EXPRESSCLUSTER® X
for Linux SAP NetWeaver

System Configuration Guide

April 17, 2018
1st Edition

EXPRESSCLUSTER X

Revision History

Edition	Revised Date	Description
1st	Apr 17, 2018	New guide

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Table of Contents

Preface

This document "EXPRESSCLUSTER X for Linux SAP NetWeaver System Configuration Guide" describes how to create and start a cluster for SAP NetWeaver.

Who Should Use This Guide

This guide is intended for administrators who want to build a cluster system, system engineers who want to provide user support, and maintenance personnel.
This guide introduces software whose operation in an EXPRESSCLUSTER environment has been verified.
The software and setup examples introduced here are for reference only. They are not meant to guarantee the operation of each software product.

How This Guide is Organized

This guide consist of the following two documents:

"EXPRESSCLUSTER X for Linux SAP NetWeaver System Configuration Guide"
"EXPRESSCLUSTER X for Linux SAP NetWeaver Configuration Example"

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

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Important:

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

Related Information:

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

The following conventions are used in this guide.

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

Related documents

EXPRESSCLUSTER X Documentation Set

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

EXPRESSCLUSTER X Getting Started Guide

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

EXPRESSCLUSTER X Installation and Configuration Guide

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

EXPRESSCLUSTER X Reference Guide

This guide is intended for system administrators. The guide covers topics such as how to operate EXPRESSCLUSTER, function of each module, 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.

SAP NetWeaver documents

For details of SAP NetWeaver please refer to the official SAP documentation available at

http://service.sap.com/installnw74/
http://service.sap.com/installnw75/

Make sure to check the "Master Guide" and the "Installation Guide" for NetWeaver according to the database you are installing on.

SAP NOTEs
   #0171356: SAP software on Linux: General information
   #0784391: SAP support terms and 3rd-party Linux kernel drivers
   #2002167: Red Hat Enterprise Linux 7.x: Installation und Upgrade
   #0941735: SAP memory management system for 64-bit Linux systems
   #1382721: Linux: Interpreting the output of the command 'free'
   #0174911: Determining the hardware key (customer key)
   #0181543: License key for high availability environment
   #0870871: License key installation
   #1391070: Linux UUID solutions
   #0146003: Application servers cannot be started
   #1553301: 7.20 EXT Kernel - Usage
   #1768213: Support details for NEC EXPRESSCLUSTER
   #2182373: NEC EXPRESSCLUSTER X: Rolling Kernel Switch in HA environments

Note:
Related documents and URL in this manual are subject to change without notice.

Terminology in this guide

Terminology used in this guide

Terminology	Description
This product	EXPRESSCLUSTER X for Linux SAP NetWeaver
Configuration Guide	EXPRESSCLUSTER X for Linux SAP NetWeaver System Configuration Guide
Configuration Example	EXPRESSCLUSTER X for Linux SAP NetWeaver Configuration Example
Connecter for Sap	The connecter which links with SAP included in this product.
SAP NW	SAP NetWeaver
ASCS	ABAP SAP Central Services Instance
ERS	Enqueue Replication Server
PAS	Primary Application Server
AAS	Additional Application Server
DA	Diagnostics Agent

EXPRESSCLUSTER X for Linux SAP NetWeaver System Configuration Guide

Section I Overview of the cluster system

Chapter 1   Overview of SAP NW Cluster

1.1. Functional Overview

A cluster with the following configuration can be built by combining SAP NW and EXPRESSCLUSTER.

1.1.1.   SAP NW cluster configuration using EXPRESSCLUSTER

Configure the following component in EXPRESSCLUSTER as independent active-standby failover group to perform failover from the active node to the standby node if a failure occurs in order to improve the availability of the SAP NW environment:

- ABAP SAP Central Services Instance (hereafter ASCS)

Configure the following components as failover groups for a single server configuration in which failover groups operate on each node.
- Enqueue Replication Server Instance (hereafter ERS)
- Primary Application Server Instance (hereafter PAS)
- Additional Application Server Instance (hereafter AAS)
- Diagnostics Agent (hereafter DA)
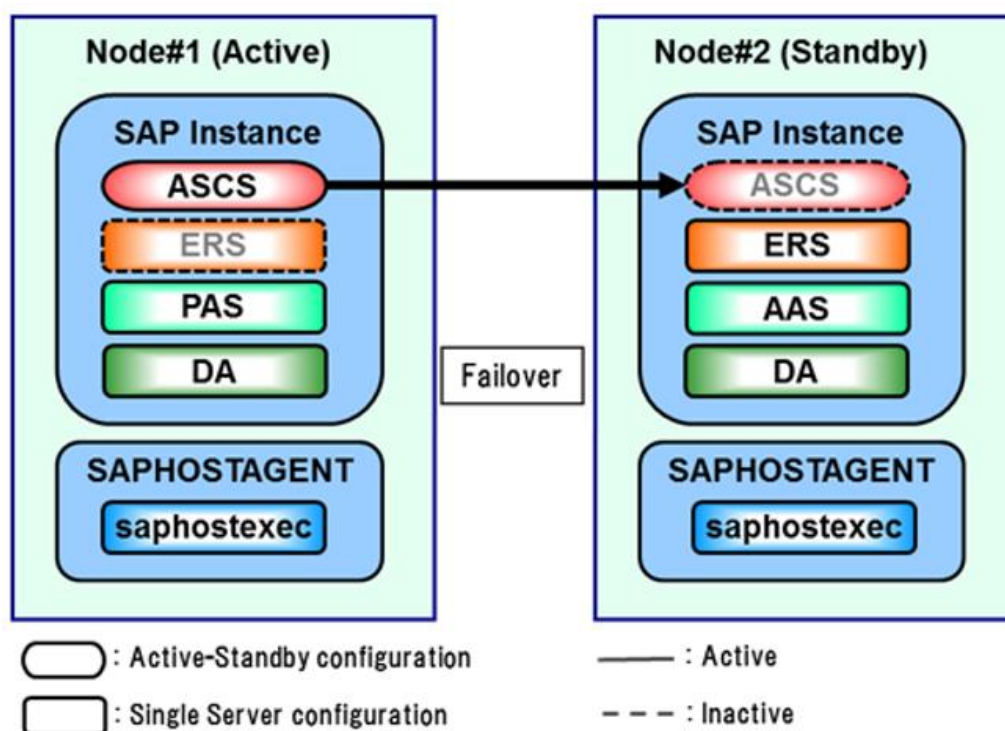- saphostexec

Figure 1.1 Clustered SAP NW System

1.1.2.   Dependency between failover groups

The SAP NW components must be started and stopped in a specific order.
With EXPRESSCLUSTER the order in which the SAP NW components are started and stopped is controlled by specifying dependencies between failover groups.

1.1.3.   SAP NW monitoring using EXPRESSCLUSTER

In addition to the monitoring functions provided by EXPRESSCLUSTER the SAP NW cluster system uses a monitoring package that supports the SAP system and an SAP NW-specific monitoring to monitor the SAP NW components for response errors and hang-ups.

1.1.4.   Instance number configuration of the SAP NW components

It is necessary to assign an instance number to each SAP NW component.
In the SAMP NW cluster system, there are the following two configurations to assign instance numbers. The cluster setting changes depending on the configuration. Therefore, determine which configuration to use before building a cluster.

Configuration	How to assign instance numbers	Example to assign instance numbers	Remarks

Pattern 1	Assign an instance number that is unique among all nodes making up a cluster to each SAP NW component.	ASCS = No. 10
		
		Node#1
		  ERS = No. 20
		  PAS = No. 30
		  DA = No. 97
		
		Node#2
		  ERS = No. 21
		  AAS = No. 40
		  DA = No. 96
			➢ This pattern is also available for a cluster composed of two or more nodes.
			➢ In this pattern, the NFS server that stores SAP NW shared data can be configured as a cluster.
			➢ ERS can run on only one node on which ASCS is not running among nodes making up a cluster.
			➢ If the instance numbers assigned to the SAP NW components are duplicated among nodes or within a node, it is necessary to re-install either component and assign a new instance number to the re-installed component.

Pattern 2	Assign an instance number that is unique among all nodes making up a cluster to each SAP NW component.	ASCS = No. 10
		
		Node#1
		  ERS = No. 20
		  PAS = No. 30
		  DA = No. 97
		
		Node#2
		  ERS = No. 20
		  AAS = No. 30
		  DA = No. 97
			➢ This pattern is available only for a cluster composed of two or more nodes.
			➢ In this pattern, the NFS server that stores SAP NW shared data cannot be configured as a cluster.
			➢ ERS can run on all nodes making up a cluster.
			➢ It is not possible to perform operations such as starting and stopping the SAP NW components by using a tool such as the SAP GUI from a server other than the nodes making up a cluster. (It is possible to operate the SAP NW components within the nodes making up a cluster.)

1.1.5. Connection between SAP NW and EXPRESSCLUSTER

User requests to SAP NW are sent to EXPRESSCLUSTER via the Connecter for SAP (clp_shi_connector).
The EXPRESSCLUSTER cluster is operated by SAP NW.
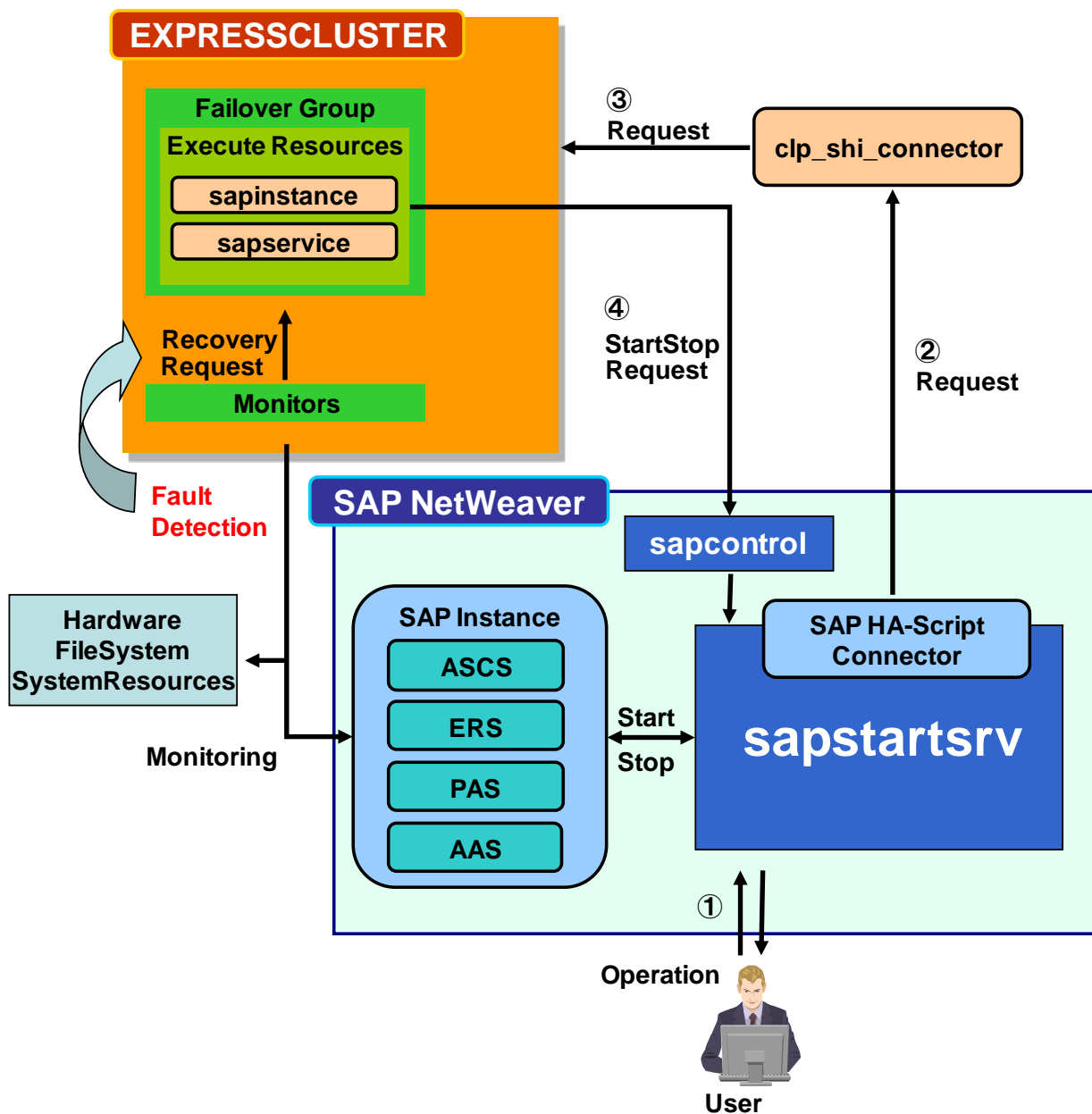
Figure 1.2: Cooperation System

1.1.6.   Illustration of exclusive control of ASCS/ERS instance by EXPRESSCLUSTER (for pattern 1)

This section describes the exclusive control of the ASCS and ERS instances that are required for the pattern 1 configuration. Since these instances are not required for the pattern 2 configuration, go to Section 1.1.7.

EXPRESSCLUSTER handles the exclusive control of the ASCS/ERS instances that is required for SAP NW as follows.

1.   Start both ASCS and ERS instances on different nodes. Start ERS instance on only one node. Start the failover group for exclusive control on all nodes except the node which ERS instance starts.
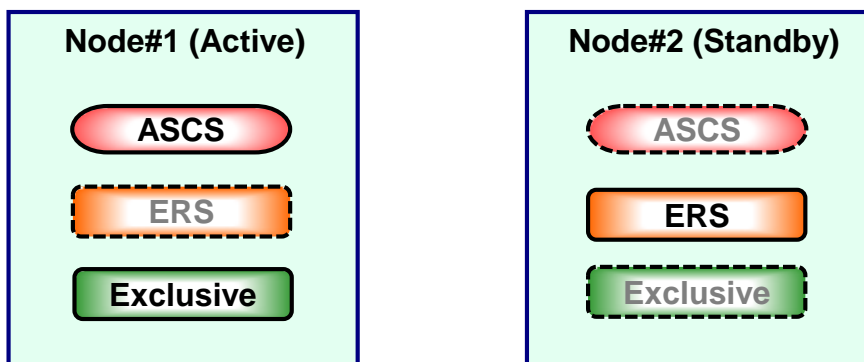
Figure 1.3 Startup Cluster

EXPRESSCLUSTER handles failover process of the ASCS instance as follows.

2.   Failover the ASCS instance to the node where the ERS instance was started before.
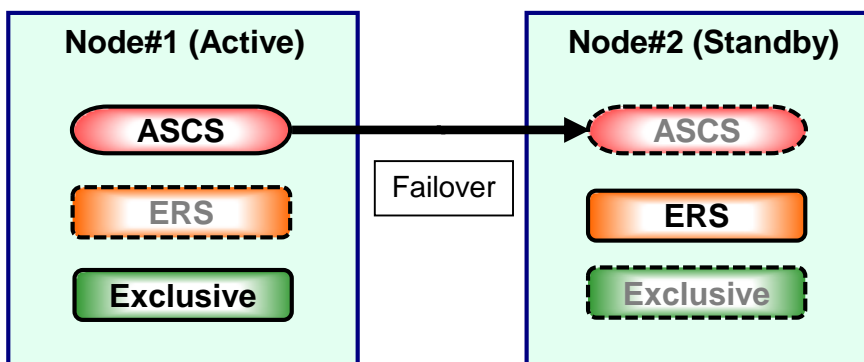
Figure 1.4 Failover ASCS Instance

3.   After failover of the ASCS instance it terminates the ERS instance automatically.
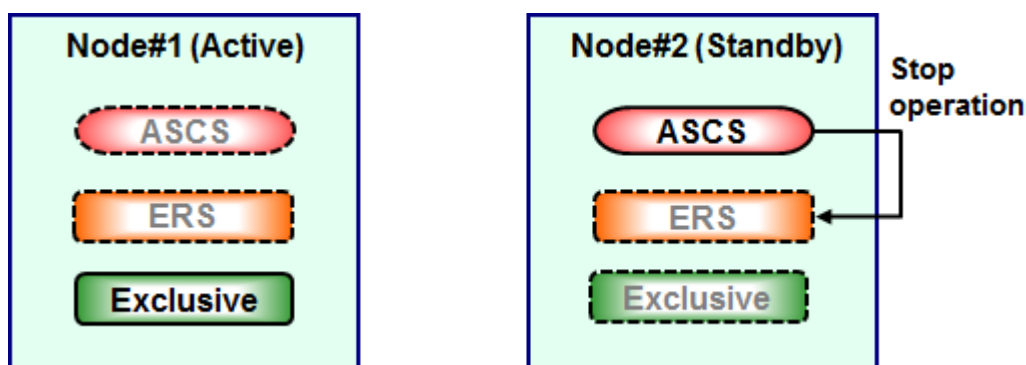
Figure 1.5 Stop ERS Instance

4.   Once the ERS instance got stopped EXPRESSCLUSTER works as follows.
     Start of the failover group for exclusive control on the node where ASCS instance was moved to.
     Start the ERS instance on the node that the ASCS instance is currently not working.
     Stop the failover group for exclusive control on the node where the ERS instance just started.
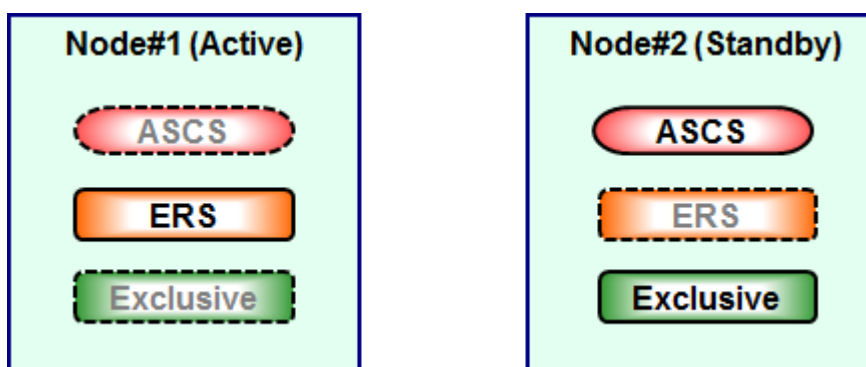
Figure 1.6 Startup ERS Instance on Other Node

The above mechanism of exclusive control of both ASCS/ERS instances by EXPRESSCLUSTER works similarly in the case of more than 3 nodes.

1.1.7.   Note on manual operation of the ERS instance (for pattern 1)

This section describes the notes on manual operation of the ERS instance for the pattern 1 configuration. Since the ERS instance is not required for the pattern 2 configuration, go to Section 1.2.

1.   The ERS instance is used for the replication of the lock table from the ASCS instance. To ensure its redundancy the ERS instance must work on the node where the ASCS instance is not running. The ERS instance should not even manually be launched on the node where the ASCS instance is running. Additionally the ERS instance should not be launched on more than two nodes at same time.

2.   The failover group of the ERS instance is not restarted automatically, when the node where the ERS instance was working recovers from a failure. After validating the health of the node a manual restart of the ERS instance failover group is required.

1.2. Operating Environment

This section describes the OS and SAP NW versions on which the operation of the Connector for SAP has been verified.

x86_64

NW Version	EXPRESSCLUSTER Version	OS	Cluster Configuration	Remarks
7.4	3.3.2-1 or later	Red Hat Enterprise Linux 7.0 Red Hat Enterprise Linux 7.1	NAS connection, shared disk type	
7.5	3.3.3-1 or later	Red Hat Enterprise Linux 7.2 Red Hat Enterprise Linux 7.3 SUSE Linux Enterprise Server 12 SP1	NAS connection, shared disk type	
	3.3.5-1 or later	Red Hat Enterprise Linux 7.4	NAS connection, shared disk type	
	4.0.0-1 or later	Red Hat Enterprise Linux 7.3 Red Hat Enterprise Linux 7.4 SUSE LINUX Enterprise Server 12 SP1	NAS connection, shared disk type	

IBM POWER

NW Version	EXPRESSCLUSTER Version	OS	Cluster Configuration	Remarks
7.5	3.3.5-1 or later 4.0.0-1 or later	SUSE Linux Enterprise Server 11 SP4	NAS connection, shared disk type	

Note the following:
- When using a LAN heartbeat, be sure to use a LAN heartbeat resource. Do not use a kernel mode LAN heartbeat resource.
- When using a user space monitor resource, specify softdog for **Method**.
- When performing shutdown monitoring, specify softdog for **Method**.

For the hardware and software requirements of SAP NW, see the SAP NW manuals.

1.3. Building Procedure

The sequence of building the SAP NW cluster is shown below.

(1) Installation and basic setup of Linux OS
(2) Setup of shared disk and network
(3) Installation of EXPRESSCLUSTER
(4) Building of cluster with NAS resource and node with floating IP
(5) Installation of SAP NW
(6) Setup of SAP NW cluster in EXPRESSCLUSTER

1.4. HA Database for SAP NW

Since SAP NW can run on several database technologies, e.g. SAP HANA, SAP MaxDB, IBM DB2, Oracle, Microsoft SQLSERVER, this guide assumes there is already a high available database setup in place. If you need help how create an HA setup for your database scenario please follow related EXPRESSCLUSTER documents on http://www.nec.com/en/global/prod/expresscluster/.
Throughout this document the HA database setup will be referred to as "database".

Chapter 2 OS Installation and basic settings

Refer to the following SAP NOTEs for SAP NW installation and needed software on Node#1 and Node#2.

```
SAP NOTEs
  #0171356 : SAP software on Linux: General information
  #0784391 : SAP support terms and 3rd-party Linux kernel drivers
  #1391070 : Linux UUID solutions
  #0146003 : Application servers cannot be started
```

For examples of settings used in this manual please refer to chapter "1.4 An example of setting OS" in the supplied *Configuration Example* document.

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Section II   Installation of EXPRESSCLUSTER and SAP NW

EXPRESSCLUSTER X for Linux SAP NetWeaver System Configuration Guide

Chapter 3 Configuration Consisting of a SAP NW Cluster and NFS Server

In this guide, a SAP NW cluster consists of an active node (Node#1) and standby node (Node#2). In addition, an NFS server is used to store SAP NW shared data and so on. Therefore, two nodes for a SAP NW cluster and one or more NFS server are required. If you want to make the NFS server redundant, configure a cluster with two or more NFS servers.

3.1. When using a single NFS server

The following figure shows a configuration using a single NFS server (Node#3).
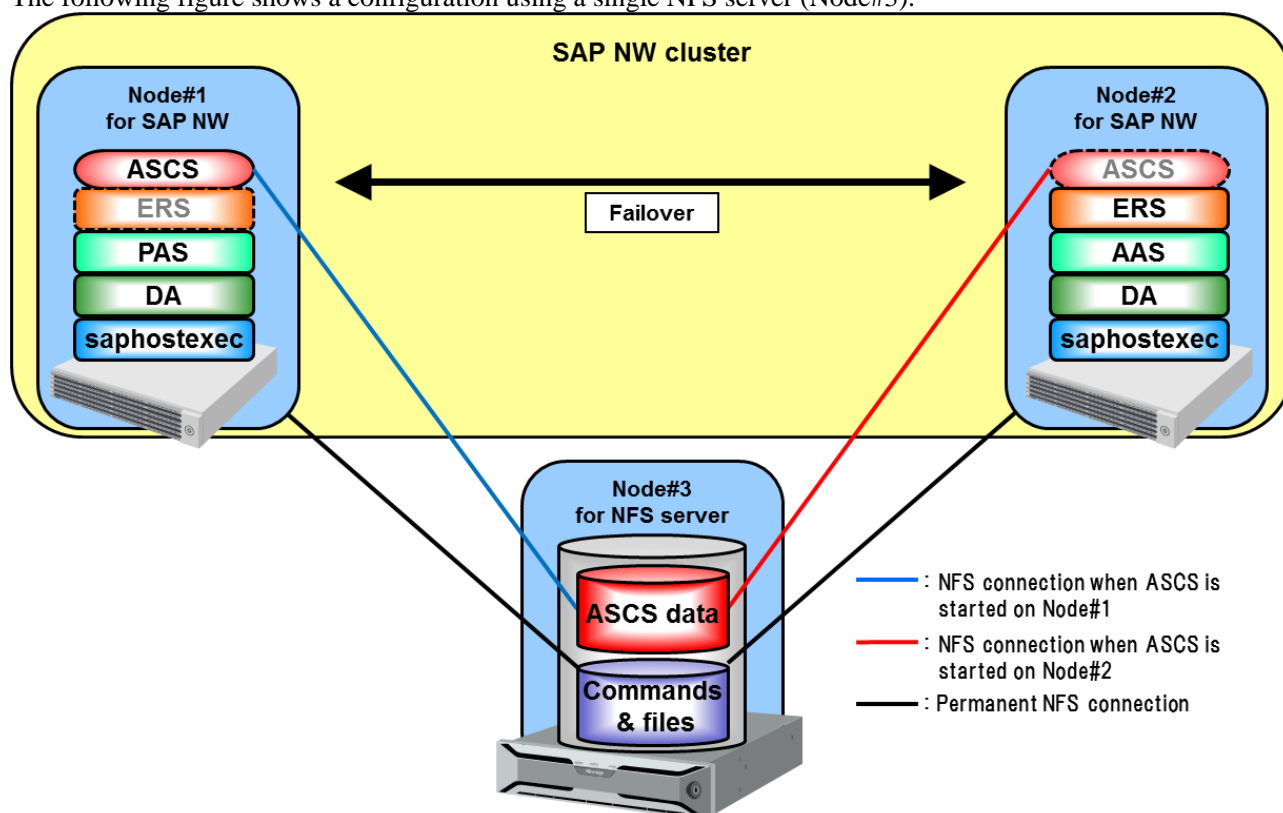
Figure 3.1 System Configuration Using a Single NFS Server

In this configuration, NW shared data and so on are provided from one NFS server. Therefore, this NFS server is a single point of failure of the SAP NW cluster.

3.2. When using two NFS servers (for pattern 1)

The following figure shows a configuration using two nodes (Node#3, Node#4) as an NFS server. For the patter 2 configuration, the following cluster configuration is not available. Go to Section 3.3.
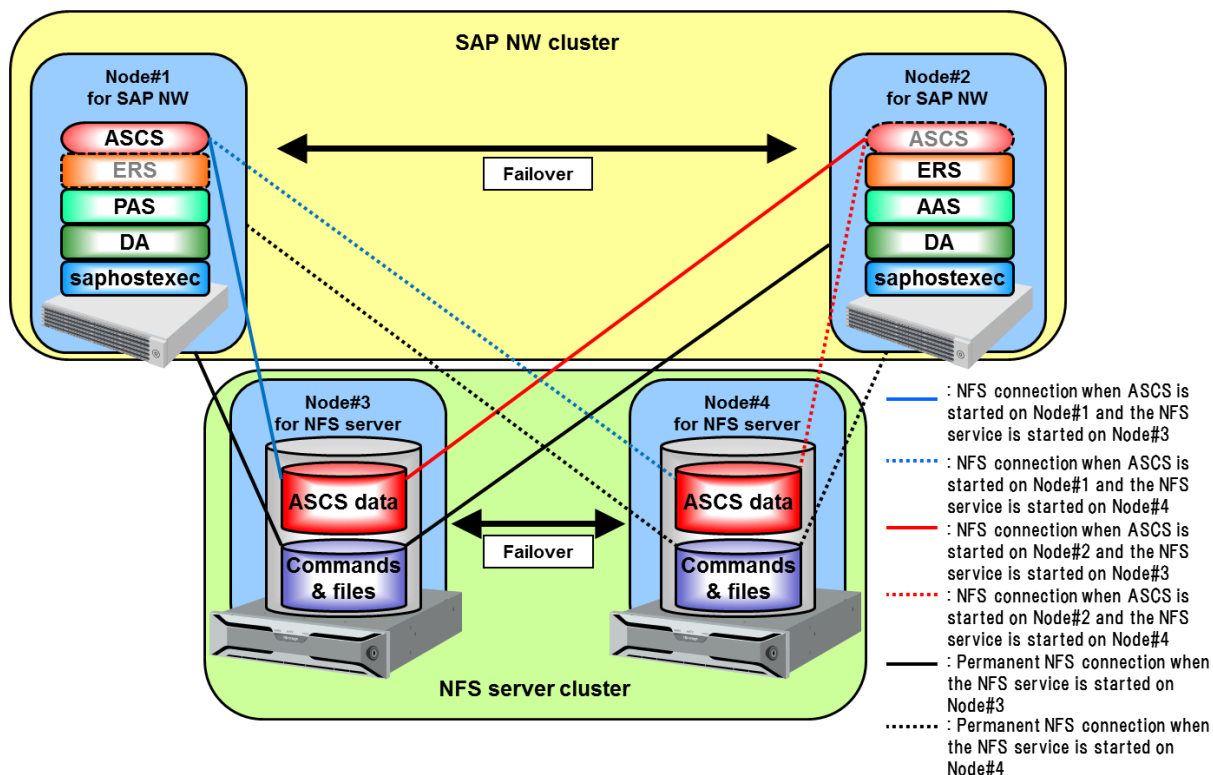
Figure 3.2 System Configuration Using Two Nodes as an NFS Server

It is also necessary to configure two nodes used as an NFS server as a cluster in a unidirectional standby configuration by using EXPRESSCLUSTER. SAP NW shared data and so on (ASCS data, and commands and files in Figure 3.2) are stored in a shared disk or mirror disk to make information consistent between these two nodes. In this configuration, the NFS service can be failed over between two nodes. Therefore, the NFS server is not a single point of failure of the SAP NW cluster.

Please refer to "2.2 Sample configuration of EXPRESSCLUSTER in an NFS cluster" in the *Configuration Example* document for further details.

3.3. Measures to be taken when monitoring fails due to NFS disconnection

The EXPRESSCLUSTER custom monitor resource that monitors SAP NW components uses the SAP NW commands installed in the NFS server. Therefore, if NFS connection between a SAP NW cluster and NFS server is disconnected, the custom monitor resource cannot access the commands. This causes a monitoring process not to be complete. If this status lasts longer than the time set to **Timeout** of the custom monitor resource, the monitoring process fails.

To reduce the possibility that a monitoring process fails, set up a SAP NW cluster so that the disk monitor resource checks whether access to the NFS connection destination is available and the custom monitor resource monitors SAP NW components only when no error is detected by the disk monitor resource.

For how to set up the custom monitor resource and disk monitor resource, please refer to "7.2 Setup of Monitor Resources."

If monitoring SAP NW components frequently fails due to NFS disconnection, take the following measures:
- Improving the network status between a SAP NW cluster and NFS server
- Extending Timeout of the custom monitor resource

When monitoring SAP NW components fails due to NFS disconnection, there is a possibility that the SAP NW components are in abnormal state and cannot be restarted. In such a case, restart the node including these SAP NW components from EXPRESSCLUSTER.

EXPRESSCLUSTER X for Linux SAP NetWeaver System Configuration Guide

Chapter 4   Shared disk and network

4.1. Creation of mount points

Create mount points before installing SAP NW.

In this guide, mount points for /sapmnt, /usr/sap/trans, and ASCS instance are created. Set up fstab of each node so that NFS is always mounted to /sapmnt and /usr/sap/trans, and use the EXPRESSCLUSTER NAS resource to control mounting to the mount point for an ASCS instance.

Please refer to "1.2 Mount Points" in the *Configuration Example* document for further details.

4.2. Network Setting

Assign the floating IPs shown below before installing SAP NW.
In addition, the host names associated with the floating IP addresses for ASCS instances must be able to be resolved.

- Floating IP for WebManager in EXPRESSCLUSTER
- Floating IP for ASCS instance (used in 5.5 and 6.2)

Please refer to "1.3.1 Static IP and floating IP for SAP NW" in the *Configuration Example* document for further details.

When creating a cluster consisting of two NFS servers, it is required to assign the following floating IP. In addition, it is required to enable name resolution for the host name of the NFS server associated with the following floating IP from the node of the SAP NW cluster.

- Floating IP for an NFS server cluster

Please refer to "1.3.2 Static IP and floating IP for an NFS server" in the *Configuration Example* document for further details.

When creating a cluster on a cloud environment such as AWS and Microsoft Azure, use the AWS virtual ip resources and Azure DNS resources instead of the Floating IP resources. Note that name resolution must be possible for host names associated with virtual IPs for ASCS instances by the AWS virtual ip resource.

EXPRESSCLUSTER X for Linux SAP NetWeaver System Configuration Guide

Chapter 5   Preparation of EXPRESSCLUSTER

Please refer to the "Installation and Configuration Guide" for additional information how to build an EXPRESSCLUSTER environment.

Create a cluster environment with two nodes and a NFS server in the order shown below.

Completely install EXPRESSCLUSTER, build a cluster with a NAS resource and a floating IP, and start EXPRESSCLUSTER before installing SAP NW.

Preparations before installing SAP NW
- Install EXPRESSCLUSTER
- License registration
- Creation of cluster configuration information
  - Create a cluster
  - Create failover groups
  - Add additional group resources
- Specify dependencies between failover groups

For details of settings used in this manual please refer to "2.1 Sample configuration of EXPRESSCLUSTER in a SAP NW cluster" in the supplied *Configuration Example* document.

After completing the above processes continue with "Chapter 6   Setup of SAP NW Environment" and "Chapter 7   Setup of   EXPRESSCLUSTER."

5.1. Install EXPRESSCLUSTER

Install this product on each node (Node#1 and Node#2).

For details on the installation please refer to the following document:

"Installation and Configuration Guide"
- "Installing EXPRESSCLUSTER"
- "Registering the license"

After the installation of EXRESSCLUSTER has finished please enter the following command and install the Connecter for SAP.

```
# rpm -i expresscls_spnw-[version].x86_64.rpm
```

5.2. License registration

The license must be registered before you can use EXPRESSCLUSTER.

For details on the license registration please refer to the following document:
    "Installation and Configuration Guide"
- "Registering the license"

This product contains the following four licenses.

Licensed Product Name
EXPRESSCLUSTER X for Linux
EXPRESSCLUSTER X Database Agent for Linux
EXPRESSCLUSTER X System Resource Agent for Linux
EXPRESSCLUSTER X File Server Agent for Linux

5.3. Create a cluster

Create a cluster from EXPRESSCLUSTER WebManager (hereafter referred to as WebManager).

For details how to create a cluster please refer to the following document:
    "Installation and Configuration Guide"
- "Creating the cluster configuration data"
- "Creating the cluster configuration data"-"Creating a cluster"

Note:
Be sure to specify English for **Language** on the **Cluster Definition** window of **Cluster Generation Wizard** of WebManager. If a language other than English is specified, the cluster will not work properly.

5.4. Create failover groups

Create the failover groups to which each node belongs from WebManager.

For details how to create a failover group please refer to the following document:
- "Installation and Configuration Guide"
  "Creating the cluster configuration data"-"Creating a failover group"

Now please create the following failover groups:
- ASCS instance
- ERS1 instance
- ERS2 instance
- PAS instance
- AAS instance
- DA1 instance
- DA2 instance
- hostexec1
- hostexec2

The numbers included in the failover group names (e.g. 1 in ERS1) refer to the node on which this failover group is running. This means DA1 is on Node#1, DA2 on Node#2, and so on.

5.4.1. Failover group for exclusive control (for pattern 1)

It is necessary for the pattern 1 configuration to create a failover group for the exclusive control of the ASCS and ERS instances. This section describes how to create a failover group. Since it is unnecessary for the pattern 2 configuration to create a failover group, go to Section 5.4.2.

Set the name of failover group for exclusive control according to the following manner. It's name consists of a common failover name component and a series of sequential numbers at the end of it.
The number 1, 2, ... at the end of the name must be set in order of the nodes where ERS instance is installed.

<common failover group name><number>

Example in this manual
    Exclusive-Group1 (Node#1)
    Exclusive-Group2 (Node#2)

Note:
The failover group name must not contain any spaces.

Note:
If the failover group name does not conform to the naming conventions, exclusive control of ASCS/ERS instance cannot function normally.

For exclusive control of ASCS/ERS instance please refer to Section 1.1.6 "Illustration of exclusive control of ASCS/ERS instance by EXPRESSCLUSTER (for pattern 1)".

5.4.2. Startup attribute of a failover group

Set "Manual Startup" for the startup attribute of ERS failover groups of the pattern 1 configuration. Set "Auto Startup" for the startup attribute of ERS failover groups of the pattern 2 configuration.
Set the startup attribute of other failover groups to auto startup.

5.5. Add additional group resources

Add the floating IP resource and NAS resource to the failover groups created in the previous section.

For details how to add a group resource please refer to the following document:
    "Reference Guide"
- "Understanding floating IP resource"
- "Understanding NAS resource"

Please add the following group resources to each failover group:

ASCS instance group	Add a floating IP resource and assign the IP address settings from chapter 3.2. Add a NAS resource and assign the mount point for ASCS.

5.6. Specify dependency between failover groups

Specify the dependency between failover groups.

The dependency between each instance in SAP NW (starting order) is shown below.

    (1)   (2)   (3)
    Database   →   ASCS   →   ERS

PAS
AAS

Each instance must be stopped in the reverse order.

Note:
As outlined in chapter 1.4 it is assumed there is a database available. This database is a prerequisite for the above dependencies and needs to be available initially. If this is not the case, then you cannot continue from here.

Note:
Do not need to specify any dependency for DA and hostexec.

For details how to specify dependencies in EXPRESSCLUSTER please refer to the following document:
  "Reference Guide"
- "Understanding setting of group start dependence and group stop dependence"
- "Understanding the settings of dependency among group resources (Common to group resources)"

PAS

Chapter 6 Setup of SAP NW Environment

Terminology used in Chapter 5 and Chapter 6.

Terminology	Description
SID	SAP System ID
DASID	Diagnostics Agent System ID
INO	Instance Number

The installation path and installation procedure for the product files for SAP NW may vary depending on your configuration.

For details how to build the SAP NW environment please refer at least to the following documents:

Master Guide
   "Master Guide for SAP NetWeaver 7.4"
   "Master Guide for SAP NetWeaver 7.5"

Installation Guide
   The installation guide for each database and OS type supported by SAP NW can be downloaded from the following URL:
   http://service.sap.com/installnw74/
   http://service.sap.com/installnw75/
   Please make sure to review the appropriate guide for environment in detail.

Please make sure to review at least the following SAP notes applicable to your environment, as well as notes mentioned in SAP's guides.

SAP NOTEs
```
#0171356 : SAP software on Linux: Essential information
#0784391 : SAP support terms and 3rd-party Linux kernel drivers
#2002167 : Red Hat Enterprise Linux 7.x: Installation und Upgrade
#0174911 : Determining the hardware key (customer key)
#0181543 : License key for high availability environment
#0870871 : License key installation
#1391070 : Linux UUID solutions
#0146003 : Application servers cannot be started
```

Build the environment for SAP NW in the order shown below.
For details how to install SAP NW please refer SAP's official documentation (see above URL).

Note:

Before you start the following procedure please make sure to have the database installed according to SAP's documents and it is available.

---

   (1) Prepare Node#1 and Node#2 for SAP NW installation (Section 6.1)
   (2) Installation of ASCS/ERS instances on Node#1 (Section 6.2)
   (3) Installation of PAS instance on Node#1 (Section 6.3)
   (4) Installation of ERS instance on Node#2 (Section 6.4)
   (5) Installation of AAS instance on Node#2 (Section 6.5)

(6) Activation of the Connector for SAP on Node#1 and Node#2 (Section 6.6)
(7) SAP license registration (Section 6.7)
(8) Changing SAP service settings (Section 5.8)
(9) Disabling auto startup for SAP instances (Section 6.9)
(10) Enabling auto stop for ERS instance (Section 6.10)

Sections 6.2 through 6.3 describe how to install SAP NW on Node#1.
Sections 6.4 through 6.5 describe how to install SAP NW on Node#2.
Sections 6.6 describes how to set up Node#1 and Node#2 to use the Connector for SAP.
Section 6.7 describes how to register SAP license.
Section 6.8 describes how to disable the automatic startup of SAP service in Node#1 and Node#2.
Section 6.9 describes the procedure for disabling auto startup for SAP Instances.
Section 6.10 describes the procedure for enabling auto stop for ERS Instance.

For an example how instance names and numbers are set in this manual please refer to "1.5 Sample settings for SAP NW" in the supplied *Configuration Example* document.

In the following description, the example to set an instance number for the pattern 1 configuration is used.

For how to update SAP NW, refer to "Chapter 9   SAP NW Update".

6.1. Prepare Node#1 and Node#2 for SAP NW installation

Completely install EXPRESSCLUSTER, specify a floating IP and NAS resource, start EXPRESSCLUSTER, and activate the floating IP and NAS resource in Node#1 before installing SAP NW.

The location to save the SAP software logistics tool including the sapinst command described later depends on your environment and the installation media used (DVD-ROM or downloaded files). The sapinst command is a command used to install SAP NW.

6.2. Installation of ASCS and ERS instances (Node#1)

Perform this work on Node#1.

Specify the host name associated with the floating IP of ASCS instance as an environment variable SAPINST_USE_HOSTNAME and execute sapinst.

```
# env SAPINST_USE_HOSTNAME=ASCS_Hostname ./sapinst
```

Note:

Enter the host name associated with the floating IP of ASCS instance for *ASCS_Hostname*.

The SIDs (SAP System IDs) and instance numbers for ACSC and ERS specified during installation are used in 7.1.1 (ASCS) and 7.1.2 (ERS1).

In this manual, set SID and INO as follows:

Instance	SID	INO
ASCS	NEC	10
ERS1	NEC	20

6.3. Installation of PAS instance (Node#1)

Perform this work on Node#1.

Because the PAS only operates on Node#1, it is not necessary to specify a floating IP.
Execute sapinst without specifying an environment variable.

```
# ./sapinst
```

The SID (SAP System ID) and instance number for PAS specified during installation are used in 7.1.4.
The DASID (Diagnostics Agent SAP System ID) and instance number for DA specified during installation are used in 7.1.6 (DA1).

In this manual, set SID and INO as follows:

Instance	SID	INO
PAS	NEC	30
DA1	DAA	97

Note:

DA (Diagnostics Agent) is the instance installed when installing of a PAS instance.

6.4. Installation of ERS instance (Node#2)

Perform this work on Node#2.

Because the ERS only operates on Node#2, it is not necessary to specify a floating IP. Execute sapinst without specifying an environment variable.

```
# ./sapinst
```

The SID (SAP System ID) and instance number for ERS specified during installation are used in 7.1.3 (ERS2).

In this manual, set SID and INO as follows:

Instance	SID	INO
ERS2	NEC	21

6.5. Installation of AAS Instance (Node#2)

Perform this work on Node#2.

Because the AAS only operates on Node#2, it is not necessary to specify a floating IP. Execute sapinst without specifying an environment variable.

```
# ./sapinst
```

The SID (SAP System ID) and instance number for AAS specified during installation are used in 7.1.5.
The DASID (Diagnostics Agent System ID) and instance number for DA specified during installation are used in 7.1.7 (DA2).

In this manual, set SID and INO as follows:

Instance	SID	INO
AAS	NEC	40
DA2	DAA	96

Note:

DA (Diagnostics Agent) is the instance installed when installing an AAS instance.

6.6. Activation of the Connector for SAP

To combine the EXPRESSCLUSTER Connector for SAP with SAP NW every instance needs according entries in their start profiles. Please perform the following steps.

Perform this work on Node#1 and Node#2.

6.6.1.   Setting up the SAP profile
Add the following specifications to every instance profile for SAP instances to activate the SAP HA Connector and combine it with EXPRESSCLUSTER.

A setting example in this manual is shown below. The path may vary according to your installation. In this environment the following settings are used:

/sapmnt/*<SID>*/profile/*<SID>_<INSTANCENAME><INO>_<HOSTNAME>*
```
service/halib = /usr/sap/<SID>/<INSTANCENAME><INO>/exe/saphascriptco.so
service/halib_cluster_connector = /opt/nec/clusterpro/bin/clp_shi_connector_wrapper
```

Please verify to add this information to each instance profile.

Additionally add this information to the instance profile of DA instance on Node#1 and Node#2.

/usr/sap/*<DASID>*/SYS/profile/*<SID>_<INSTANCENAME><INO>_<HOSTNAME>*
```
service/halib = /usr/sap/<DASID>/<INSTANCENAME><INO>/exe/saphascriptco.so
service/halib_cluster_connector = /opt/nec/clusterpro/bin/clp_shi_connector_wrapper
```

6.6.2. Assigning the `sudo` privilege to the SAP NW user

Assign the `sudo` privilege to the SAP NW user so that the SAP HA Connector can be executed. Set up the privilege by using the `visudo` command as the root user. Add the following specification:

```
Defaults:%sapsys        !requiretty

%sapsys ALL=(ALL)       NOPASSWD: ALL
```

> **Note:**
>
> Set up the groups automatically created during installation of SAP NW so that `sudo` can be executed to normally combine SAP NW and EXPRESSCLUSTER. If the SAP NW user cannot execute `sudo`, starting and stopping of SAP NW instances cannot be normally controlled.

6.7. SAP license registration

For details how to register the SAP license refer to the official SAP documentation.

6.8. Changing SAP Service Setting

Perform this work on Node#1 and Node#2.

Enter the following command for disabling the automatic startup of SAP service, because each SAP process is run by EXPRESSCLUSTER.

```
# systemctl disable sapinit
```

After entering the above command, check that the automatic startup of SAP service is disabled.

```
 # chkconfig --list sapinit
 sapinit        0:off   1:off   2:off   3:off   4:off   5:off   6:off
```

6.9. Disabling Auto Startup for SAP Instances

Perform this work on Nodes #1 and #2.

To disable auto startup by the SAP interface for the ERS and DA instances, change the relevant configuration in the profile of these instances.

The ERS instance profile is placed in the following location.

```
/sapmnt/<SID>/profile/<SID>_ERS<INO>_<hostname>
```

The DA instance profile is placed in the following location.

```
/usr/sap/<DASID>/SYS/profile/<DASID>_SMDA<INO>_<hostname>
```

Change the Autostart value in each profile to 0.

```
Autostart=0
```

6.10. Enabling Auto Stop for ERS Instance

Perform this work on Nodes #1 and #2.

In case that ASCS had a failover to the node where ERS instance is running, ERS needs to be stopped automatically.

The ERS instance profile is placed in the following location.

```
/sapmnt/<SID>/profile/<SID>_ERS<INO>_<hostname>
```

Comment out the line "Restart_Program_00 = local $(_ER) pf=$(_PFL) NR=$(SCSID)" in each profile.
Add "Start_Program_00 = local $(_ER) pf=$(_PFL) NR=$(SCSID)" in each profile.

```
#Restart_Program_00 = local $(_ER) pf=$(_PFL) NR=$(SCSID)
Start_Program_00 = local $(_ER) pf=$(_PFL) NR=$(SCSID)
```

Chapter 7   Setup of EXPRESSCLUSTER

7.1. Setup of Resources

Add the exec resource to the failover groups created in 5.4.

Set up the exec resource to control starting and stopping of each instance.

A script to control starting and stopping of various SAP instances is available.
To control start and stop of SAP instances with this script set up the exec resource.
The script to control start and stop uses resource names as keys for control, so it is necessary to specify resource names appropriate to the control target.

Include the following string in the resource name:

```
instance_<SID>_<INO>
```

The words in <> indicate the following items:
SID: SAP System ID
INO: Instance number

Note:
Modify the SAP user (SAPUSER), SAP System ID (SID), SAP profile path (PROFILE), and the instance number (INO) in the supplied script according to your environment.

For how to add the exec resource, refer to the following document:
   "Reference Guide"
   * "Understanding EXEC resources"

7.1.1.   Setting up the ASCS resource
Add the following two exec resources to the group for which the floating IP for ASCS instance is specified.
   * Add the exec resource for controlling SAP services.
   * Add the exec resource for starting SAP instances.
      * Include the SID (SAP System ID) and INO (instance number) specified in 6.2 in the resource name.
      Example in this manual
            exec-ascs-SAP-instance_NEC_10

7.1.2.   Setting up the ERS1 (Node#1) resource
Add the following two exec resources for the group for ERS1.
   * Add the exec resource for controlling SAP services.
   * Add the exec resource for starting SAP instances.
      * Include the SID (SAP System ID) and INO (instance number) specified in 6.2 in the resource name.
      Example in this manual
            exec-ERS1-SAP-instance_NEC_20

7.1.3.   Setting up the ERS2 (Node#2) resource
Add the following two exec resources for the group for ERS2.
   * Add the exec resource for controlling SAP services.
   * Add the exec resource for starting SAP instances.
      * Include the SID (SAP System ID) and INO (instance number) specified in 6.4 in the resource name.

Example in this manual
```
exec-ERS2-SAP-instance_NEC_21
```

7.1.4. Setting up the PAS resource
Add the following two exec resources for the group for PAS.
- Add the exec resource for controlling SAP services.
- Add the exec resource for starting SAP instances.
  * Include the SID (SAP System ID) and INO (instance number) specified in 6.3 in the resource name.
  Example in this manual
```
exec-PAS-SAP-instance_NEC_30
```

7.1.5. Setting up the AAS resource
Add the following two exec resources for the group for AAS.
- Add the exec resource for controlling SAP services.
- Add the exec resource for starting SAP instances.
  * Include the SID (SAP System ID) and INO (instance number) specified in 6.5 in the resource name.
  Example in this manual
```
exec-AAS-SAP-instance_NEC_40
```

7.1.6. Setting up the DA1 (Node#1) resource
Add the following two exec resources for the group for DA1.
- Add the exec resource for controlling SAP services.
- Add the exec resource for starting SAP instances.
  * Include the SID (SAP System ID) and INO (instance number) specified in 6.3 in the resource name.
  Example in this manual
```
exec-DA1-instance_DAA_97
```

7.1.7. Setting up the DA2 (Node#2) resource
Add the following two exec resources for the group for DA2.
- Add the exec resource for controlling SAP services.
- Add the exec resource for starting SAP instances.
  * Include the SID (SAP System ID) and INO (instance number) specified in 6.5 in the resource name.
  Example in this manual
```
exec-DA2-instance_DAA_96
```

7.1.8. Setting up the hostexec1 (Node#1) resource
Add the following exec resource for the group for hostexec1.
- Add the exec resource for controlling saphostexec.

7.1.9. Setting up the hostexec2 (Node#2) resource
Add the following exec resource for the group for hostexec2.
- Add the exec resource for controlling saphostexec.

7.1.10. Setting up resources for the exclusive control of Node#1 (for pattern 1)
- Add no group resources.

7.1.11. Setting up resources for the exclusive control of Node#2 (for pattern 1)
- Add no group resources.

For detailed settings used in this manual please refer to "2.1 Sample configuration of EXPRESSCLUSTER in a SAP NW cluster" and "3.1 Exec resources" in the supplied *Configuration Example* document.

Note:
Specify a resource name that conforms to the naming conventions for the exec resource that controls start and stop of SAP NW instances. If the resource name does not conform to the naming conventions starting and stopping of SAP NW instances cannot be normally controlled.

7.2. Setup of Monitor Resources

Add the custom monitor resource, NIC Link Up/Down monitor resource, and disk monitor resource to the group resources created in the previous section.

For details please refer to the following documents.

"Reference Guide"
- "Understanding NIC Link Up/Down monitor resources"
- "Understanding custom monitor resources"
- "Understanding the disk monitor resources"

For detailed settings used in this manual please refer to "2.1 Sample configuration of EXPRESSCLUSTER in a SAP NW cluster" and "3.2 Custom monitor" in the supplied *Configuration Example* document.

The script specified for the custom monitor resource is included in the installation media of this product.

Note:
Modify the SAP user (`SAPUSER`) and the instance number (`INO`) in the supplied script according to your environment.

7.2.1. Add the NIC Link Up/Down monitor resource
For how to add the NIC Link Up/Down monitor resource please refer to the following document:

"Reference Guide"
- "Understanding NIC Link Up/Down monitor resources"

7.2.2. Setting up the SAP NW instance monitor resource
Specify the script included in this product for the custom monitor resource to monitor the following instances: Use the sapcotrol command to monitor these instances. For the script using the sapcontrol command, see "3.2. Custom monitor" in the *Configuration Example*. For EXPRESSCLUSTER X 3.3, you can download this sample script form the support portal (Content ID: 9510100151).
- ASCS
- ERS1
- ERS2
- PAS
- AAS
- DA1
- DA2

7.2.3. Setting up the SAP NW instance service monitor resource
Specify the script included in this product for the custom monitor resource to monitor the following instance services:

- ASCS
- ERS1
- ERS2
- PAS
- AAS
- DA1
- DA2
- hostexec1
- hostexec2

7.2.4. Setting up the disk monitor resource

For how to add the disk monitor resource, see the following:

"Reference Guide"
- " Understanding the disk monitor resources"

Chapter 8 Connector for SAP

8.1. Log configuration

This section describes the log output of the Connector for SAP.

For information about the logs in EXPRESSCLUSTER please refer to the following document:

"Reference Guide"
- "Section III Maintenance information"

8.1.1. `logrotate` configuration
Use Linux `logrotate` to specify the log location and version control.

The following setup file is created when this product is installed:

```
/etc/logrotate.d/clp_shi_connector
```

The default setup is as shown below.

```
/opt/nec/clusterpro/log/clp_shi_connector.log
{
        rotate 1
        size 1M
}
```

The Connector for SAP log is written to the following location:

```
/opt/nec/clusterpro/log/clp_shi_connector.log
```

8.1.2. Setting up the log level

To set up the log level of the Connecter for SAP log please change the parameter of following file.

```
/opt/nec/clusterpro/etc/clp_shi_connector.conf
```

Parameter	Level	Description

LOGLEVEL	0, 1, 2, 4, 8 (The default is 4)	Specify the output log level.
		* In spite of setting LOGLEVEL, logs of the ERROR level are output to standard error output and syslog.
		    0: Do not output any log.
		    1: (ERROR):
		       Output logs of the ERROR level.
		    2: (WARNING):
		       Output logs of the WARNING level and the ERROR level.
		    4: (INFORMATION):
		       Output logs of the INFORMSTION level, the WARNING level and the ERROR level.
		    8: (TRACE):
		       Output logs of the internal trace, the INFORMSTION

		level, the WARNING level and the ERROR level.

The setting method is as follows. LOGLEVEL is set as 4 in the following example.

```
LOGLEVEL=4
```

8.1.3. Format of log
An example of a Connector for SAP output log is shown below.

Log format

```
LEVEL YY/MM/DD HH:MM:SS[PID] message
```

Example of output log

```
I 12/08/22 18:54:50[32412] ********** main: clp_shi_connector start **********
E 12/08/22 18:54:50[32412] Invalid options. (aaa bbb)
I 12/08/22 18:54:50[32412] main: retval: 2
I 12/08/22 18:54:50[32412] ********** main: clp_shi_connector end **********
```

8.1.4. List of error messages
Error messages that the Connector for SAP outputs to syslog

Message	Description	Solution
clp_shi_connector invoked. (options: *args*)	clp_shi_connector started(specified option: *args*).	-
Invalid options. (*args*)	The option is incorrectly specified (specified option: *args*).	Correctly specify the option referring to the usage.
failed to get cluster resource name. (SID: ${sid}, INO: ${ino})	The name of the resource that controls the SAP instance of which SID is ${sid} and INO is ${ino} could not be acquired.	• Correctly specify the name of the resource that controls the SAP instance of which SID is ${sid} and INO is ${ino} according to the naming conventions. • Correctly set up sudo. • Start the cluster. • Check the status of the system.
failed to get cluster group name.	The cluster group name could not be acquired.	• Correctly set up sudo. • Start the cluster. • Check the status of the system.
failed to get cluster node name.	The cluster node name could not be acquired.	• Correctly set up sudo. • Start the cluster. • Check the status of the system.
failed to get current node name. (ret=${ret})	The name of the node on which the group is currently operating could not be acquired.	• Correctly set up sudo. • Start the cluster. • Check the status of the system.

`resource "${res_name}" is not ONLINE.`	The resource with the resource name `${res_name}` is not active.	• Correctly set up `sudo`. • Start the cluster. • Start the resource `${res_name}`. • Check the status of the system.
`clpfunctions is missing.`	There is no `clpfunctions` file.	• Install EXPRESSCLUSTER again. • Check the status of the system.
`clpstat failed. (ret=${ret})`	Executing `clpstat` command has failed (return value:`${ret}`).	• Correctly set up `sudo`. • Start the cluster. • Check the status of the system.
`Can't find cluster resource. (SID: $1, INO: $2)`	The cluster resource controlling SID: `$1` and INO: `$2` could not be found.	• Following the naming conventions, correct the name of the resource which control SAP instance whose SID and INO are `${sid}` and `${ino}` respectively. • Correctly set up `sudo`. • Start the cluster. • Check the status of the system.
`Failed to analyze resource line.`	The resource line could not be analyzed.	• Check the status of the system.
`Can't find cluster group. (resource: $1)`	The cluster group related to resource: `$1` could not be found.	• Correctly set up `sudo`. • Start the cluster. • Check the status of the system.
`failed to control group resource (${res_name}) because group is stopped.`	The group resource (`${res_name}`) could not be controlled because the group stopped.	• Correctly set up `sudo`. • Start the group to which the resource belongs. • Check the status of the system.
`failed to start group resource (${res_name}) because group resource is not OFFLINE. (ret=${ret})`	The group resource could not be active because the group resource (`${res_name}`) did not stop (return value: `${set}`).	• Correctly set up `sudo`. • Stop the resource. • Check the status of the system.
`failed to stop group resource (${res_name}) because group resource is not ONLINE. (ret=${ret})`	The group could not stop because the group resource (`${res_name}`) was not active (return value: `${set}`).	• Correctly set up `sudo`. • Start the resource. • Check the status of the system.
`Start action to group`	The starting action to group resource	• Check the setting of

resource (${res_name}) was canceled because this group resource is specified in REFUSE_START_GROUP_RESOURCE .	(${res_name}) was canceled because this group resource is specified in REFUSE_START_GROUP_RESOURCE .	REFUSE_START_GRO UP_ RESOURCE.
Stop action to group resource (${res_name}) was canceled because this group resource is specified in REFUSE_STOP_GROUP_RESOURCE.	The stopping action to group resource (${res_name}) was canceled because this group resource is specified in REFUSE_STOP_GROUP_RESOURCE.	• Check the setting of REFUSE_STOP_GROU P_ RESOURCE.

8.2. Timeout settings

The below procedures may fail due to a timeout depending on the system load, when executed by the linkage connector.

- Obtaining product information of EXPRESSCLUSTER when the cluster is started.
- Checking the group resource status when Rolling Kernel Switch is activated.

In these cases adjust the parameters below in the following file.

```
/opt/nec/clusterpro/etc/clp_shi_connector.conf
```

Parameter	Value	Description
GVI_CHECKCOUNT	1 - 60 (The default is 30)	The number of retries EXPRESSCLUSTER will try to obtain product information when the cluster is started. The interval between these attempts is set by GVI_CHECK_INTERVAL as stated below. Even if the count does not reach to the setting, obtaining product information finishes when one attempt succeeded.
GVI_CHECKINTERVAL	1 - 60 (The default is 10)	The interval in seconds between EXPRESSCLUSTER attempts to obtain product information. If obtaining product information will be done only once (GVI_CHECKCOUNT=1), then this value will be ignored.
FRA_CHECKCOUNT	1 - 60 (The default is 30)	The number of retries to check the status of the group resource when the Rolling Kernel Switch is done. The interval between the check is set by FRA_CHECK_INTERVAL as stated below. Even if the count does not reach to the setting, the status check finishes when one attempt succeeded.
FRA_CHECKINTERVAL	1 - 60 (The default is 10)	The interval in seconds between checks of the status of the group resource. If the status check will be done only once (FRA_CHECKCOUNT=1), then this value will be ignored.

Section III   Miscellaneous

- Chapter 9   SAP NW Update
- Chapter 10   Notes and Restrictions

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Chapter 9 SAP NW Update

To update SAP NW, use Software Update Manager (hereafter referred to as SUM). The update procedure with SUM involves restarting SAP instances and therefore it may interfere with EXPRESSCLUSTER which tries to keep the SAP components available. To avoid such interference with EXPRESSCLUSTER, suspend EXPRESSCLUSTER's monitoring for all SAP components that SUM has to restart.

Please select from the following two options to suspend EXPRESSCLUSTER's monitoring.

- Suspending the whole cluster
- Suspending monitor resources related to SAP instances and services

Update SAP NW with SUM while the cluster or the monitor resources are suspended. After the update is completed, resume the suspended cluster or the suspended monitor resources.

For how to suspend and resume a cluster or a monitor resource, please refer to the following document.

   "Reference Guide"
- "Chapter 1   Functions of the WebManager"
  - "Operations from the WebManager"

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Chapter 10 Notes and Restrictions

- Notes on starting/stopping groups
  Refer to the following sections in the "Reference Guide":
  "Group resource details"
  → "Attributes common to group resource"
      → "Group start dependence and group stop dependence"
      → "Notes"
- Restriction of using spaces
  A node name , a failover group and a resource name must not contain any spaces. If they contain some spaces, starting and stopping of SAP NW instances cannot be controlled correctly.
- For the instance number configurations of the SAP NW components and the notes on these configurations, refer to Section1.1.4 "Instance number configuration of the SAP NW components".
- Naming conventions for failover groups (for pattern 1)
  Specify a failover group name according to the naming conventions for the failover group for exclusive control of ASCS/ERS instance. If the failover group name does not follow the naming conventions, exclusive control of ASCS/ERS instance cannot function correctly.
- Naming conventions for exec resources
  Specify a resource name that conforms to the naming conventions for the exec resource that controls starting and stopping of SAP NW instances. If the resource name does not conform to the naming conventions, starting and stopping of SAP NW instances cannot be normally controlled.
- Attention when one node recovers (for pattern 1)
  When the node where ERS instance was working gets recovered and joins the cluster, then the failover group of the ERS instance is not restarted automatically.
  You need to validate the node is working healthy and then restart the failover group of ERS instance manually.
- Privilege setup
  Set up the groups automatically created during installation of SAP NW so that sudo can be executed to normally combine SAP NW and EXPRESSCLUSTER. If the SAP NW user cannot execute sudo, starting and stopping of SAP NW instances cannot be normally controlled.
- Languages setting
  Be sure to specify English for **Language** on the **Cluster Definition** window of **Cluster Generation Wizard** of WebManager. If a language other than English is specified, the cluster will not work properly.