.i686	Yes	Yes	3.2.0-1 or later	
Asianux Server 3 (SP2)	2.6.18-128.7AXS3 2.6.18-128.7AXS3PAE 2.6.18-128.7AXS3xen	Yes	Yes	3.0.0-1 or later	
Asianux Server 3 (SP3)	2.6.18-194.1.AXS3 2.6.18-194.1.AXS3PAE 2.6.18-194.1.AXS3xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-194.2.AXS3 2.6.18-194.2.AXS3PAE 2.6.18-194.2.AXS3xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-194.6.AXS3 2.6.18-194.6.AXS3PAE 2.6.18-194.6.AXS3xen	Yes	Yes	3.0.1-1 or later	
	2.6.18-194.9.AXS3 2.6.18-194.9.AXS3PAE 2.6.18-194.9.AXS3xen	Yes	Yes	3.0.3-1 or later	
Asianux Server 3 (SP4)	2.6.18-238.2.AXS3 2.6.18-238.2.AXS3PAE 2.6.18-238.2.AXS3xen	Yes	Yes	3.1.0-1 or later	
	2.6.18-308.1.AXS3 2.6.18-308.1.AXS3PAE 2.6.18-308.1.AXS3xen	Yes	Yes	3.1.5-1 or later	
	2.6.18-308.7.AXS3 2.6.18-308.7.AXS3PAE 2.6.18-308.7.AXS3xen	Yes	Yes	3.1.7-2 or later	

Distribution	Kernel version	Replicator Replicator DR support	Run clpka and clpkhb support	Express Cluster Version	Remarks
	2.6.18-348.1.AXS3 2.6.18-348.1.AXS3PAE 2.6.18-348.1.AXS3xen	Yes	Yes	3.1.8-1 or later	
	2.6.18-348.4.AXS3 2.6.18-348.4.AXS3PAE 2.6.18-348.4.AXS3xen	Yes	Yes	3.1.8-2 or later	
Asianux Server 4	2.6.32-71.7.1.el6.i686	Yes	Yes	3.0.4-1 or later	
Asianux Server 4 (SP1)	2.6.32-131.12.1.el6.i686	Yes	Yes	3.1.3-1 or later	
	2.6.32-220.13.1.el6.i686	Yes	Yes	3.1.4-1 or later	
Asianux Server 4 (SP2)	2.6.32-279.2.1.el6.i686	Yes	Yes	3.1.7-1 or later	
	2.6.32-279.14.1.el6.i686	Yes	Yes	3.1.7-2 or later	
	2.6.32-279.19.1.el6.i686	Yes	Yes	3.1.8-1 or later	
	2.6.32-358.2.1.el6.i686	Yes	Yes	3.1.8-2 or later	
	2.6.32-358.6.1.el6.i686	Yes	Yes	3.1.8-2 or later	
	2.6.32-358.6.2.el6.i686	Yes	Yes	3.1.10-1 or later	
	2.6.32-358.11.1.el6.i686	Yes	Yes	3.1.10-1 or later	
Asianux Server 4 (SP3)	2.6.32-358.14.1.el6.i686	Yes	Yes	3.2.0-1 or later	
Novell SUSE LINUX Enterprise Server 10 (SP2)	2.6.16.60-0.21-default 2.6.16.60-0.21-smp 2.6.16.60-0.21-bigsmp 2.6.16.60-0.21-xen	Yes	Yes	3.0.0-1 or later	
Novell SUSE LINUX Enterprise Server 10 (SP3)	2.6.16.60-0.54.5-default 2.6.16.60-0.54.5-smp 2.6.16.60-0.54.5-bigsmp 2.6.16.60-0.54.5-xen	Yes	Yes	3.0.0-1 or later	
	2.6.16.60-0.69.1-default 2.6.16.60-0.69.1-smp 2.6.16.60-0.69.1-bigsmp 2.6.16.60-0.69.1-xen	Yes	Yes	3.0.1-1 to 3.0.3-1, 3.1.0-1 or later	
	2.6.16.60-0.83.2-default 2.6.16.60-0.83.2-smp 2.6.16.60-0.83.2-bigsmp 2.6.16.60-0.83.2-xen	Yes	Yes	3.1.4-1 or later	
Novell SUSE LINUX Enterprise Server 10 (SP4)	2.6.16.60-0.85.1-default 2.6.16.60-0.85.1-smp 2.6.16.60-0.85.1-bigsmp 2.6.16.60-0.85.1-xen	Yes	Yes	3.0.4-1 or later	
	2.6.16.60-0.91.1-default 2.6.16.60-0.91.1-smp 2.6.16.60-0.91.1-bigsmp 2.6.16.60-0.91.1-xen	Yes	Yes	3.1.3-1 or later	
	2.6.16.60-0.93.1-default 2.6.16.60-0.93.1-smp 2.6.16.60-0.93.1-bigsmp 2.6.16.60-0.93.1-xen	Yes	Yes	3.1.4-1 or later	

Distribution	Kernel version	Replicator Replicator DR support	Run clpka and clpkhb support	Express Cluster Version	Remarks
	2.6.16.60-0.97.1-default 2.6.16.60-0.97.1-smp 2.6.16.60-0.97.1-bigsmp 2.6.16.60-0.97.1-xen	Yes	Yes	3.1.5-1 or later	
Novell SUSE LINUX Enterprise Server 11	2.6.27.19-5-default 2.6.27.19-5-pae 2.6.27.19-5-xen	Yes	Yes	3.0.0-1 or later	
	2.6.27.48-0.12-default 2.6.27.48-0.12-pae 2.6.27.48-0.12-xen	Yes	Yes	3.0.1-1 or later	
Novell SUSE LINUX Enterprise Server 11 (SP1)	2.6.32.12-0.7-default 2.6.32.12-0.7-pae 2.6.32.12-0.7-xen	No	Yes	3.0.0-1 or later	
		Yes	Yes	3.0.2-1 or later	
	2.6.32.19-0.3-default 2.6.32.19-0.3-pae 2.6.32.19-0.3-xen	No	Yes	3.0.1-1 or later	
		Yes	Yes	3.0.2-1 or later	
	2.6.32.23-0.3-default 2.6.32.23-0.3-pae 2.6.32.23-0.3-xen	No	Yes	3.0.1-1 or later	
		Yes	Yes	3.0.2-1 or later	
	2.6.32.49-0.3-default 2.6.32.49-0.3-pae 2.6.32.49-0.3-xen	Yes	Yes	3.1.3-1 or later	
Novell SUSE LINUX Enterprise Server 11 (SP2)	3.0.13-0.27-default 3.0.13-0.27-pae	Yes	Yes	3.1.4-1 or later	
	3.0.34-0.7-default 3.0.34-0.7-pae	Yes	Yes	3.1.5-1 or later	
	3.0.80-0.7-default 3.0.80-0.7-pae	Yes	Yes	3.1.10-1 or later	
Novell SUSE LINUX Enterprise Server 11 (SP3)	3.0.76-0.11-default 3.0.76-0.11-pae	Yes	Yes	3.2.0-1 or later	
	3.0.82-0.7-default 3.0.82-0.7-pae	Yes	Yes	3.2.0-1 or later	
XenServer 5.5 (update2)	2.6.18-128.1.6.el5.xs5.5.0.505.1024xen	No	Yes	3.0.0-1 or later	
XenServer 5.6	2.6.27.42-0.1.1.xs5.6.0.44.111158xen	No	Yes	3.1.0-1 or later	
XenServer 5.6 (SP2)	2.6.32.12-0.7.1.xs5.6.100.323.170596xen	No	Yes	3.1.0-1 or later	
XenServer 6.0	2.6.32.12-0.7.1.xs6.0.0.529.170661xen	No	Yes	3.1.1-1 or later	

x86_64

Distribution	Kernel version	Replicator Replicator DR support	Run clpka and clpkhb support	Express Cluster Version	Remarks
Turbolinux 11 Server (SP1)	2.6.23-10	Yes	Yes	3.0.0-1 or later	
	2.6.23-12	Yes	Yes	3.0.0-1 or later	
Turbolinux Appliance Server 3.0 (SP1)	2.6.23-10	Yes	Yes	3.0.0-1 or later	
	2.6.23-12	Yes	Yes	3.0.0-1 or later	
Red Hat Enterprise Linux 5 (update4)	2.6.18-164.el5 2.6.18-164.el5xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-164.6.1.el5 2.6.18-164.6.1.el5xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-164.9.1.el5 2.6.18-164.9.1.el5xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-164.11.1.el5 2.6.18-164.11.1.el5xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-164.15.1.el5 2.6.18-164.15.1.el5xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-164.38.1.el5 2.6.18-164.38.1.el5xen	Yes	Yes	3.1.4-1 or later	
Red Hat Enterprise Linux 5 (update5)	2.6.18-194.el5 2.6.18-194.el5xen-	Yes	Yes	3.0.0-1 or later	
	2.6.18-194.8.1.el5 2.6.18-194.8.1.el5xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-194.11.4.el5 2.6.18-194.11.4.el5xen	Yes	Yes	3.0.1-1 or later	
	2.6.18-194.17.1.el5 2.6.18-194.17.1.el5xen	Yes	Yes	3.0.1-1 or later	
	2.6.18-194.32.1.el5 2.6.18-194.32.1.el5xen	Yes	Yes	3.0.3-1 or later	
Red Hat Enterprise Linux 5 (update6)	2.6.18-238.el5 2.6.18-238.el5xen	Yes	Yes	3.0.3-1 or later	
	2.6.18-238.1.1.el5 2.6.18-238.1.1.el5xen	Yes	Yes	3.0.3-1 or later	
	2.6.18-238.9.1.el5 2.6.18-238.9.1.el5xen	Yes	Yes	3.1.0-1 or later	
	2.6.18-238.37.1.el5 2.6.18-238.37.1.el5xen	Yes	Yes	3.1.4-1 or later	
Red Hat Enterprise Linux 5 (update7)	2.6.18-274.el5 2.6.18-274.el5xen	Yes	Yes	3.1.0-1 or later	
	2.6.18-274.18.1.el5 2.6.18-274.18.1.el5xen	Yes	Yes	3.1.3-1 or later	

Section II Installing ExpressCluster

Distribution	Kernel version	Replicator Replicator DR support	Run clpka and clpkhb support	Express Cluster Version	Remarks
Red Hat Enterprise Linux 5 (update8)	2.6.18-308.el5 2.6.18-308.el5xen	Yes	Yes	3.1.4-1 or later	
	2.6.18-308.4.1el5 2.6.18-308.4.1el5xen	Yes	Yes	3.1.4-1 or later	
	2.6.18-308.11.1el5 2.6.18-308.11.1el5xen	Yes	Yes	3.1.5-1 or later	
	2.6.18-308.24.1el5 2.6.18-308.24.1el5xen	Yes	Yes	3.1.8-2 or later	
Red Hat Enterprise Linux 5 (update9)	2.6.18-348.el5 2.6.18-348.el5xen	Yes	Yes	3.1.8-1 or later	
	2.6.18-348.4.1.el5 2.6.18-348.4.1.el5xen	Yes	Yes	3.1.10-1 or later	
	2.6.18-348.6.1.el5 2.6.18-348.6.1.el5xen	Yes	Yes	3.1.10-1 or later	
	2.6.18-348.12.1.el5 2.6.18-348.12.1.el5xen	Yes	Yes	3.1.10-1 or later	
	2.6.18-348.18.1.el5 2.6.18-348.18.1.el5xen	Yes	Yes	3.1.10-1 or later	
Red Hat Enterprise Linux 5 (update10)	2.6.18-371.el5 2.6.18-371.el5xen	Yes	Yes	3.2.0-1 or later	
	2.6.18-371.3.1.el5 2.6.18-371.3.1.el5xen	Yes	Yes	3.2.0-1 or later	
Red Hat Enterprise Linux 6	2.6.32-71.el6.x86_64	Yes	Yes	3.0.2-1 or later	
	2.6.32-71.7.1.el6.x86_64	Yes	Yes	3.0.3-1 or later	
	2.6.32-71.14.1.el6.x86_64	Yes	Yes	3.0.3-1 or later	
	2.6.32-71.18.1.el6.x86_64	Yes	Yes	3.0.3-1 or later	
	2.6.32-71.40.1.el6.x86_64	Yes	Yes	3.1.10-1 or later	
Red Hat Enterprise Linux 6 (update1)	2.6.32-131.0.15.el6.x86_64	Yes	Yes	3.0.4-1 or later	
	2.6.32-131.21.1.el6.x86_64	Yes	Yes	3.1.3-1 or later	
	2.6.32-131.39.1.el6.x86_64	Yes	Yes	3.1.10-1 or later	
Red Hat Enterprise Linux 6 (update2)	2.6.32-220.el6.x86_64	Yes	Yes	3.1.3-1 or later	
	2.6.32-220.4.2.el6.x86_64	Yes	Yes	3.1.3-1 or later	
	2.6.32-220.17.1.el6.x86_64	Yes	Yes	3.1.4-1 or later	
	2.6.32-220.23.1.el6.i686	Yes	Yes	3.1.5-1 or later	
	2.6.32-220.39.1.el6.x86_64	Yes	Yes	3.1.10-1 or later	
	2.6.32-220.45.1.el6.x86_64	Yes	Yes	3.1.10-1 or later	
Red Hat Enterprise Linux 6 (update3)	2.6.32-279.el6.x86_64	Yes	Yes	3.1.4-1 or later	
	2.6.32-279.2.1.el6.i686	Yes	Yes	3.1.5-1 or later	
	2.6.32-279.11.1.el6.x86_64	Yes	Yes	3.1.7-1 or later	
	2.6.32-279.14.1.el6.x86_64	Yes	Yes	3.1.7-1 or later	
	2.6.32-279.19.1.el6.x86_64	Yes	Yes	3.1.8-1 or later	

Distribution	Kernel version	Replicator Replicator DR support	Run clpka and clpkhb support	Express Cluster Version	Remarks
	2.6.32-279.22.1.el6.x86_64	Yes	Yes	3.1.10-1 or later	
	2.6.32-279.31.1.el6.x86_64	Yes	Yes	3.1.10-1 or later	
	2.6.32-279.33.1.el6.x86_64	Yes	Yes	3.1.10-1 or later	
	2.6.32-279.37.2.el6.x86_64	Yes	Yes	3.1.10-1 or later	
	2.6.32-279.41.1.el6.x86_64	Yes	Yes	3.2.0-1 or later	
Red Hat Enterprise Linux 6 (update4)	2.6.32-358.el6.x86_64	Yes	Yes	3.1.8-1 or later	
	2.6.32-358.0.1.el6.x86_64	Yes	Yes	3.1.8-1 or later	
	2.6.32-358.2.1.el6.x86_64	Yes	Yes	3.1.8-1 or later	
	2.6.32-358.6.1.el6.x86_64	Yes	Yes	3.1.10-1 or later	
	2.6.32-358.6.2.el6.x86_64	Yes	Yes	3.1.8-2 or later	
	2.6.32-358.11.1.el6.x86_64	Yes	Yes	3.1.8-2 or later	
	2.6.32-358.14.1.el6.x86_64	Yes	Yes	3.1.8-1 or later	
	2.6.32-358.18.1.el6.x86_64	Yes	Yes	3.2.0-1 or later	
	2.6.32-358.23.2.el6.x86_64	Yes	Yes	3.1.10-1 or later	
Red Hat Enterprise Linux 6 (update5)	2.6.32-431.el6.x86_64	Yes	Yes	3.2.0-1 or later	
	2.6.32-431.1.2.el6.x86_64	Yes	Yes	3.2.0-1 or later	
	2.6.32-431.3.1.el6.x86_64	Yes	Yes	3.2.0-1 or later	
	2.6.32-431.5.1.el6.x86_64	Yes	Yes	3.2.0-1 or later	
	2.6.32-431.11.2.el6.x86_64	Yes	Yes	3.2.0-1 or later	
Asianux Server 3 (SP2)	2.6.18-128.7AXS3 2.6.18-128.7AXS3xen	Yes	Yes	3.0.0-1 or later	
Asianux Server 3 (SP3)	2.6.18-194.1.AXS3 2.6.18-194.1.AXS3xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-194.2.AXS3 2.6.18-194.2.AXS3xen	Yes	Yes	3.0.0-1 or later	
	2.6.18-194.6.AXS3 2.6.18-194.6.AXS3xen	Yes	Yes	3.0.1-1 or later	
	2.6.18-194.9.AXS3 2.6.18-194.9.AXS3xen	Yes	Yes	3.0.3-1 or later	
Asianux Server 3 (SP4)	2.6.18-238.2.AXS3 2.6.18-238.2.AXS3xen	Yes	Yes	3.1.0-1 or later	
	2.6.18-308.1.AXS3 2.6.18-308.1.AXS3xen	Yes	Yes	3.1.5-1 or later	
	2.6.18-308.7.AXS3 2.6.18-308.7.AXS3xen	Yes	Yes	3.1.7-2 or later	
	2.6.18-348.1.AXS3 2.6.18-348.1.AXS3xen	Yes	Yes	3.1.8-1 or later	
	2.6.18-348.4.AXS3 2.6.18-348.4.AXS3xen	Yes	Yes	3.1.8-2 or later	
Asianux Server 4	2.6.32-71.7.1.el6.x86_64	Yes	Yes	3.0.4-1 or later	
Asianux Server 4 (SP1)	2.6.32-131.12.1.el6.x86_64	Yes	Yes	3.1.3-1 or later	
	2.6.32-220.13.1.el6.x86_64	Yes	Yes	3.1.4-1 or later	

Section II Installing ExpressCluster

Distribution	Kernel version	Replicator Replicator DR support	Run clpka and clpkhb support	Express Cluster Version	Remarks
Asianux Server 4 (SP2)	2.6.32-279.2.1.el6.x86_64	Yes	Yes	3.1.7-1 or later	
	2.6.32-279.14.1.el6.x86_64	Yes	Yes	3.1.7-2 or later	
	2.6.32-279.19.1.el6.x86_64	Yes	Yes	3.1.8-1 or later	
	2.6.32-358.2.1.el6.x86_64	Yes	Yes	3.1.8-2 or later	
	2.6.32-358.6.1.el6.x86_64	Yes	Yes	3.1.8-2 or later	
	2.6.32-358.6.2.el6.x86_64	Yes	Yes	3.0.10-1 or later	
	2.6.32-358.11.1.el6.x86_64	Yes	Yes	3.0.10-1 or later	
Asianux Server 4 (SP3)	2.6.32-358.14.1.el6.x86_64	Yes	Yes	3.2.0-1 or later	
Novell SUSE LINUX Enterprise Server 10 (SP2)	2.6.16.60-0.21-default 2.6.16.60-0.21-smp 2.6.16.60-0.21-xen	Yes	Yes	3.0.0-1 or later	
Novell SUSE LINUX Enterprise Server 10 (SP3)	2.6.16.60-0.54.5-default 2.6.16.60-0.54.5-smp 2.6.16.60-0.54.5-xen	Yes	Yes	3.0.0-1 or later	
	2.6.16.60-0.69.1-default 2.6.16.60-0.69.1-smp 2.6.16.60-0.69.1-xen	Yes	Yes	3.0.1-1 or later 3.0.3-1, 3.1.0-1 or later	
	2.6.16.60-0.83.2-default 2.6.16.60-0.83.2-smp 2.6.16.60-0.83.2-xen	Yes	Yes	3.1.4-1 or later	
Novell SUSE LINUX Enterprise Server 10 (SP4)	2.6.16.60-0.85.1-default 2.6.16.60-0.85.1-smp 2.6.16.60-0.85.1-xen	Yes	Yes	3.0.4-1 or later	
	2.6.16.60-0.91.1-default 2.6.16.60-0.91.1-smp 2.6.16.60-0.91.1-xen	Yes	Yes	3.1.3-1 or later	
	2.6.16.60-0.93.1-default 2.6.16.60-0.93.1-smp 2.6.16.60-0.93.1-xen	Yes	Yes	3.1.4-1 or later	
	2.6.16.60-0.97.1-default 2.6.16.60-0.97.1-smp 2.6.16.60-0.97.1-xen	Yes	Yes	3.1.5-1 or later	
Novell SUSE LINUX Enterprise Server 11	2.6.27.19-5-default 2.6.27.19-5-xen	Yes	Yes	3.0.0-1 or later	
	2.6.27.48-0.12-default 2.6.27.48-0.12-xen	Yes	Yes	3.0.1-1 or later	
Novell SUSE LINUX Enterprise Server 11 (SP1)	2.6.32.12-0.7-default 2.6.32.12-0.7-xen	No	Yes	3.0.0-1 or later	
		Yes	Yes	3.0.2-1 or later	
	2.6.32.19-0.3.1-default 2.6.32.19-0.3.1-xen	No	Yes	3.0.1-1 or later	
		Yes	Yes	3.0.2-1 or later	
	2.6.32.23-0.3.1-default 2.6.32.23-0.3.1-xen	No	Yes	3.0.1-1 or later	
		Yes	Yes	3.0.2-1 or later	
	2.6.32.49-0.3-default 2.6.32.49-0.3-xen	Yes	Yes	3.1.3-1 or later	

Distribution	Kernel version	Replicator Replicator DR support	Run clpka and clpkhb support	Express Cluster Version	Remarks
Novell SUSE LINUX Enterprise Server 11 (SP2)	3.0.13-0.27-default 3.0.13-0.27-xen	Yes	Yes	3.1.4-1 or later	
	3.0.34-0.7-default 3.0.34-0.7-xen	Yes	Yes	3.1.5-1 or later	
	3.0.80-0.7-default 3.0.80-0.7-xen	Yes	Yes	3.1.10-1 or later	
Novell SUSE LINUX Enterprise Server 11 (SP3)	3.0.76-0.11-default 3.0.76-0.11-xen	Yes	Yes	3.2.0-1 or later	
	3.0.82-0.7-default 3.0.82-0.7-xen	Yes	Yes	3.2.0-1 or later	
Oracle Enterprise Linux 5 (5.5)	2.6.18-194.el5 2.6.18-194.el5xen	Yes	Yes	3.0.0-1 or later	
Oracle Linux 6.2	2.6.39-200.29.1.el6uek.x86_64	Yes	Yes	3.1.5-1 or later	
Oracle Linux 6.4	2.6.39-400.17.1.el6uek.x86_64	Yes	Yes	3.1.10-1 or later	
	2.6.39-400.109.5.el6uek.x86_64	Yes	Yes	3.1.10-1 or later	
	2.6.39-400.211.1.el6uek.x86_64	Yes	Yes	3.2.0-1 or later	
VMware ESX 4.0	2.6.18-128.ESX	No	Yes	3.0.0-1 or later	
VMware ESX 4.0 (update1)					
VMware ESX 4.1	2.6.18-164.ESX	No	Yes	3.0.0-1 or later	
VMware ESX 4.1 (update1)	2.6.18-194.ESX	No	Yes	3.0.3-1 or later	

Section II Installing ExpressCluster

IBM POWER

Distribution	Kernel version	Replicator Replicator DR support	Run clpka and clpkhb support	Express Cluster Version	Remarks
Red Hat Enterprise Linux 5 (update4)	2.6.18-164.el5	No	Yes	3.0.0-1 or later	
	2.6.18-164.6.1.el5	No	Yes	3.0.0-1 or later	
	2.6.18-164.9.1.el5	No	Yes	3.0.0-1 or later	
	2.6.18-164.11.1.el5	No	Yes	3.0.0-1 or later	
	2.6.18-164.15.1.el5	No	Yes	3.0.0-1 or later	
	2.6.18-164.38.1.el5	No	Yes	3.1.4-1 or later	
Red Hat Enterprise Linux 5 (update5)	2.6.18-194.el5	No	Yes	3.0.0-1 or later	
	2.6.18-194.8.1.el5	No	Yes	3.0.0-1 or later	
	2.6.18-194.11.4.el5	No	Yes	3.0.1-1 or later	
	2.6.18-194.17.1.el5	No	Yes	3.0.1-1 or later	
	2.6.18-194.32.1.el5	No	Yes	3.0.3-1 or later	
Red Hat Enterprise Linux 5 (update6)	2.6.18-238.el5	No	Yes	3.0.3-1 or later	
	2.6.18-238.1.1.el5	No	Yes	3.0.3-1 or later	
	2.6.18-238.9.1.el5	No	Yes	3.1.0-1 or later	
	2.6.18-238.37.1.el5	No	Yes	3.1.4-1 or later	
Red Hat Enterprise Linux 5 (update7)	2.6.18-274.el5	No	Yes	3.1.0-1 or later	
	2.6.18-274.18.1.el5	No	Yes	3.1.3-1 or later	
Red Hat Enterprise Linux 5 (update8)	2.6.18-308.el5	No	Yes	3.1.4-1 or later	
	2.6.18-308.4.1.el5	No	Yes	3.1.4-1 or later	
	2.6.18-308.11.1.el5	No	Yes	3.1.5-1 or later	
Red Hat Enterprise Linux 5 (update9)	2.6.18-348.el5	No	Yes	3.2.0-1 or later	
Red Hat Enterprise Linux 5 (update10)	2.6.18-371.el5	No	Yes	3.2.0-1 or later	
	2.6.18-371.3.1.el5	No	Yes	3.2.0-1 or later	
Red Hat Enterprise Linux 6	2.6.32-71.el6.ppc64	No	Yes	3.0.2-1 or later	
	2.6.32-71.7.1.el6.ppc64	No	Yes	3.0.3-1 or later	
	2.6.32-71.14.1.el6.ppc64	No	Yes	3.0.3-1 or later	
	2.6.32-71.18.1.el6.ppc64	No	Yes	3.0.3-1 or later	
Red Hat Enterprise Linux 6 (update1)	2.6.32-131.0.15.el6.ppc64	No	Yes	3.0.4-1 or later	
	2.6.32-131.21.1.el6.ppc64	No	Yes	3.1.3-1 or later	
Red Hat Enterprise Linux 6 (update2)	2.6.32-220.el6.ppc64	No	Yes	3.1.3-1 or later	
	2.6.32-220.4.2.el6.ppc64	No	Yes	3.1.3-1 or later	
	2.6.32-220.17.1.el6.ppc64	No	Yes	3.1.4-1 or later	
	2.6.32-220.23.1.el6.ppc64	No	Yes	3.1.5-1 or later	
Red Hat	2.6.32-279.el6.ppc64	No	Yes	3.1.5-1 or later	

Distribution	Kernel version	Replicator Replicator DR support	Run clpka and clpkhb support	Express Cluster Version	Remarks
Enterprise Linux 6 (update3)	2.6.32-279.2.1.el6.ppc64	No	Yes	3.1.5-1 or later	
	2.6.32-279.11.1.el6.ppc64	No	Yes	3.1.7-1 or later	
	2.6.32-279.14.1.el6.ppc64	No	Yes	3.1.7-1 or later	
	2.6.32-279.19.1.el6.ppc64	No	Yes	3.1.8-1 or later	
Red Hat Enterprise Linux 6 (update4)	2.6.32-358.el6.ppc64	No	Yes	3.1.8-1 or later	
	2.6.32-358.0.1.el6.ppc64	No	Yes	3.1.8-1 or later	
	2.6.32-358.2.1.el6.ppc64	No	Yes	3.1.8-1 or later	
Red Hat Enterprise Linux 6 (update5)	2.6.32-431.el6.ppc64	No	Yes	3.2.0-1 or later	
Asianux Server 4 (SP2)	2.6.32-279.14.1.el6.ppc64	No	Yes	3.1.8-2 or later	
Novell SUSE LINUX Enterprise Server 10 (SP2)	2.6.16.60-0.21-ppc64	No	Yes	3.0.0-1 or later	
Novell SUSE LINUX Enterprise Server 10 (SP3)	2.6.16.60-0.54.5-ppc64	No	Yes	3.0.0-1 or later	
	2.6.16.60-0.69.1-ppc64	No	Yes	3.1.0-1 or later	
Novell SUSE LINUX Enterprise Server 10 (SP4)	2.6.16.60-0.85.1-ppc64	No	Yes	3.0.4-1 or later	
Novell SUSE LINUX Enterprise Server 11	2.6.27.19-5-ppc64	No	Yes	3.0.0-1 or later	
Novell SUSE LINUX Enterprise Server 11 (SP1)	2.6.32.12-0.7-ppc64	No	Yes	3.0.2-1 or later	
Novell SUSE LINUX Enterprise Server 11 (SP2)	3.0.13-0.27-ppc64	No	Yes	3.1.5-1 or later	

Section II Installing ExpressCluster

Applications supported by monitoring options

Version information of the applications to be monitored by monitor resources is described below.

IA32

Monitor resource	Monitored application	ExpressCluster version	Remarks
Oracle monitor	Oracle Database 10g Release 2 (10.2)	3.0.0-1 or later	
	Oracle Database 11g Release 1 (11.1)	3.0.0-1 or later	
	Oracle Database 11g Release 2 (11.2)	3.0.0-1 or later	
DB2 monitor	DB2 V9.5	3.0.0-1 or later	
	DB2 V9.7	3.0.0-1 or later	
	DB2 V10.1	3.1.3-1 or later	
	DB2 V10.5	3.1.8-1 or later	
PostgreSQL monitor	PostgreSQL 8.1	3.0.0-1 or later	
	PostgreSQL 8.2	3.0.0-1 or later	
	PostgreSQL 8.3	3.0.0-1 or later	
	PostgreSQL 8.4	3.0.0-1 or later	
	PostgreSQL 9.0	3.0.3-1 or later	
	PostgreSQL 9.1	3.1.0-1 or later	
	PostgreSQL 9.2	3.1.7-1 or later	
	PostgreSQL 9.3	3.1.8-1 or later	
	PowerGres on Linux 6.0	3.0.0-1 or later	
	PowerGres on Linux 7.0	3.0.0-1 or later	
	PowerGres on Linux 7.1	3.0.0-1 or later	
	PowerGres on Linux 9.0	3.0.3-1 or later	
MySQL monitor	MySQL 5.0	3.0.0-1 or later	
	MySQL 5.1	3.0.0-1 or later	
	MySQL 5.5	3.0.3-1 or later	
	MySQL 5.6	3.1.8-1 or later	
Sybase monitor	Sybase ASE 15.0	3.0.0-1 or later	
	Sybase ASE 15.5	3.1.0-1 or later	
	Sybase ASE 15.7	3.1.0-1 or later	
Samba monitor	Samba 3.0	3.0.0-1 or later	
	Samba 3.2	3.0.0-1 or later	
	Samba 3.3	3.0.0-1 or later	
	Samba 3.4	3.0.0-1 or later	
	Samba 3.5	3.1.5-1 or later	
	Samba 4.0	3.1.8-1 or later	
	Samba 4.1	3.2.1-1 or later	

ExpressCluster X 3.2 for Linux Getting Started Guide

Monitor resource	Monitored application	ExpressCluster version	Remarks
nfs monitor	nfsd 2 (udp)	3.0.0-1 or later	
	nfsd 3 (udp)	3.1.5-1 or later	
	nfsd 4 (tcp)	3.1.5-1 or later	
	mountd 1 (tcp)	3.0.0-1 or later	
	mountd 2 (tcp)	3.1.5-1 or later	
	mountd 3 (tcp)	3.1.5-1 or later	
HTTP monitor	No specified version	3.0.0-1 or later	
SMTP monitor	No specified version	3.0.0-1 or later	
Pop3 monitor	No specified version	3.0.0-1 or later	
imap4 monitor	No specified version	3.0.0-1 or later	
ftp monitor	No specified version	3.0.0-1 or later	
Tuxedo monitor	Tuxedo 10g R3	3.0.0-1 or later	
	Tuxedo 11g R1	3.0.0-1 or later	
OracleAS monitor	Oracle Application Server 10g Release 3 (10.1.3.4)	3.0.0-1 or later	
Weblogic monitor	WebLogic Server 10g R3	3.0.0-1 or later	
	WebLogic Server 11g R1	3.0.0-1 or later	
	WebLogic Server 12c	3.1.3-1 or later	
Websphere monitor	WebSphere 6.1	3.0.0-1 or later	
	WebSphere 7.0	3.0.0-1 or later	
	WebSphere 8.0	3.1.5-1 or later	
	WebSphere 8.5	3.1.8-1 or later	
WebOTX monitor	WebOTX V7.1	3.0.0-1 or later	
	WebOTX V8.0	3.0.0-1 or later	
	WebOTX V8.1	3.0.0-1 or later	
	WebOTX V8.2	3.0.0-1 or later	
	WebOTX V8.3	3.1.0-1 or later	
	WebOTX V8.4	3.1.0-1 or later	
	WebOTX V9.1	3.1.10-1 or later	
	WebOTX V9.2	3.2.1-1 or later	
JVM monitor	WebLogic Server 11g R1	3.1.0-1 or later	
	WebLogic Server 12c	3.1.3-1 or later	
	WebOTX V8.2	3.1.0-1 or later	
	WebOTX V8.3	3.1.0-1 or later	
	WebOTX V8.4	3.1.0-1 or later	
	WebOTX V9.1	3.1.10-1 or later	

Section II Installing ExpressCluster

Monitor resource	Monitored application	ExpressCluster version	Remarks
	WebOTX V9.2	3.2.1-1 or later	WebOTX update is required to monitor process groups
	WebOTX Enterprise Service Bus V8.4	3.1.3-1 or later	
	WebOTX Enterprise Service Bus V8.5	3.1.5-1 or later	
	JBoss Application Server 4.2.3.GA/5.1.0.GA	3.1.0-1 or later	
	JBoss Enterprise Application Platform 4.3.0.GA_CP06	3.1.0-1 or later	
	JBoss Enterprise Application Platform 5	3.2.1-1 or later	
	JBoss Enterprise Application Platform 6	3.2.1-1 or later	
	JBoss Enterprise Application Platform 6.1.1	3.2.1-1 or later	
	JBoss Enterprise Application Platform 6.2	3.2.1-1 or later	
	Apache Tomcat 6.0	3.1.0-1 or later	
	Apache Tomcat 7.0	3.1.3-1 or later	
	WebSAM SVF for PDF 9.0	3.1.3-1 or later	
	WebSAM SVF for PDF 9.1	3.1.4-1 or later	
	WebSAM Report Director Enterprise 9.0	3.1.3-1 or later	
	WebSAM Report Director Enterprise 9.1	3.1.5-1 or later	
	WebSAM Universal Connect/X 9.0	3.1.3-1 or later	
	WebSAM Universal Connect/X 9.1	3.1.5-1 or later	
	Oracle iPlanet Web Server 7.0	3.1.3-1 or later	
System monitor	No specified version	3.1.0-1 or later	

x86_64

Monitor resource	Monitored application	ExpressCluster version	Remarks
Oracle monitor	Oracle Database 10g Release 2 (10.2)	3.0.0-1 or later	
	Oracle Database 11g Release 1 (11.1)	3.0.0-1 or later	
	Oracle Database 11g Release 2 (11.2)	3.0.0-1 or later	
	Oracle Database 12c Release1 (12.1)	3.1.8-1 or later	Tested operation of traditional compatibility function only
DB2 monitor	DB2 V9.5	3.0.0-1 or later	
	DB2 V9.7	3.0.0-1 or later	
	DB2 V10.1	3.1.3-1 or later	
	DB2 V10.5	3.1.8-1 or later	
PostgreSQL monitor	PostgreSQL 8.1	3.0.0-1 or later	
	PostgreSQL 8.2	3.0.0-1 or later	
	PostgreSQL 8.3	3.0.0-1 or later	
	PostgreSQL 8.4	3.0.0-1 or later	
	PostgreSQL 9.0	3.0.3-1 or later	
	PostgreSQL 9.1	3.1.0-1 or later	
	PostgreSQL 9.2	3.1.7-1 or later	
	PostgreSQL 9.3	3.1.8-1 or later	
	PowerGres on Linux 6.0	3.0.0-1 or later	
	PowerGres on Linux 7.0	3.0.0-1 or later	
	PowerGres on Linux 7.1	3.0.0-1 or later	
	PowerGres on Linux 9.0	3.0.3-1 or later	
	PowerGres on Linux 9.1	3.1.8-1 or later	
	PowerGres Plus V5.0	3.0.0-1 or later	
MySQL monitor	MySQL 5.0	3.0.0-1 or later	
	MySQL 5.1	3.0.0-1 or later	
	MySQL 5.5	3.0.3-1 or later	
	MySQL 5.6	3.1.8-1 or later	
Sybase monitor	Sybase ASE 15.0	3.0.0-1 or later	
	Sybase ASE 15.5	3.1.0-1 or later	
	Sybase ASE 15.7	3.1.0-1 or later	
Samba monitor	Samba 3.0	3.0.0-1 or later	
	Samba 3.2	3.0.0-1 or later	
	Samba 3.3	3.0.0-1 or later	
	Samba 3.4	3.0.0-1 or later	

Section II Installing ExpressCluster

Monitor resource	Monitored application	ExpressCluster version	Remarks
	Samba 3.5	3.1.5-1 or later	
	Samba 4.0	3.1.8-1 or later	
NFS monitor	nfsd 2 (udp)	3.0.0-1 or later	
	nfsd 3 (udp)	3.1.5-1 or later	
	nfsd 4 (tcp)	3.1.5-1 or later	
	mountd 1 (tcp)	3.0.0-1 or later	
	mountd 2 (tcp)	3.1.5-1 or later	
	mountd 3 (tcp)	3.1.5-1 or later	
HTTP monitor	No specified version	3.0.0-1 or later	
SMTP monitor	No specified version	3.0.0-1 or later	
pop3 monitor	No specified version	3.0.0-1 or later	
imap4 monitor	No specified version	3.0.0-1 or later	
ftp monitor	No specified version	3.0.0-1 or later	
Tuxedo monitor	Tuxedo 10g R3	3.0.0-1 or later	
	Tuxedo 11g R1	3.0.0-1 or later	
OracleAS monitor	Oracle Application Server 10g Release 3 (10.1.3.4)	3.0.0-1 or later	
Weblogic monitor	WebLogic Server 10g R3	3.0.0-1 or later	
	WebLogic Server 11g R1	3.0.0-1 or later	
	WebLogic Server 12c	3.1.3-1 or later	
Websphere monitor	WebSphere 6.1	3.0.0-1 or later	
	WebSphere 7.0	3.0.0-1 or later	
	WebSphere 8.0	3.1.5-1 or later	
	WebSphere 8.5	3.1.8-1 or later	
WebOTX monitor	WebOTX V7.1	3.0.0-1 or later	
	WebOTX V8.0	3.0.0-1 or later	
	WebOTX V8.1	3.0.0-1 or later	
	WebOTX V8.2	3.0.0-1 or later	
	WebOTX V8.3	3.1.0-1 or later	
	WebOTX V8.4	3.1.0-1 or later	
	WebOTX V8.5	3.1.5-1 or later	
	WebOTX V9.1	3.1.10-1 or later	
JVM monitor	WebLogic Server 11g R1	3.1.0-1 or later	
	WebLogic Server 12c	3.1.3-1 or later	
	WebOTX V8.2	3.1.0-1 or later	
	WebOTX V8.3	3.1.0-1 or later	
	WebOTX V8.4	3.1.0-1 or later	
	WebOTX V8.5	3.1.5-1 or later	

ExpressCluster X 3.2 for Linux Getting Started Guide

Monitor resource	Monitored application	ExpressCluster version	Remarks
	WebOTX V9.1	3.1.10-1 or later	
	WebOTX Enterprise Service Bus V8.4	3.1.3-1 or later	
	WebOTX Enterprise Service Bus V8.5	3.1.5-1 or later	
	JBoss Application Server 4.2.3.GA/5.1.0.GA	3.1.0-1 or later	
	JBoss Enterprise Application Platform 4.3.0.GA_CP06	3.1.0-1 or later	
	Apache Tomcat 6.0	3.1.0-1 or later	
	Apache Tomcat 7.0	3.1.3-1 or later	
	WebSAM SVF for PDF 9.0	3.1.3-1 or later	
	WebSAM SVF for PDF 9.1	3.1.4-1 or later	
	WebSAM Report Director Enterprise 9.0	3.1.3-1 or later	
	WebSAM Report Director Enterprise 9.1	3.1.5-1 or later	
	WebSAM Universal Connect/X 9.0	3.1.3-1 or later	
	WebSAM Universal Connect/X 9.1	3.1.5-1 or later	
	Oracle iPlanet Web Server 7.0	3.1.3-1 or later	
System monitor	No specified version	3.1.0-1 or later	

Note: To use monitoring options in x86_64 environments, applications to be monitored must be x86_64 version.

IBM POWER

Monitor resource	Monitored application	ExpressCluster version	Remarks
Oracle monitor	Oracle Database 10g Release 2 (10.2)	3.0.0-1 or later	
DB2 monitor	DB2 V9.5	3.1.0-1 or later	
	DB2 V9.7	3.0.0-1 or later	
	DB2 V10.1	3.1.3-1 or later	
	DB2 V10.5	3.1.8-1 or later	
PostgreSQL monitor	PostgreSQL 8.1	3.1.0-1 or later	
	PostgreSQL 8.2	3.1.0-1 or later	
	PostgreSQL 8.3	3.1.0-1 or later	
	PostgreSQL 8.4	3.0.0-1 or later	
	PostgreSQL 9.0	3.1.0-1 or later	
	PostgreSQL 9.1	3.1.0-1 or later	
	PostgreSQL 9.2	3.1.7-1 or later	
	PostgreSQL 9.3	3.1.8-1 or later	

Note: To use monitoring options in IBM POWER environments, applications to be monitored must be IBM POWER version.

Operation Environment of VM resources

The followings are the version information of the virtual machines on which VM resources operation are verified.

Virtual Machine	Version	ExpressCluster version	Remarks
vSphere	4.0 update1 (x86_64)	3.0.0-1 or later	
	4.0 update2 (x86_64)	3.0.0-1 or later	
	4.1 (x86_64)	3.0.0-1 or later	
	5	3.1.0-1 or later	Need management VM
	5.1	3.1.0-1 or later	Need management VM
	5.5	3.2.0-1 or later	Need management VM
XenServer	5.5 (IA32)	3.0.0-1 or later	
	5.6 (IA32)	3.0.0-1 or later	
KVM	Red Hat Enterprise Linux 5.5 (x86_64)	3.0.0-1 or later	
	Red Hat Enterprise Linux 5.6 (x86_64)	3.0.0-1 or later	
	Red Hat Enterprise Linux 5.7 (x86_64)	3.2.0-1 or later	
	Red Hat Enterprise Linux 5.8 (x86_64)	3.2.0-1 or later	
	Red Hat Enterprise Linux 5.9 (x86_64)	3.2.0-1 or later	
	Red Hat Enterprise Linux 5.10 (x86_64)	3.2.0-1 or later	
	Red Hat Enterprise Linux 6.0 (x86_64)	3.1.0-1 or later	
	Red Hat Enterprise Linux 6.1 (x86_64)	3.1.0-1 or later	
	Red Hat Enterprise Linux 6.2 (x86_64)	3.2.0-1 or later	
	Red Hat Enterprise Linux 6.3 (x86_64)	3.2.0-1 or later	
	Red Hat Enterprise Linux 6.4 (x86_64)	3.2.0-1 or later	
	Red Hat Enterprise Linux 6.5 (x86_64)	3.2.0-1 or later	

Operation environment for SNMP linkage functions

The tables below list the SNMP agents on which the operation of the SNMP linkage functions was verified.

IA32

Distribution	SNMP agent	ExpressCluster version	Remarks
Red Hat Enterprise Linux 5.4	Net-SNMP 5.3.2.2	3.1.0-1 or later	
Red Hat Enterprise Linux 5.6	Net-SNMP 5.3.2.2	3.1.0-1 or later	
Red Hat Enterprise Linux 6.1	Net-SNMP 5.5	3.1.0-1 or later	
Novell SUSE LINUX Enterprise Server 11 (SP1)	Net-SNMP 5.4.2.1	3.1.0-1 or later	

x86_64

Distribution	SNMP agent	ExpressCluster version	Remarks
Red Hat Enterprise Linux 5.4	Net-SNMP 5.3.2.2	3.1.0-1 or later	
Red Hat Enterprise Linux 5.6	Net-SNMP 5.3.2.2	3.1.0-1 or later	
Red Hat Enterprise Linux 6.1	Net-SNMP 5.5	3.1.0-1 or later	
Novell SUSE LINUX Enterprise Server 11 (SP1)	Net-SNMP 5.4.2.1	3.1.0-1 or later	
Oracle Enterprise Linux 5 (5.5)	Net-SNMP 5.3.2.2	3.1.0-1 or later	

IBM POWER

Distribution	SNMP agent	ExpressCluster version	Remarks
Red Hat Enterprise Linux 6.1	Net-SNMP 5.5	3.1.0-1 or later	
Novell SUSE LINUX Enterprise Server 11 (SP1)	Net-SNMP 5.4.2.1	3.1.0-1 or later	

Note: Use Novell SUSE LINUX Enterprise Server 11 (SP1) or later to obtain SNMP information on a Novell SUSE LINUX Enterprise Server.

Operation environment for JVM monitor

The use of the JVM monitor requires a Java runtime environment. Also, monitoring a domain mode of JBoss Enterprise Application Platform 6 or later requires Java® SE Development Kit.

Java®Runtime Environment
Version6.0 Update 21 (1.6.0_21) or later

Java®SE Development Kit
Version 6.0 Update 21(1.6.0_21) or later

Java®Runtime Environment
Version7.0

Java®SE Development Kit
Version 7.0

Open JDK

The tables below list the load balancers that were verified for the linkage with the JVM monitor.

IA32

Load balancer	ExpressCluster version	Remarks
Express5800/LB400h or later	3.1.0-1 or later	
InterSec/LB400i or later	3.1.0-1 or later	
InterSecVM/LB V1.0 or later * When Rel1.0 or later is applied	3.1.0-1 or later	
BIG-IP v11	3.1.3-1 or later	
MIRACLE LoadBalancer	3.1.3-1 or later	
CoyotePoint Equalizer	3.1.3-1 or later	

x86_64

Load balancer	ExpressCluster version	Remarks
Express5800/LB400h or later	3.1.0-1 or later	
InterSec/LB400i or later	3.1.0-1 or later	
InterSecVM/LB V1.0 or later * When Rel1.0 or later is applied	3.1.0-1 or later	
BIG-IP v11	3.1.3-1 or later	
MIRACLE LoadBalancer	3.1.3-1 or later	
CoyotePoint Equalizer	3.1.3-1 or later	

Required memory and disk size

	Required memory size		Required disk size	
	User mode	**Kernel mode**	**Right after installation**	**Max. during operation**
IA-32	96 MB(*1)	When the synchronization mode is used: (number of request queues x I/O size) + (2MB x number of mirror disk resources and hybrid disk resources)	140 MB	2.0 GB
x86_64	96 MB(*1)	When the asynchronous mode is used: (number of request queues x I/O size) + ((2MB + (number of asynchronous queues)) x number of mirror disk resources and hybrid disk resources)	140 MB	2.0 GB
IBM POWER	64 MB(*1)	-	24 MB	1.1 GB

 (*1) excepting for optional products.

Note:

The I/O size is 128 KB for the vxfs file system and 4 KB for file systems other than it.

For the setting value of the number of request queues and asynchronization queues, see "Understanding mirror disk resources" in the *Reference Guide*.

System requirements for the Builder

Supported operating systems and browsers

Refer to the website, *http://www.nec.com/global/prod/expresscluster/,* for the latest information. Currently supported operating systems and browsers are the following:

Operating system	Browser	Language
Microsoft Windows® XP SP3 or later (IA32)	IE7	English/Japanese/Chinese
	IE8	English/Japanese/Chinese
Microsoft Windows Vista® (IA32)	IE7	English/Japanese/Chinese
	IE8	English/Japanese/Chinese
Microsoft Windows® 7 (IA32)	IE8	English/Japanese/Chinese
Microsoft Windows® 7 SP1 (IA32)	IE8	English/Japanese/Chinese
Microsoft Windows® 7 SP1 (IA32)	IE9	English/Japanese/Chinese
Microsoft Windows® 7 SP1 (IA32)	Firefox 10	English/Japanese/Chinese
Microsoft Windows® 8 (IA32, x86_64)	IE10	English/Japanese/Chinese
Microsoft Windows® 8 (IA32, x86_64)	Firefox 15	English/Japanese/Chinese
Microsoft Windows® 8.1 (IA32, x86_64)	IE 11	English/Japanese/Chinese
Microsoft Windows Server 2008 (IA32)	IE7	English/Japanese/Chinese
Microsoft Windows Server 2008 R2	IE 9	English/Japanese/Chinese
Microsoft Windows Server 2012	IE 10	English/Japanese/Chinese
Microsoft Windows Server 2012	Firefox 15	English/Japanese/Chinese
Microsoft Windows Server 2012 R2	IE 11	English/Japanese/Chinese
Novell SUSE LINUX Enterprise Server 10 (IA32)	Firefox 2.0.0.2	English/Japanese/Chinese
Novell SUSE LINUX Enterprise Server 11 (x86_64)	Firefox 10	English/Japanese/Chinese
Red Hat Enterprise Linux 5 update5 (IA32)	Firefox 3.0.18	English/Japanese/Chinese
Red Hat Enterprise Linux 6 update3 (IA32)	Firefox 10	English/Japanese/Chinese
Asianux Server 3 (IA32)	Firefox 1.5.0.12	English/Japanese/Chinese
	Konqueror3.5.5	English/Japanese/Chinese
Turbolinux 11 Server (IA32)	Firefox 2.0.0.8	English/Japanese/Chinese

Note:

The Builder does not run on a browser of a x86_64 or IBM POWER machine. Use a browser supporting IA32 to run the Builder.

Note:

When using Internet Explorer 9, to connect to WebManager by using `http://<IP address>:2900`, the IP address must be registered to **Site** of **Local Intranet** in advance.

Java runtime environment

Required:

Java™ Runtime Environment, Version 6.0 Update 21 (1.6.0_21) or later

Java™ Runtime Environment, Version 7.0 Update 2 (1.7.0_2) or later

Note:

The 32-bit Java Runtime is necessary to run the Builder on x86_64 machines.

Note:

The offline Builder 3.1.8-1 or earlier does not run on Java Runtime Environment Version 7 Update 25.

Note:

The offline Builder does not run on Java Runtime Environment Version 7 Update 40 or later.

Required memory and disk size

Required memory size: 32 MB or more

Required disk size: 5 MB (excluding the size required for Java runtime environment)

Supported ExpressCluster versions

Offline Builder version	ExpressCluster X rpm version
3.0.0-1	3.0.0-1
3.0.1-1	3.0.1-1
3.0.2-1	3.0.2-1
3.0.3-2	3.0.3-1
3.0.4-1	3.0.4-1
3.1.0-1	3.1.0-1
3.1.1-1	3.1.1-1
3.1.3-1	3.1.3-1
3.1.4-1	3.1.4-1
3.1.5-1	3.1.5-1
	3.1.6-1
3.1.7-1	3.1.7-1
3.1.8-1	3.1.8-1
3.2.0-1	3.2.0-1

Note:

When you use the Offline Builder and the ExpressCluster rpm, a combination of their versions should be the one shown above. The Builder may not operate properly if they are used in a different combination.

System requirements for the WebManager

Supported operating systems and browsers

Refer to the website, *http://www.nec.com/global/prod/expresscluster/,* for the latest information. Currently the following operating systems and browsers are supported:

Operating system	Browser	Language
Microsoft Windows® SP3(IA32)	IE7	English/Japanese/Chinese
	IE8	English/Japanese/Chinese
Microsoft Windows Vista® (IA32)	IE7	English/Japanese/Chinese
	IE8	English/Japanese/Chinese
Microsoft Windows® 7 (IA32)	IE8	English/Japanese/Chinese
Microsoft Windows® 7 SP1 (IA32)	IE8	English/Japanese/Chinese
Microsoft Windows® 7 SP1 (IA32)	IE9	English/Japanese/Chinese
Microsoft Windows® 7 SP1 (IA32)	Firefox 10	English/Japanese/Chinese
Microsoft Windows® 8 (IA32, x86_64)	IE10	English/Japanese/Chinese
Microsoft Windows® 8 (IA32, x86_64)	Firefox 15	English/Japanese/Chinese
Microsoft Windows® 8.1 (IA32, x86_64)	IE 11	English/Japanese/Chinese
Microsoft Windows Server 2008 (IA32)	IE7	English/Japanese/Chinese
Microsoft Windows Server 2008 R2	IE 9	English/Japanese/Chinese
Microsoft Windows Server 2012	IE 10	English/Japanese/Chinese
Microsoft Windows Server 2012	Firefox 15	English/Japanese/Chinese
Microsoft Windows Server 2012 R2	IE 11	English/Japanese/Chinese
Novell SUSE LINUX Enterprise Server 10 (IA32)	Firefox 2.0.0.2	English/Japanese/Chinese
Novell SUSE LINUX Enterprise Server 11 (x86_64)	Firefox 10	English/Japanese/Chinese
Red Hat Enterprise Linux 5 update5 (IA32)	Firefox 3.0.18	English/Japanese/Chinese
Red Hat Enterprise Linux 6 update3 (IA32)	Firefox 10	English/Japanese/Chinese
Asianux Server 3 (IA32)	Firefox 1.5.0.12	English/Japanese/Chinese
	Konqueror3.5.5	English/Japanese/Chinese
Turbolinux 11 Server (IA32)	Firefox 2.0.0.8	English/Japanese/Chinese

Note:

The WebManager does not run on a browser of an x86_64 or IBM POWER machine. Use a browser supporting IA32 to run the WebManager .

Note:

When using Internet Explorer 9, to connect to WebManager by using `http://<IP address>:2900`, the IP address must be registered to **Site** of **Local Intranet** in advance.

Java runtime environment

Required:

Java™ Runtime Environment, Version 6.0 Update 21 (1.6.0_21) or later

Java™ Runtime Environment, Version 7.0 Update 2 (1.7.0_2) or later

Note:

The 32-bit Java Runtime is necessary to run the Builder on x86_64 machines.

Required memory and disk size

Required memory size: 40 MB or more

Required disk size: 600 KB (excluding the size required for Java runtime environment)

System requirements for the Integrated WebManager

This section explains system requirements to operate the Integrated WebManager. Refer to the *Integrated WebManager Administrator's Guide* for the Java application version Integrated WebManager.

Supported operating systems and browsers

Currently the following operating systems and browsers are supported:

Operating system	Browser	Language
Windows® XP SP3	IE7	English/Japanese/Chinese
	IE8	English/Japanese/Chinese
Microsoft Windows Vista™ (IA32)	IE7	English/Japanese/Chinese
	IE8	English/Japanese/Chinese
Microsoft Windows® 7 (IA32)	IE8	English/Japanese/Chinese
Microsoft Windows® 7 SP1 (IA32)	IE8	English/Japanese/Chinese
Microsoft Windows® 7 SP1 (IA32)	IE9	English/Japanese/Chinese
Microsoft Windows® 7 SP1 (IA32)	Firefox 10	English/Japanese/Chinese
Microsoft Windows® 8 (IA32, x86_64)	IE10	English/Japanese/Chinese
Microsoft Windows® 8 (IA32, x86_64)	Firefox 15	English/Japanese/Chinese
Microsoft Windows® 8.1 (IA32, x86_64)	IE 11	English/Japanese/Chinese
Microsoft Windows Server 2008 (IA32)	IE7	English/Japanese/Chinese
Microsoft Windows Server 2008 R2	IE 9	English/Japanese/Chinese
Microsoft Windows Server 2012	IE 10	English/Japanese/Chinese
Microsoft Windows Server 2012	Firefox 15	English/Japanese/Chinese
Microsoft Windows Server 2012 R2	IE 11	English/Japanese/Chinese
Novell SUSE LINUX Enterprise Server 10 (IA32)	Firefox 2.0.0.2	English/Japanese/Chinese
Novell SUSE LINUX Enterprise Server 11 (x86_64)	Firefox 10	English/Japanese/Chinese
Red Hat Enterprise Linux 5 update5 (IA32)	Firefox 3.0.18	English/Japanese/Chinese
Red Hat Enterprise Linux 6 update3 (IA32)	Firefox 10	English/Japanese/Chinese
Asianux Server 3 (IA32)	Firefox 1.5.0.12	English/Japanese/Chinese
	Konqueror3.5.5	English/Japanese/Chinese
Turbolinux 11 Server (IA32)	Firefox 2.0.0.8	English/Japanese/Chinese

Note:

The Integrated WebManager does not run on a browser of an x86_64 or IBM POWER machine. Use a browser supporting IA32 to run the Integrated WebManager .

Java runtime environment

Required:

Java™ Runtime Environment, Version 6.0 Update 21 (1.6.0_21) or later.

Java™ Runtime Environment, Version 7.0 Update 2 (1.7.0_2) or later

Note:

The 32-bit Java Runtime is necessary to run the Builder on x86_64 machines.

Required memory size and disk size

Required memory size: 40 MB or more

Required disk size: 300 KB or more (excluding the size required for Java runtime environment)

System requirements for WebManager Mobile

This section explains the system requirements to run the WebManager Mobile.

Supported operating systems and browsers

Currently the following operating systems and browsers are supported:

Operating system	Browser	Language
Android 2.2	Standard browser	English/Japanese/Chinese
Android 2.3	Standard browser	English/Japanese/Chinese
Android 3.0	Standard browser	English/Japanese/Chinese
iOS 5	Safari (standard)	English/Japanese/Chinese

Chapter 4   Latest version information

This chapter provides the latest information on ExpressCluster.
This chapter covers:

Correspondence list of ExpressCluster and a manual

This book has explained on the assumption that ExpressCluster of the following version. Be careful of the number of versions of the version of ExpressCluster, and a manual.

ExpressCluster Version	Manual	Manual Version	Remarks
3.2.1-1	Installation and Configuration Guide	2nd Edition	
	Getting Started Guide	2nd Edition	
	Reference Guide	2nd Edition	
	Integrated WebManager Administrator's Guide	8th Edition	
	WebManager Mobile Administrator's Guide	1st Edition	

Enhanced functions

Upgrade has been performed on the following minor versions.

Number	Version (in detail)	Upgraded section
1	3.0.0-1	The WebManager and Builder can now be used from the same browser window.
2	3.0.0-1	The cluster generation wizard has been upgraded.
3	3.0.0-1	Some settings can now be automatically acquired in the cluster generation wizard.
4	3.0.0-1	The Integrated WebManager can now be used from a browser.
5	3.0.0-1	A function has been implemented to check settings when uploading configuration data.
6	3.0.0-1	ExpressCluster can now automatically select the failover destination when an error occurs.
7	3.0.0-1	A function has been implemented to control failovers across server groups.
8	3.0.0-1	**All Groups** can now be selected as the failover target when an error is detected.
9	3.0.0-1	The start wait time can now be skipped.
10	3.0.0-1	ExpressCluster can now manage external errors.
11	3.0.0-1	Dump information can now be acquired when the target monitoring application times out.

ExpressCluster X 3.2 for Linux Getting Started Guide

Number	Version (in detail)	Upgraded section
12	3.0.0-1	Detailed information about an Oracle database can now be acquired if an error is detected while monitoring it.
13	3.0.0-1	Mirror data can now be compressed for transfer during asynchronous mirroring.
14	3.0.0-1	Whole mirror synchronization has been accelerated.
15	3.0.0-1	A function has been implemented to register a virtual host name to the dynamic DNS server.
16	3.0.0-1	A guest OS can now be handled as a resource when the host OS of vSphere, XenServer, or kvm is clustered.
17	3.0.0-1	A function has been implemented to automatically follow a guest OS in the virtualization infrastructure if it is moved by software other than ExpressCluster.
18	3.0.0-1	vMotion can now be executed at error detection or during operation if the vSphere host OS is clustered.
19	3.0.0-1	The Logical Volume Manager (LVM) can now be controlled.
20	3.0.0-1	Disk settings have been consolidated.
21	3.0.0-1	Additional OSs are now supported.
22	3.0.0-1	Additional applications are now supported.
23	3.0.0-1	Additional network warning lights are now supported.
24	3.0.2-1	The newly released kernel is now supported.
25	3.0.2-1	An improvement has been made to the WebManager display that indicates the specification of all groups as recovery targets of the monitor resource.
26	3.0.3-1	The newly released kernel is now supported.
27	3.0.3-1	Coordination with the migration function of XenServer has been enabled.
28	3.0.4-1	The newly released kernel is now supported.
29	3.1.0-1	The number of group and resource has been doubled.
30	3.1.0-1	Options have been added for dynamic failover.
31	3.1.0-1	Waiting for startup or stopping a faiover group has been enabled.
32	3.1.0-1	Failover to a resource outside the server group has been added as a recovery action for an message receive monitor resource (mrw).
33	3.1.0-1	A function whereby the WebManager and the `clpmonctrl` command can be used to trigger a Dummy Failure for a monitor resource has been implemented.
34	3.1.0-1	WebManager that can be connected from an Android terminal has been implemented.

Section II Installing ExpressCluster

Number	Version (in detail)	Upgraded section
35	3.1.0-1	The MIB of ExpressCluster has been defined.
36	3.1.0-1	An SNMP trap transmission function has been added.
37	3.1.0-1	Information acquisition requests on SNMP are now supported.
38	3.1.0-1	A function has been implemented to execute a specified script to recover a monitor resource. In addition, script execution has been enabled prior to reactivation or failover.
39	3.1.0-1	A function has been implemented to disable recovery action caused by monitor resource error.
40	3.1.0-1	Parallel processing now occurs when all groups failover due to a monitoring error.
41	3.1.0-1	Database monitoring functions have been enhanced.
42	3.1.0-1	Some environment variables have been added for use in scripts.
43	3.1.0-1	Script setting has been simplified by the use of script templates.
44	3.1.0-1	The display of the configuration mode screen has been corrected for the 800*600 screen size.
45	3.1.0-1	Logs can be downloaded even if the browser is set to block popups.
46	3.1.0-1	Functions for which licenses have not been installed are no longer displayed during setup.
47	3.1.0-1	The number of monitor resources that are automatically registered has been increased.
48	3.1.0-1	The default command timeout value for the `clprexec` command has been changed from 30 seconds to 180 seconds.
49	3.1.0-1	Process name monitor resource (psw) has been added.
50	3.1.0-1	JVM monitor resource (jraw) has been added.
51	3.1.0-1	System monitor resource (sraw) has been added.
52	3.1.0-1	A function has been added to save the mirror disk performance data as a log.
53	3.1.0-1	Short options are available for mirror disk-related commands.
54	3.1.0-1	Configuration screen for mirror disk connect is now the same before and after running Cluster Generation Wizard.
55	3.1.0-1	A function has been added to prevent the startup of the ExpressCluster services when the operating system has been shut down abnormally.
56	3.1.0-1	Conditions for triggering the function that stalls shutdown can now be specified.
57	3.1.0-1	Rotating log (internal log) can now be selected as the script execution log for EXEC resources and custom monitor resources (genw).

ExpressCluster X 3.2 for Linux Getting Started Guide

Number	Version (in detail)	Upgraded section
58	3.1.0-1	A list of registered licenses can now be displayed by using the `clplcns` command.
59	3.1.0-1	A function for using the `clplcns` command to delete only the trial license has been added.
60	3.1.0-1	The newly released kernel is now supported.(RHEL5.7, AXS3SP4)
61	3.1.0-1	In linkage with vSphere5, the cluster on the guest operating system has been enabled to control startup and stopping of another guest operating system.
62	3.1.0-1	Coordination with the migration function of kvm has been enabled.
63	3.1.0-1	Timeout decision processing has been improved when an invalid OS time is returned from while running for 447 or 497 continuous days.
64	3.1.0-1	LVM and VxVM information has been added to the function that collects server information in configuration mode.
65	3.1.0-1	A function has been added to limit the bandwidth for communication with the mirror disks (in asynchronous mode).
66	3.1.0-1	A command function has been added to display mirror disk performance data.
67	3.1.0-1	If BMC detects some serious error on Express5800/A1080, BMC can wait for its recovery action until recovery action of message receive monitor (mrw) is completed.
68	3.1.0-1	Heartbeat path via networks among BMC interfaces is newly added for exclusive use with Express5800/A1080.
69	3.1.1-1	The newly released kernel is now supported. (XenServer6)
70	3.1.1-1	The conditions to wait for the group stop can now be specified. (Cluster stop, server stop)
71	3.1.1-1	The view of the recovery action control function popup window that is displayed at the end of the Cluster Generation Wizard is improved.
72	3.1.1-1	The number of disks of which size is to be monitored by System Resource Agent has been changed from 10 to 64.
73	3.1.3-1	The newly released kernel is now supported.
74	3.1.3-1	A function for displaying time information has been added to WebManager.
75	3.1.3-1	A function for forcibly stopping a virtual machine has been added.
76	3.1.3-1	A function for automatically starting or resuming the cluster after reflecting the configuration data has been added.
77	3.1.3-1	A function has been added to prevent a Web browser from being terminated or reloaded when the configuration data is edited in WebManager Config Mode.
78	3.1.3-1	WebManager can now set and display physical machines and virtual machines separately.
79	3.1.3-1	The setting that assumes that a diskfull detection is not an error has been added to the disk monitor resource.
80	3.1.3-1	A function for monitoring the number of processes has been added to the

Number	Version (in detail)	Upgraded section
		process name monitor resource.
81	3.1.3-1	The Oracle monitor resource has been improved so that a specific error (ORA-1033) which occurs when Oracle is being started is regarded as being the normal state.
82	3.1.3-1	The disk resource monitoring function of the system monitor resource can now monitor disks and mirror disks that are mounted after the system started.
83	3.1.3-1	The floating IP monitor resource has been added.
84	3.1.3-1	The process to deactivate a resource has been improved so that the process can be executed as far as possible in case of emergency shutdown.
85	3.1.3-1	It is now possible to specify whether to enable or disable the deactivity check of the floating IP address resource.
86	3.1.3-1	The conditions to determine whether a timeout occurs in Database Agent, Java Resource Agent, System Resource Agent, virtual IP monitor resource, and DDNS monitor resource has been enhanced.
87	3.1.3-1	A message queue has been added as an internal log communication method.
88	3.1.3-1	The mirror disk resource can now be used in LVM environments.
89	3.1.3-1	A mirror synchronization packet is now not sent when the latest data is saved in both mirror disks.
90	3.1.3-1	An improvement has been made in the performance when small amount of data is written to a mirror data partition with O_SYNC specified.
91	3.1.3-1	An improvement has been made in the performance of the initial mirror construction and full mirror recovery when the mirror data partition format is ext4.
92	3.1.3-1	The JVM monitor resource now supports OpenJDK.
93	3.1.4-1	The newly released kernel is now supported.
94	3.1.4-1	An attempt to reopen the COM device is now made if a hard ware error occurs during RS232C communication.
95	3.1.4-1	WebManager now supports Java SE Runtime Environment 7.
96	3.1.4-1	ext4 can now be selected as the file system for a disk resource.
97	3.1.4-1	The load imposed by the WebLogic monitoring processing by the WebLogic monitor resource has been reduced.
98	3.1.5-1	The newly released kernel is now supported.
99	3.1.5-1	The simplified version of the cluster configuration wizard, which facilitates configuration of a shared disk type cluster, is now supported.
100	3.1.5-1	You can now select the servers that continue to work even if it is detected that both systems are activated.
101	3.1.5-1	A warning message is now output if information becomes inconsistent between servers because both systems are activated or for some other reason.
102	3.1.5-1	The monitor resource exclusion list used for determining dynamic failover can now be edited.

Number	Version (in detail)	Upgraded section
103	3.1.5-1	Shutdown operations, including OS shutdown, can be now avoided if no other servers continue to work.
104	3.1.5-1	The license information list can be now viewed from WebManager.
105	3.1.5-1	The DN-1500GL series from ISA is now supported as the warning light for the ExpressCluster X AlertService option.
106	3.1.5-1	When linked with DN-1500GL, the ExpressCluster X AlertService option can link with the voice play function in DN-1500GL.
107	3.1.5-1	The start/stop linkage processing between the monitor resources and the group resources when the monitoring time is "Active" has been reviewed and accelerated.
108	3.1.5-1	If an error occurs in a monitor resource registered in the exclusion list, that resource can be now restarted on the same server.
109	3.1.5-1	The NFS monitor resource now supports NFS v3 and v4.
110	3.1.5-1	The samba monitor resource now supports samba 3.5.
111	3.1.5-1	The Websphere monitor resource now supports WebSphere 8.0.
112	3.1.5-1	The load balancer link function for the JVM monitor resource now supports BIG-IP LTM.
113	3.1.5-1	The JVM monitor resource now supports WebOTX 8.5 (x86_64 only), WebOTX ESB 8.5, MasterScope/NEC Storage SVF for PDF 9.1, MasterScope/NEC Storage Report Director Enterprise 9.1, and MasterScope/NEC Storage Universal Connect/X 9.1.
114	3.1.5-1	The WebOTX monitor resource now supports WebOTX 8.5 (x86_64 only).
115	3.1.5-1	MDC heartbeat-related parameters have been added as adjustment parameters for the mirror and hybrid disk resources.
116	3.1.5-1	A command that can be used for capacity planning (clpprer) has been added. This command can estimate future values based on time-series data indicating system resource usage.
117	3.1.5-1	A function to collect system resource information that can be used to easily determine the cause of a failure resulting from a shortage of system resources has been added.
118	3.1.5-1	The stack size of applications started from the EXEC resources now matches the OS setting value.
119	3.1.7-1	The newly released kernel is now supported.
120	3.1.7-1	PostgreSQL monitor now supports PostgreSQL9.2.
121	3.1.7-1	It can now be judged as abnormal if an NIC Link down occurs at activation of floating IP resource.
122	3.1.7-1	It can now be judged as abnormal if an NIC Link down occurs at activation of virtual IP resource.
123	3.1.7-1	The NH-SPL from PATLITE is now supported as the warning light for the ExpressCluster X AlertService option.
124	3.1.7-1	The DN-1300GL series from ISA is now supported as the warning light for the ExpressCluster X AlertService option.
125	3.1.7-1	Actions configurable for Action at NP Occurrence have been expanded.

Section II Installing ExpressCluster

Number	Version (in detail)	Upgraded section
126	3.1.8-1	The newly released kernel is now supported.
127	3.1.8-1	A log collection type is added. (By default, logs are not now collected for the Java Resource Agent or the System Resource Agent.)
128	3.1.8-1	The type of action in the event of a group resource activation/deactivation stall can now be selected.
129	3.1.8-1	The samba monitor resource now supports samba 4.0.
130	3.1.8-1	The Websphere monitor resource now supports WebSphere 8.5.
131	3.1.8-1	The guards have been reinforced to prevent activation if multiple mirror disk resources use the same cluster partition as a result of a setting error.
132	3.1.10-1	The newly released kernel is now supported.
133	3.1.10-1	The model of script of exec resource was changed.
134	3.1.10-1	The unbinding setting when being activated, could type a disk of a disk resource in case of raw.
135	3.1.10-1	In the failover procession which made the server down opportunity, improved the precision of the search processing ahead of the failover.
136	3.1.10-1	The offline Builder now supports JRE7 update25.
137	3.1.10-1	The volume status check timeout for a volume manager resource can now be set.
138	3.1.10-1	Multiple volume groups can now be specified for a volume manager resource.
139	3.1.10-1	The WebOTX monitor resource now supports WebOTX V9.1.
140	3.1.10-1	The JVM monitor resource now supports WebOTX V9.1.
141	3.2.0-1	The newly released kernel is now supported.
142	3.2.0-1	The NX7700x/A2010M.A2010L series linkage function is now supported.
143	3.2.0-1	The Oracle Grid Infrastructure linkage function is now supported.
144	3.1.4-1	The `clplcnsc` command now supports the `--ID` option to display the product ID list.
145	3.1.8-1	The `clpgrp` command now supports the `-n` option to display the server where the resource has been activated.
146	3.1.8-1	The `clprsc` command now supports the `-n` option to display the server where the group has been activated.
147	3.2.1-1	The Weblogic monitor resource is now able to specify options transferring to the webLogic.WLST command to be used to monitor WebLogic
148	3.2.1-1	The Samba monitor resource now supports Samba 4.1.
149	3.2.1-1	The WebOTX monitor resource now supports WebOTX V9.2.
150	3.2.1-1	The JVM monitor resource now supports WebOTX V9.2.
151	3.2.1-1	The JVM monitor resource now supports JBoss Enterprise Application Platform 6.0, 6.1, and 6.2.

Number	Version (in detail)	Upgraded section
152	3.2.1-1	The JVM monitor resource can now execute commands based on the error cause upon the detection of an error.
153	3.2.1-1	The JVM monitor resource is now able to specify options for starting Java VM.
154	3.2.1-1	Group resources (exec, disk, volmgr, fip, and vip resources) can now be added without stopping the target group.
155	3.2.1-1	The exec, disk, volmgr, fip, and vip resources now support the configuration check function.
156	3.2.1-1	The offline version of Builder now supports Java Runtime Environment Version 7 Update 40 and Java Runtime Environment Version 7 Update 51.
157	3.2.1-1	The WebManager and Builder now support Java Runtime Environment Version 7 Update 51.
158	3.2.1-1	The --apito option used to specify a timeout value has been added to the clpgrp command.
159	3.2.1-1	The --apito option used to specify a timeout value has been added to the clprsc command.
160	3.2.1-1	The --apito option used to specify a timeout value has been added to the clpcl command.
161	3.2.1-1	For the Database Agent products, library path choices that can be set on the [Monitor (special)] tab have been increased.
162	3.2.1-1	The function to check whether the command is duplicatedly started has been added to the clpstat command.

Corrected information

Modification has been performed on the following minor versions.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
1	3.0.1-1 /3.0.0-1	A problem that a cluster cannot start up with VM license has been fixed.	Error in the license management table
2	3.0.2-1 /3.0.0-1 to 3.0.1-1	The final action upon group resource or monitor resource failure was displayed as a final action upon cluster service failure for Builder, and a final action upon cluster daemon failure for WebManager.	The terms have not been unified among the functions.
3	3.0.2-1 /3.0.0-1 to 3.0.1-1	In Builder, an exclusive attribute could be specified from the virtual machine properties.	Specifying exclusive attributes from the properties was not prohibited. (In the case of the wizard, this has been prohibited.)
4	3.0.2-1 /3.0.0-1 to 3.0.1-1	In an environment where XenServer could not be used, the VM monitor abnormally terminated (core dump) when the XenServer VM monitor was set up.	A NULL pointer was issued in the VM monitor initialization.
5	3.0.2-1 /3.0.0-1 to 3.0.1-1	When connecting to WebManager by using FIP, and adding the settings, the notes on connecting by using FIPs were not displayed.	WebManager was not taken into consideration for the process to evaluate connection using FIP.
6	3.0.2-1 /3.0.0-1 to 3.0.1-1	When using the `clprexec` command, Unknown request was output to syslog and the alert log.	Script execution and group failover were not taken into consideration for the process to create a character string output to syslog and the alert log.
7	3.0.2-1 /3.0.0-1 to 3.0.1-1	In WebManager, the pingnp status of the stopped server was displayed as normal.	Because the NP status was not initialized, it is assumed as an undefined value if no information was obtained.
8	3.0.2-1 /3.0.0-1 to 3.0.1-1	When changing the settings on the monitor resource properties dialog box, **Apply** could not be clicked.	There was no consideration for the decision process.
9	3.0.2-1 /3.0.0-1 to 3.0.1-1	On the Builder Interconnect Setting window, when attempting to delete inter connect settings by selecting all settings, only some settings were deleted.	There was no consideration for selecting multiple interconnects.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
10	3.0.2-1 /3.0.0-1 to 3.0.1-1	The system abnormally terminated when the WebManager service was stopped.	The timing to release the Mutex resource, which was used by the realtime update thread, was not correct.
11	3.0.2-1 /3.0.0-1 to 3.0.1-1	The alert synchronization service abnormally terminated when restarting the server after changing its name.	There was an error in the process to obtain the server list.
12	3.0.2-1 /3.0.0-1 to 3.0.1-1	When mdw was timed out or forcibly killed, the OS resources were leaked.	There was no timing to release the obtained semaphore.
13	3.0.2-1 /3.0.0-1 to 3.0.1-1	When it was specified that the initial mirror construction was not executed, resynchronization did not become enabled until full synchronization was performed.	When a user did not execute the initial mirror construction intentionally, the flag to guarantee the consistency of the disk contents was not established.
14	3.0.2-1 /3.0.0-1 to 3.0.1-1	When a cluster name was changed in the Cluster Generation Wizard, the name was reset to a default name.	This occurred when returning to the cluster name change screen after the cluster name was changed in the Cluster Generation Wizard and the next step was selected.
15	3.0.2-1 /3.0.0-1 to 3.0.1-1	the recovery action was not executed even if a volmgrw monitor error was detected.	The process to decide whether to execute the recovery action was not correct.
16	3.0.2-1 /3.0.0-1 to 3.0.1-1	The timeout for the volmgr resource could not be correctly specified.	The formula to calculate the time out was not correct.
17	3.0.2-1 /3.0.0-1 to 3.0.1-1	When a keyword over 256 characters was specified, linkage with external monitoring was not started even if the mnw monitor was set.	The size of the buffer to save the keyword was insufficient.
18	3.0.2-1 /3.0.0-1 to 3.0.1-1	When disabling shutdown monitoring, user space monitoring could not be started.	The check process of shutdown monitoring was executed by the initialization process of user space monitoring.
19	3.0.2-1 /3.0.0-1 to 3.0.1-1	The timeout for shutdown monitoring could not be changed.	The heartbeat timeout was specified to use at any time.
20	3.0.3-1 /3.0.0-1 to 3.0.2-1	In config mode, non-numeric data (alphabetic characters and symbols) could be incorrectly entered for **Wait Time When External Migration Occurs** for VM monitor resources.	There was an error in the design of the Builder input control.
21	3.0.3-1 /3.0.0-1 to 3.0.2-1	The method designed for applying a change in the server priority involved suspending and resuming the cluster and then restarting WebManager. However, it actually requires the stopping and starting of the cluster and then restarting WebManager.	Because the server ID of the server used to activate the group resources was stored in the shared memory, the information on that server became inconsistent when the server ID was changed.

Section II Installing ExpressCluster

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
22	3.0.3-1 /3.0.0-1 to 3.0.2-1	When "0" was specified as the timeout period for EXEC resources, the activation of EXEC resources failed and emergency shutdown was performed.	There was an error in the design of the Builder input control.
23	3.0.3-1 /3.0.0-1 to 3.0.2-1	In a specific environment, pressing the **Add Server** button in the Cluster Generation Wizard of the Builder caused an application error.	The error was caused by a problem with JRE.
24	3.0.3-1 /3.0.0-1 to 3.0.2-1	When a hybrid configuration was used, the mirror agent sometimes failed to start.	There was a problem in the logic used for searching server groups.
25	3.0.3-1 /3.0.0-1 to 3.0.2-1	When "0" was specified for the **Server Sync Wait Time**, the main process of the cluster sometimes failed to start.	When "0" (minutes) was specified for the **Server Sync Wait Time**, the value of the startup wait timeout became identical to that of the HB transmission start timeout. Therefore, the startup wait processing was not performed appropriately because of the timing of the processing.
26	3.0.3-1 /3.0.0-1 to 3.0.2-1	When an attempt was made to perform failover between absolute exclusion groups upon the occurrence of multiple and concurrent monitor errors, both systems were sometimes activated.	There was an error in the design of the value that was returned as the group status.
27	3.0.3-1 /3.0.0-1 to 3.0.2-1	The setting for forced FIP activation was ignored.	The setting was overwritten with another setting in the implementation.
28	3.0.3-1 /3.0.0-1 to 3.0.2-1	The units of the time values to be displayed in the alert (syslog) for delay warning in the user space monitor resources were incorrect, and the values to be displayed in units of tick count were displayed in units of seconds.	The output conversion method was incorrect.
29	3.0.3-1 /3.0.0-1 to 3.0.2-1	When the size of an alert message exceeded 512 bytes, the alert daemon terminated abnormally.	The size of the alert message buffer was insufficient.
30	3.0.3-1 / 3.0.2-1	WebManager could not be normally terminated by selecting **Exit** from the **Config File** menu.	When terminating WebManager, the termination process of **Config Mode** (Builder) is inadequate.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
31	3.1.0-1 / 3.0.0-1 to 3.0.4-1	Uploading is unavailable if the cluster has been suspended and a temporary suspension of a monitored resource modified a necessary configuration	When checking processes while uploading, a cluster configuration file only judged whether the status of monitor resources was suspended.
32	3.1.0-1 / 3.0.0-1 to 3.0.4-1	Sometimes unnecessary logs were output when an attempt was made to perform failover between absolute exclusion groups upon the occurrence of multiple and concurrent monitor errors.	After the failover destination server was decided in the first monitor error processing, in the next monitor error processing, a different server was decided for the failover destination server because it was determined that absolute exclusion groups were running on that server.
33	3.1.0-1 / 3.0.0-1 to 3.0.4-1	When waiting to start monitoring a resident monitor resource, the timeout time rather than the start wait time is referenced.	The processing for the monitor start wait time was invalid.
34	3.1.0-1 / 3.0.0-1 to 3.0.4-1	An error occurred when collecting logs, delivering settings information, or during other activities, but the process appears to have terminated normally.	There were faults in the processing that determines whether the action was successful or nor.
35	3.1.0-1 / 3.0.0-1 to 3.0.4-1	When adding a server to a mirror environment, suspending the cluster and mirror agent is required to apply the new settings, but suspend/resume is displayed.	When confirming settings while adding a server, it was not checked whether mirror disk connect has been set.
36	3.1.0-1 / 3.0.0-1 to 3.0.4-1	When a standby mirror agent is suspended during mirror recovery, retrieving the recovery data may fail, generating OOPS.	A buffer is released if receiving data failed, but a NULL pointer was issued when trying to receive the next data.
37	3.1.0-1 / 3.0.0-1 to 3.0.4-1	OOPS occurred sometimes in the driver termination processing when the standby server mirror agent was stopped during mirror recovery.	Mirror driver functions which process the completion notification for processing writing to data partitions do not exist in the memory when rmmod mirror drivers are no longer present after a request to write mirror recovery data to a data partition.
38	3.1.0-1 / 3.0.0-1 to 3.0.4-1	The OS sometimes freezes when the active server mirror agent is stopped during mirror recovery	Interruptible sleep occurred while waiting for the recovery data read to finish, that sleep was interrupted during shutdown, and the CPU usage for the thread waiting for read to finish increased.

Section II Installing ExpressCluster

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
39	3.1.0-1 / 3.0.0-1 to 3.0.4-1	Multiple syslog messages may mix and be output from the mirror driver so that the same message is output twice at times such as server shutdown when mirror driver syslog output frequency is high.	The functions for mirror driver syslog output uses the same buffer without exclusion.
40	3.1.0-1 / 3.0.0-1 to 3.0.4-1	When the IP address for integrated WebManager was not specified, error messages output due to failures to connect to clusters were invalid.	The names of previous setting items were not updated.
41	3.1.0-1 / 3.0.0-1 to 3.0.4-1	Sometimes core dump occurred while stopping a cluster service when max reboot count limitation was set.	Illegal memory access occurred when a log was output after log library termination processing during termination processing.
42	3.1.0-1 / 3.0.0-1 to 3.0.4-1	When a destination server was down while moving a group, sometimes the group was moved to a server which was not included in the failover policy.	No failover policy check process existed in the recovery processing associated with the server being down at the destination.
43	3.1.0-1 / 3.0.0-1 to 3.0.4-1	Server down notification settings were changed and uploaded, but the changes were not applied.	Cluster configuration information was not reloaded upon termination.
44	3.1.0-1 / 3.0.0-1 to 3.0.4-1	A minor memory leak occurred when performing a group or resource operation.	Thread information was not discarded after the thread terminated.
45	3.1.0-1 / 3.0.0-1 to 3.0.4-1	When a script execution process times out before the final operation runs and is force killed, sometimes a zombie process was generated.	Sometimes `waitpid()` was executed before a process was terminated by SIGKILL.
46	3.1.0-1 / 3.0.0-1 to 3.0.4-1	Suspending a user space monitor sometimes failed if the monitoring method for user space monitoring was modified and uploaded when WebManager was connected to a server other than the master server.	When WebManager was connected to a server other than the master server, the monitor status of the other servers was not checked.
47	3.1.0-1 / 3.0.0-1 to 3.0.4-1	The value of the EXEC resource environmental variable CLP_EVENT, is set to START instead of FAILOVER when the failover occurs for groups to which "Prioritize the failover policy within the server group" is set.	An internal flag of "Prioritize failover policy in the server group" was processed incorrectly.
48	3.1.0-1 / 3.0.0-1 to 3.0.4-1	The monitor resource startup status was not restored when failover was performed for groups to which "Prioritize failover policy in the server group" is set.	A internal flag of "Prioritize failover policy in the server group" was processed incorrectly.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
49	3.1.0-1 / 3.0.0-1 to 3.0.4-1	Recovery action counts were not reset by the clpmonctrl command when the monitor error recovery action was fully executed.	Shared memory values were reset, but values saved in the memory of monitor resource processes are not reset.
50	3.1.0-1 / 3.0.0-1 to 3.0.4-1	When a server is added while BMC or a warning light is set, the BMC and warning light are not set to the new server information.	Information to be added and associated with the server addition was insufficient.
51	3.1.0-1 / 3.0.0-1 to 3.0.4-1	Cluster Generation Wizard was started and two servers were added to a cluster. After that, the wizard was canceled (but the settings were saved). Then, the add a server wizard was started but a server was not displayed on the interconnect configuration screen.	In the processing of canceling Cluster Generation Wizard, not all data was discarded.
52	3.1.0-1 / 3.0.0-1 to 3.0.4-1	If a license error occurs while processing NP resolution when stopping the cluster due to a license error, sometimes the cluster does not normally stop.	A thread which was processing NP resolution was canceled when a cluster was stopped by a license error, but the thread was dead locked because of canceling the locked thread.
53	3.1.0-1 / 3.0.0-1 to 3.0.4-1	The name of a server cannot be fully displayed in the list of available servers in the server tab of group properties.	A horizontal scroll bar was not displayed.
54	3.1.0-1 / 3.0.0-1 to 3.0.4-1	Mirror commands (such as executions by using sudo commands and script executions by using crond) from the root user did not run properly when a path to an OS standard command (such as /usr/sbin/) was not taken..	When an internal command was executed, there was a location that did not reference an absolute path.
55	3.1.0-1 / 3.0.0-1 to 3.0.4-1	If an I/O error occurred on a server, and a disk error flag remains on the cluster partition, the server is restarted repeatedly if the CPU is restarted without replacing the disk.	The remaining disk error flag was not properly dealt with.
56	3.1.0-1 / 3.0.0-1 to 3.0.4-1	In an x86_64 environment in which an I/O error occurred on the mirror disk, panic is performed rather than reset.	A stack was destroyed while performing reset processing.
57	3.1.0-1 / 3.0.0-1 to 3.0.4-1	When an asynchronous mode mirror on a VMware guest OS is used and ACK timeout is set to less than 30 seconds, 100% of CPU usage is the VMware task, and the OS stalls.	The data transmission processing delay was not properly dealt with.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
58	3.1.0-1 / 3.0.0-1 to 3.0.4-1	When an asynchronous mode mirror on a VMware guest OS is used, the server caused PANIC while writing in an environment running multiple guest OSes, each of which is assigned only one CPU.	Cases exist in which processing which should not be in reverse of the original processing order is in reverse order due to the order of the VMware CPU switch.
59	3.1.0-1 / 3.0.0-1 to 3.0.4-1	If, in the first cluster configuration, the environment consisted of 3 or more nodes and the CPU licenses were only registered to a single server, sometimes license authentication failed and the CPU could not start.	Return value determination of the license collection processing was incorrect.
60	3.1.0-1 / 3.0.0-1 to 3.0.4-1	If there was a group whose failover attribute set to "Dynamic failover", all groups take longer to startup.	Startup processing on another server was executed at the same time.
61	3.1.0-1 / 3.0.0-1 to 3.0.4-1	When stopping a monitor resource which is being continuously monitored, Application Server Agent sometimes terminated other processes when it was stopped.	There was a flaw in the processing that terminates the child processes of the Application Server Agent.
62	3.1.0-1 / 3.0.0-1 to 3.0.4-1	Monitor status changed to a status other than "suspend" after suspending the monitor resource.	Sometimes the status was overwritten after it was set to suspend.
63	3.1.0-1 / 3.0.0-1 to 3.0.4-1	When a monitor resource is suspended, it sometimes remained as a zombie process.	Depending on timing, `waitpid()` was not executed when child processes were terminated.
64	3.1.0-1 / 3.0.0-1 to 3.0.4-1	When using diverse resources or monitors, if the number of ExpressCluster module types that output logs exceeds 128, sometimes internal logs are not output.	The initialized area that manages the types is only for use with 128 types.
65	3.1.0-1 / 3.0.0-1 to 3.0.4-1	MA memory leak occurred when suspending a cluster failed because a group was moving.	Internal information was not discarded at the time of the failure to suspend the cluster.
66	3.1.0-1 / 3.0.0-1 to 3.0.4-1	A memory leak occurred when stopping a cluster failed because a group was moving.	Internal information was not discarded at the time of the failure to stop the cluster.
67	3.1.0-1 / 3.0.0-1 to 3.0.4-1	Child processes remained when a genw monitor timeout occurred while the enw settings were set to synchronous and the dump collection function was enabled..	The custom monitor terminated before the child process.
68	3.1.0-1 / 3.0.0-1 to 3.0.4-1	If there was a group whose failover attribute was set to "Prioritize failover policy within the server group", memory leak occurred at failover.	Space was not freed server group management.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
69	3.1.0-1 / 3.0.0-1 to 3.0.4-1	When group resources were activated on a server that was not connected by WebManager, stopping the group resources failed when uploading cluster configuration information associated with stopping group resources.	Resource stop processing (other than that of a server to which WebManager is connected) was incomplete.
70	3.1.0-1 / 3.0.0-1 to 3.0.4-1	Sometimes the mirror agent does not start in a hybrid configuration when the server group that is used is a group in which no hybrid disk resource exists, and only one server group was specified. .	There was a problem with the logic used to search for the server group..
71	3.1.0-1 / 3.0.0-1 to 3.0.4-1	When the host name was FQDN, requests from the `clprexec` command failed.	If the host name which was obtained from the OS was FQDN, the server cannot find items from a cluster configuration file.
72	3.1.0-1 / 3.0.0-1 to 3.0.4-1	If there are many objects will be displayed on WebManager, WebManager server process may be terminated abnormally.	There was a problem in the source code to allocate memory to display objects.
73	3.1.1-1 / 3.0.0-1 to 3.1.0-1	If initializing XenServer virtual machine resources failed in an environment where XenServer could not be used, WebManager server process might be terminated abnormally.	Environments where XenServer could not be used were not considered.
74	3.1.1-1 / 3.0.0-1 to 3.1.0-1	If initializing XenServer virtual machine monitor resources failed in an environment where XenServer could not be used, WebManager server process might be terminated abnormally.	Environments where XenServer could not be used were not considered.
75	3.1.1-1 / 3.0.0-1 to 3.1.0-1	After collecting logs, some OS resources of the log collection function might remain.	After initializing threads is complete, if the process to wait for the initialization completion is executed on the parent thread, the command waits for the initialization completion endlessly.
76	3.1.1-1 / 3.0.0-1 to 3.1.0-1	The cluster configuration data could be uploaded even if there is a server on which the ExpressCluster service did not start in the cluster.	It was not considered some changes require to stop resources to be reflected to the configuration.
77	3.1.1-1 / 3.0.0-1 to 3.1.0-1	After collecting logs, the files that must be deleted might remain.	For SuSE Linux, the `tar` command options were not considered.

Section II Installing ExpressCluster

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
78	3.1.1-1 / 3.0.0-1 to 3.1.0-1	If the VM license is used, an unnecessary alert might be output when starting the cluster.	The message that was not necessary to output when using the VM license has been output.
79	3.1.1-1 / 3.0.0-1 to 3.1.0-1	If the configuration data is uploaded with clearing the default resource dependency and without specifying any dependencies, only the cluster suspend is requested even if it is necessary to stop a group.	The file that defines the method to reflect changes is inadequate.
80	3.1.1-1 / 3.1.0-1	If the smart failover is set and memory is insufficient when starting the cluster, the clprc process might abnormally terminate and the server might be shut down.	When allocating the resource data storage area failed, an illegal memory access occurs due to the API allocation request.
81	3.1.1-1 / 3.0.0-1 to 3.1.0-1	WebManager might abnormally terminate if there is a lot of information to be displayed for WebManager because there are a lot of servers.	Because the size of the temporary buffer is fixed to 4096 bytes, an illegal memory access occurs if there is information exceeding 4096 bytes.
82	3.1.1-1 / 3.0.0-1 to 3.1.0-1	When the setting to start the WebManager service and WebAlert service is disabled, the alert indicating that starting the WebManager service and WebAlert service failed at OS startup might be output.	The monitor processes of WebManager service and WebAlert service did not consider the setting to disable the WebManager service and WebAlert service to start.
83	3.1.1-1 / 3.1.0-1	The description (in English) of rc message ID=26 was not correct.	In the current description, "has started" was used, but, "has been completed" is correct.
84	3.1.1-1 / 3.1.0-1	The correct method to reflect the added group resource is "stopping/suspending the group", but "stopping the cluster" was performed.	The file that defines the method to reflect changes was inadequate.
85	3.1.1-1 / 3.0.0-1 to 3.1.0-1	The warning dialog box might be displayed when uploading configuration data in an environment of which ExpressCluster X was upgraded from 2.x to3.x.	The process to check the configuration data ID did not consider old configuration data.
86	3.1.1-1 / 3.0.0-1 to 3.1.0-1	The file descriptor used by the `clprc` process might leak if WebManager was frequently updated or `clpstat` was frequently executed.	The process to close the file descriptor might not be performed.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
87	3.1.1-1 / 3.0.0-1 to 3.1.0-1	When a valid COM heartbeat device name was specified in the blank field, the system prompted to suspend and resume the cluster. In this case, if the cluster was not stopped, the COM heartbeat did not operate properly.	The status setting process at resuming the cluster was not correct.
88	3.1.1-1 / 3.1.0-1	A monitor resource name was not correctly output in the alert of rm ID=170 or 171.	The process to output ID=170 and 171 was not correct.
89	3.1.1-1 / 3.0.0-1 to 3.1.0-1	If an error was detected when multiple resources were being activated, the final action was performed for the abnormal resource that was found at first in the alphabetical order. Therefore, if the resource to which **No Operation** was set, the operation such as shutdown was not performed.	Only the final action for the abnormal resource that was found at first was performed.
90	3.1.1-1 / 3.0.0-1 to 3.1.0-1	An unnecessary rc alert might be logged for a deactivation error if the failover count was set to 0 when a deactivation error occurred in a resource in a group to which dynamic failover was set.	Even if the failover count is 0, the process to find a failover target was performed when a deactivation error was occurred.
91	3.1.1-1 / 3.1.0-1	Multiple confirmation dialog boxes might be displayed when continuously pressing the operation button in WebManager Mobile.	An exclusive processing when pressing the operation button was inadequate.
92	3.1.1-1 / 3.1.0-1	The ulimit setting of the default script was deleted in WebManager config mode.	The default script was not correct in config mode.
93	3.1.1-1 / 3.0.0-1 to 3.1.0-1	Configuration data of which mirror configuration consisted 3 or more nodes could be created.	The process to check server addition was in adequate.
94	3.1.1-1 / 3.0.0-1 to 3.1.0-1	When deleting a virtual machine resource, a related virtual machine resource could not be deleted automatically.	The delete condition decision process of the automatic monitor resource delete process was inadequate.
95	3.1.1-1 / 3.0.0-1 to 3.1.0-1	When linkage with a server management infrastructure was available, the status might remain OFFLINE if monitoring the message receive monitor was started before starting the infrastructure module.	The process to update the message receive monitor status was inadequate.

Section II Installing ExpressCluster

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
96	3.1.1-1 / 3.0.3-1 to 3.1.0-1	The NFS monitor resource could not detect that only nfsd was disappeared.	It was determined normal that the unmount process was normally performed.
97	3.1.1-1 / 3.0.3-1 to 3.1.0-1	If multiple targets were registered to a JVM monitor resource, monitoring might fail and a warning might be issued when starting to monitor the JVM monitor resource.	Java API was not thread-safe.
98	3.1.1-1 / 3.1.0-1	If a process of which name length was 1024 bytes or more existed, a process name monitor resource might abnormally terminate.	An environment that included a process of which name length was 1024 bytes or more was not considered.
99	3.1.1-1 / 3.1.0-1	If the monitoring level is level 2 and no records were created at creation of a table for monitoring, the PostgreSQL monitor resource might abnormally terminate.	The action to be taken when there is no record when reading data from a database by select during level 2 monitoring was not defined.
100	3.1.1-1 / 3.1.0-1	When Database Agent detected a timeout, monitoring was immediately retried without waiting for the monitoring interval.	The retry process after a monitoring timeout was not considered.
101	3.1.0-1/ 3.0.0-1 to 3.0.4-1	It might fail to start a specific monitor resource for the first time, causing a monitor error. In a specific machine environment, this might occur for an ARP monitor resource, DDNS monitor resource, mirror disk monitor resource, mirror disk connect monitor resource, hybrid disk monitor resource, hybrid disk connect monitor resource, message receive monitor resource, and virtual IP monitor resource.	There was a variable that had not been initialized.
102	3.1.3-1/ 3.1.0-1 to 3.1.1-1	When the cluster was resumed from WebManager, **Failed to resume** was mistakenly displayed instead of **The request to resume the cluster failed on some servers**. This occurred when the cluster was forcibly suspended and then resumed with some servers stopped.	The message text was not correct.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
103	3.1.3-1/ 3.0.0-1 to 3.1.1-1	After the ExpressCluster Web Alert service might abnormally terminate, this service might start. When the ExpressCluster Web Alert service was killed for some reason, this infrequently occurred at the next service startup. Also, this might infrequently occur in normal operation.	The buffer area used to read /proc/pid/cmdline was insufficient, or strerr(), which was not thread-safe, was sometimes used by multiple threads.
104	3.1.3-1/ 3.0.0-1 to 3.1.1-1	Mirror recovery might fail immediately after the processing started, and then auto mirror recovery might start. This might occur when the mirror disk connect was recovered from disconnection.	Even if data was sent through an old connection before disconnection occurred, a send error might not occur. Also, there might be a gap in timing of communication recovery detection between an active server and a standby server.
105	3.1.3-1/ 3.0.0-1 to 3.1.1-1	In SuSE11 environments, an internal log was not output when UDP was set to a log communication method. This occurred when UDP was set to a log communication method in SuSE11 environments.	The method to create a socket was inadequate.
106	3.1.3-1/ 3.1.0-1 to 3.1.1-1	When a volume manager resource was added, a default value of an automatically added volume manager monitor resource was invalid. This occurred for a volume manager monitor resource that was automatically generated when a volume manager resource was added.	A default value of an automatically generated volume manager monitor resource had not been defined.
107	3.1.3-1/ 3.0.0-1 to 3.1.1-1	Multiple volume manager monitor resources might be registered. This occurred when multiple VxVM volume manager resources were added.	For VxVM, only one volume manager monitor resource had to be automatically registered, but a monitor resource was registered for each volume manager resource.
108	3.1.3-1/3.1.1-1	When stopping a group by using the clpgrp command failed, an error message indicating that starting the group failed might be displayed. This occurred when a group, which had been started on another server, was stopped by the clpgrp -t command without the -h and -f options specified.	The message text was not correct.

Section II Installing ExpressCluster

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
109	3.1.3-1/3.1.1-1	In an environment where a specific monitor resource existed, suspending and resuming the monitor resource might fail. This might occur in an environment that included any of the following monitor resources: - ARP monitor resource - DDNS monitor resource - Mirror disk monitor resource - Mirror disk connect monitor resource - Hybrid disk monitor resource - Hybrid disk connect monitor resource - User mode monitor resource - Message receive monitor resource - Virtual IP monitor resource - Virtual machine monitor resource	The monitor resource name save area was not initialized.
110	3.1.3-1/ 3.0.0-1 to 3.1.1-1	Executing a script by the `clprexec` command might fail. This occurred when a script to be executed by the `clprexec` command was stored in the path described in the guide.	The path to store a `clptrnreq` command script was used.
111	3.1.3-1/ 3.0.0-1 to 3.1.1-1	It took extra five seconds to perform a final retry upon a group resource activation/deactivation error. This occurred upon a group resource activation/deactivation error when it was set to retry activate or deactivate the group resource.	A final retry entered in unnecessary sleep state (five seconds) when an activation or deactivation retry was performed upon a group resource activation/deactivation error.
112	3.1.3-1/ 3.0.0-1 to 3.1.1-1	When a network used by mirror disk connect was brought down by a command such as `ifdown`, mirror recovery might be executed repeatedly. This occurred when there was a path to a remote server other than mirror connect and a network used by mirror disk connect was brought down by `ifdown`.	When an attempt was made to bind a socket in a sending process by ICMP, the socket was connected without checking the return value.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
113	3.1.3-1/ 3.0.0-1 to 3.1.1-1	A message receive monitor error might be detected when the cluster was being stopped. This might occur when a message receive monitor was monitored when the cluster was being stopped.	A monitor process was not generated when the cluster was being stopped, and the stopping process was always assumed to be completed successfully. In such a case, it was checked whether a monitor process existed or not.
114	3.1.3-1/ 3.0.0-1 to 3.1.1-1	Changes were supposed to be reflected to the forced stop function settings by uploading, but could not be reflected. This occurred when **Forced Stop** was changed to enable (**ON**) after the cluster was started with **Forced Stop** and **Chassis Identify** disabled (**OFF**).	When the **Forced Stop** and **Chassis Identify** are disabled (**OFF**), the setting information was not acquired in the process to acquire.
115	3.1.3-1/ 3.0.2-1 to 3.1.1-1	When collecting logs, a rotated syslog file might not be collected. This occurred when logs were collected in RHEL6 or later environments.	The name of the rotated messages file did not comply with the changed naming rule.
116	3.1.3-1/ 3.0.0-1 to 3.1.1-1	Stopping the cluster might not be completed. This might infrequently occur when a message receive monitor resource was set.	A termination process was missing in the process to check a thread termination request.
117	3.1.3-1/ 3.1.0-1 to 3.1.1-1	33 or more destinations to which a SNMP trap was sent could be set. This occurred when the SNMP trap sending destination settings screen was started again after 32 destinations had been set.	The control processing of the **Add** button on the SNMP trap sending destination settings screen was inadequate.
118	3.1.3-1/ 3.0.0-1 to 3.1.1-1	When a mirror disk resource or hybrid disk resource was forcibly activated by a command or other operations, auto mirror recovery might be repeated after a server including forcibly activated resources was restarted. This occurred when a server was restarted with a mirror disk resource or hybrid disk resource forcibly activated.	When a forcibly activated server was rebooted, the internal state of other servers were not updated and entered the state disabling mirror synchronization in the same way as forced activation. Therefore, synchronization was canceled after auto mirror recovery and then auto mirror recovery was repeated.

Section II Installing ExpressCluster

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
119	3.1.3-1/ 3.0.0-1 to 3.1.1-1	When **READ** was selected as **Method** to monitor a disk resource, **I/O Size** might return to the default value. This occurred when **Method** was changed from **READ** to **TUR**, and then returned to **READ**.	A process to store the value specified for **I/O Size** was missing when changing **Method**.
120	3.1.3-1/ 3.0.0-1 to 3.1.1-1	A monitor resource might mistakenly detect an error when uploading the configuration data. This occurred on very rare occasions when uploading the configuration data.	Reading the configuration data file failed if a monitor resource tried to refer to the configuration data when the file was being replaced.
121	3.1.3-1/ 3.0.0-1 to 3.1.1-1	An FTP monitor resource might mistakenly detect a monitoring timeout. This occurred when an FTP server returned an intermediate response and final response together.	The process to be performed when an intermediate response and final response were returned together was not correct.
122	3.1.3-1/ 3.1.0-1 to 3.1.1-1	When a monitoring target of the JVM monitor resource was terminated by a failover, the load status of Java VM to be monitored that was collected immediately before the failover was continuously reported to the distributed node module from a source server of failover even after the failover. When using the load calculation function of Java VM to be monitored by the load balancer linkage, this occurred when the monitoring target was terminated by a failover.	Even after the monitoring target was terminated, the load status information collected before the failover was still maintained.
123	3.1.3-1/ 3.0.0-1 to 3.1.1-1	When a monitoring timeout occurred in a PostgreSQL monitor resource, the next monitoring might fail because a PostgreSQL session remained. This occurred when a monitoring timeout occurred and the specified timeout interval was short.	The process to cancel monitoring a PostgreSQL monitor resource when a timeout occurred was inadequate.
124	3.1.3-1/ 3.0.0-1 to 3.1.1-1	It might take 10 seconds or more to display the execution results of the `clpstat` command. This occurred on very rare occasions when executing the `clpstat` command.	Waiting for the completion of the thread initialization might fail depending on the timing, and the `clpstat` command might wait for a timeout.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
125	3.1.3-1/ 3.1.0-1 to 3.1.1-1	Even if the necessary license had been registered, hybrid disk resources might not be displayed in the resource list. This occurred when the registered license is Replicator DR Upgrade.	Replicator DR Upgrade was not included in the information that associated group resources and licenses.
126	3.1.3-1/ 3.0.0-1 to 3.1.1-1	When changing the WebManager mode from **Operation Mode** to **Reference Mode**, the **Execute** button on the Mirror Disk Helper screen was initially enabled. This occurred when the WebManager mode was changed to **Reference Mode** with the Mirror Disk Helper screen open.	The Mirror Disk Helper screen was not initialized when the WebManager mode was changed to **Reference Mode**.
127	3.1.4-1/ 3.1.3-1	When starting a cluster from WebManager/WebManager Mobile, an error message may not be displayed correctly. This occurred when a server that could not start existed.	The process for handling an error when a server that cannot start exists was not correct.
128	3.1.4-1/ 3.0.0-1 to 3.1.3-1	A memory leak occurred in the resource management process when obtaining information for pingnp or when executing the clpstat command. This occurred when the PingNP resource was configured and multiple IP address groups were set.	A process to release memory was found to be missing when looping over multiple IP address groups.
129	3.1.4-1/ 3.1.3-1	The time information icon might not blink on WebManager even when the time information was updated. This occurred when a server was stopped and started after WebManager connection.	It was determined that the server had not been connected before when it was started.
130	3.1.4-1/ 3.0.0-1 to 3.1.3-1	Restart of the alert synchronization service might occur. This occurred on very rare occasions during normal operation.	A system call, which was not thread-safe, was sometimes used by multiple threads.
131	3.1.4-1/ 3.0.0-1 to 3.1.3-1	A memory leak might occur in the alert synchronization service. This occurred when WebManager could not communicate with a server for which two or more interconnects were established.	A memory release process was missing from the processing to be performed after a communication failure.

Section II Installing ExpressCluster

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
132	3.1.4-1/ 3.0.0-1 to 3.1.3-1	Information on WebManager, `clpstat` command, SNMP manager linkage, etc., could fail to display. This occurred when internal communication timed out for some reason such as interconnect disconnection or overload, after which control returned to the state existing before interconnect switchover.	Information acquisition requests between servers were made in an irregular order.
133	3.1.4-1/ 3.1.0-1 to 3.1.3-1	The JVM monitor resource might mistakenly detect the number of occurrences of Full GC either before or after restart of the monitored Java VM, causing an error. This occurred when the monitored Java VM restarted in an application in which Full GC occurred frequently.	The number of occurrences of Full GC that was retained by the JVM monitor resource was not cleared when the monitored Java VM restarted.
134	3.1.4-1/ 3.0.0-1 to 3.1.3-1	When using the `clpcfctrl` command to upload configuration information, a message indicating that the upload was successful might be displayed even though the upload has failed. This occurred when a configuration information file from which a mirror disk resource was deleted was uploaded while the mirror agent was running.	When confirming the status while applying settings, a check of whether the mirror agent was suspended was not made.
135	3.1.4-1/ 3.0.0-1 to 3.1.3-1	The `clplogcf` command execution results may not be displayed. This occurred when the event service updated a temporary file for storing display information upon execution of the `clplogcf` command.	When the event service updated the file of display information, it emptied the file once for writing.
136	3.1.4-1/ 3.0.0-1 to 3.1.3-1	In WebManager config mode, an exception in Java might occur when using the group addition wizard to add a disk resource. This occurred when the use of server group was repeatedly selected and deselected for the startup servers in the group settings.	There was an error when checking whether the checkbox for using server group was selected.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause

137	3.1.4-1/ 3.1.0-1 to 3.1.3-1	When the `clpstat` command was used to display property information for a disk monitor resource, "Disk full Action" was not displayed.
		This occurred when the following command was executed:
		
		`clpstat --mon`
		`disk_monitor_name --detail`
			There was an error in the parameter display settings.

138	3.1.4-1/ 3.0.0-1 to 3.1.3-1	Stopping a monitor resource sometimes caused other processes to be killed. This might occur when stopping a monitor resource if the pid of a monitor resource managed by ExpressCluster is used for other processes.	Whether the process was alive, and the process name, were not checked before SIGKILL was issued.
139	3.1.4-1/ 3.0.0-1 to 3.1.3-1	There might be a delay in starting a kernel mode LAN heartbeat resource. This occurred in some servers when there was a kernel mode LAN heartbeat resource for which no IP address had been specified (which was not used for the server).	A function for IP address acquisition was called even when no IP address was specified.
140	3.1.4-1/ 3.0.0-1 to 3.1.3-1	A system stall might occur when the system is highly loaded. This occurred in circumstances in which kernel mode LAN heartbeat resources were used and the available amount of system memory ran low.	A function for switching threads was used with a spinlock acquired.
141	3.1.4-1/ 3.0.0-1 to 3.1.3-1	The configuration information may not be reflected. This might occur when the OS language setting was other than Japanese, English, or Chinese.	The setting of environment variable LANG was missing when obtaining system information.
142	3.1.4-1/ 3.0.0-1 to 3.1.3-1	The user mode monitor resource might mistakenly detect a delay warning. In a 32-bit OS environment, this might occur when the OS was running for 198 or more consecutive days with the user mode monitor resources set up.	Difference calculation was performed on the number of clock ticks using a sign.

Section II Installing ExpressCluster

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
143	3.1.4-1/ 3.1.3-1	Some monitor resources might mistakenly detect monitor errors. In a 32-bit OS environment, this might occur when the OS was running for 198 or more consecutive days with any of the following monitor resources set up. [Relevant monitor resources] - db2w - ddnsw - genw - jraw - mysqlw - oraclew - psqlw - psw - sraw - sybasew - vipw	Difference calculation was performed on the number of clock ticks using a sign.
144	3.1.4-1/ 3.1.3-1	The default fsck execution timing value for disk resources was changed from "Execute Every 10 Times" to "Not Execute." This occurred when a new disk resource was created or when the default value was used for an existing disk resource.	The default value in the internal settings contained an error.
145	3.1.4-1/ 3.0.0-1 to 3.1.3-1	The disconnection of a mirror disk connect might be mistakenly detected for a mirror in a remote configuration. This might occur in an environment with a large communication delay.	In Ping communication processing for networking monitoring, there was an error in retrying reception upon the receipt of ICMP ECHO REQUEST from the other server.
146	3.1.4-1/ 3.1.0-1 to 3.1.3-1	The process name monitor resource might end abnormally. This might occur when the cluster was suspended/stopped in an environment in which the process name monitor resource was set up.	The reception of a suspension/stop request was not properly handled in the internal operation.
147	3.1.4-1/ 3.0.0-1 to 3.1.3-1	Monitoring by the HTTP monitor resource might fail. This occurred in an environment in which renegotiate was requested upon reception via SSL due to monitoring on https.	The HTTP monitor resource did not properly deal with a renegotiate request.
148	3.1.4-1/ 3.1.1-1 to 3.1.3-1	Some core files might not be collected during log collection. This might occur when multiple core files existed during log collection.	When compressing log files, the first core file was compressed, but the subsequent core files were deleted.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
149	3.1.5-1/ 3.0.0-1 to 3.1.4-1	The clpmonctrl command displays the recovery action execution count in an invalid order. This problem always occurs when you execute clpmonctrl -v.	The restart count and the failover count are displayed in the reverse order.
150	3.1.5-1/ 3.1.0-1 to 3.1.4-1	The comment field will be blank when you click Get License Info on the resource addition wizard in Config Mode in WebManager. This problem always occurs when you click the Get License Info button.	The entry field was not properly initialized after Get License Info was executed.
151	3.1.5-1/ 3.1.0-1 to 3.1.4-1	When you click the Get License Info button in the monitor addition wizard in Config Mode in WebManager, the initial value is not set to the Name field. This problem always occurs when you click the Get License Info button.	The entry field was not properly initialized after Get License Info was executed.
152	3.1.5-1/ 3.0.0-1 to 3.1.4-1	Monitor resources may be created more than the upper limit in the setup mode in WebManager. This problem occurs if you add resources that trigger the automatic addition of monitor resources when the upper limit of monitor resources has been reached.	The automatic monitor resource addition process did not include an upper limit check.
153	3.1.5-1/ 3.0.0-1 to 3.1.4-1	An application error may occur causing an emergency shutdown in the group resource management process. This problem occurs if internal communication is established when the maximum number of file descriptors that can be used in the OS is exceeded.	When the maximum number of file descriptors that can be used in the OS is exceeded, the currently used socket is improperly operated.
154	3.1.5-1/ 3.0.0-1 to 3.1.4-1	When the virtual machine monitor resources detect that the virtual machine is down, that virtual machine may not start at the failover destination. This problem occurs if it is detected that a virtual machine is down when you use the virtual machine monitor resource settings to attempt migration before failover.	The stopped virtual machine is migrated because the migration request to vCenter is successfully executed even if the virtual machine stops.

Section II Installing ExpressCluster

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
155	3.1.5-1/ 3.0.0-1 to 3.1.4-1	Migration may not be performed if the monitor resource with the setting to attempt migration before failover detects an error. This problem occurs if an error is detected by a monitor resource whose recovery target is not groups but resources.	Only virtual machine groups can be migrated by internal processing.
156	3.1.5-1/ 3.1.0-1 to 3.1.4-1	exec resources may fail to activate. This problem may occur if you simultaneously execute multiple exec resources for which the setting to rotate logs has been specified and it is the first startup for the server.	If directory creation processes for temporary files are executed at the same time, the directory creation process started later fails.
157	3.1.5-1/ 3.0.0-1 to 3.1.4-1	For some monitor resources, an abnormal alert may be continuously logged at each interval. This problem occurs when an initialization error (such as an invalid library path) occurs in the following monitor resources. Relevant monitor resources - db2w - ddnsw - genw - jraw - mysqlw - oraclew - psqlw - psw - sraw - sybasew - vipw	A setting to log an alert every time an initialization error occurs had been specified.
158	3.1.5-1/ 3.0.0-1 to 3.1.4-1	The FTP monitor resource may mistakenly detect a monitor error. This problem occurs if the banner message registered in the FTP server or the message at the time of connection is a long character string or spans multiple lines.	The FTP monitor executes the next command before receiving all responses from the FTP server.
159	3.1.5-1/ 3.1.0-1 to 3.1.4-1	An unnecessary message about a System Resource Agent background process may be output in when a cluster stops. This problem occurs if the cluster stops in an environment in which System Resource Agent is used.	A case in which resources are released in a multi-thread process was not taken into consideration.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
160	3.1.5-1/ 3.1.0-1 to 3.1.4-1	If all groups are subject to recovery by a message receive monitor resource, failover may not be performed when an error is detected. This problem occurs if you use message receive monitor resources for linkage with the server management infrastructure or A1080a/A1040a, and there is a group that did not activate in a local server.	Whether to fail over all the groups was not properly determined.
161	3.1.3-1/ 3.0.0-1 to 3.1.2-1	If the process to unmount the mirror disk resource or hybrid disk resource times out, the system may misidentify that the unmount process is successfully completed. This problem occurs if the mirror disk resource or hybrid disk resource unmount process takes longer than the unmount timeout time.	OS mountpoint information was already removed even though the unmount process is still being executed.
162	3.1.5-1/ 3.0.0-1 to 3.1.4-1	Activating/deactivating a volume manager resource may fail. This problem may occur when LVM is selected as the volume manager type and the vgs command is executed while activating/deactivating a volume manager resource.	The vgchange command might fail when the vgs command is executed while the vgchange command is being executed.
163	3.1.5-1/ 3.0.0-1 to 3.1.4-1	The mail report function might fail to send a mail. This problem occurs when a domain name is not included in the greeting message of the destination SMTP server.	The domain name of the greeing message retured by the SMTP server is used as the domain of the HELO or EHLO command.
164	3.1.7-1/ 3.1.0-1 to 3.1.6-1	When the configuration information is uploaded using the clpcfctrl command, an OS memory shortage error might occur although this is not the case.	This occurred when the configuration information including interconnect settings having IPs not existing on the sever is uploaded.
165	3.1.7-1/ 3.1.0-1 to 3.1.6-1	The result of virtual machine resource activation processing was reflected on the environment variable CLP_DISK to be used for EXEC resources.	This occurred while virtual machine resources were used.
166	3.1.7-1/ 3.1.5-1 to 3.1.6-1	Sometimes recovery action upon monitor error could not be executed.	This occurred when recovery action by another monitor resource on the same server was tried for the group and resource for which group stop had been executed as the final action upon monitor error.

Section II Installing ExpressCluster

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
167	3.1.7-1/ 3.1.0-1 to 3.1.6-1	In executing the clplogcc command, a log file might not be saved in a directory specified by the -o option.	This occurred when a directory in a file system other than the ExpressCluster installation path was specified by the -o option in executing clplogcc -l.
168	3.1.7-1/ 3.1.5-1 to 3.1.6-1	The following alert might be output to the WebManager. TYPE:rc, ID:503 A mismatch in the group failover-md status occurs between the servers.	This occurred when a server was stopped and there was no failover destination for the failover group that was running on that server and when manual failover was configured.
169	3.1.7-1/ 3.1.5-1	The following alert might be output to the WebManager. TYPE:rc, ID:503 A mismatch in the group failover-md status occurs between the servers.	This occurred when there were differences in the startup times between the servers when the cluster started.
170	3.1.7-1/ 3.1.0-1 to 3.1.6-1	In Config Mode of the WebManager, the final action setting might be changed at an unintended timing.	This occurred when the recovery target was changed on the recovery action tab of monitor resource properties.
171	3.1.7-1/ 3.1.0-1 to 3.1.6-1	The same monitor resource might be started redundantly, resulting in unnecessary recovery action being executed.	This occurred on very rare occasions when a monitor resource set to Always monitors and a monitor resource set to Monitors while activated were started simultaneously when the cluster started.
172	3.1.7-1/ 3.1.5-1	The following alerts might be output to the WebManager. TYPE:rm, ID:9 Detected an error in monitoring <monitor_resource_name>. (<error_number> :<error_message> TYPE:rm, ID:25 Recovery will not be executed since the recovery target <group_name_or_group_resource_name> is not active.	This occurred when it took time to stop a failover group in stopping the cluster.
173	3.1.7-1/ 3.1.0-1 to 3.1.6-1	On the title line displayed when clpmdstat --perf was executed, "Cur", which indicated the latest value, was displayed in place of "Avg" in the average column.	This occurred when clpmdstat --perf was executed.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
174	3.1.7-1/ 3.1.0-1 to 3.1.6-1	The following alert might not be output to the WebManager. TYPE:rm, ID:100 Restart count exceeded the maximum of <count>. Final action of monitoring <monitor_resource_name> will not be executed.	This occurred when the monitor resource returned to normal once after the alert was output, and upon detecting an error again within 24 hours, and the final action was ignored.
175	3.1.7-1/ 3.1.5-1 to 3.1.6-1	When a live migration of a virtual machine resource is executed, the virtual machine resource might fail to be activated at the migration destination.	This occurred when the virtual machine type was KVM.
176	3.1.7-1/ 3.1.0-1 to 3.1.6-1	In Config Mode of the WebManager, Nursery Space and Old Space might not become monitor targets when a JVM monitor resource is created.	This occurred when a new JVM monitor resource was created by selecting Oracle JRockit for JVM Type and not opening Tuning Properties.
177	3.1.7-1/ 3.1.0-1 to 3.1.6-1	In Config Mode of the WebManager, executing Apply the Configuration File caused a memory leak to occur in the WebManager server process. A leak of 80 + 256 * number of monitor types in use + 256 * number of monitor resources occurred per execution.	This occurred when Apply the Configuration File was executed.
178	3.1.7-1/ 3.1.0-1 to 3.1.6-1	When an IP address or the like is changed in Server Properties - BMC Tab in Config Mode of the WebManager, the execution of Suspend and Resume might not apply the change.	This occurred when the Chassis Identify function was used.
179	3.1.7-1/ 3.1.0-1 to 3.1.6-1	The icon of the virtual machine resource to be displayed on the WebManager was wrong.	This occurred when a virtual machine resource was used.
180	3.1.7-1/ 3.1.0-1 to 3.1.6-1	Sometimes disk resource activation might fail.	This occurred when "lvm" or "vxvm" was specified for Disk Type of a disk resource.
181	3.1.7-1/ 3.1.3-1 to 3.1.6-1	There might be a delay in executing recovery action upon detection of a monitoring error.	This occurred when the time information display function was enabled and a monitor resource detected an error at disconnection of the primary interconnect.
182	3.1.7-1/ 3.1.0-1 to 3.1.6-1	A VMW monitor resource might make erroneous detection of an error.	This occurred when the monitor interval of the VMW monitor resource was set to 15 seconds or more.

Section II Installing ExpressCluster

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
183	3.1.7-1/ 3.1.0-1 to 3.1.6-1	Migration, move, or failover (other than server down) of a virtual machine might fail.	This might occur when it took time to complete migration. This might occur when it took time to stop the virtual machine.
184	3.1.7-1/ 3.1.5-1 to 3.1.6-1	A virtual machine will restart after it is migrated by other than EXPRESSCLUSTER.	The virtual machine is restarted by EXPRESSCLUSTER even though the restart is unnecessary when it is migrated by other than EXPRESSCLUSTER.
185	3.1.8-1/ 3.1.0-1 to 3.1.7-1	If, while a failover is being performed for all groups as a recovery operation upon the detection of a failure, another failure is detected, a recovery operation for a single group (such as group restart) may be executed as an interrupt, resulting in an emergency shutdown.	A condition for excluding a recovery operation for a single group had not been specified while a recovery operation for all the groups was being executed.
186	3.1.8-1/ 3.1.0-1 to 3.1.7-1	Even though manual failover is set as a failover attribute, it may be possible to set a condition that is effective for automatic failover only	When you changed **Use Server Group Settings** in the **Info** tab, no processing was specified to control the settings in the related **Attribute** tab.
187	3.1.8-1/ 3.1.0-1 to 3.1.7-1	Full mirror recovery may be performed, including areas not used by the file system.	Even unwanted areas, which did not require recovery, were specified as copy targets.
188	3.1.8-1/ 3.1.0-1 to 3.1.7-1	A WebManager service process may terminate abnormally.	A POST request in which "Content-length" did not exist could not be anticipated.
189	3.1.8-1/ 3.1.7-1	Only part of the alert messages or syslog may be output.	There was a problem with the message information acquisition process not set with an alert notification setting.
190	3.1.8-1/ 3.1.0-1 to 3.1.7-1	A process monitor resource may mistakenly detect a monitoring timeout.	The timeout judgment process may mistakenly recognize the time during the last monitoring as that required for the present monitoring.
191	3.1.8-1/ 3.1.0-1 to 3.1.7-1	When a monitor resource set to Active stops as a result of a group stop, it may enter the suspend state, rather than the stop state.	In the clpmonctrl command processing and the group resource management process processing, exclusive processing was inadequate.
192	3.1.8-1/ 3.1.7-1	Virtual machine resource deactivation may fail.	When a UUID was specified, the virtual machine start confirmation was not appropriate.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
193	3.1.8-1/ 3.1.5-1 to 3.1.7-1	Network warning light information for some models is not displayed with the clpstat command.	The DN-1500GL processing was omitted from the display processing.
194	3.1.8-1/ 3.1.3-1 to 3.1.7-1	An application error may occur in the group resource management process, causing an emergency shutdown.	No consideration was given to the processing to be performed if time information acquisition fails in a cluster configuration with three or more nodes.
195	3.1.8-1/ 3.0.0-1 to 3.1.7-1	If full mirror recovery is performed for an active mirror disk resource, the mirror recovery may not be performed correctly, causing differences between the data on the active server and that on the standby server. (If such an event occurs, the file will be judged as being invalid when a failover to the standby server is performed and the mirror disk resource is activated.)	In full mirror recovery, the area to copy is identified based on the block information actually used in the file system, but depending on the timing, it may not have been possible to acquire the latest information on use.
196	3.1.10-1/ 3.0.0-1 to 3.1.8-2	If, in a system in which two mirror disk connects (MDCs) are defined and used, one server is restarted while the two MDCs are in the normal state, the lower priority MDC may be used for mirror communication.	When one server was being restarted, the active server was set up so that it would use the MDC that first establishes ICMP communication when it selected an MDC, regardless of the priority.
197	3.1.10-1/ 3.0.0-1 to 3.1.8-1	An invalid error message may be displayed when the clprsc command is executed. [Internal error. Check if memory or OS resources are sufficient.]	The message displayed when it is not possible to stop the resource with the clprsc command contained an error.
198	3.1.10-1/ 3.0.0-1 to 3.1.8-1	The clpcfctrl command may terminate abnormally.	An invalid pointer reference is made during the processing of the clpcfctrl command.
199	3.1.10-1/ 3.0.0-1 to 3.1.8-1	A log may not be output if the exec resource log output function is set.	The log file name is restricted to 31 bytes, and is set up so a log is not output for any file name exceeding this size.
200	3.1.10-1/ 3.1.0-1 to 3.1.8-1	When the browser connected to WebManager is to be terminated, a security warning dialog box may be displayed.	For JRE7 update 21 and later, signature checking has been changed.
201	3.1.10-1/ 3.1.0-1 to 3.1.8-1	For a disk resource, if VxVM is specified for "type", fsck execution may not be performed normally.	In the case of VxVM, fsck was executed unconditionally on the device specified for "RAW device name".

Section II Installing ExpressCluster

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
202	3.1.10-1/ 3.1.0-1 to 3.1.8-1	The server which cannot start failover group in the cluster exists.	The consideration leakage when cannot confirm the status of a self-server at the time of a cluster start.
203	3.2.0-1/ 3.1.0-1 to 3.1.10-1-	A file of 0byte as wlst_xxxx.log and wlst_xxxx.out is output by a [Middleware_Home] /logs follower every interval in a WebLogic monitor resource.	WebLogic monitor resource is executes WLST every interval and is executes a watch of life and death of WebLogic Server. WebLogic Server Because it started to output a logfile every WLST execution by a change of specifications after 10.3.4.
204	3.2.0-1/ 3.1.3-1 to 3.1.10-1	In a PostgreSQL monitor resource, when a monitoring timeout occurred, recovery action will be carried out. A monitoring error occur independently of the retry number of times.	After a monitoring timeout occurred, a renewal of inside information is leaking by processing before a performed watch retry, because a resource monitor process judged the state of the watch resource to be abnormal.
205	3.2.0-1/ 3.1.10-1	When information of a server is acquired by WebManager or clpstat command, WebManager Server and clpstat command may dump core.	An unnecessarily, return value used by the internal communication was converted from host byte oder to network byte order.
206	3.1.4-1/ 3.1.0-1-3.1.10-1	Even if starting the iptables service is disabled, the iptables service is started after collecting logs.	The iptables service is started if the iptables command is executed when collecting logs. However, after collecting logs, the iptables service is not returned to its original state.
207	3.2.1-1/ 3.0.0-1-3.2.0-1	If only IPv6 addresses are set for interconnects with RHEL6 or later, the activation of the mirror disk resources or hybrid disk resources fails.	The behavior of the OS-side functions has changed with RHEL6, causing LISTEN for IPv4 addresses only.
208	3.2.1-1/ 3.0.0-1-3.2.0-1	If only IPv6 addresses are set for interconnects on RHEL6 or later, logs for the other servers are not displayed on the alert pane in the bottom part of WebManager.	The behavior of the OS-side functions has changed with RHEL6, causing LISTEN for IPv4 addresses only.
209	3.2.1-1/ 3.0.0-1-3.2.0-1	With RHEL6 or later, the browser cannot connect to WebManager using the IPv6 address.	The behavior of the OS-side functions has changed with RHEL6, causing LISTEN for IPv4 addresses only.
210	3.2.1-1/ 3.0.0-1-3.2.0-1	When a monitor resource for which Monitor Timing is set to Active detects an error while the group is starting or stopping, its recovery action may fail.	The recovery action was performed at an unrecoverable timing.

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
211	3.2.1-1/ 3.2.0-1	When the setting made for Action When the Cluster Service Process Is Abnormal is other than "OS shutdown" and "OS reboot", the specified action does not take place.	There was an error in the parameter associated with the display name on Builder and the action.
212	3.2.1-1/ 3.1.5-1-3.2.0-1	When the cluster service is stopped, the monitor resource may detect an error and the recovery action may be performed.	Stop processing for the monitor resource with Monitor Timing set to Active and the group resource was executed in parallel while the cluster service was stopped.
213	3.2.1-1/ 3.0.0-1-3.2.0-1	A failover may fail.	At failover, the process that queries the active server about the group status fails. Because the startup server information for the group is rewritten, a group status mismatch error is detected after internal communication is restored.
214	3.2.1-1/ 3.1.10-1-3.2.0-1	Activation may fail when "raw" is set to [Disk Type] of the disk resource.	There is an error in the process for checking the bind status of the target RAW device.
215	3.2.1-1/ 3.1.3-1-3.2.0-1	For some Database Agent products, when a monitoring timeout occurs, it is assumed that a monitoring error occurs and a recovery action is executed regardless of the monitoring retry count setting.	The resource monitor process determines that the monitor resource is abnormal because internal information has not been updated in the process before the monitoring retry that is executed when a monitoring timeout occurs.
216	3.2.1-1/ 3.0.0-1-3.2.0-1	When 80 is set to the WebManager port number, connection cannot be established from the client.	The default port of HTTP is not considered.
217	3.2.1-1/ 3.0.0-1-3.2.0-1	When the WebManager is used on Linux, display of he WebManager and Integrated WebManager screens may be illegal.	The behavior of the method that automatically adjusts the component size is different between Linux Java and Windows.
218	3.2.1-1/ 3.0.0-1-3.2.0-1	It takes time greater than the specified timeout value to detect a timeout of the script started by the EXEC resource.	The timeout decision process is not appropriate.
219	3.2.1-1/ 3.1.5-1-3.2.0-1	When NFSv4 is being monitored by using the NFS monitor resource and if UDP is disabled, a monitoring error occurs and a recovery action is performed.	UDP is used for reception even when the NFS listen protocol is v4.

Section II Installing ExpressCluster

Number	Version in which the problem has been solved / Version in which the problem occurred	Upgraded section	Cause
220	3.2.1-1/ 3.1.3-1-3.2.0-1	In the case of Novell SUSE LINUX Enterprise Server 10, the JVM monitor resource cannot start and the status became abnormal.	A wrong library is linked.

Chapter 5   Notes and Restrictions

This chapter provides information on known problems and how to troubleshoot the problems.
This chapter covers:

Designing a system configuration

Hardware selection, option products license arrangement, system configuration, and shared disk configuration are introduced in this section.

Function list and necessary license

The following option products are necessary as many as the number of servers.

Those resources and monitor resources for which the necessary licenses are not registered are not on the resource list of the Builder (online version).

Necessary function	Necessary license
Mirror disk resource	ExpressCluster X Replicator 3.2*1
Hybrid disk resource	ExpressCluster X Replicator DR 3.2*2
Oracle monitor resource	ExpressCluster X Database Agent 3.2
DB2 monitor resource	ExpressCluster X Database Agent 3.2
PostgreSQL monitor resource	ExpressCluster X Database Agent 3.2
MySQL monitor resource	ExpressCluster X Database Agent 3.2
Sybase monitor resource	ExpressCluster X Database Agent 3.2
Samba monitor resource	ExpressCluster X File Server Agent 3.2
nfs monitor resource	ExpressCluster X File Server Agent 3.2
http monitor resource	ExpressCluster X Internet Server Agent 3.2
smtp monitor resource	ExpressCluster X Internet Server Agent 3.2
pop3 monitor resource	ExpressCluster X Internet Server Agent 3.2
imap4 monitor resource	ExpressCluster X Internet Server Agent 3.2
ftp monitor resource	ExpressCluster X Internet Server Agent 3.2
Tuxedo monitor resource	ExpressCluster X Application Server Agent 3.2
OracleAS monitor resource	ExpressCluster X Application Server Agent 3.2
Weblogic monitor resource	ExpressCluster X Application Server Agent 3.2
Websphere monitor resource	ExpressCluster X Application Server Agent 3.2
WebOTX monitor resource	ExpressCluster X Application Server Agent 3.2
JVM monitor resource	ExpressCluster X Java Resource Agent 3.2
System monitor resource	ExpressCluster X System Resource Agent 3.2
Mail report actions	ExpressCluster X Alert Service 3.2
Network Warning Light status	ExpressCluster X Alert Service 3.2

*1 When configuring data mirror form, product **Replicator** must be purchased.
*2 When configuring mirror between shared disk, product **Replicator DR** must be purchased.

Supported operating systems for the Builder and WebManager

◆ Use a Web browser and Java Runtime supporting 32-bit machine to run the Builder and WebManager on an x86_64 machine.

Hardware requirements for mirror disks

◆ Linux md stripe set, volume set, mirroring, and stripe set with parity cannot be used for either mirror disk resource cluster partitions or data partitions.
(Linux LVM volumes can be used for both cluster partitions and data partitions.)

◆ Mirror disk resource cannot be made as a target of a Linux md stripe set, volume set, mirroring, and stripe set with parity.

◆ Mirror partitions (data partition and cluster partition) to use a mirror disk resource.

◆ There are two ways to allocate mirror partitions:

• Allocate a mirror partition (data partition and cluster partition) on the disk where the operating system (such as root partition and swap partition) resides.

• Reserve (or add) a disk (or LUN) not used by the operating system and allocate a mirror partition on the disk.

◆ Consider the following when allocating mirror partitions:

• When maintainability and performance are important:
- It is recommended to have a mirror disk that is not used by the OS.

• When LUN cannot be added due to hardware RAID specification or when changing LUN configuration is difficult in hardware RAID pre-install model:
- Allocate a mirror partition on the same disk where the operating system resides.

◆ When multiple mirror disk resources are used, it is recommended to prepare (adding) a disk per mirror disk resource. Allocating multiple mirror disk resources on the same disk may result in degraded performance and it may take a while to complete mirror recovery due to disk access performance on Linux operating system.

◆ Disks used for mirroring must be the same in all servers.

• Disk type

Mirror disks on both servers and disks where mirror partition is allocated should be of the same disk type

For supported disk types, see "Supported disk interfaces" on page 52.

Example

Combination	server1	server2
OK	SCSI	SCSI
OK	IDE	IDE
NG	IDE	SCSI

◆ Notes when the geometries of the disks used as mirror disks differ between the servers.

The partition size allocated by the `fdisk` command is aligned by the number of blocks (units) per cylinder. Allocate a data partition considering the relationship between data partition size and direction for initial mirror configuration to be as indicated below:

Source server ≤ Destination server

"Source server" refers to the server where the failover group that a mirror disk resource belongs has a higher priority in failover policy. "Destination server" refers to the server where the failover group that a mirror disk resource belongs has a lower priority in failover policy.

If the data partition sizes differ significantly between the copy source and the copy destination, initial mirror construction may fail. Be careful, therefore, to secure data partitions of similar sizes.

Hardware requirements for shared disks

◆ A shared disk does not support a Linux md stripe set, volume set, mirroring, and stripe set with parity.

◆ When a Linux LVM stripe set, volume set, mirroring, or stripe set with parity is used:

  • ExpressCluster cannot control ReadOnly/ReadWrite of the partition configured for the disk resource.

◆ When you use VxVM or LVM, a LUN that is not controlled by VxVM or LVM is required on a shared disk for the disk heartbeat of ExpressCluster. You should bear this in your mind when configuring LUN on the shared disk.

Disk heartbeat-dedicated LUN

Actual disk

Disk group
(Virtual disks)
VxVM disk group
resource in
ExpressCluster

dg1   dg2

Volume
(Partitions allocated
from disk group)
VxVM disk volume
resource in
ExpressCluster

vxvol1   vxvol3

vxvol2   vxvol4
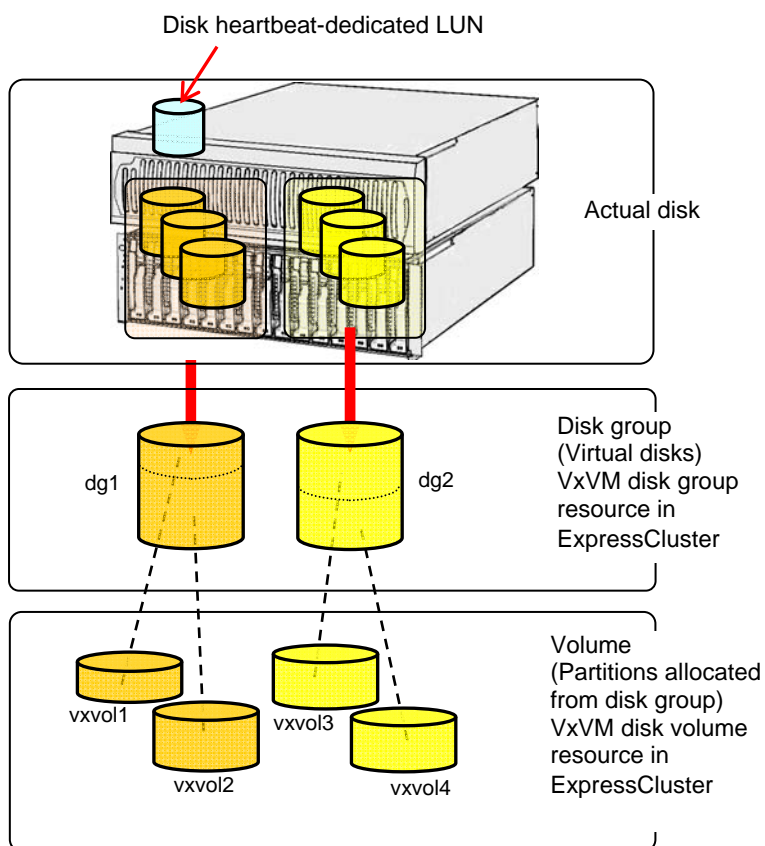
Hardware requirements for hybrid disks

◆ Disks to be used as a hybrid disk resource do not support a Linux md stripe set, volume set, mirroring, and stripe set with parity.

◆ Hybrid disk resource cannot be made as a target of a Linux md stripe set, volume set, mirroring, and stripe set with parity.

◆ Hybrid partitions (data partition and cluster partition) are required to use a hybrid disk resource.

◆ When a disk for hybrid disk is allocated in the shared disk, a partition for disk heartbeat resource between servers sharing the shared disk device is required.

◆ The following are the two ways to allocate partitions when a disk for hybrid disk is allocated from a disk which is not a shared disk:

• Allocate hybrid partitions (data partition and cluster partition) on the disk where the operating system (such as root partition and swap partition) resides.

• Reserve (or add) a disk (or LUN) not used by the operating system and allocate a hybrid partition on the disk.

◆ Consider the following when allocating hybrid partitions:

• When maintainability and performance are important:
- It is recommended to have a hybrid disk that is not used by the OS.

• When LUN cannot be added due to hardware RAID specification or when changing LUN configuration is difficult in hardware RAID pre-install model:
- Allocate a hybrid partition on the same disk where the operating system resides.

◆ When multiple hybrid disk resources are used, it is recommended to prepare (add) a LUN per hybrid disk resource. Allocating multiple hybrid disk resources on the same disk may result in degraded in performance and it may take a while to complete mirror recovery due to disk access performance on Linux operating system.

Type of required partition	Device for which hybrid disk resource is allocated	
	Shared disk device	Non-shared disk device
Data partition	Required	Required
Cluster partition	Required	Required
Partition for disk heart beat	Required	Not Required
Allocation on the same disk (LUN) as where the OS is	-	Possible

◆ Notes when the geometries of the disks used as hybrid disks differ between the servers.

Allocate a data partition considering the relationship between data partition size and direction for initial mirror configuration to be as indicated below:

Source server ≤ Destination server

"Source server" refers to the server with a higher priority in failover policy in the failover group where the hybrid disk resource belongs. "Destination server" refers to the server with a lower priority in failover policy in the failover group where the hybrid disk resource belongs has.

If the data partition sizes differ significantly between the copy source and the copy destination, initial mirror construction may fail. Be careful, therefore, to secure data partitions of similar sizes.

IPv6 environment

The following function cannot be used in an IPv6 environment:

◆ BMC heartbeat resource

The following functions cannot use link-local addresses:

◆ LAN heartbeat resource

◆ Kernel mode LAN heartbeat resource

◆ Mirror disk connect

◆ PING network partition resolution resource

◆ FIP resource

◆ VIP resource

Network configuration

The cluster configuration cannot be configured or operated in an environment, such as NAT, where an IP address of a local server is different from that of a remote server.

Example of network configuration
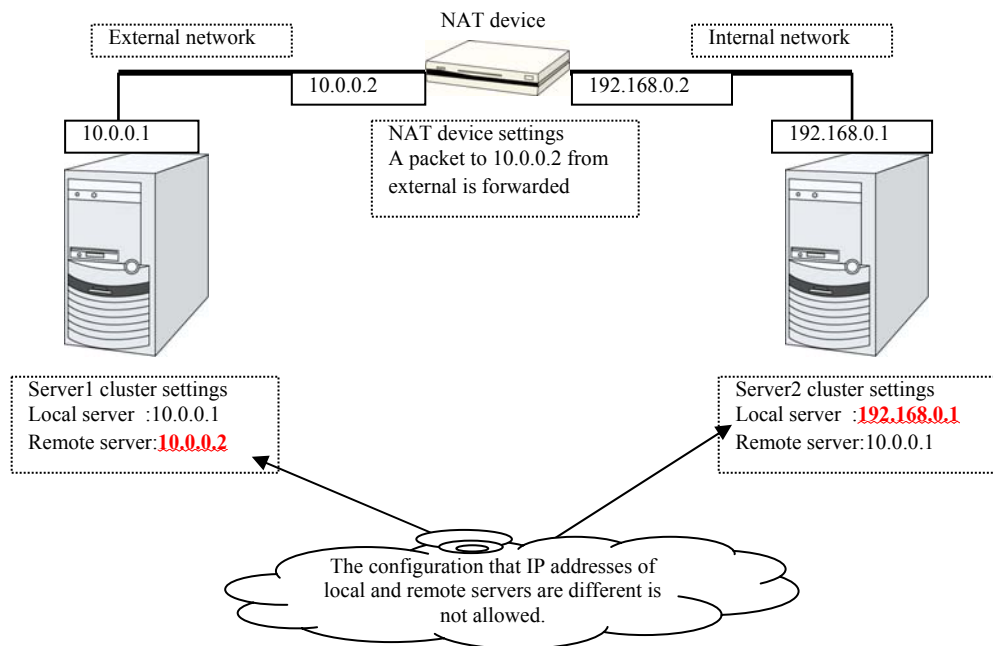
Execute Script before Final Action setting for monitor resource recovery action

ExpressCluster version 3.1.0-1 and later supports the execution of a script before reactivation and before failover.

The same script is executed in either case. Therefore, if **Execute Script before Final Action** is set with a version earlier than 3.1.0-1, editing of the script file may be required.

For the additional script configuration needed to execute the script before reactivation and before failover, the script file must be edited to assign processing to each recovery action.

For the assignment of processing for a recovery action, see "Recovery/pre-recovery action script" in Chapter 5, "Monitor resource details" in the *Reference Guide*.

NIC link up/down monitor resource

Some NIC boards and drivers do not support required `ioctl()`.

The propriety of a NIC Link Up/Down monitor resource of operation can be checked by the `ethtool` command which each distributor offers.

```
ethtool eth0
Settings for eth0:
    Supported ports: [ TP ]
    Supported link modes:   10baseT/Half 10baseT/Full
                            100baseT/Half 100baseT/Full
                            1000baseT/Full
    Supports auto-negotiation: Yes
    Advertised link modes:  10baseT/Half 10baseT/Full
                            100baseT/Half 100baseT/Full
                            1000baseT/Full
    Advertised auto-negotiation: Yes
    Speed: 1000Mb/s
    Duplex: Full
    Port: Twisted Pair
    PHYAD: 0
    Transceiver: internal
    Auto-negotiation: on
    Supports Wake-on: umbg
    Wake-on: g
    Current message level: 0x00000007 (7)
    Link detected: yes
```

◆ When the LAN cable link status ("Link detected: yes") is not displayed as the result of the `ethtool` command:

- It is highly likely that NIC Link Up/Down monitor resource of EXPRESSCLUSTER is not operable. Use IP monitor resource instead.

◆ When the LAN cable link status ("Link detected: yes") is displayed as the result of the `ethtool` command:

- In most cases NIC Link Up/Down monitor resource of ExpressCluster can be operated, but sometimes it cannot be operated.

- Particularly in the following hardware, NIC Link Up/Down monitor resource of ExpressCluster may not be operated. Use IP monitor resource instead.

- When hardware is installed between the actual LAN connector and NIC chip such as a blade server

- When the monitored NIC is in a bonding environment, check whether the MII Polling Interval is set to 0 or higher.

To check if NIC Link Up/Down monitor resource can be used by using ExpressCluster on an actual machine, follow the steps below to check the operation.

1. Register NIC Link Up/Down monitor resource with the configuration information.
   Select **No Operation** for the configuration of recovery operation of NIC Link Up/Down monitor resource upon failure detection.

2. Start the cluster.

3. Check the status of NIC Link Up/Down monitor resource.
   If the status of NIC Link Up/Down monitor resource is abnormal while LAN cable link status is normal, NIC Link Up/Down monitor resource cannot be operated.

4. If NIC Link Up/Down monitor resource status becomes abnormal when LAN cable link status is made abnormal status (link down status), NIC Link Up/Down monitor resource cannot be operated.
   If the status remains to be normal, NIC Link Up/Down monitor resource cannot be operated.

Write function of the mirror disk resource and hybrid disk resource

◆ A mirror disk and a hybrid disk resource write data in the disk of its own server and the disk of the remote server via network. Reading of data is done only from the disk on own server.

◆ Writing functions shows poor performance in mirroring when compared to writing to a single server because of the reason provided above. For a system that requires through-put as high as single server, use a shared disk.

Not outputting syslog to the mirror disk resource or the hybrid disk resource

Do not set directories or subdirectories which mounted the mirror disk resource or the hybrid disk resource as syslog output destination directories.

When the mirror disk connection is disconnected, the I/O to the mirror partition may stop until the disconnection is detected. The system may become abnormal because of the syslog output stoppage at this time.

When outputting syslog to the mirror disk resource or the hybrid disk resource is necessary, consider the followings.

◆ Use bonding as a way of path redundancy of the mirror disk connection.

◆ Adjust the user space monitoring timeout value or the mirror related timeout values.

Notes when terminating the mirror disk resource or the hybrid disk resource

◆ In case that processes which access to the directories, subdirectories and files which mounted the mirror disk resource or the hybrid disk resource exist, terminate the accesses to each disk resource by using ending script or other methods at deactivation of each disk resource like when shutdown or failover.
   Depending on the settings of each disk resource, action at abnormity detection when unmounting (forcibly terminate processes while each disk resource is being accessed) may occur, or recovery action at deactivation failure caused by unmount failure (OS shutdown or other actions) may be executed.

◆ In case that a massive amount of accesses to directories, subdirectories or files which mounted the mirror disk resource or hybrid disk resource are executed, it may take much time before the cache of the file systems is written out to the disks when unmounting at disk resource deactivation.
   At times like this, set the timeout interval of unmount longer enough so that the writing to the disks will successfully complete.

◆ For the details of this setting,
   see Chapter 4, "Group resource details" in Reference Guide,
   Settings Tab or **Mirror Disk Resource Tuning Properties** or **Unmount Tab** in **Details Tab** in "Understanding mirror disk resources" or "Understanding mirror disk resources".

Data consistency among multiple asynchronous mirror disks

In mirror disk or hybrid disk with asynchronous mode, writing data to the data partition of the active server is performed in the same order as the data partition of the standby server.

This writing order is guaranteed except during the initial mirror disk configuration or recovery (copy) period after suspending mirroring the disks. The data consistency among the files on the standby data partition is guaranteed.

However, the writing order is not guaranteed among multiple mirror disk resources and hybrid disk resources. For example, if a file gets older than the other and files that cannot maintain the data consistency are distributed to multiple asynchronous mirror disks, an application may not run properly when it fails over due to server failure.

For this reason, be sure to place these files on the same asynchronous mirror disk or hybrid disk.

Mirror data reference at the synchronization destination if mirror synchronization is interrupted

If mirror synchronization is interrupted for a mirror disk or a hybrid disk in the mirror synchronization state, using the mirror disk helper or the `clpmdctrl` / `clphdctrl` command (with the `--break` / `-b` / `--nosync` option specified), the file system and application data may be abnormal if the mirror disk on the server on the mirror synchronization destination (copy destination) is made accessible by performing forced activation (removing the access restriction) or forced mirror recovery.

This occurs because if mirror synchronization is interrupted on the server on the mirror synchronization source (server on which the resources are activated) leading to an inconsistent state in which there are portions that can be synchronized with the synchronization destination and portions that cannot be synchronized such as; for example, when an application is writing to a mirror disk area, part of the data and so on will be retained in the cache and so on (memory) of the OS, but not yet actually written to the mirror disk, or may be in the process of being written.

If you want to perform access in a state in which consistency with the mirror disk on the mirror synchronization destination (standby server) is ensured, secure a rest point on the mirror synchronization source (active server on which the resources are activated) first and then interrupt mirror synchronization. Alternatively, secure a rest point by deactivating. (With an application end, access to the mirror area ends, and by unmounting the mirror disk, the cache and so on of the OS are all written to the mirror disk.)

For an example of securing a rest point, refer to the "ExpressCluster X PP Guide (Schedule Mirror)," provided with the StartupKit.

Similarly, if mirror recovery is interrupted for a mirror disk or a hybrid disk that is in the middle of mirror recovery (mirror resynchronization), the file system and application data may be abnormal if the mirror disk on the mirror synchronization destination is accessed by performing forced activation (removing the access restriction) or forced mirror recovery.
This also occurs because mirror recovery is interrupted in an inconsistent state in which there are portions that can be synchronized but also portions that cannot.

O_DIRECT for mirror or hybrid disk resources

Do not use the O_DIRECT flag of the `open()` system call for mirror or hybrid disk resources. Examples include the Oracle parameter `filesystemio_options = setall`.

Do not specify the disk monitor O_DIRECT mode for mirror or hybrid disk resources.

Initial mirror construction time for mirror or hybrid disk resources

The time that takes to construct the initial mirror is different between ext2/ext3/ext4 and other file systems.

Mirror or hybrid disk connect

◆ When using redundant mirror or hybrid disk connect, both version of IP address are needed to be the same.

◆ All the IP addresses used by mirror disk connect must be set to IPv4 or IPv6.

JVM monitor resources

◆ Up to 25 Java VMs can be monitored concurrently. The Java VMs that can be monitored concurrently are those which are uniquely identified by the Builder (with **Identifier** in the **Monitor (special)** tab).

◆ Connections between Java VMs and Java Resource Agent do not support SSL.

◆ If, during the monitoring of Java VM, there is another process with the same name as the monitoring target, C heap monitoring may be performed for a different monitoring target.

◆ It may not be possible to detect thread deadlocks. This is a known problem in Java VM. For details, refer to "Bug ID: 6380127" in the Oracle Bug Database.

◆ Monitoring of the WebOTX process group is disabled when the process multiplicity is two or more. WebOTX V8.4 and later can be monitored.

◆ The Java Resource Agent can monitor only the Java VMs on the server on which the JVM monitor resources are running.

◆ The Java Resource Agent can monitor only one JBoss server instance per server.

◆ The Java installation path setting made by the Builder (with **Java Installation Path** in the **JVM monitor** tab in **Cluster Property**) is shared by the servers in the cluster. The version and update of Java VM used for JVM monitoring must be the same on every server in the cluster.

◆ The management port number setting made by the Builder (with **Management Port** in the **Connection Setting** dialog box opened from the **JVM monitor** tab in **Cluster Property**) is shared by all the servers in the cluster.

◆ Application monitoring is disabled when an application to be monitored on the IA32 version is running on an x86_64 version OS or when an application to be monitored on an x86_64 version is running on an IA32 version OS.

◆ If a large value such as 3,000 or more is specified as the maximum Java heap size by the Builder (by using Maximum Java Heap Size on the **JVM monitor** tab in **Cluster Property**), The Java Resource Agent will fail to start up. The maximum heap size differs depending on the environment, so be sure to specify a value based on the capacity of the mounted system memory.

◆ Using SingleServerSafe is recommended if you want to use the target Java VM load calculation function of the coordination load balancer.

Mail reporting

The mail reporting function is not supported by STARTTLS and SSL.

Requirements for network warning light

◆ When using "DN-1000S" or "DN-1500GL," do not set your password for the warning light.

◆ To play an audio file as a warning, you must register the audio file for "DN-1500GL" beforehand. For details on how to register an audio file, see the "DN-1500GL" operation manual.

Installing operating system

Notes on parameters to be determined when installing an operating system, allocating resources, and naming rules are described in this section.

/opt/nec/clusterpro file system

It is recommended to use a file system that has journaling functions to improve tolerance for system failure.

Mirror disks

◆ Disk partition

Example: When adding one SCSI disk to each of both servers and making a pair of mirrored disks:
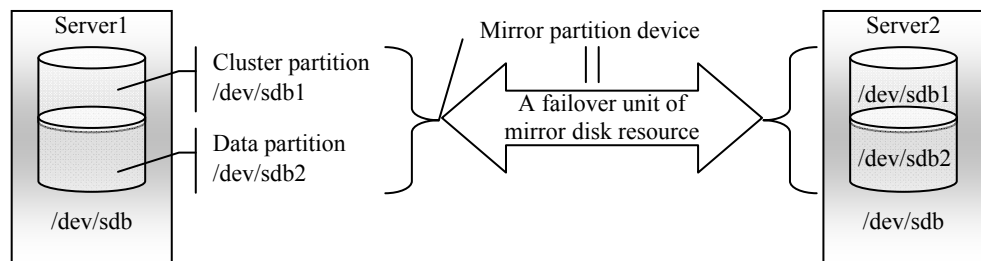
Example: When using free space of IDE disks of both servers, where the OS is stored, and making a pair of mirrored disks:
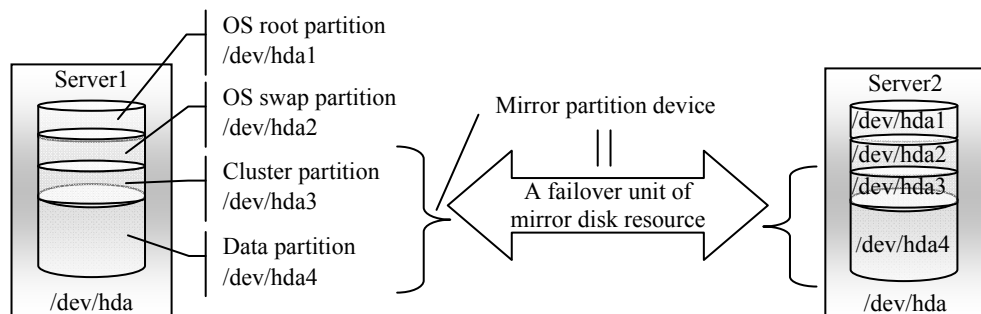
- Mirror partition device refers to cluster partition and data partition.

- Allocate cluster partition and data partition on each server as a pair.

- It is possible to allocate a mirror partition (cluster partition and data partition) on the disk where the operating system resides (such as root partition and swap partition.).

  - When maintainability and performance are important:

    It is recommended to have a mirror disk that is not used by the operating system (such as root partition and swap partition.)

  - When LUN cannot be added due to hardware RAID specification: or
    When changing LUN configuration is difficult in hardware RAID pre-install model:

It is possible to allocate a mirror partition (cluster partition and data partition) on the disk where the operating system resides (such as root partition and swap partition.)

◆ Disk configurations

Multiple disks can be used as mirror disks on a single server. Or, you can allocate multiple mirror partitions on a single disk.

Example: When adding two SCSI disks to each of both servers and making two pairs of mirrored disks:
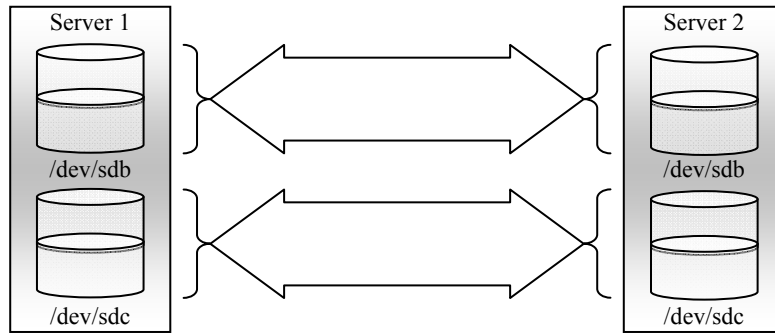
- Allocate two partitions, cluster partition and data partition, as a pair on each disk.

- Use of the data partition as the first disk and the cluster partition as the second disk is not permitted.

Example: When adding one SCSI disk to each of both servers and making two mirror partitions:
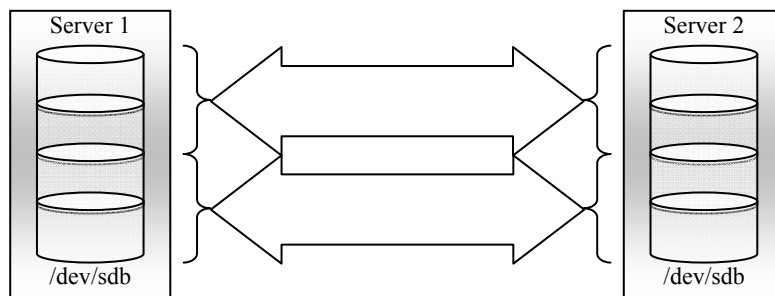
◆ A disk does not support a Linux md stripe set, volume set, mirroring, and stripe set with parity.

ExpressCluster X 3.2 for Linux Getting Started Guide

Hybrid disks

◆ Disk partition

Disks that are shared or not shared (server with built-in disk, external disk chassis not shared by servers etc.) can be used.

Example) When two servers use a shared disk and the third server uses a built-in disk in the server:
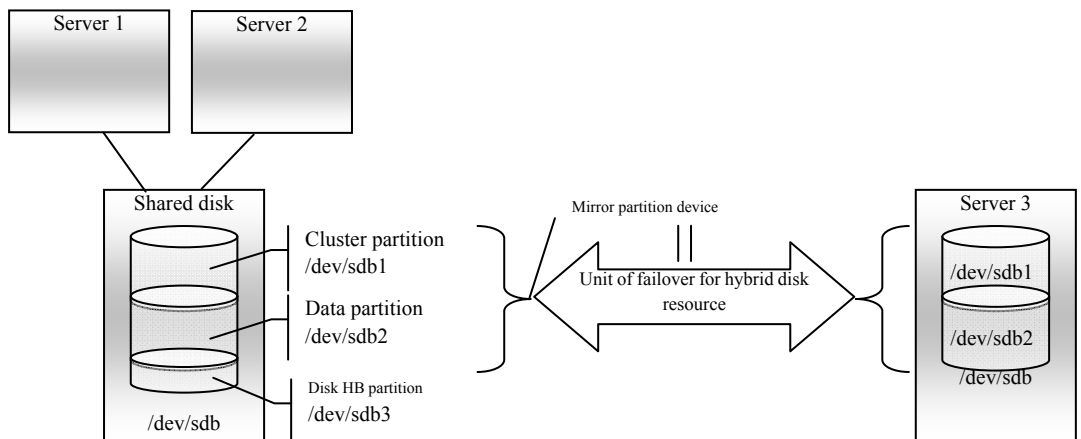
- Mirror partition device is a device ExpressCluster mirroring driver provides in the upper.
- Allocate cluster partition and data partition on each server as a pair.
- When a disk that is not shared (e.g. server with a built-in disk, external disk chassis that is not shared among servers) is used, it is possible to allocate mirror partitions (cluster partition and data partition) on the disk where the operating system resides (such as root partition and swap partition.).
    - When maintainability and performance are important:

        It is recommended to have a mirror disk that is not used by the operating system (such as root partition and swap partition.)
    - When LUN cannot be added due to hardware RAID specification: or
      When changing LUN configuration is difficult in hardware RAID pre-install model:

        It is possible to allocate mirror partitions (cluster partition and data partition) on the disk where the operating system resides (such as root partition and swap partition.)
- When a hybrid disk is allocated in a shared disk device, allocate a partition for the disk heart beat resource between servers sharing the shared disk device.
- A disk does not support a Linux md stripe set, volume set, mirroring, and stripe set with parity.

Dependent library

◆ libxml2

Install libxml2 when installing the operating system.

Dependent driver

◆ softdog

This driver is necessary when softdog is used to monitor user mode monitor resource.

Configure a loadable module. Static driver cannot be used.

The major number of Mirror driver

Use mirror driver's major number 218. Do not use major number 218 for other device drivers.

The major number of Kernel mode LAN heartbeat and keepalive drivers

◆ Use major number 10, minor number 240 for kernel mode LAN heartbeat driver.

◆ Use major number 10, minor number 241 for keepalive driver.

Make sure to check that other drivers are not using major and minor numbers described above.

Partition for RAW monitoring of disk monitor resources

Allocate a partition for monitoring when setting up RAW monitoring of disk monitor resources. The partition size should be 10 MB.

SELinux settings

◆ Configure permissive or disabled for the SELinux settings.

◆ If you set enforcing, communication required in ExpressCluster may not be achieved.

NetworkManager settings

If the NetworkManager service is running in a Red Hat Enterprise Linux 6 environment, an unintended behavior (such as detouring the communication path, or disappearance of the network interface) may occur upon disconnection of the network. It is recommended to set NetworkManager to stop the service.

Before installing ExpressCluster

Notes after installing an operating system, when configuring OS and disks are described in this section.

Communication port number

In ExpressCluster, the following port numbers are used. You can change the port number by using the Builder except "keepalive between mirror drivers.".

Make sure not to access the following port numbers from a program other than ExpressCluster.

Configure to be able to access the port number below when setting a firewall on a server.

Server to Server					
Loopback in servers					
From			**To**		**Used for**
Server	Automatic allocation[1]	$\rightarrow$	Server	29001/TCP	Internal communication
Server	Automatic allocation	$\rightarrow$	Server	29002/TCP	Data transfer
Server	Automatic allocation	$\rightarrow$	Server	29002/UDP	Heartbeat
Server	Automatic allocation	$\rightarrow$	Server	29003/UDP	Alert synchronization
Server	Automatic allocation	$\rightarrow$	Server	29004/TCP	Communication between mirror agents
Server	Automatic allocation	$\rightarrow$	Server	29006/UDP	Heartbeat (kernel mode)
Server	Automatic allocation	$\rightarrow$	Server	XXXX[2]/TCP	Mirror disk resource data synchronization
Server	Automatic allocation	$\rightarrow$	Server	XXXX[3]/TCP	Communication between mirror drivers
Server	Automatic allocation	$\rightarrow$	Server	XXXX[4]/TCP	Communication between mirror drivers
Server	icmp	$\rightarrow$	Server	icmp	keepalive between mirror drivers, duplication check for FIP/VIP resource and mirror agent
Server	Automatic allocation	$\rightarrow$	Server	XXXX[5]/UDP	Internal log communication

WebManager to Server					
From			**To**		**Used for**
WebManager	Automatic allocation	$\rightarrow$	Server	29003/TCP	http communication

Server connected to the Integrated WebManager to Target server				
From			**To**	**Used for**
Server connected to the Integrated WebManager	Automatic allocation	→	Server 29003/TCP	http communication
Server to be managed by the Integrated WebManager	29003	→	Client 29010/UDP	UDP communication

Others					
From			**To**		**Used for**
Server	Automatic allocation	→	Network warning light	See the manual for each product.	Network warning light control
Server	Automatic allocation	→	Management LAN of server BMC	623/UDP	BMC control (Forced stop / Chassis lamp association)
Management LAN of server BMC	Automatic allocation	→	Server	162/UDP	Monitoring target of the external linkage monitor configured for BMC linkage
Management LAN of server BMC	Automatic allocation	→	Management LAN of server BMC	5570/UDP	BMC HB communication
Server	icmp	→	Monitoring target	icmp	IP monitor
Server	icmp	→	NFS server	icmp	Checking if NFS server is active by NAS resource
Server	icmp	→	Monitoring target	icmp	Monitoring target of Ping method network partition resolution resource
Server	Automatic allocation	→	Server	Management port number set by the Builder[6]	JVM monitor
Server	Automatic allocation	→	Monitoring target	Connection port number set by the Builder[6]	JVM monitor
Server	Automatic allocation	→	Monitoring target	Load balancer linkage management port number set by the Builder[6]	JVM monitor
Server	Automatic allocation	→	BIG-IP LTM	Communication port number set by the Builder[6]	JVM monitor

1. In automatic allocation, a port number not being used at a given time is allocated.

2. This is a port number used per mirror disk resource or hybrid disk resource and is set when creating mirror disk resource or hybrid disk resource. A port number 29051 is set by default. When you add a mirror disk resource or hybrid disk resource, this value is automatically

incremented by 1. To change the value, click **Details** tab in the **[md] Resource Properties** or the **[hd] Resource Properties** dialog box of the Builder. For more information, refer to Chapter 4, "Group resource details" in the *Reference Guide*.

3. This is a port number used per mirror disk resource or hybrid disk resource and is set when creating mirror disk resource or hybrid disk resource. A port number 29031 is set by default. When you add a mirror disk resource or a hybrid disk resource, this value is automatically incremented by 1. To change the value, click **Details** tab in the **[md] Resource Properties** or the **[hd] Resource Properties** dialog box of the Builder. For more information, refer to Chapter 4, "Group resource details" in the *Reference Guide*.

4. This is a port number used per mirror disk resource or hybrid disk resource and is set when creating mirror disk resource or hybrid disk resource. A port number 29071 is set by default. When you add a mirror disk resource or hybrid disk resource this value is automatically incremented by 1. To change the value, click **Details** tab in the **[md] Resource Properties** or the **[hd] Resource Properties** dialog box of the Builder. For more information, refer to Chapter 4, "Group resource details" in the *Reference Guide*.

5. Select **UDP** for the **Communication Method for Internal Logs** in the **Port No. (Log)** tab in **Cluster Properties**. Use the port number configured in Port No. Communication port is not used for the default log communication method **UNIX Domain**.

6. The JVM monitor resource uses the following four port numbers.

    *   A management port number is used for the JVM monitor resource to communicate with the Java VM on which it runs. To set this number, use the **Connection Setting** dialog box opened from the **JVM monitor** tab in **Cluster Property** of the Builder. For details, refer to Chapter 2, "Function of the Builder" in the *Reference Guide*.

    *   A connection port number is used to establish a connection to the target Java VM (WebLogic Server or WebOTX). To set this number, use the **Monitor (special)** tab in **Properties** of the Builder for the corresponding JVM monitor resource. For details, refer to Chapter 6, "Monitor resource details" in the *Reference Guide*.

    *   A load balancer linkage management port number is used for load balancer linkage. When load balancer linkage is not used, this number does not need to be set. To set the number, use opened from the **JVM monitor** tab in **Cluster Property** of the Builder. For details, refer to Chapter 2, "Function of the Builder" in the *Reference Guide*.

    *   A communication port number is used to accomplish load balancer linkage with BIG-IP LTM. When load balancer linkage is not used, this number does not need to be set. To set the number, use the **Load Balancer Linkage Settings** dialog box opened from the **JVM monitor** tab in **Cluster Property** of the Builder. For details, refer to Chapter 2, "Function of the Builder" in the *Reference Guide*.

Changing the range of automatic allocation for the communication port numbers

◆ The range of automatic allocation for the communication port numbers managed by the OS might overlap the communication port numbers used by ExpressCluster.

◆ Change the OS settings to avoid duplication when the range of automatic allocation for the communication numbers managed by OS and the communication numbers used by ExpressCluster are duplicated.

Examples of checking and displaying OS setting conditions.

The range of automatic allocation for the communication port numbers depends on the distribution.

```
# cat /proc/sys/net/ipv4/ip_local_port_range
```
1024   65000

This is the condition to be assigned for the range from 1024 to 65000 when the application requests automatic allocation for the communication port numbers to the OS.

```
# cat /proc/sys/net/ipv4/ip_local_port_range
```
32768   61000

This is the condition to be assigned for the range from 32768 to 61000 when the application requests automatic allocation for the communication port numbers to the OS.

Examples of OS settings change

Add the line below to /etc/sysctl.conf. (When changing to the range from 30000 to 65000)

net.ipv4.ip_local_port_range = 30000   65000

This setting takes effect after the OS is restarted.

After changing /etc/sysctl.conf, you can reflect the change instantly by executing the command below.

```
# sysctl -p
```

Clock synchronization

In a cluster system, it is recommended to synchronize multiple server clocks regularly. Synchronize server clocks by using ntp.

NIC device name

Because of the ifconfig command specification, when the NIC device name is shortened, the length of the NIC device name which ExpressCluster can handle depends on it.

ExpressCluster X 3.2 for Linux Getting Started Guide

Shared disk

◆ When you continue using the data on the shared disk at times such as server reinstallation, do not allocate a partition or create a file system.

◆ The data on the shared disk gets deleted if you allocate a partition or create a file system.

◆ ExpressCluster controls the file systems on the shared disk. Do not include the file systems on the shared disk to /etc/fstab in operating system.
(Do not enter /etc/fstab even with the ignore option specified.
If you enter /etc/fstab with the ignore option specified, the entry will be ignored when mount is executed, but an error may subsequently occur when fsck is executed.)

◆ See the *Installation and Configuration Guide* for steps for shared disk configuration.

Mirror disk

◆ Set a management partition for mirror disk resource (cluster partition) and a partition for mirror disk resource (data partition).

◆ ExpressCluster controls the file systems on mirror disks. Do not set the file systems on the mirror disks to /etc/fstab in operating system.
(Do not enter a mirror partition device, mirror mount point, cluster partition, or data partition in /etc/fstab of the operating system.)
(Do not enter /etc/fstab even with the ignore option specified.
If you enter /etc/fstab with the ignore option specified, the entry will be ignored when mount is executed, but an error may subsequently occur when fsck is executed.)
(Entering /etc/fstab with the noauto option specified is not recommended, either, because it may lead to an inadvertent manual mount or result in some application being mounted.)

◆ See the *Installation and Configuration Guide* for steps for mirror disk configuration.

Hybrid disk

◆ Configure the management partition (cluster partition) for hybrid disk resource and the partition used for hybrid disk resource (data partition).

◆ When a hybrid disk is allocated in the shared disk device, allocate the partition for the disk heart beat resource between servers sharing the shared disk device.

◆ ExpressCluster controls the file systems on the hybrid disk. Do not include the file systems on the hybrid disk to /etc/fstab in operating system.
(Do not enter a mirror partition device, mirror mount point, cluster partition, or data partition in /etc/fstab of the operating system.)
(Do not enter /etc/fstab even with the ignore option specified.
If you enter /etc/fstab with the ignore option specified, the entry will be ignored when mount is executed, but an error may subsequently occur when fsck is executed.)
(Entering /etc/fstab with the noauto option specified is not recommended, either, because it may lead to an inadvertent manual mount or result in some application being mounted.)

◆ See the *Installation and Configuration Guide* for steps for hybrid disk configuration.

◆ When using this ExpressCluster version, a file system must be manually created in a data partition used by a hybrid disk resource. For details about what to do when a file system is not created in advance, see "Settings after configuring hardware" in Chapter 1 " Determining a system configuration" of the *Installation and Configuration Guide*.

Adjusting OS startup time

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 disks to the point they become available.

◆ Heartbeat timeout time

See the *Installation and Configuration Guide* for configuration steps.

Verifying the network settings

◆ The network used by Interconnect or Mirror disk connect is checked. It checks by all the servers in a cluster.

◆ See the *Installation and Configuration Guide* for configuration steps.

ipmiutil and OpenIPMI

◆ The following functions use `ipmiutil` or OpenIPMI.

  - Final Action at Activation Failure / Deactivation Failure

  - Monitor resource action upon failure

  - User space monitor

  - Shutdown monitor

  - Forcibly stopping a physical machine

  - Chassis Identify

◆ `ipmiutil` and OpenIPMI do not come with ExpressCluster. You need to download and install the rpm packages for `ipmiutil` and OpenIPMI.

◆ Users are responsible for making decisions and assuming responsibilities. NEC does not support or assume any responsibilities for:

  - Inquires about `ipmiutil` and OpenIPMI themselves.

  - Tested operation of `ipmiutil` and OpenIPMI

  - Malfunction of `ipmiutil` and OpenIPMI or error caused by such malfunction.

  - Inquiries about whether or not `ipmiutil` and OpenIPMI are supported by servers.

◆ Check whether or not your server (hardware) supports `ipmiutil` and OpenIPMI in advance.

◆ Note that even if the machine complies with `ipmi` standard as hardware, `ipmiutil` and OpenIPMI may not run if you actually try to run them.

◆ If you are using a software program for server monitoring provided by a server vendor, do not choose `ipmi` as a monitoring method for user space monitor resource and shutdown stall monitor. Because these software programs for server monitoring and `ipmiutil` both use BMC (Baseboard Management Controller) on the server, a conflict occurs preventing successful monitoring.

User mode monitor resource (monitoring method: softdog)

◆ When softdog is selected as a monitoring method, make sure to set heartbeat that comes with OS not to start.

◆ When it sets softdog in a monitor method in SUSE LINUX 10/11, it is impossible to use with an i8xx_tco driver. When an i8xx_tco driver is unnecessary, make it the setting that i8xx_tco is not loaded.

◆ For Red Hat Enterprise Linux 6, when softdog is selected as a monitoring method, softdog cannot be used together with the iTCO_WDT driver. If the iTCO_WDT driver is not used, specify not to load iTCO_WDT.

Log collection

◆ The designated function of the generation of the syslog does not work by a log collection function in SUSE LINUX 10/11. The reason is because the suffixes of the syslog are different.
Please change setting of rotate of the syslog as follows to use the appointment of the generation of the syslog of the log collection function.

◆ Please comment out "compress" and "date ext" of the /etc/logrotate.d/syslog file.

◆ When the total log size exceeds 2GB on each server, log collection may fail.

nsupdate and nslookup

◆ The following functions use nsupdate and nslookup.

- Dynamic DNS resource of group resource (ddns)

- Dynamic DNS monitor resource of monitor resource (ddnsw)

◆ ExpressCluster does not include nsupdate and nslookup. Therefore, install the rmp files of nsupdate and nslookup, in addition to the ExpressCluster installation.

◆ NEC does not support the items below regarding nsupdate and nslookup. Use nsupdate and nslookup at your own risk.

- Inquiries about nsupdate and nslookup

- Guaranteed operations of nsupdate and nslookup

- Malfunction of nsupdate or nslookup or failure caused by such a malfunction

- Inquiries about support of nsupdate and nslookup on each server

FTP monitor resources

◆ If a banner message to be registered to the FTP server or a message to be displayed at connection is long or consists of multiple lines, a monitor error may occur. When monitoring by the FTP monitor resource, do not register a banner message or connection message.

Notes when creating ExpressCluster configuration data

Notes when creating a cluster configuration data and before configuring a cluster system is described in this section.

Environment variable

The following processes cannot be executed in an environment in which more than 255 environment variables are set. When using the following function of resource, set the number of environmental variables less than 256.

◆ Group start/stop process

◆ Start/Stop script executed by EXEC resource when activating/deactivating

◆ Script executed by Custom monitor Resource when monitoring

◆ Script before final action after the group resource or the monitor resource error is detected.

Note:

The total number of environment variables set in the system and ExpressCluster must be less than 256. About 30 environment variables are set in ExpressCluster.

Force stop function, chassis identify lamp linkage

When using forced stop function or chassis identify lamp linkage, settings of BMC IP address, user name and password of each server are necessary. Use definitely the user name to which the password is set.

Server reset, server panic and power off

When ExpressCluster performs "Server Reset", "Server Panic," or "Server power off", servers are not shut down normally. Therefore, the following may occur.

◆ Damage to a mounted file system

◆ Loss of unsaved data

◆ Suspension of OS dump collection

"Server reset" or "Server panic" occurs in the following settings:

◆ Action at an error occurred when activating/inactivating group resources
-Sysrq Panic
-Keepalive Reset
-Keepalive Panic
-BMC Reset
-BMC Power Off
-BMC Power Cycle
-BMC NMI
-I/O Fencing(High-End Server Option)

◆ Final action at detection of an error in monitor resource
-Sysrq Panic
-Keepalive Reset

-Keepalive Panic
-BMC Reset
-BMC Power Off
-BMC Power Cycle
-BMC NMI
- I/O Fencing(High-End Server Option)

◆ Action at detection of user space monitor timeout
- Monitoring method softdog
- Monitoring method ipmi
- Monitoring method keepalive
- Monitoring method ipmi(High-End Server Option)

Note: "Server panic" can be set only when the monitoring method is "keepalive."

◆ Shutdown stall mentoring
- Monitoring method softdog
- Monitoring method ipmi
- Monitoring method keepalive
- Monitoring method ipmi(High-End Server Option)

Note: "Server panic" can be set only when the monitoring method is "keepalive."

◆ Operation of Forced Stop
-BMC reset
-BMC power off
-BMC cycle
-BMC NMI
-VMware vSphere power off

Final action for group resource deactivation error

If you select **No Operation** as the final action when a deactivation error is detected, the group does not stop but remains in the deactivation error status. Make sure not to set **No Operation** in the production environment.

Verifying raw device for VxVM

Check the raw device of the volume raw device in advance:

1. Import all disk groups which can be activated on one server and activate all volumes before installing ExpressCluster.

2. Run the command below:

   # raw -qa

   ```
   /dev/raw/raw2:  bound to major 199, minor 2
   /dev/raw/raw3:  bound to major 199, minor 3
   ```
      (A)   (B)

   Example: Assuming the disk group name and volume name are:

   - Disk group name: dg1

   - Volume name under dg1: vol1, vol2

3. Run the command below:

   # ls -l /dev/vx/dsk/dg1/

   ```
   brw-------   1 root     root     199,    2  May 15 22:13 vol1
   brw-------   1 root     root     199,    3  May 15 22:13 vol2
   ```
                                       (C)

4. Confirm that major and minor numbers are identical between (B) and (C).

Never use these raw devices (A) as an ExpressCluster disk heartbeat resource, raw resource, raw monitor resource, disk resource for which the disk type is not VxVM, or disk monitor resource for which the monitor method is not READ(VxVM).

Selecting mirror disk file system

Following is the currently supported file systems:

- ext3
- ext4
- xfs
- reiserfs
- jfs
- vxfs

ext4 operations are not proved for operating systems other than Red Hat Enterprise Linux 6.

Selecting hybrid disk file system

The following are the currently supported file systems:

◆ ext3

◆ ext4

◆ reiserfs

Setting of mirror or hybrid disk resource action

In a system that uses mirror or hybrid disks, do not set the monitoring resources final action to **Stop the cluster service**.

If only the cluster service is stopped while the mirror agent is active, hybrid disk control or collecting mirror disk status may fail.

Time to start a single serve when many mirror disks are defined.

If many mirror disk resources are defined and a short time is set to **Time to wait for the other servers to start up**, it may take time to start a mirror agent and mirror disk resources and monitor resources related to mirror disks may not start properly when a single server is started.

If such an event occurs when starting a single server, change the value set to the time to wait for synchronization to a large value (by selecting **Cluster Properties** - **Timeout** tab - **Server Sync Wait Time**).

RAW monitoring of disk monitor resources

◆ When raw monitoring of disk monitor resources is set up, partitions cannot be monitored if they have been or will possibly be mounted. These partitions cannot be monitored even if you set device name to "whole device" (device indicating the entire disks).

◆ Allocate a partition dedicated to monitoring and set up the partition to use the raw monitoring of disk monitor resources.

Delay warning rate

If the delay warning rate is set to 0 or 100, the following can be achieved:

◆ When 0 is set to the delay monitoring rate

An alert for the delay warning is issued at every monitoring.
By using this feature, you can calculate the polling time for the monitor resource at the time the server is heavily loaded, which will allow you to determine the time for monitoring time-out of a monitor resource.

◆ When 100 is set to the delay monitoring rate

The delay warning will not be issued.

Be sure not to set a low value, such as 0%, except for a test operation.

Disk monitor resource (monitoring method TUR)

◆ You cannot use the TUR methods on a disk or disk interface (HBA) that does not support the Test Unit Ready (TUR) and SG_IO commands of SCSI. Even if your hardware supports these commands, consult the driver specifications because the driver may not support them.

◆ S-ATA disk interface may be recognized as IDE disk interface (hd) or SCSI disk interface (sd) by OS depending on disk controller type and distribution. When it is recognized as IDE interface, all TUR methods cannot be used. If it is recognized as SCSI disk interface, TUR (legacy) can be used. Note that TUR (generic) cannot be used.

◆ TUR methods burdens OS and disk load less compared to Read methods.

◆ In some cases, TUR methods may not be able to detect errors in I/O to the actual media.

WebManager reload interval

◆ Do not set the "Reload Interval" in the WebManager tab for less than 30 seconds.

LAN heartbeat settings

◆ As a minimum, you need to set either the LAN heartbeat resource or kernel mode LAN heartbeat resource.

◆ You need to set at least one LAN heartbeat resource. It is recommended to set two or more LAN heartbeat resources.

◆ It is recommended to set both LAN heartbeat resource and kernel mode LAN heartbeat resource together.

Kernel mode LAN heartbeat resource settings

◆ As a minimum, you need to set either the LAN heartbeat resource or kernel mode LAN heartbeat resource.

◆ It is recommended to use kernel mode LAN heartbeat resource for distribution kernel of which kernel mode LAN heartbeat can be used.

COM heartbeat resource settings

◆ It is recommended to use a COM heartbeat resource if your environments allows. This is because using COM heartbeat resource prevents activating both systems when the network is disconnected.

BMC heartbeat settings

◆ The hardware and firmware of the BMC must support BMC heartbeat. For available BMCs, see Chapter 3, "Servers supporting BMC-related functions" in the *Getting Started Guide*.

BMC monitor resource settings

◆ The hardware and firmware of the BMC must support BMC heartbeat. For available BMCs, see Chapter 3, "Servers supporting BMC-related functions" in the *Getting Started Guide*.

IP address for Integrated WebManager settings

◆ **Public LAN IP address** setting, ExpressCluster X2.1 or before, is available in the Builder at **IP address for Integrated WebManager** which is on the **WebManager** tab of **Cluster Properties**.

Double-byte character set that can be used in script comments

◆ Scripts edited in Linux environment are dealt as EUC code, and scripts edited in Windows environment are dealt as Shift-JIS code. In case that other character codes are used, character corruption may occur depending on environment.

Failover exclusive attribute of virtual machine group

◆ When setting virtual machine group, do not set **Normal** or **Absolute** to **Failover exclusive attribute**.

System monitor resource settings

◆ Pattern of detection by resource monitoring
The System Resource Agent detects by using thresholds and monitoring duration time as parameters.
The System Resource Agent collects the data (number of opened files, number of user processes, number of threads, used size of memory, CPU usage rate, and used size of virtual memory) on individual system resources continuously, and detects errors when data keeps exceeding a threshold for a certain time (specified as the duration time).

Message receive monitor resource settings

◆ Error notification to message receive monitor resources can be done in any of three ways: using the `clprexec` command, BMC linkage, or linkage with the server management infrastructure.

◆ To use the `clprexec` command, use the relevant file stored on the ExpressCluster CD. Use this method according to the OS and architecture of the notification-source server. The notification-source server must be able to communicate with the notification-destination server.

◆ To use BMC linkage, the BMC hardware and firmware must support the linkage function. For available BMCs, see "Hardware Servers supporting BMC-related functions" on page 53 in Chapter 3, "Installation requirements for ExpressCluster" in this guide. This method requires communication between the IP address for management of the BMC and the IP address of the OS.

◆ For the linkage with the server management infrastructure, see Chapter 9, "Linkage with Server Management Infrastructure" in the *Reference Guide*.

JVM monitor resource settings
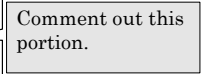
◆ When the monitoring target is the WebLogic Server, the maximum values of the following JVM monitor resource settings may be limited due to the system environment (including the amount of installed memory):

- **The number** under **Monitor the requests in Work Manager**

- **Average** under **Monitor the requests in Work Manager**

- **The number** of **Waiting Requests** under **Monitor the requests in Thread Pool**

- **Average** of **Waiting Requests** under **Monitor the requests in Thread Pool**

- **The number** of **Executing Requests** under **Monitor the requests in Thread Pool**

- **Average** of **Executing Requests** under **Monitor the requests in Thread Pool**

◆ When the monitoring-target is a 64-bit JRockit JVM, the following parameters cannot be monitored because the maximum amount of memory acquired from the JRockit JVM is a negative value that disables the calculation of the memory usage rate:

- **Total Usage** under **Monitor Heap Memory Rate**

- **Nursery Space** under **Monitor Heap Memory Rate**

- **Old Space** under **Monitor Heap Memory Rate**

- **Total Usage** under **Monitor Non-Heap Memory Rate**

- **Class Memory** under **Monitor Non-Heap Memory Rate**

◆ To use the Java Resource Agent, install the Java runtime environment (JRE) described in "Operation environment for JVM monitor" in Chapter 3, "Installation requirements for ExpressCluster" You can use either the same JRE as that used by the monitoring target (WebLogic Server or WebOTX) or a different JRE.

◆ The monitor resource name must not include a blank.

◆ **Command**, which is intended to execute a command for a specific failure cause upon error detection, cannot be used together with the load balancer linkage function.

ExpressCluster startup when using volume manager resources

◆ When using volume manager resources in ExpressCluster X3.1.7-1 or later, note the following:
When ExpressCluster starts up, the system startup may take some time because of the deactivation processing performed by the `vgchange` command if the volume manager is lvm or the deport processing if it is vxvm. If this presents a problem, edit the `init` script of the ExpressCluster main body as shown below.

Edit `/etc/init.d/clusterpro` as shown below.

```
#!/bin/sh
#
# Startup script for the EXPRESSCLUSTER daemon
#
                        :
                        :
# See how we were called.
case "$1" in
  start)
                        :
                        :
        # export all volmgr resource
#       clp_logwrite "$1" "clpvolmgrc start." init_main          Comment out this
#       ./clpvolmgrc -d > /dev/null 2>&1                          portion.
#       retvolmgrc=$?
#       clp_logwrite "$1" "clpvolmgrc end.("$retvolmgrc")" init_main
                        :
                        :
```

Changing the default activation retry threshold/deactivation retry threshold for volume manager resources

◆ When using volume manager resources with ExpressCluster X3.1.5-1 or later:
The default activation retry threshold/deactivation retry threshold for volume manager resources has been changed from 0 to 5.

Check below when updating ExpressCluster.

◆ When updating from ExpressCluster X2.x to X3.1.4-1 to X3.1.5-1 or later

  • When using activation retry threshold/deactivation retry threshold of volume manager resource setting as a default(X3.1.4-1 or older), the setting has been changed from 0 to 5 after updating. If you want to set 0, please set again 0 with Builder.

  • When using activation retry threshold/deactivation retry threshold of volume manager resource setting as not a default(X3.1.4-1 or older), the setting is not changed after updating.

◆ For an update path other than that shown above

  (For example, if updating from X3.1.5-1 to X3.1.8-1)

  • No changes are made to the default activation retry threshold/deactivation retry threshold for the volume manager resources, so there is no need to reconfigure them.

After starting operating ExpressCluster

Notes on situations you may encounter after start operating ExpressCluster are described in this section.

Error message in the load of the mirror driver in an environment such as udev

In the load of the mirror driver in an environment such as udev, logs like the following may be recorded into the message file:

```
kernel: [I] <type: liscal><event: 141> NMP1 device does not exist.
(liscal_make_request)

kernel: [I] <type: liscal><event: 141> - This message can be
recorded on udev environment when liscal is initializing NMPx.

kernel: [I] <type: liscal><event: 141> - Ignore this and following
messages 'Buffer I/O error on device NMPx' on udev environment.

kernel: Buffer I/O error on device NMP1, logical block 0
```

```
kernel: <liscal liscal_make_request> NMP1 device does not exist.

kernel: Buffer I/O error on device NMP1, logical block 112
```

This phenomenon is not abnormal.

When you want to prevent the output of the error message in the udev environment, add the following file in /etc/udev/rules.d.

filename: 50-liscal-udev.rules

```
ACTION=="add", DEVPATH=="/block/NMP*", OPTIONS+="ignore_device"
ACTION=="add", DEVPATH=="/devices/virtual/block/NMP*", OPTIONS+="ignore_device"
```

Buffer I/O error log for the mirror partition device

If the mirror partition device is accessed when a mirror disk resource or hybrid disk resource is inactive, log messages such as the ones shown below are recorded in the messages file.

```
kernel: [W] <type: liscal><event: 144> NMPx I/O port has been
closed, mount(0), io(0). (PID=xxxxx)
kernel: [I] <type: liscal><event: 144> - This message can be
recorded on hotplug service starting when NMPx is not active.
kernel: [I] <type: liscal><event: 144> - This message can be
recorded by fsck command when NMPx becomes active.
kernel: [I] <type: liscal><event: 144> - Ignore this and following
messages 'Buffer I/O error on device NMPx' on such environment.
:
kernel: Buffer I/O error on device /dev/NMPx, logical block xxxx
kernel: [W] <type: liscal><event: 144> NMPx I/O port has been
closed, mount(0), io(0). (PID=xxxx)
:
kernel: [W] <type: liscal><event: 144> NMPx I/O port has been
closed, mount(0), io(0). (PID=xxxx)
```

```
kernel: <liscal liscal_make_request> NMPx I/O port is close,
mount(0), io(0).
kernel: Buffer I/O error on device /dev/NMPx, logical block xxxx
```

(Where *x* and *xxxx* each represent a given number.)

The possible causes of this phenomenon are described below.
(In the case of a hybrid disk resource, the term "mirror disk resource" should be replaced with "hybrid disk resource" hereinafter.)

◆ When the udev environment is responsible

- • In this case, when the mirror driver is loaded, the message "`kernel: Buffer I/O error on device /dev/NMPx, logical block xxxx`" is recorded together with the message "`kernel: [I] <type: liscal><event: 141>`".

- • These messages do not indicate any error and have no impact on the operation of ExpressCluster.

- • For details, see "Error message in the load of the mirror driver in an environment such as udev" in this chapter.

◆ When an information collection command (`sosreport`, `sysreport`, `blkid`, etc.) of the operating system has been executed

- • In this case, these messages do not indicate any error and have no impact on the operation of ExpressCluster.

- • When an information collection command provided by the operating system is executed, the devices recognized by the operating system are accessed. When this occurs, the inactive mirror disk is also accessed, resulting in the above messages being recorded.

- • There is no way of suppressing these messages by using the settings of ExpressCluster or other means.

◆ When the unmount of the mirror disk has timed out

- In this case, these messages are recorded together with the message that indicates that the unmount of the mirror disk resource has timed out.

- ExpressCluster performs the "recovery operation for the detected deactivation error" of the mirror disk resource. It is also possible that there is inconsistency in the file system.

- For details, see "Cache swell by a massive I/O " in this chapter.

◆ When the mirror partition device may be left mounted while the mirror disk is inactive

- In this case, the above messages are recorded after the following actions are taken.

  (1) After the mirror disk resource is activated, the user or an application (for example, NFS) specifies an additional mount in the mirror partition device (/dev/NMP*x*) or the mount point of the mirror disk resource.

  (2) Then, the mirror disk resource is deactivated without unmounting the mount point added in (1).

- While the operation of ExpressCluster is not affected, it is possible that there is inconsistency in the file system.

- For details, see "When multiple mounts are specified for a resource like a mirror disk resource " in this chapter.

◆ When multiple mirror disk resources are configured

- With some distributions, when two or more mirror disk resources are configured, the above messages may be output due to the behavior of fsck if the resources are active.

- For details, see "Messages written to syslog when multiple mirror disk resources or hybrid disk resources are used."

◆ When the hotplug service searches for the device

- In this case, the above messages are recorded because the hotplug service is started when the mirror disk resource is not active.

- These messages do not indicate any error and have no impact on the operation of ExpressCluster.

- This phenomenon can be prevented by removing the ExpressCluster driver (liscal) from the hotplug target. (Add liscal to /etc/hotplug/blacklist, and then restart the operating system.)

- In RHEL5 or later, this phenomenon due to this cause does not occur, because the hotplug service does not exist.

◆ When the mirror disk resource is accessed by a certain application

- Besides the above cases, it is possible that a certain application has attempted to access the inactive mirror disk resource.

- When the mirror disk resource is not active, the operation of ExpressCluster is not affected.

Cache swell by a massive I/O

◆ In case that a massive amount of write over the disk capability to the mirror disk resource or the hybrid disk resource are executed, even though the mirror connection is alive, the control from write may not return or memory allocation failure may occur.

In case that a massive amount of I/O requests over transaction performance exist, and then the file system ensure a massive amount of cache and the cache or the memory for the user space (HIGHMEM zone) are insufficient, the memory for the kernel space (NORMAL zone) may be used.

Change the settings so that the parameter will be changed at OS startup by using sysctl or other commands.

```
/proc/sys/vm/lomem_reserve_ratio
```

◆ In case that a massive amount of accesses to the mirror disk resource or the hybrid disk resource are executed, it may take much time before the cache of the file systems is written out to the disks when unmounting at disk resource deactivation.
If, at this moment, the unmounting times out before the writing from the file system to the disks is completed, I/O error messages or unmount failure messages like those shown below may be recorded.

In this case, change the unmount timeout length for the disk resource in question to an adequate value such that the writing to the disk will be normally completed.

Example 1:

```
expresscls: [I] <type: rc><event: 40> Stopping mdx resource has
started.

kernel: [I] <type: liscal><event: 193> NMPx close I/O   port OK.

kernel: [I] <type: liscal><event: 195> NMPx close mount port OK.

kernel: [I] <type: liscal><event: 144> NMPx I/O port has been closed,
mount(0), io(0).

kernel: [I] <type: liscal><event: 144> - This message can be recorded
on hotplug service starting when NMPx is not active.

kernel: [I] <type: liscal><event: 144> - This message can be recorded
by fsck command when NMPx becomes active.

kernel: [I] <type: liscal><event: 144> - Ignore this and following
messages 'Buffer I/O error on device NMPx' on such environment.

kernel: Buffer I/O error on device NMPx, logical block xxxx

kernel: [I] <type: liscal><event: 144> NMPx I/O port has been closed,
mount(0), io(0).

kernel: Buffer I/O error on device NMPx, logical block xxxx

:
```

Example 2:

```
expresscls: [I] <type: rc><event: 40> Stopping mdx resource has
started.
kernel: [I] <type: liscal><event: 148> NMPx holder 1. (before umount)
expresscls: [E] <type: md><event: 46> umount timeout. Make sure that
the length of Unmount Timeout is appropriate. (Device:mdx)
:
expresscls: [E] <type: md><event: 4> Failed to deactivate mirror
disk. Umount operation failed.(Device:mdx)
kernel: [I] <type: liscal><event: 148> NMPx holder 1. (after umount)
expresscls: [E] <type: rc><event: 42> Stopping mdx resource has
failed.(83 : System command timeout (umount, timeout=xxx))
:
```

When multiple mounts are specified for a resource like a mirror disk resource

◆ If, after activation of a mirror disk resource or hybrid disk resource, you have created an additional mount point in a different location by using the mount command for the mirror partition device (/dev/NMPx) or the mount point (or a part of the file hierarchy for the mount point), you must unmount that additional mount point before the disk resource is deactivated. If the deactivation is performed without the additional mount point being unmounted, the file system data remaining in memory may not be completely written out to the disks. As a result, the I/O to the disks is closed and the deactivation is completed although the data on the disks are incomplete.
Because the file system will still try to continue writing to the disks even after the deactivation is completed, I/O error messages like those shown below may be recorded.
After this, an attempt to stop the mirror agent, such as when stopping the server, will fail, since the mirror driver cannot be terminated. This may cause the server to restart.

Example:

```
expresscls: [I] <type: rc><event: 40> Stopping mdx resource has
started.
kernel: [I] <type: liscal><event: 148> NMP1 holder 1. (before umount)
kernel: [I] <type: liscal><event: 148> NMP1 holder 1. (after umount)
kernel: [I] <type: liscal><event: 193> NMPx close I/O   port OK.
kernel: [I] <type: liscal><event: 195> NMPx close mount port OK.
expresscls: [I] <type: rc><event: 41> Stopping mdx resource has
completed.


kernel: [I] <type: liscal><event: 144> NMPx I/O port has been closed,
mount(0), io(0).
kernel: [I] <type: liscal><event: 144> - This message can be recorded
on hotplug service starting when NMPx is not active.
kernel: [I] <type: liscal><event: 144> - This message can be recorded
by fsck command when NMPx becomes active.
```

```
kernel: [I] <type: liscal><event: 144> - Ignore this and following
messages 'Buffer I/O error on device NMPx' on such environment.
```

kernel: Buffer I/O error on device *NMPx*, logical block *xxxxx*

```
kernel: lost page write due to I/O error on NMPx
```

kernel: [I] <type: liscal><event: 144> NMPx I/O port has been closed, mount(*0*), io(*0*).

kernel: Buffer I/O error on device *NMPx*, logical block *xxxxx*

```
kernel: lost page write due to I/O error on NMPx
```

:

Messages written to syslog when multiple mirror disk resources or hybrid disk resources are used

When more than two mirror disk resources or hybrid disk resources are configured on a cluster, the following messages may be written to the OS message files when the resources are activated.

This phenomenon may occur due to the behavior of the fsck command of some distributions (fsck accesses an unintended block device).

```
kernel: [I] <type: liscal><event: 144> NMPx I/O port has been
closed, mount(0), io(0).

kernel: [I] <type: liscal><event: 144> - This message can be
recorded by fsck command when NMPx becomes active.

kernel: [I] <type: liscal><event: 144> - This message can be
recorded on hotplug service starting when NMPx is not active.

kernel: [I] <type: liscal><event: 144> - Ignore this and following
messages 'Buffer I/O error on device NMPx' on such environment.

kernel: Buffer I/O error on device /dev/NMPx, logical block xxxx
```

```
kernel: <liscal liscal_make_request> NMPx I/O port is close,
mount(0), io(0).

kernel: Buffer I/O error on device /dev/NMPx, logical block xxxx
```

This is not a problem for ExpressCluster. If this causes any problem such as heavy use of message files, change the following settings of mirror disk resources or hybrid disk resources.

- Select "Not Execute" on "fsck action before mount"

- Select "Execute" on "fsck Action When Mount Failed"

Messages displayed when loading a driver

When loading a mirror driver, messages like the following may be displayed at the console and/or syslog. However, this is not an error.

```
kernel: liscal: no version for "xxxxx" found: kernel tainted.
kernel: liscal: module license 'unspecified' taints kernel.
```

(Any character strings are set to *xxxxx*.)

And also, when loading the clpka or clpkhb driver, messages like the following may be displayed on the console and/or syslog. However, this is not an error.

```
kernel: clpkhb: no version for "xxxxx" found: kernel tainted.
kernel: clpkhb: module license 'unspecified' taints kernel.
```

```
kernel: clpka: no version for "xxxxx" found: kernel tainted.
kernel: clpka: module license 'unspecified' taints kernel.
```

(Any character strings are input into *xxxxx*.)

Messages displayed for the first I/O to mirror disk resources or hybrid disk resources

When reading/writing data from/to a mirror disk resource or hybrid disk resource for the first time after the resource was mounted, a message like the following may be displayed at the console and/or syslog. However, this is not an error.

```
kernel: JBD: barrier-based sync failed on NMPx – disabling barriers
```

(Any character strings are set to *x*.)

File operating utility on X-Window

Some of the file operating utilities (coping and moving files and directories via GUI) on X-Window perform the following:

◆ Checks if the block device is usable.

◆ Mounts the file system if there is any that can be mounted.

Make sure not to use file operating utility that perform above operations. They may cause problem to the operation of ExpressCluster.

IPMI message

When you are using ipmi for user mode monitor resources, the following kernel module warning log is recorded many times in the syslog.

```
modprobe: modprobe: Can`t locate module char-major-10-173
```

When you want to prevent this log from being recorded, rename /dev/ipmikcs.

Limitations during the recovery operation

Do not control the following commands, clusters and groups by the WebManager while recovery processing is changing (reactivation → failover → last operation), if a group resource is specified as a recovery target and when a monitor resource detects an error.

◆ Stop and suspend of a cluster

◆ Start, stop, moving of a group

If these operations are controlled at the transition to recovering due to an error detected by a monitor resource, the other group resources in the group may not be stopped.

Even if a monitor resource detects an error, it is possible to control the operations above after the last operation is performed.

Executable format file and script file not described in manuals

Executable format files and script files which are not described in Chapter 4, "ExpressCluster command reference" in the *Reference Guide* exist under the installation directory. Do not run these files on any system other than ExpressCluster. The consequences of running these files will not be supported.

Message of kernel page allocation error

When using the Replicator on the TurboLinux 10 Server, the following message may be recorded in syslog. However, it may not be recorded depending on the physical memory size and I/O load.

```
kernel: [kernel Module Name]: page allocation failure. order:X,
mode:0xXX
```

When this message is recorded, you need to change the kernel parameter described below. By using the sysctl command, make the settings to change the parameter when starting OS.

```
/proc/sys/vm/min_free_kbytes
```

The maximum value that can be set to min_free_kbytes is different depending on the physical memory size installed on the server. Make the settings by referring to the table below:

Physical memory size (Mbyte)	Maximum value (Mbyte)
1024	1024
2048	1448
4096	2048
8192	2896
16384	4096

Executing fsck

◆ When fsck is specified to execute at activation of disk resources, mirror disk resources, or hybrid disk resources, fsck is executed when an ext2/ext3/ext4 file system is mounted. Executing fsck may take times depending on the size, usage or status of the file system, resulting that an fsck timeout occurs and mounting the file system fails.

This is because fsck is executed in either of the following ways.

(a) Only performing simplified journal check.
   Executing fsck does not take times.
(b) Checking consistency of the entire file system.
   When the data saved by OS has not been checked for 180 days or more or the data will be checked after it is mounted around 30 times.
   In this case, executing fsck takes times depending the size or usage of the file system.

Specify a time in safe for the fsck timeout of disk resources so that no timeout occurs.

◆ When fsck is specified not to execute at activation of disk resources, mirror disk resources, or hybrid disk resources, the warning described below may be displayed on the console and/or syslog when an ext2/ext3/ext4 file system is mounted more than the mount execution count set to OS that it is recommended to execute fsck.

```
EXT2-fs warning: xxxxx, running e2fsck is recommended.
```

Note: There are multiple patterns displayed in *xxxxx*.

It is recommended to execute fsck when this waning is displayed.

ExpressCluster X 3.2 for Linux Getting Started Guide

Follow the steps below to manually execute `fsck`.
Be sure to execute the following steps on the server where the disk resource in question has been activated.

(1) Deactivate a group to which the disk resource in question belongs by using a command such as `clpgrp`.

(2) Confirm that no disks have been mounted by using a command such as `mount` and `df`.

(3) Change the state of the disk from Read Only to Read Write by executing one of the following commands depending on the disk resource type.

Example for disk resources: A device name is `/dev/sbd5`

```
# clproset –w –d /dev/sbd5
/dev/sbd5 : success
```

Example for mirror disk resources: A resource name is `md1`.

```
# clpmdctrl --active –nomount md1
<md1@server1>: active successfully
```

Example for hybrid disk resources: A resource name is `hd1`.

```
# clphdctrl --active –nomount hd1
<hd1@server1>: active successfully
```

(4) Execute `fsck`.
(If you specify the device name for fsck execution in the case of a mirror disk resource or hybrid disk resource, specify the mirror partition device name (/dev/NMP*x*) corresponding to the resource.)

(5) Change the state of the disk from Read Write to Read Only by executing one of the following commands depending on the disk resource type.

Example for disk resources: A device name is `/dev/sbd5`.

```
# clproset –o –d /dev/sbd5
/dev/sbd5 : success
```

Example for mirror disk resources: A resource name is `md1`.

```
# clpmdctrl --deactive md1
<md1@server1>: active successfully
```

Example for hybrid disk resources: A resource name is `hd1`.

```
# clphdctrl --deactive –nomount hd1
<hd1@server1>: active successfully
```

(6) Activate a group to which the disk resource in question belongs by using a command such as `clpgrp`.

If you need to specify that the warning message is not output without executing fsck, for ext2/ext3/ext4, change the maximum mount count by using tune2fs. Be sure to execute this command on the server where the disk resource in question has been activated.

(1) Execute one of the following commands..

Example for disk resources: A device name is /dev/sbd5.

```
# tune2fs –c –l /dev/sbd5
tune2fs 1.27 (8-Mar-2002)
Setting maximal mount count to -1
```

Example for mirror disk resources: A resource name is /dev/NMP1.

```
# tune2fs –c –l /dev/NMP1
tune2fs 1.27 (8-Mar-2002)
Setting maximal mount count to -1
```

Example for hybrid disk resources: A resource name is /dev/NMP1.

```
# tune2fs –c –l /dev/NMP1
tune2fs 1.27 (8-Mar-2002)
Setting maximal mount count to -1
```

(2) Confirm that the maximum mount count has been changed.

Example: A device name is /dev/sbd5.

```
# tune2fs -l /dev/sbd5
tune2fs 1.27 (8-Mar-2002)
Filesystem volume name: <none>
      :
Maximum mount count: -1
      :
```

Messages when collecting logs

When collecting logs, the message described below is displayed at the console, but this is not an error. Logs are collected successfully.

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

("hd#" is replaced with the device name of IDE.)

```
kernel: Warning: /proc/ide/hd?/settings interface is obsolete, and
will be removed soon!
```

Failover and activation during mirror recovery

◆ When mirror recovery is in progress for a mirror disk resource or hybrid disk resource, a mirror disk resource or hybrid disk resource placed in the deactivated state cannot be activated.
During mirror recovery, a failover group including the disk resource in question cannot be moved.
If a failover occurs during mirror recovery, the copy destination server does not have the latest status, so a failover to the copy destination server or copy destination server group will fail.
Even if an attempt to fail over a hybrid disk resource to a server in the same server group is made by actions for when a monitor resource detects an error, it will fail, too, since the current server is not changed.
Note that, depending on the timing, when mirror recovery is completed during a failover, move, or activation, the operation may be successful.

◆ At the first mirror startup after configuration information registration and also at the first mirror startup after a mirror disk is replaced after a failure, the initial mirror configuration is performed.
In the initial mirror configuration, disk copying (full mirror recovery) is performed from the active server to the mirror disk on the standby server immediately after mirror activation.
Until this initial mirror configuration (full mirror recovery) is completed and the mirror enters the normal synchronization state, do not perform either failover to the standby server or group movement to the standby server.
If a failover or group movement is performed during this disk copying, the standby server may be activated while the mirror disk of the standby server is still incomplete, causing the data that has not yet been copied to the standby server to be lost and thus causing mismatches to occur in the file system.

Cluster shutdown and reboot (mirror disk resource and hybrid disk resource)

When using a mirror disk resource or a hybrid disk resource, do not execute cluster shutdown or cluster shutdown reboot from the `clpstdn` command or the WebManager while a group is being activated.

A group cannot be deactivated while a group is being activated. Therefore, OS may be shut down in the state that mirror disk resource or hybrid disk resources is not deactivated successfully and a mirror break may occur.

Shutdown and reboot of individual server (mirror disk resource and hybrid disk resource)

When using a mirror disk and a hybrid disk resource, do not shut down the server or run the shutdown reboot command from the `clpdown` command or the WebManager while activating the group.

A group cannot be deactivated while a group is being activated. Therefore, OS may be shut down and a mirror break may occur in the state that mirror disk resources and hybrid disk resources are not deactivated successfully.

Scripts for starting/stopping ExpressCluster services

Errors occur in starting/stopping scripts as follows:

◆ After installing ExpressCluster (For SUSE Linux)
When a server shutdown, the error occurs in the following stopping scripts. There is no problem for the error because services have not started.

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

◆ Before start operating ExpressCluster
When a server start up, the error occurs in the following starting scripts. There is no problem for the error because cluster configuration data has not uploaded.

- `clusterpro_md`

◆ After start operating ExpressCluster (For SUSE Linux)
When mirror disk resources and hybrid disk resources are not used, the error occurs in stopping scripts at OS shutdown. There is no problem for the error because mirror agent has not started.

- `clusterpro_md`

◆ OS shutdown after stopping services manually (Fro SUSE Linux)
After stopping services manually, the error occurs in the following stopping scripts at OS shutdown. There is no problem for the error because services have already stopped.

- `clusterpro`
- `clusterpro_md`

At following case, the script to terminate ExpressCluster services may be executed in the wrong order.

◆ ExpressCluster services may be terminated in the wrong order at OS shutdown if all of ExpressCluster services are disabled. This problem is caused by failure in termination process for the service has been already disabled.
As long as the system shutdown is executed by WebManager or `clpstdn` command, there is no problem even if the services is terminated in the wrong order. But, any other problem may not be happened by wrong order termination.

Service startup time

ExpressCluster services might take a while to start up, depending on the wait processing at startup.

◆ `clusterpro_evt`
Servers other than the master server wait up to two minutes for configuration data to be downloaded from the master server. Downloading usually finishes within several seconds if the master server is already operating. The master server does not have this wait process.

◆ `clusterpro_trn`
There is no wait process. This process usually finishes within several seconds.

ExpressCluster X 3.2 for Linux Getting Started Guide

◆ clusterpro_md
This service starts up only when the mirror or hybrid disk resources exist. The system waits up to one minute for the mirror agent to normally start up. This process usually finishes within several seconds.

◆ clusterpro
Although there is no wait process, ExpressCluster might take several tens of seconds to start up. This process usually finishes within several seconds.

◆ clusterpro_webmgr
There is no wait process. This process usually finishes within several seconds.

◆ clusterpro_alertsync
There is no wait process. This process usually finishes within several seconds.

In addition, the system waits for cluster activation synchronization after the ExpressCluster daemon is started. By default, this wait time is five minutes.

For details, see Chapter 10, "The system maintenance information" in the Reference Guide.

Scripts in EXEC resources

EXEC resource scripts of group resources stored in the following location.

/opt/nec/clusterpro/scripts/*group-name*/*resource-name*/

The following cases, old EXEC resource scripts are not deleted automatically.

- When the EXEC resource is deleted or renamed
- When a group that belongs to the EXEC resource is deleted or renamed

Old EXEC resource scripts can be deleted when unnecessary.

Monitor resources that monitoring timing is "Active"

When monitor resources that monitoring timing is "Active" have suspended and resumed, the following restriction apply:

◆ In case stopping target resource after suspending monitor resource, monitor resource becomes suspended. As a result, monitoring restart cannot be executed.

◆ In case stopping or starting target resource after suspending monitor resource, monitoring by monitor resource starts when target resource starts.

Notes on the WebManager

◆ The information displayed on the WebManager does not necessarily show the latest status. If you want to get the latest information, click the **Reload** button.

◆ If the problems such as server shutdown occur while the WebManager is getting the information, acquiring information may fail and a part of object may not be displayed correctly. Wait for the next automatic update or click the **Reload** button to reacquire the latest information.

◆ When using a browser on Linux, a dialog box may be displayed behind the window managers depending on the combination of the managers. Change the window by pressing the **ALT** + **TAB** keys.

◆ Collecting logs of ExpressCluster cannot be executed from two or more WebManager simultaneously.

◆ If the WebManager is operated in the state that it cannot communicate with the connection destination, it may take a while until the control returns.

◆ If you move the cursor out of the browser in the state that the mouse pointer is displayed as a wristwatch or hourglass, the cursor may be back to an arrow.

◆ When going through the proxy server, make the settings for the proxy server be able to relay the port number of the WebManager.

◆ When going through the reverse proxy server, the WebManager will not operate properly.

◆ When updating ExpressCluster, close all running browsers. Clear the Java cache (not browser cache) and open browsers.

◆ When updating Java, close all running browsers. Clear the Java cache (not browser cache) and open browsers

Notes on the Builder (Config mode of Cluster Manager)

◆ ExpressCluster does not have the compatibility of the cluster configuration data with the following products.

  • Builder for Linux other than ExpressCluster X 3.2 for Linux

◆ Cluster configuration data created using a later version of this product cannot be used with this product.

◆ Cluster configuration data of ExpressCluster X1.0/2.0/2.1/3.0/3.1/3.2 for Linux can be used with this product.
  You can use such data by clicking **Import** from the **File** menu in the Builder.

◆ Closing the Web browser (by clicking **Exit** from the menu), the dialog box to confirm to save is displayed.
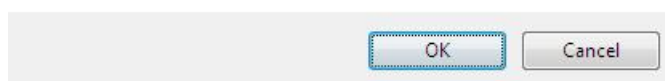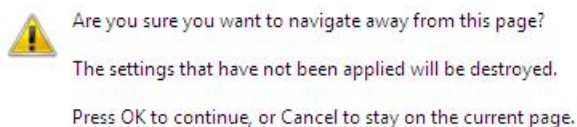
> ⚠ Are you sure you want to navigate away from this page?
>
> The settings that have not been applied will be destroyed.
>
> Press OK to continue, or Cancel to stay on the current page.
>
> [OK]   [Cancel]

When you continue to edit, click the **Cancel** button.

Note:

This dialog box is not displayed if JavaScript is disabled.

◆ Reloading the Web browser (by selecting **Refresh** button from the menu or tool bar), the dialog box to confirm to save is displayed.
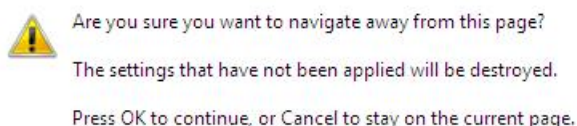
> ⚠ Are you sure you want to navigate away from this page?
>
> The settings that have not been applied will be destroyed.
>
> Press OK to continue, or Cancel to stay on the current page.
>
> [OK]   [Cancel]

When you continue to edit, click the **Cancel** button.

Note:

This dialog box is not displayed if JavaScript is disabled.

◆ When creating the cluster configuration data using the Builder, do not enter the value starting with 0 on the text box. For example, if you want to set 10 seconds for a timeout value, enter "10" but not "010."

◆ When going through the reverse proxy server, the Builder will not operate properly.

Changing the partition size of mirror disks and hybrid disk resources

When changing the size of mirror partitions after the operation is started, see "Changing offset or size of a partition on mirror disk resource" in Chapter 10 "The system maintenance information" in the *Reference Guide*.

Changing kernel dump settings

If you are changing the kdump settings and "applying" them through "kernel dump configuration" (system-config-kdump) while the cluster is running on Red Hat Enterprise Linux 6 or the like, you may see the following error message output.

In this case, stop the cluster once (stop the mirror agent as well as the cluster when using a mirror disk resource or hybrid disk resource), and then retry the kernel dump configuration.

* The following *{driver_name}* indicates clpka, clpkhb, or liscal.

```
No module {driver_name} found for kernel {kernel_version}, aborting
```

Notes on floating IP and virtual IP resources

◆ Do not execute a network restart on a server on which floating IP resources are active. If the network is restarted, any IP addresses that have been added as floating IP resources are deleted.

Notes on system monitor resources

◆ To change a setting, the cluster must be suspended.

◆ System monitor resources do not support a delay warning for monitor resources.

◆ If the date or time setting on the OS is changed by the data(1) command or another method while a system monitor resource is operating, that system monitor resource may fail to operate normally.
If you have changed the date or time setting on the OS, suspend and then resume the cluster.

◆ Set SELinux to either the permissive or disabled state.
If SELinux is set to the enforcing state, the communication required for ExpressCluster may be disabled.

◆ If the "system monitor" is not displayed in the **Type** field of the monitor resource definition dialog box, update the server information by selecting **Update Server Data** from the **File** menu in the Builder.

◆ Up to 64 disks that can be monitored by the disk resource monitor function at the same time.

Notes on JVM monitor resources

◆ When restarting the monitoring-target Java VM, suspend or shut down the cluster before restarting the Java VM.

◆ To change a setting, the cluster must be suspended.

◆ JVM monitor resources do not support a delay warning for monitor resources.

Notes on final action (group stop) at detection of a monitor resource error (Target versions: 3.1.5-1 to 3.1.6-1)

◆ When the final action (group stop) has been executed, suspend and resume the cluster, or restart the cluster for the server.

◆ If the group is started on the server on which the final action (group stop) has been executed, the recovery action for the group from the monitor resource will not be executed.

HTTP monitor resource

◆ The HTTP monitor resource uses the OpenSSL library, libssl.so. If you individually upgrade the version of the OpenSSL library bundled with the operating system, an error is detected because the HTTP monitor resource cannot link with the OpenSSL library.
Therefore after upgrading implementation of the OpenSSL library, please confirm that libssl.so exist in /usr/lib or /usr/lib64.When not exist, libssl.so does like the following command example to make symbolic link libssl.so.

command example:
cd /usr/lib64   # change dir /usr/lib64
ln –s libssl.so.10 libssl.so   # make symbolic link

Notes when changing the ExpressCluster configuration

The section describes what happens when the configuration is changed after starting to use ExpressCluster in the cluster configuration.

Failover exclusive attribute of group properties

When the failover exclusive attribute is changed, the change is reflected by suspending and resuming the cluster.

If the failover exclusive attribute is changed from **No exclusion** or **Normal** to **Absolute**, multiple groups of **Absolute** may be started on the same server depending on the group startup status before suspending the cluster.

Exclusive control will be performed at the next group startup.

Dependency between resource properties

When the dependency between resources has been changed, the change is applied by suspending and resuming the cluster.

If a change in the dependency between resources that requires the resources to be stopped during application is made, the startup status of the resources after the resume may not reflect the changed dependency.

Dependency control will be performed at the next group startup.

Updating ExpressCluster

This section describes notes on updating ExpressCluster after starting cluster operation.

If the alert destination setting is changed

If the alert destination setting is changed in the previous version, perform the following procedure after updating ExpressCluster. This procedure applies to an update from X2.0.0-1-X3.0.0-1 to X3.1.0-1-X3.1.5-1.

1. Connect the WebManager to one server constituting the cluster.

2. Start the online version Builder from the connected WebManager. If this is the first time to start the online version Builder, you need to configure the Java user policy file. For details, refer to the *Installation and Configuration Guide*.

3. Open the **Alert Service** tab of **Cluster Properties**, and then click the **Edit** button for **Enable Alert Setting** to open the **Change Alert Destination** dialog box.

4. Click the **OK** button to close the **Change Alert Destination** dialog box.

5. Click the **OK** button to close **Cluster Properties**.

6. Make sure that the server in the cluster is running, and then upload the configuration information from the online version Builder. For details on how to operate the online version Builder, refer to the *Reference Guide*.

Chapter 6   Upgrading ExpressCluster

This chapter provides information on how to upgrade ExpressCluster.
This chapter covers:

> **Linkage Information:**
> For the update from X3.0 to X3.2, see "Update Guide".

How to update from ExpressCluster X 2.0 or 2.1

How to upgrade from X2.0 or X2.1 to X3.0 or X3.1 or X3.2

Install the ExpressCluster Server RPM as root user.

1. Disable the services by running the **chkconfig --del** *name* in the following order on all the servers. Specify one of the following services in *name*.

    clusterpro_alertsync

    clusterpro_webmgr

    clusterpro

    clusterpro_md

    clusterpro_trn

    clusterpro_evt

2. Shut down and reboot the cluster by using WebManager or the clpstdn command.

3. Mount the installation CD-ROM media.

4. Confirm that ExpressCluster services are not running, and then install the package file by executing the rpm command. The RPM for installation is different depending on architecture.

    In the CD-ROM, move to /Linux/3.2/en/server and run the following:
    rpm –Uvh expresscls-<*version*>.<*architecture*>.rpm

    For architecture, there are i686, x86_64 and IBM POWER. Select architecture according to the system requirements of the machine where ExpressCluster is installed. Architecture can be verified by the arch command.

    ExpressCluster is installed in the following directory. Note that if you change this directory you cannot uninstall ExpressCluster.

    Installation directory: /opt/nec/clusterpro

5. After completing installation, unmount the installation CD-ROM media, and remove it.

6. Enable the services by running the **chkconfig --add** *name* in the following order. Specify one of the following services in *name*. For SUSE Linux, run the command with the **–force** option.

    clusterpro_evt

    clusterpro_trn

    clusterpro_webmgr

    clusterpro_alertsync

7. Repeat the steps 3 to 6 on all the servers.

8. Reboot all the servers that constitute the cluster.

9. Register the license. For details on registering license, see "Chapter 4 Registering the license" in the *Installation and Configuration Guide*.

10. Connect the WebManager to one of the servers of the cluster.

11. Start the Builder from the connected WebManager. For details on how to start the online Builder, see the *Installation and Configuration Guide*.

12. Confirm that all servers of the cluster are started, and then upload the configuration data from the online Builder. For details on how to operate the online Builder, see the *Reference Guide*.

ExpressCluster X 3.2 for Linux Getting Started Guide

13. Enable the services in the following order by running the **chkconfig --add *name***
    command. Specify the following services on *name*.

    ```
    clusterpro_md
    ```

    ```
    clusterpro
    ```

14. Perform step 14 on all the servers.

15. Run **Restart Manager** on the WebManager.

16. Run **Start Mirror Agent** on the WebManager.

17. Restart the browser connecting the WebManager.

18. Run **Start Cluster** on the WebManager.

Appendix

- Appendix A Glossary
- Appendix B Index

Appendix A. Glossary

Cluster partition
A partition on a mirror disk. Used for managing mirror disks.
(Related term: Disk heartbeat partition)

Interconnect
A dedicated communication path for server-to-server communication in a cluster.
(Related terms: Private LAN, Public LAN)

Virtual IP address
IP address used to configure a remote cluster.

Management client
Any machine that uses the 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 and hybrid disks.
(Related term: Cluster partition)

Network partition
All heartbeat is lost and the network between servers is partitioned.
(Related terms: Interconnect, Heartbeat)

Node	A server that is part of a cluster in a cluster system. In networking terminology, it refers to devices, including computers and routers, that can transmit, receive, or process signals.
Heartbeat	Signals that servers in a cluster send to each other to detect a failure in a cluster. (Related terms: Interconnect, Network partition)
Public LAN	A communication channel between clients and servers. (Related terms: Interconnect, Private LAN)
Failover	The process of a standby server taking over the group of resources that the active server previously was handling due to error detection.
Failback	A process of returning an application back to an active server after an application fails over to another server.
Failover group	A group of cluster resources and attributes required to execute an application.
Moving failover group	Moving an application from an active server to a standby server by a user.
Failover policy	A priority list of servers that a group can fail over to.
Private LAN	LAN in which only servers configured in a clustered system are connected. (Related terms: Interconnect, Public LAN)
Primary (server)	A server that is the main server for a failover group. (Related term: Secondary server)
Floating IP address	Clients can transparently switch one server from another when a failover occurs. Any unassigned IP address that has the same network address that a cluster server belongs to can be used as a floating address.
Master server	The server displayed at the top of **Master Server** in **Server Common Properties** of the Builder
Mirror disk connect	LAN used for data mirroring in mirror disks and hybrid disks. 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 B. Index

ExpressCluster X 3.2 for Linux Getting Started Guide