EXPRESSCLUSTER® X 3.3

HA Cluster Configuration Guide
for Amazon Web Services
(Linux)

10/03/2016
2nd Edition

Revision History

Edition	Revised Date	Description
1	01/29/2016	New manual
2	10/03/2016	Corresponds to the internal version 3.3.3-1

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Preface

Who Should Use This Guide

The "EXPERSSCLUSTER® X3.3 HA Cluster Configuration Guide (Linux) for Amazon Web Services" is intended for administrators who set up cluster systems, system engineers who provide user support for such systems, and cluster-system maintenance personnel. They must also have knowledge of Amazon EC2, Amazon VPC, and IAM provided by Amazon Web Services.

Scope of Application

This guide covers the following EXPRESSCLUSTER version.
- EXPRESSCLUSTER X 3.3 for Linux

How This Guide is Organized

Chapter 1, Overview: Describes the functional overview.

Chapter 2, Operating environment:
                       Describes the operating environemnt on which the operation of EXPRESSCLUSTER has been verified.

Chapter 3, Notes: Describes the notes on construcing a cluster.

Chapter 4, Constructing an HA cluster based on VIP control:
                       Describes how to create an HA cluster based on VIP control.

Chapter 5, Constructing an HA cluster based on EIP control:
                       Describes how to create an HA cluster based on EIP control.

Chapter 6, Configuring the IAM:
                       Describes how to configure the IAM.

Chapter 7, Troubleshooting:
                       Describes the problems and their solutions.

ExpressCluster 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. This guide follows the actual sequence of actions performed when introducing a cluster system using ExpressCluster to describe how to design the system, install and set up ExpressCluster X, check the operation after the setup, and perform evaluation before starting operation.

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*

Integrated WebManager Administrator's Guide

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

WebManager Mobile Administrator's Guide

This guide is intended for system administrators who manage cluster system using ExpressCluster with ExpressCluster WebManager Mobile and for system engineers who introduce the WebManager Mobile. In this guide, details on those items required for introducing 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 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/3.0/eng/server/`
Monospace bold (courier)	Indicates the value that a user actually enters from a command line.	Enter the following: `# clpcl -s -a`
Monospace italic (courier)	Indicates that users should replace italicized part with values that they are actually working with.	`rpm -i expressclsbuilder -<version_number>- <release_number>.i686.rpm`

Contacting NEC

For the latest product information, visit our website below:

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

Chapter 1 Overview

1-1. Functional overview

The settings described in this guide allow you to construct an HA cluster with EXPERSSCLUSTER in the Amazon Virtual Private Cloud (VPC) environment provided by Amazon Web Services (AWS). Because more important applications can be performed by constructing an HA cluster, a wider range of system configuration options are available in the AWS environment. The AWS has a robust configuration made up of multiple availability zones (hereafter referred to as AZ) in each region. The user can select and use an AZ as needed. EXPERSSCLUSTER realizes highly available applications by allowing the HA cluster to operate between multiple AZs in a region (hereafter referred to as Multi-AZ).
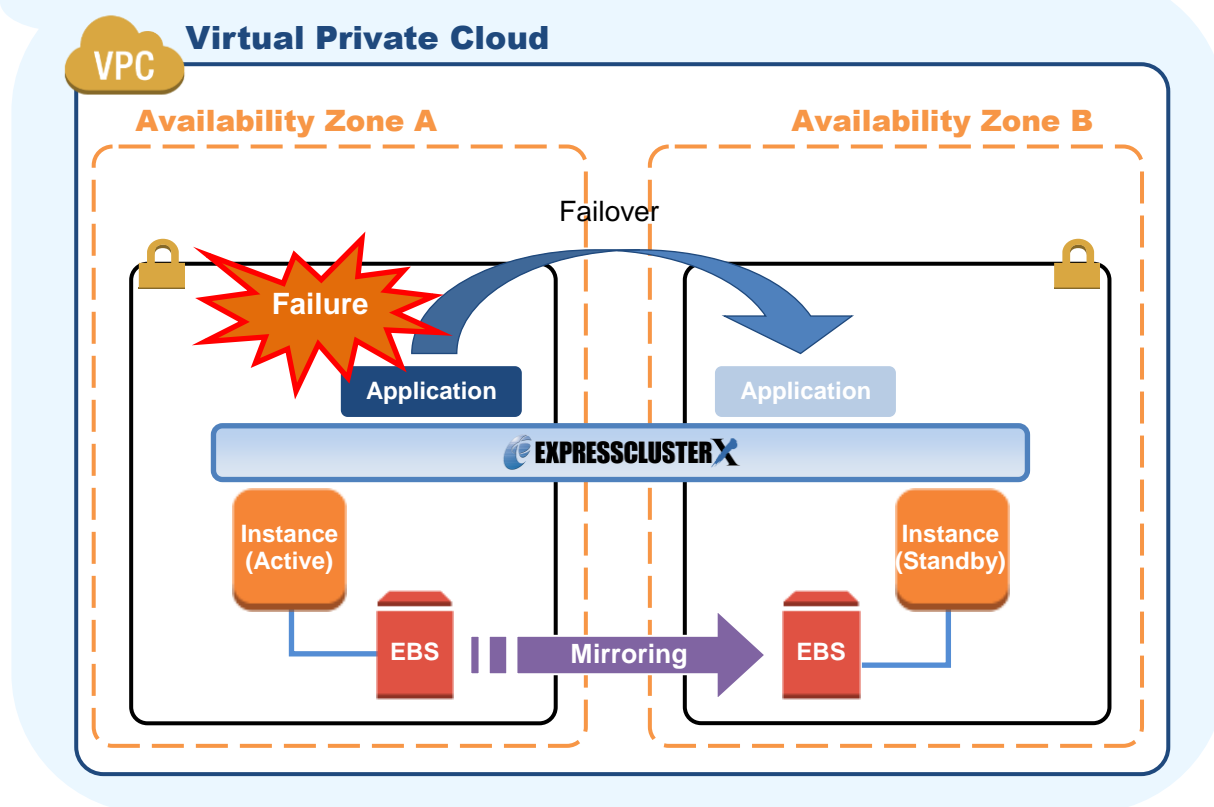
Figure 1-1 Mirror Type HA Cluster in Multi-AZ Configuration

In the AWS environment, a virtual IP can be used to connect to the cluster server. The AWS virtual ip resource and AWS elastic ip resource enable the client not to be aware of switching the destination server even if a "failover" or "group transition" occurred.

1-2. HA cluster configuration

This guide describes two HA cluster configurations: HA cluster based on virtual IP (VIP) control and HA cluster based on elastic IP (EIP) control. This section describes a single AZ configuraiton. For a multi-AZ configuration, refer to "1-3 Multi-AZ."

Location of a client accessing an HA cluster	Resource to be selected	Reference in this chapter
In the same VPC	AWS virtual ip resource	HA cluster based on VIP control
Internet	AWS elastic ip resource	HA cluster based on EIP control

HA cluster based on VIP control

This guide assumes the configuration in which a client in the same VPC accesses an HA cluster via a VIP address. For example, a DB server is clustered and accessed from a web server via a VIP address.
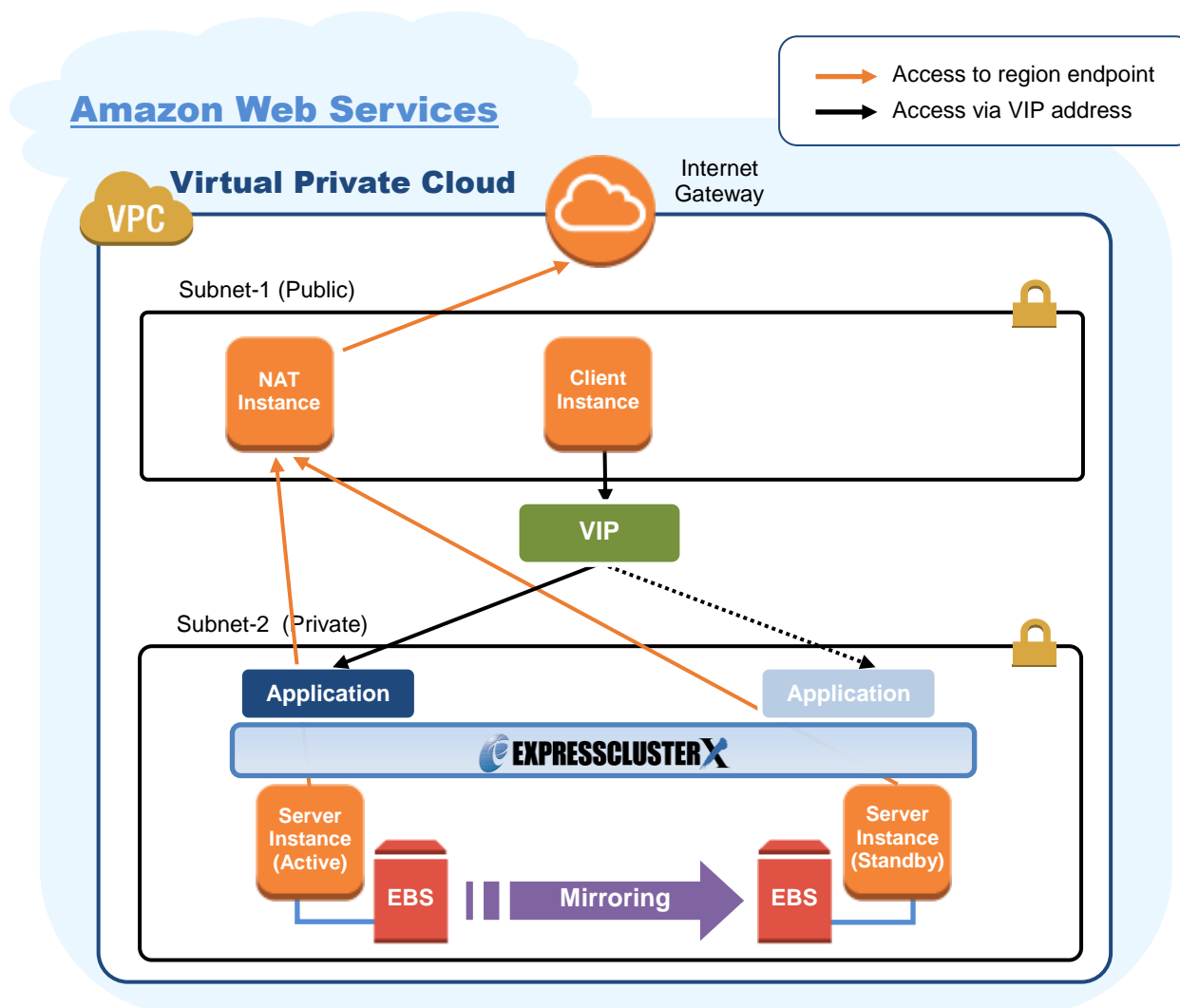
Figure 1-2 HA Cluster Based on VIP Control

In the above figure, the server instances are clustered and placed on the private subnet. The AWS virtual ip resource of EXPRESSCLUSTER sets a VIP address to the active server instance and rewrites the VPC route table. This enables the client instance placed on any subnet in the VPC to access the active server instance via the VIP address. The VIP address must be out of the VPC CIDR range.

NEC has verified that the AWS specifications do not allow clients outside the VPC to access the server instance via the VIP address assigned by the AWS virtual ip resource. Therefore, to enable clients outside the VPC to access, specify the EIP address assigned by the AWS elastic ip resource.

When executing the AWS CLI or referencing the DNS, each server instance accesses the regional endpoint or the Internet via a NAT instance placed on the public subnet as needed.

* When executing the AWS CLI, each instance must be able to communicate with the regional endpoint by -. In this guide, NAT is used for the HA cluster based on VIP control.

The following resources and monitor resources are required for an HA cluster based on VIP control configuration.

| Resource type	Description	Setup
AWS virtual ip resource	Assigns a VIP address to an active sever instance, changes the route table of the assigned VIP address, and publishes operations within the VPC.	Required
AWS virtual ip monitor resource	Periodically monitors whether the VIP address assigned by the AWS virtual ip resource exists in the local server and whether the VPC route table is changed illegally. (This monitor resource is automatically added when the AWS virtual ip resource is added.)	Required
AWS AZ monitor resource	Periodically monitors the health of the AZ in which the local server exists by using Multi-AZ. If Multi-AZ is not used, this monitor resource can be used to monitor whether the AWS CLI is available.	Recommended
IP monitor resource	Monitors the health of communication between subnets by checking whether communication with a NAT is available.	Required to check the health of communication between subnets.
Other resources and monitor resources	Depends on the configuration of the application, such as a mirror disk, used in an HA cluster.	Optional

For details of the above resources and monitor resources, refer to the following:
- EXPRESSCLUSTER X 3.3 for Linux Reference Guide
  → Chapter 4 Group resource details
- EXPRESSCLUSTER X 3.3 for Linux Reference Guide
  → Chapter 5 Monitor resource details

HA cluster based on EIP control

This guide assumes the configuration in which a client accesses an HA cluster via a global IP address assigned to the EIP through the Internet.
Clustered instances are placed on a public subnet. Each instance can access the Internet via the Internet gateway.
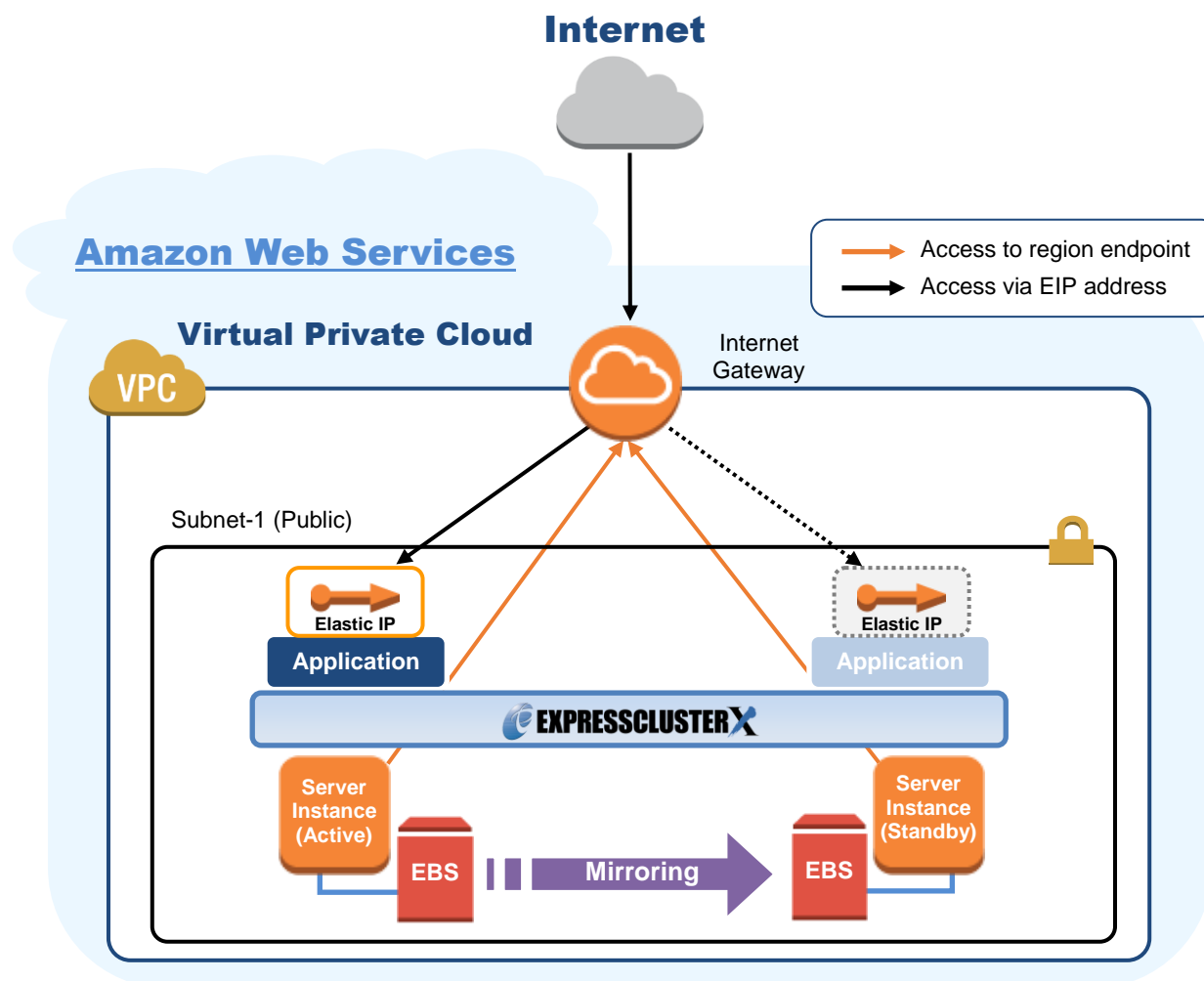
Figure 1-3 HA Cluster Based on EIP Control

In the above figure, the server instances are clustered and placed on the public subnet. The AWS virtual ip resource of EXPRESSCLUSTER attaches the EIP to the active server instance. This enables a client on the Internet to access the active server instance via the EIP address.

* When executing the AWS CLI, each instance must be able to communicate with the regional endpoint by using a method such as a proxy server, NAT, public IP, and EIP. In this guide, a public IP assigned to the instance is used for the HA cluster based on EIP control.

The following resources and monitor resources are required for an HA cluster based on EIP control configuration.

Resource type	Description	Setup
AWS elastic ip resource	Assigns an EIP address to an active sever instance and publishes operations to the Internet.	Required
AWS elastic IP monitor resource	Periodically monitors whether the EIP address assigned by the AWS elastic ip resource exists in the local server. (This monitor resource is automatically added when the AWS elastic ip resource is added.)	Required
AWS AZ monitor resource	Periodically monitors the health of the AZ in which the local server exists by using Multi-AZ. If Multi-AZ is not used, this monitor resource can be used to monitor whether the AWS CLI is available.	Recommended
Custom monitor resource	Monitors a network partition (NP) so that the same resource does not start in multiple instances at the same time.	Required to perform NP resolution
Other resources and monitor resources	Depends on the configuration of the application, such as a mirror disk, used in an HA cluster.	Optional

For details of the above resources and monitor resources, refer to the following:
- EXPRESSCLUSTER X 3.3 for Linux Reference Guide
  → Chapter 4 Group resource details
- EXPRESSCLUSTER X 3.3 for Linux Reference Guide
  → Chapter 5 Monitor resource details

1-3. Multi-AZ

In the AWS environment, the instances configuring an HA cluster can be distributed to AZs. This provides the instance redundancy for a failure occurrence in an AZ, and increases the system availability.

The AWS AZ monitor resource monitors the health of each AZ. If the monitor resource detects a failure, it makes EXPRESSCLUSTER to issue a warning or perform a recovery operation.

For details, refer to the following:

- EXPRESSCLUSTER X 3.3 for Linux Reference Guide
  → Chapter 5 Monitor resource details
    → Understanding AWS AZ monitor resources
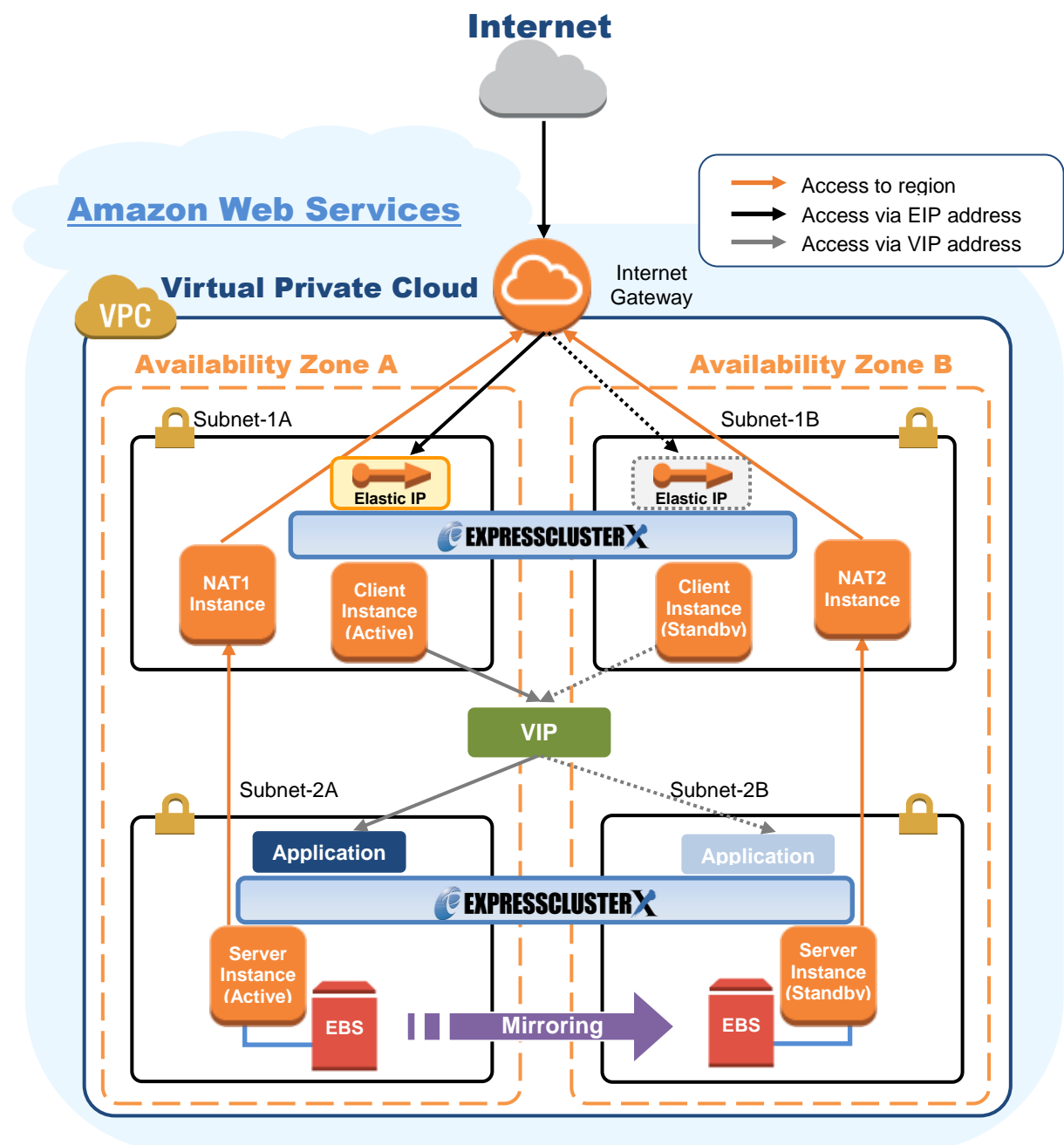
Figure 1-4 HA Cluster Using Multi-AZ

1-4. Network partition resolution

The instances configuring an HA cluster perform alive monitoring on each other by using heartbeat. In the configuration in which instances are distributed to multiple subnets, an undesirable condition such as redundant startup of a service occurs if the heartbeat is lost. To prevent redundant startup of a service, it is required to determine whether the instance itself was isolated in a network (network partition: NP) or the other instance was down.

The NP resolution conducts a ping or LISTEN port test for an always running device that can return a response (hereafter referred to as an *acknowledgement device*). If the acknowledgement device does not return a response, it is determined that an NP has occurred and the predefined process is performed (for example, issuing a warning, performing a recovery operation, or shutting down the server).

The Amazon VPC uses the following as the ping device usually.

HA cluster type	ping device	Method	Remarks
HA cluster based on VIP control	Instance always running on another subnet	Ping	In this guide, NAT is used.
HA cluster based on EIP control	Regional endpoint	LISTEN port acknowledgement	For the regional endpoints, refer to the following URL: http://docs.aws.amazon.com/general/latest/gr/rande.html Example: When the region name is Asia Pacific (Tokyo), the regional endpoint is ec2.ap-northeast-1.amazonaws.com.

For details, refer to the following:
- EXPRESSCLUSTER X 3.3 for Linux Reference Guide
    → Chapter 7 Details on network partition resolution resources

1-5. On-premises and AWS

The following table describes the EXPRESSCLUSTER functional differences between the on-premises and AWS environments.
A: Available, N: Not available

Function	On-premises	AWS
Creation of a shared disk type cluster	A	NA
Creation of a mirror disk type cluster	A	A
Floating IP resource	A	NA
Virtual IP resource	A	NA
AWS elastic ip resource	NA	A
AWS virtual ip resource	NA	A

The following table describes the creation flow of a 2-node cluster that uses a mirror disk and IP alias (on-premises: floating IP resource, AWS: AWS virtual ip resource) in the on-premises and AWS environments.

	Step	On-premises	AWS
		Before installing EXPRESSCLUSTER	
1	Configure the VPC environment.	Not required	◇ When using the AWS virtual ip resource, refer to "4-1 Configuring the VPC Environment" in this guide. ◇ When using the AWS elastic ip resource, refer to "5-1 Configuring the VPC Environment" in this guide.
2	Configure the instance.	Not required	◇ When using the AWS virtual ip resource, refer to "4-2 Configuring the instance" in this guide. ◇ When using the AWS elastic ip resource, refer to "5-2 Configuring the instance" in this guide.
3	Configure a partition for a mirror disk resource.	Refer to the following: • EXPRESSCLUSTER X 3.3 for Linux Installation and Configuration Guide → Chapter 1 Determining a system configuration → Settings after configuring hardware • EXPRESSCLUSTER X 3.3 for Linux Reference Guide → Chapter 5 Group resource details → Understanding mirror disk resources	Same as the on-premises environment

4	Adjust the OS startup time.	Refer to the following: EXPRESSCLUSTER X 3.3 for Linux Installation and Configuration Guide → Chapter 1 Determining a system configuration → Settings after configuring hardware	Same as the on-premises environment
5	Check the network.		
6	Check the root file system		
7	Check the firewall.		
8	Synchronize the server time.		
9	Install EXPRESSCLUSTER.	Refer to the following: • EXPRESSCLUSTER X 3.3 for Linux Installation and Configuration Guide → Chapter 3 Installing EXPRESSCLUSTER	Same as the on-premises environment
		After installing EXPRESSCLUSTER	
10	Register the EXPRESSCLUSTER license.	Refer to the following: • EXPRESSCLUSTER X 3.3 for Linux Installation and Configuration Guide → Chapter 4 Registering the license	Same as the on-premises environment
11	Construct a cluster - Set up the heartbeat method.	Refer to the following: • EXPRESSCLUSTER X 3.3 for Linux Installation and Configuration Guide → Chapter 5 Creating the cluster configuration data → Creating the configuration data of a 2-node cluster	COM heartbeat, BMC heartbeat and DISK heartbeat cannot be used.
12	Construct a cluster: Set up the NP resolution.	Use an NP resolution resource. Refer to the following: • EXPRESSCLUSTER X 3.3 for Linux Installation and Configuration Guide → Chapter 5 Creating the cluster configuration data → Creating the cluster configuration data • EXPRESSCLUSTER X 3.3 for Linux Reference Guide → Chapter 7 Network partition resolution resources details	◇ When using the AWS virtual ip resource, refer to "4-3 Setting up EXPRESSCLUSTER" → "3) Add a monitor resource." → "IP monitor resource" in this guide. ◇ When using the AWS elastic ip resource, refer to "5-3 Setting up EXPRESSCLUSTER" →"1) Construct a cluster" in this guide.

| 13 | Construct a cluster: Create a failover group Create a monitor resource. | Refer to the following:
• EXPRESSCLUSTER X 3.3 for Linux Installation and Configuration Guide
→ Chapter 5 Creating the cluster configuration data
  → Creating the cluster configuration data | In addition to the reference for the on-premises environment, refer to the following:
◇ When using the AWS virtual ip resource
• "4-3 Setting up EXPRESSCLUSTER" in this guide
• EXPRESSCLUSTER X 3.3 for Linux Reference Guide
→ Chapter 4 Group resource details
  → Understanding AWS virtual ip resources

◇ When using the AWS elastic ip resource, refer to the following:
• "5-3 Setting up EXPRESSCLUSTER" in this guide
• EXPRESSCLUSTER X 3.3 for Linux Reference Guide
→ Chapter 4 Group resource details
  → Understanding AWS elastic ip resources |

Chapter 2   Operating Environment

For details, refer to the following:

- EXPRESSCLUSTER X 3.3 for Linux Getting Started Guide
    → Chapter 3 Installation requirements for EXPRESSCLUSTER
      →Operation environment for AWS elastic ip resource, AWS virtual ip resource, AWS Elastic IP monitor resource, AWS virtual IP monitor resource, AWS AZ monitor resource

Chapter 3   Notes

Notes on Using EXPRESSCLUSTER in the VPC

Note the following points when using EXPRESSCLUSTER in the VPC environment.

Access from the Internet
NEC has verified that the AWS specifications do not allow clients outside the VPC to access the server instance via the VIP address assigned by the AWS virtual ip resource. Therefore, to enable clients outside the VPC to access, specify the EIP address assigned by the AWS elastic ip resource.

Restrictions on the group resource functions
Refer to the following:
*   EXPRESSCLUSTER X 3.3 for Linux Getting Started Guide
          → Chapter 5 Notes and Restrictions
              → Setting up AWS elastic ip resources
              → Setting up AWS virtual ip resources

Mirror disk performance
For a mirror type HA cluster, a write request to a mirror disk takes the following routes:
Write request I/O:
      Guest OS on the active server → Host OS on the active server → Host OS on the standby server → Guest OS on the standby server
Writing completion notice:
      Guest OS on the standby server → Host OS on the standby server → Host OS on the active server → Guest OS on the active server

If an HA cluster is constructed in a Multi-AZ configuration, the instances are located at long distances from each other, causing a TCP/IP response delay. This might affect a mirroring operation.
Also, the usage of other systems affects the mirroring performance due to multi-tenancy. Therefore, the difference in the mirror disk performance in a cloud environment tends to be larger than that in a physical or general virtualized environment (non-cloud environment) (that is, the degradation rate of the mirror disk performance tends to be larger).
Take this point into consideration at the design phase if priority is put on writing performance in your system.

Chapter 4 Constructing an HA cluster based on VIP control

This chapter describes how to construct an HA cluster based on VIP control.
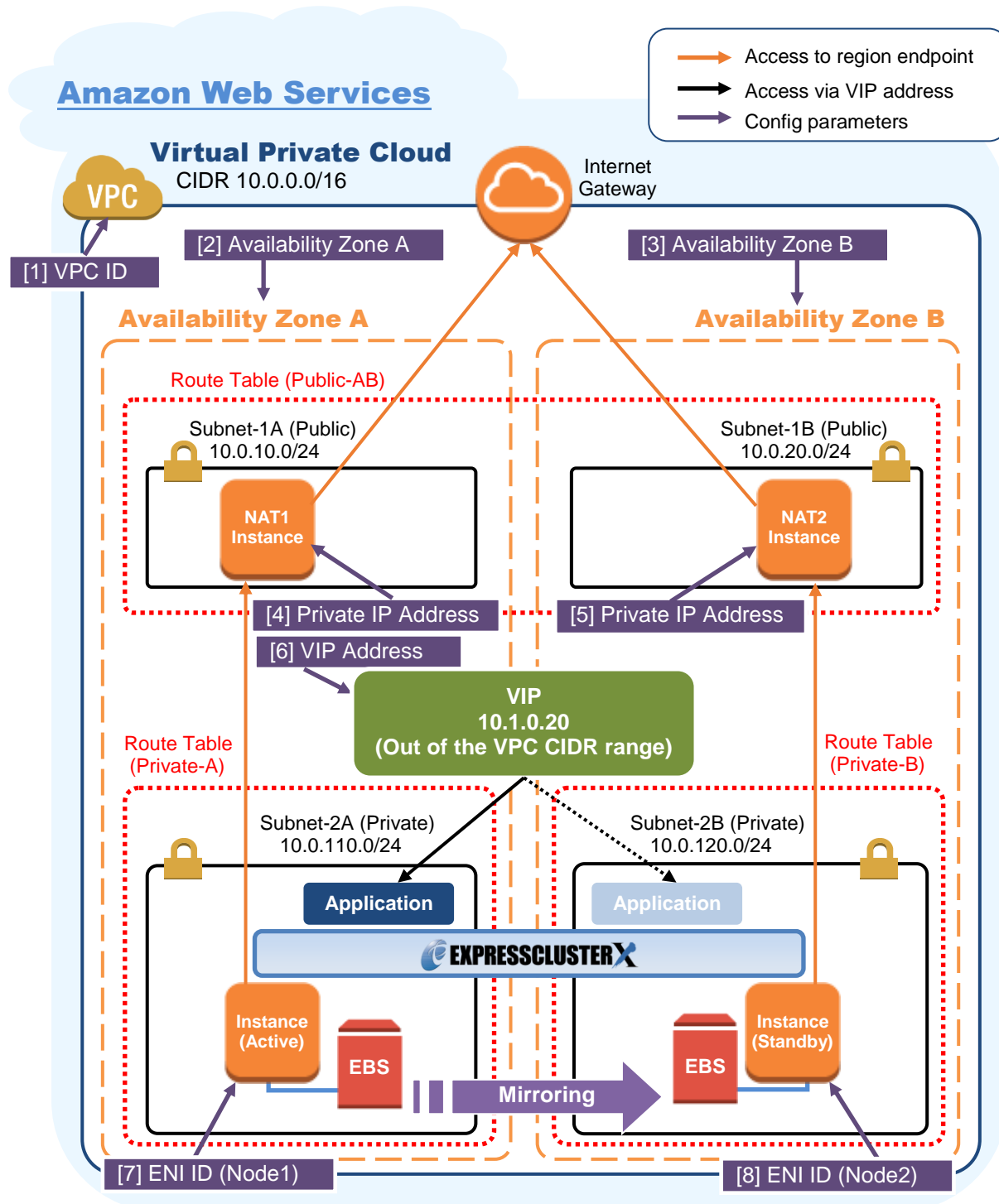The numbers in the figure correspond to the descriptions and setting values in the following sections.

Figure 4-1 System Configuration of the HA Cluster Based on VIP Control

4-1. Configuring the VPC Environment

Configure the VPC on the VPC Management console and EC2 Management console.
The IP addresses used in the figures and description are an example. In the actual configuration, use the actual IP addresses assigned to the VPC. When installing EXPRESSCLUSTER in the existing VPC, specify the appropriate settings such as adding a subnet if the number of subnets is insufficient. This guide does not describe the case to perform operations by adding an ENI to an instance of an HA cluster node.

1) **Configure the VPC and subnet.**
   Create a VPC and subnet first.
   → Add a VPC and subnet in **VPC** and **Subnets** on the VPC Management console.

   [1] VPC ID
   Write down the VPC ID (vpc-xxxxxxxx) because it is necessary to set up the AWS virtual ip resource later.

2) **Configure the Internet gateway.**
   Add an Internet gateway to access the Internet from the VPC.
   → To create an Internet gateway, select **Internet Gateways > Create Internet Gateway** on the VPC Management console. Attach the created Internet gateway to the VPC.

3) **Configure the network ACL and security group.**
   Specify the appropriate network ACL and security group settings to prevent unauthorized network access from in and out of the VPC.
   Change the network ACL and security group path settings so that the instances of the HA cluster node can communicate with the Internet gateway via HTTPS, communicate with WebManager, and communicate with each other. The instances are to be placed on the private networks (Subnet-2A and Subnet-2B).
   → Change the settings in **Network ACLs** and **Security Groups** on the VPC Management console.

   For the port numbers that are used by the EXPRESSCLUSTER components, refer to the following:
   - EXPRESSCLUSTER X 3.3 for Linux Getting Started Guide
     → Chapter 5 Notes and Restrictions
       → Before installing EXPRESSCLUSTER

4) **Add an HA cluster instance.**
   Create an HA cluster node instance on the private networks (Subnet-2A and Subnet-2B).
   To use an IAM role by assigning it to an instance, be sure to specify the IAM role to the instance when creating it. (After the instance has been created, it is not possible to change the assigned IAM role or assign a new IAM role.)
   → To create an instance, select **Instances > Launch Instance** on the EC2 Management console.
   → For details about the IAM settings, refer to "Chapter 1

Configuring the IAM."

Disable **Source/Dest. Check** of the elastic network interface (ENI) assigned to each created instance.

To perform the VIP control by using the AWS virtual ip resource, communication with the VIP address (10.1.0.20 in the above figure) must be routed to the ENI of the instance. It is necessary to disable **Source/Dest. Check** of the ENI of each instance to communicate with the private IP address and VIP address.

→ To change the settings, right-click the added instance in **Instances** on the EC2 Management console, and select **Networking > Change Source/Dest. Check**.

[7] ENI ID (Node1)   [8] ENI ID (Node2)

Write down the ENI ID (eni-xxxxxxxx) of each instance because it is necessary to set up the AWS virtual ip resource later.

Use the following procedure to check the ENI ID assigned to the instance.
1. Select the instance to display its detailed information.
2. Click the target device in **Network Interfaces**.
3. Check **Interface ID** displayed in the pop-up window.
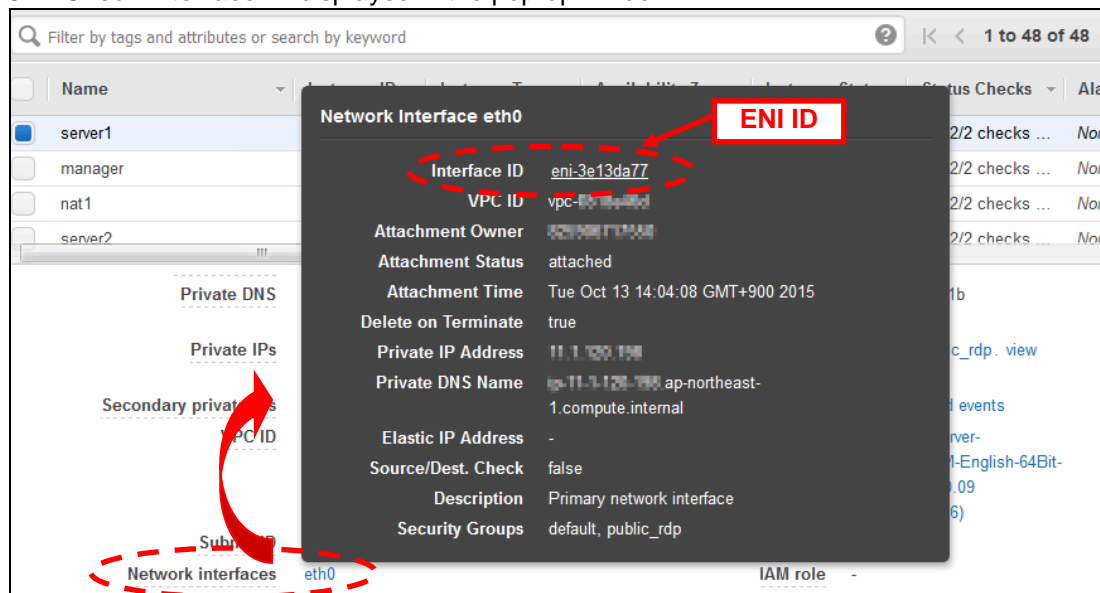
5) Add a NAT instance.

To perform the VIP control by using the AWS CLI, communication from the instance of the HA cluser node to the regional endpoint via HTTPS must be enabled.

To do so, create a NAT instance on the public networks (Subnet-1A and Subnet-1B). In the AWS environment, `amzn-ami-vpc-nat-pv-2014.09.1.x86_64-ebs` is prepared as the AMI for NAT.

When creating a NAT instance, enable the public IP. In addition, disable **Source/Dest. Check** of the added NAT instance to enable the NAT function.

→ To change the settings, right-click the NAT instance in **Instances** on the EC2 Management console, and select **Networking > Change Source/Dest. Check**.

6) Configure the route table.

Add the routing to the Internet gateway so that the AWS CLI can communicate with the regional endpoint via NAT and the routing so that a client in the VPC can access the VIP address. The number of CIDR blocks of the VIP address must always be 32.

The following routings must be set in the route table (Public-AB) of the public networks (Subnet-1A and Subnet-1B in the above figure).

◇ Route table (Public-AB)

Destination	Target	Remarks
VPC network (Example: 10.0.0.0/16)	local	Existing by default
0.0.0.0/0	***Internet gateway***	Add (required)
VIP address (Example: 10.1.0.20/32)	*eni-xxxxxxxx (ENI ID of the active server instance)* [7] ENI ID (Node1)	Add (required)

The following routings must be set in the route tables (Private-A and Private-B) of the private networks (Subnet-2A and Subnet-2B in the above figure).

◇ Route table (Private-A)

Destination	Target	Remarks
VPC network (Example: 10.0.0.0/16)	local	Existing by default
0.0.0.0/0	***NAT1***	Add (required)
VIP address (Example: 10.1.0.20/32)	*eni-xxxxxxxx (ENI ID of the active server instance)* [7] ENI ID (Node1)	Add (required)

◇ Route table (Private-B)

Destination	Target	Remarks
VPC network (Example: 10.0.0.0/16)	local	Existing by default
0.0.0.0/0	***NAT2***	Add (required)
VIP address (Example: 10.1.0.20/32)	*eni-xxxxxxxx (ENI ID of the active server instance)* [7] ENI ID (Node1)	Add (required)

When a failover occurred, the AWS virtual ip resource switches all routings to the VIP address set in these route tables to the ENI of the standby server instance by using the AWS CLI.

[6] VIP Address

The VIP address must be out of the VPC CIDR range of the VPC.
Write down the VIP address set to the route table because it is necessary to set up the AWS virtual ip resource later.

Configure other routings according to the environment.

7) Add a mirror disk (EBS).
Add an EBS to be used as the mirror disk (cluster partition or data partition) as needed.

> → To add an EBS, select **Volumes > Create Volume** on the EC2 Management console, and then attach the created volume to an instance.

4-2. Configuring the instance

Log in to each instance of the HA cluster and specify the following settings.
For the Python and AWS CLI versions supported by EXPRESSCLUSTER, refer to the following:

- EXPRESSCLUSTER X 3.3 for Linux Getting Started Guide
   → Chapter 3 Installation requirements for EXPRESSCLUSTER
      → Operation environment for AWS elastic ip resource, AWS virtual ip resource

1) **Disable SELinux.**
   Set `permissive` or `disabled` to SELinux to perform communication required by EXPRESSCLUSTER.

   Run the following command to check the status of SELinux.
   ```
   $ getenforce
   Enforcing     (* Enforcing indictes that SELinux is enabled.)
   ```

   Change the status of SELinux to "`disabled`" by using `/etc/sysconfig/selinux` and restart SELinux. Then run the `getenforce` command to confirm that `Disabled` is returned.

2) **Configure a firewall.**
   Change the firewall setting as needed.
   For the port numbers that are used by the EXPRESSCLUSTER components, refer to the following:
   - EXPRESSCLUSTER X 3.3 for Linux Getting Started Guide
      → Chapter 5 Notes and Restrictions
         → Before installing EXPRESSCLUSTER

3) **Install Python.**
   Install Python required by EXPRESSCLUSTER.
   First, confirm that Python is installed.
   If Python has not been installed, install it by using a command such as `yum`.
   The installation path of the python commands must be any of the following:
      `/sbin, /bin, /usr/sbin, /usr/bin`

4) **Install the AWS CLI.**
   Install the AWS CLI by running the pip command from a shell.
   ```
   $ pip install awscli
   ```

   For details about the pip command, refer to the following:
   https://pip.pypa.io/en/latest/

   The installation path of the AWS CLI must be any of the following:
   /sbin, /bin, /usr/sbin, /usr/bin, /usr/local/bin

   For details about how to set up the AWS CLI, refer to the following:
   http://docs.aws.amazon.com/cli/latest/userguide/installing.html

   (If EXPRESSCLUSTER has been installed before installing Python or the AWS CLI, be sure to restart the OS before using EXPRESSCLUSTER.)

5) **Register the AWS access key.**
   Run the following command from the shell.

31

```
$ sudo aws configure
```

Enter information such as the AWS access key to the inquiries.
The settings to be specified vary depending on whether an IAM role is assigned to the instance or not.

◇ Instance to which an IAM role is assigned.

```
AWS Access Key ID [None]: (Press Enter without entering anything.)
AWS Secret Access Key [None]: (Press Enter without entering anything.)
Default region name [None]: <default region name>
Default output format [None]: text
```

◇ Instance to which an IAM role is not assigned.

```
AWS Access Key ID [None]: <AWS access key>
AWS Secret Access Key [None]: <AWS secrete access key>
Default region name [None]: <default region name>
Default output format [None]: text
```

If you specified incorrect settings, delete the directory /root/.aws entirely, and specify the above settings again.

6) Prepare the mirror disk.
If an EBS has been added to be used as the mirror disk, divide the EBS into partitions and use each partition as the cluster partition and data partition.

Figure 4-2 EBS Partitioning Example

For details about the mirror disk partition, refer to the following:
- EXPRESSCLUSTER X 3.3 for Linux Installation & Configuration Guide
   → Chapter 1 Determining a system configuration
    → Partition settings for mirror disk resource(when using Replicator)

7) Install EXPRESSCLUSTER.
For the installation procedure, refer to "EXPRESSCLUSTER X 3.3 for Linux Installation & Configuration Guide".
Store the EXPRESSCLUSTER installation media in the environment to which to install EXPRESSCLUSTER.
(To transfer data, use any method such as Remote Desktop and Amazon S3.)

After the installation, restart the OS.

4-3. Setting up EXPRESSCLUSTER

This section describes how to set up EXPRESSCLUSTER by using the WebManeger cluster generation wizard.
For details about how to set up and connect to WebManager, refer to the following:

- EXPRESSCLUSTER X 3.3 for Linux Installation and Configuration Guide
  → Chapter 5 Creating the cluster configuration data

This section describes how to add the following resources:
> Mirror disk resource
> AWS virtual ip resource
> AWS AZ monitor resource
> AWS virtual ip monitor resource
> NP resolution (IP monitor resource)

For the settings other than the above, refer to "EXPRESSCLUSTER X 3.3 for Linux Installation and Configuration Guide".

1) Construct a cluster.

Start the cluster generation wizard to construct a cluster.

◇ Construct a cluster.

> **Steps**
> 1. Access WebManager. The dialog box below is displayed.
>   Click **Start Cluster Generation Wizard**.

> 2. The dialog box below is displayed.
>   Click **Start Standard Cluster Generation Wizard**.

> 3. The **Cluster Definition** page is displayed.
>   Enter a cluster name in **Cluster Name**.
>   Select an appropriate language from **Language**. The display language of WebManager will be changed to the language selected here by applying the settings.

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4. The **Server Definition** page is displayed.
   The instance connecting to WebManager is displayed as the registered master server.
   Click **Add** to add other instances (by specifying their private IP addresses).

5. Click **Next**.

6. The **Interconnect** page is displayed.
   Specify the IP address (private IP address of each instance) to be used for interconnect.
   Select mdc1 from **MDC** for the communication path of the mirror disk resource to be
   created later.

7. Click **Next**.

8. The **NP Resolution** page is displayed.
    However, the NP resolution is not set on this page. The same operation as the NP resolution can be achieved by adding the IP monitor resource and monitoring a NAT instance set in each AZ. (The NP resolution will be set in "3) Add a monitor resource. " described later.)
    Click **Next**.

2) Add a group resource.

◇ Group definition
    Create a failover group.

> **Steps**
> 1. The **Group Definition** dialog box is displayed.
>   Enter the failover group name (failover1) in the **Name** box.

2. Click **Next**.

3. The **Available Servers** page is displayed.
    Click **Next** without specifying anything.

4. The **Group Attribute Settings** page is displayed.
    Click **Next** without specifying anything.

5. The **Group Resource** page is displayed.
    Add a group resource on this page following the procedure below.

◇ Mirror disk resource

Create a mirror disk resource according the mirror disk (EBS) as needed.
For details, refer to the following:
- EXPRESSCLUSTER X 3.3 for Linux Reference Guide
  - → Chapter 4, Group resource details
    - → Understanding mirror disk resources

Steps
1. Click **Add** in **Group Resource List**.

2. The **Resource Definition of Group(failover1)** window is displayed.
   Select the group resource type (Mirror disk resource) from the **Type** box and enter the group resource name (md) in the **Name** box.
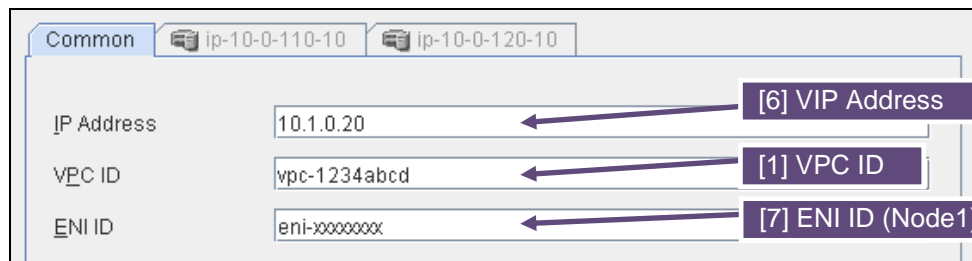
3. Click **Next**.

4. The **Dependency** page is displayed.
   Click **Next** without specifying anything.

5. The **Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** pages are displayed.
   Click **Next**.

6. Enter the drive letter for the partition set up in "4-2 Configuring the instance" → "6) Prepare the mirror disk." in **Data Partition Drive Letter** and **Cluster Partition Drive Letter**.

7. Click **Add** for **Available Servers**.

8. The **Selection of Partition** window is displayed.
   Click **Connect** to obtain partition information.
   Select the data and cluster partitions and click **OK**.

9. Perform steps 7 and 8 on the other node.

10. Return to the **Advanced Settings** page and click **Finish** to complete setting.
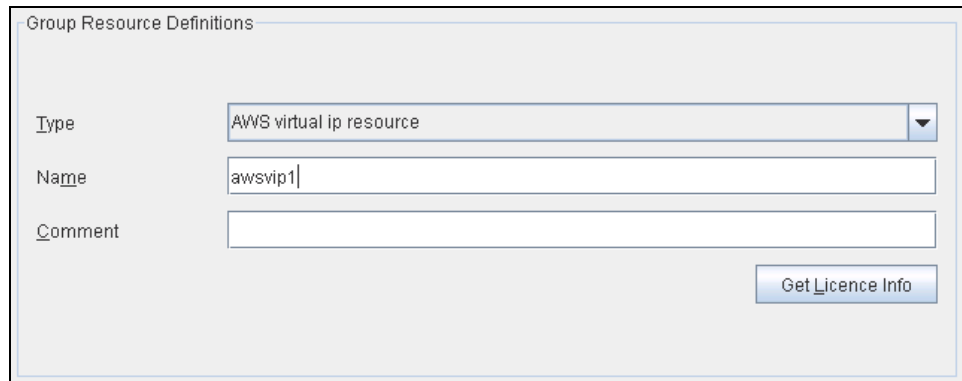
◇ AWS virtual ip resource
Add the AWS virtual ip resource that controls the VIP by using the AWS CLI.

For details, refer to the following:
- EXPRESSCLUSTER X 3.3 for Linux Reference Guide
  - → Chapter 4, Group resource details
    - → Understanding AWS virtual ip resources

Steps
1. Click **Add** in **Group Resource List**.

2. The **Resource Definition of Group(failover1)** window is displayed.
   Select the group resource type (AWS virtual ip resource) from the **Type** box and enter the group resource name (awsvip1) in the **Name** box.

Group Resource Definitions

Type: AWS virtual ip resource

Name: awsvip1

Comment:

Get Licence Info

3. Click **Next**.

4. The **Dependency** page is displayed. Click **Next** without specifying anything.

5. The **Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** pages are displayed.
   Click **Next**.

6. The **Advanced Settings** page is displayed.
   Set a VIP address to be assigned in the **IP Address** box on the **Common** tab.

   Set the ID of the VPC including instances in the **VPC ID** box.
   To set up the servers individually, enter the VPC ID of one server on the **Common** tab and specify the VPC ID of the other server separately.

   Enter the ENI ID of the active server instance to which the VIP address is to be routed in the **ENI ID** box.
   The ENI IDs of the servers must be set up individually. Enter the ENI ID of one server on the **Common** tab and specify the ENI ID of the other server separately.
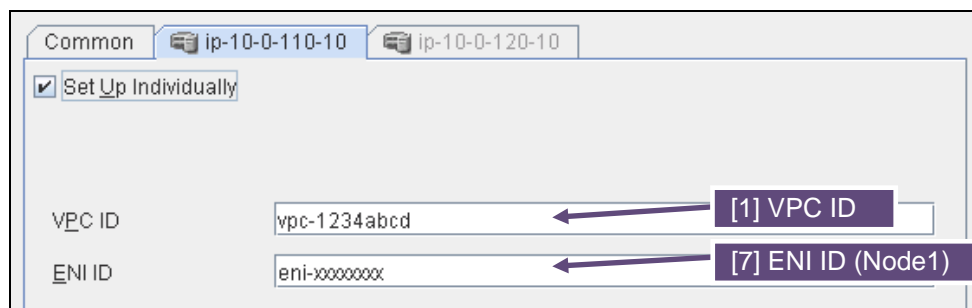
   Common | ip-10-0-110-10 | ip-10-0-120-10

   IP Address: 10.1.0.20 ← [6] VIP Address
   VPC ID: vpc-1234abcd ← [1] VPC ID
   ENI ID: eni-xxxxxxxx ← [7] ENI ID (Node1)

7. Specify the node settings on each node tab
   Select the **Individually Set Up Servers** check box.
   Confirm that the VPC ID specified on the **Common** tab is entered in the **VPC ID** box.
   Enter the ENI ID of the instance corresponding to the node in the **ENI ID** box.

   Common | ip-10-0-110-10 | ip-10-0-120-10

   ☑ Set Up Individually

   VPC ID: vpc-1234abcd ← [1] VPC ID
   ENI ID: eni-xxxxxxxx ← [7] ENI ID (Node1)

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8. Click **Finish** to complete setting.

3) Add a monitor resource.

◇ AWS AZ monitor resource
Create an AWZ AZ monitor resource to check whether the specified AZ is usable by using the monitor command.
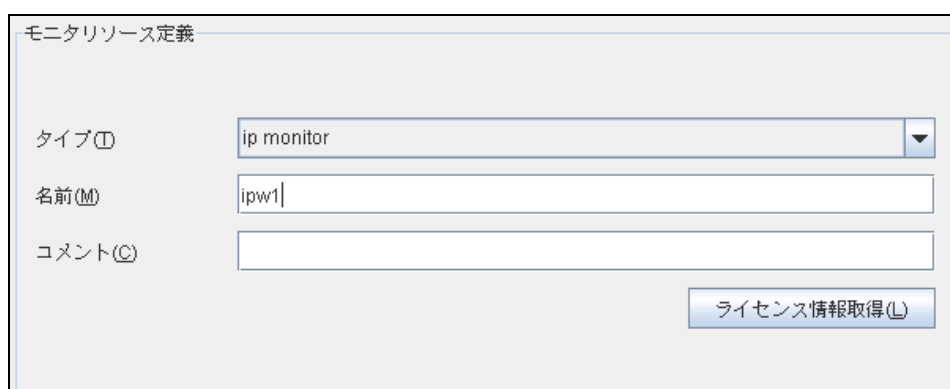For details, refer to the following:

- EXPRESSCLUSTER X 3.3 for Linux Reference Guide
  → Chapter 5, Monitor resource details
  → Understanding AWS AZ monitor resources

Steps

1. Click **Add** in **Monitor Resource List**.

2. Select the monitor resource type (AWS AZ monitor) from the **Type** box and enter the monitor resource name (awsazw1) in the **Name** box.

3. Click **Next**.

4. The **Monitor (common)** page is displayed.
   Click **Next** without specifying anything.

5. The **Monitor (special)** page is displayed.
   Enter the AZ to be monitored in the **Availability Zone** box on the **Common** tab.
   (Specify the AZ of the active server instance.)

[2] Availability Zone A

6. Specify the node settings on each node tab.
   Select the **Individually Set Up Servers** check box.
   Enter the AZ of the instance corresponding to the node in the **Availability Zone** box.

[2] Availability Zone A

[3] Availability Zone B

7. Click **Next**.

8. The **Recovery Action** page is displayed.
   Set LocalServer in the **Recovery Target** box.

9. Click **Finish** to complete setting.

◇ AWS virtual ip monitor resource
This resource is automatically added when the AWS virtual ip resource is added.
The existence of the VIP address and the health of the route table can be checked by using the OS API and the AWS CLI commands.
For details, refer to the following:
- EXPRESSCLUSTER X 3.3 for Linux Reference Guide
  → Chapter 5, Monitor resource details
    → Understanding AWS virtual ip monitor resources

◇ IP monitor resource
Create the IP monitor resource to monitor the health of the subnet by sending a ping to a NAT instance placed in each AZ. Specify the following:

Steps
1. Click **Add** in **Monitor Resource List**.

2. Select the monitor resource type (IP monitor) from the **Type** box and enter the monitor resource name (ipw1) in the **Name** box.

3. Click **Next**.

4. The **Monitor (common)** page is displayed.
   Confirm that **Monitoring Timing** is **Always** and click **Next**.

5. The **Monitor (special)** page is displayed.
   Enter the private IP address of the NAT instance used by each node in the **IP Address** box of the **Common** tab.

6. Click **Next**.

7. The **Recovery Action** page is displayed.
   Set LocalServer in the **Recovery Target** box.
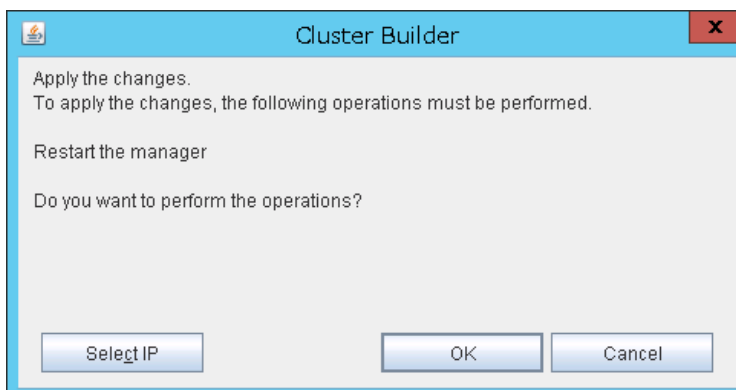   Select **Stop cluster service and shutdown OS** in **Final Action**.

8. Click **Finish** to complete setting.

4) Apply the settings and start the cluster.

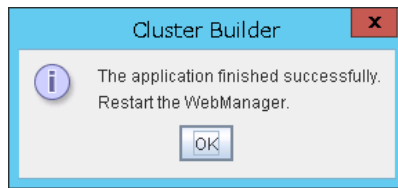After the settings are complete, click the **Apply Settings** icon under the menu.
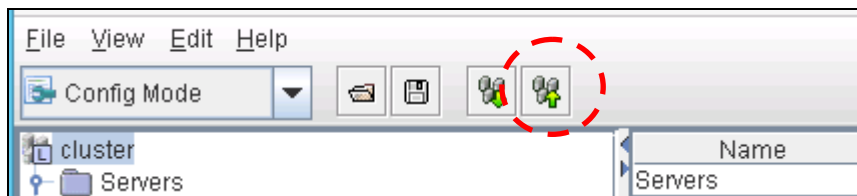
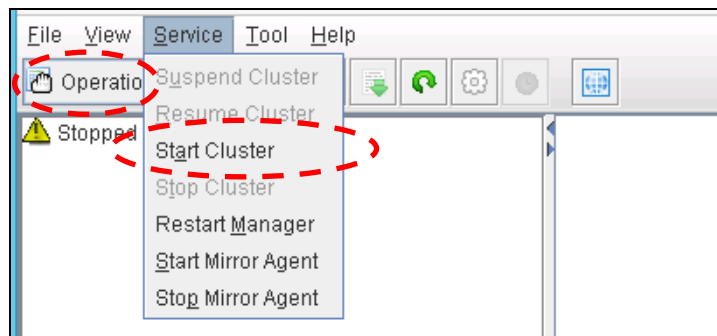The dialog box to confirm to restart the manager is displayed.

Click **OK**.

Click **OK**.

Change the mode to **Operation Mode** and select **Start Cluster** from the **Service** menu.

Chapter 5 Constructing an HA cluster based on EIP control

This chapter describes how to construct an HA cluster based on EIP control.
The numbers in the figure correspond to the descriptions and setting values in the following sections.
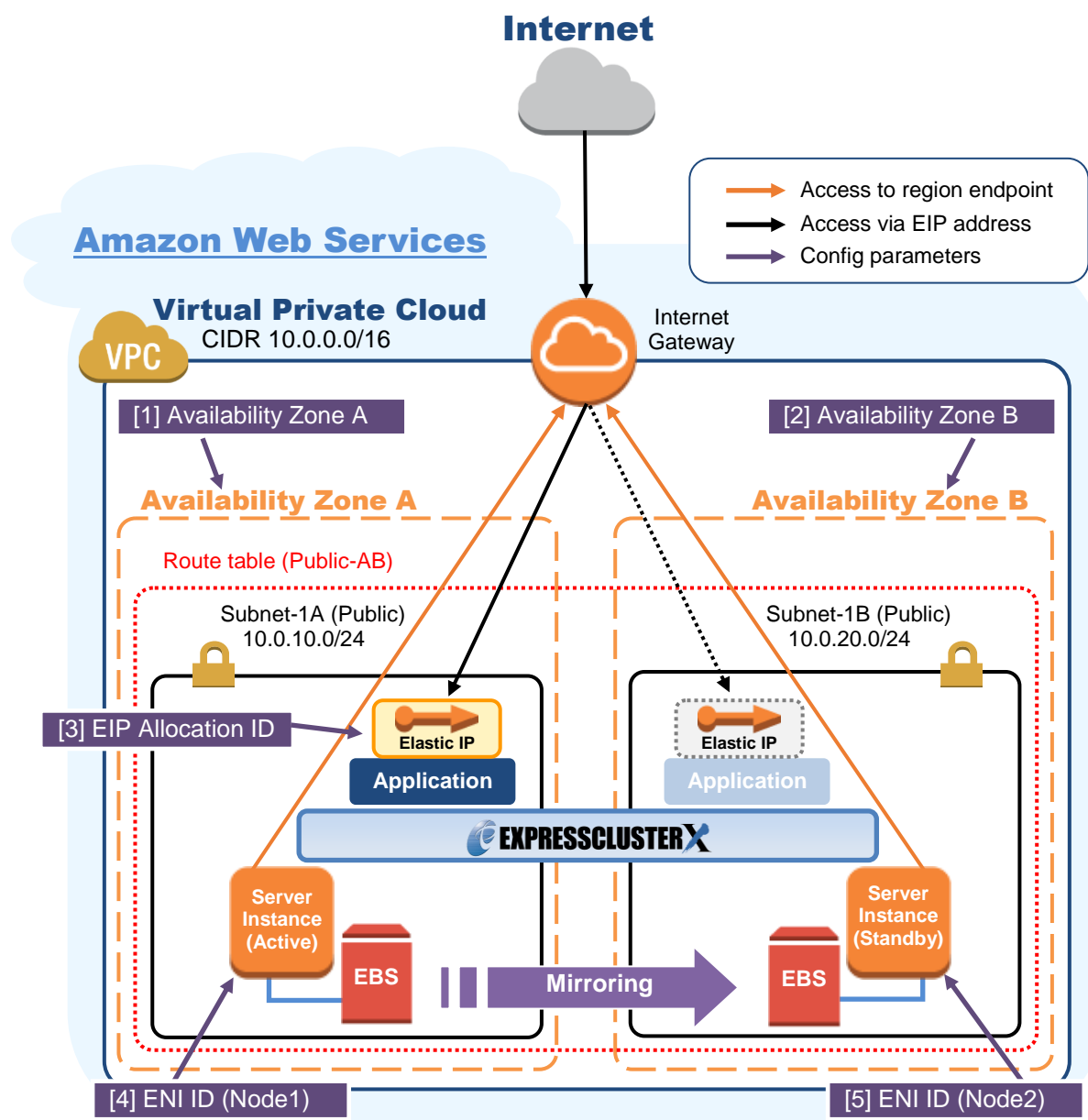

Figure 5-1 System Configuration of the HA cluster based on EIP control

5-1. Configuring the VPC Environment

Configure the VPC on the VPC Management console and EC2 Management console.
The IP address used in the figures and description is an example. In the actual configuration, use the actual IP address assigned to the VPC. When installing EXPRESSCLUSTER in the existing VPC, specify the appropriate settings such as adding a subnet if the number of subnets is insufficient. This guide does not describe the case to perform operations by adding an ENI to an instance of an HA cluster node.

1) **Configure the VPC and subnet.**
   Create a VPC and subnet first.
   > → Add a VPC and subnet in **VPC** and **Subnets** on the VPC Management console.

2) **Configure the Internet gateway.**
   Add an Internet gateway to access the Internet from the VPC.
   > → To create an Internet gateway, select **Internet Gateways > Create Internet Gateway** on the VPC Management console. Attach the created Internet gateway to the VPC.

3) **Configure the network ACL and security group.**
   Specify the appropriate network ACL and security group settings to prevent unauthorized network access from in and out of the VPC.
   Change the network ACL and security group path settings so that the instances of the HA cluster node can communicate with the Internet gateway via HTTPS, communicate with WebManager, and communicate with each other. The instances are to be placed on the public networks (Subnet-1A and Subnet-1B).
   > → Change the settings in **Network ACLs** and **Security Groups** on the VPC Management console.

   For the port numbers that are used by the EXPRESSCLUSTER components, refer to the following:
   - EXPRESSCLUSTER X 3.3 for Linux Getting Started Guide
     → Chapter 5 Notes and Restrictions
       → Before installing EXPRESSCLUSTER

4) **Add an HA cluster instance.**
   Create an HA cluster node instance on the public networks (Subnet-1A and Subnet-1B).
   When creating an HA cluster node instance, be sure to specify the setting to enable a public IP. If an instance is created without using a public IP, it is necessary to add an EIP or a NAT instance later. (This gudie does not describe this case.)
   To use an IAM role by assigning it to an instance, be sure to specify the IAM role to the instance when creating it. (After the instance has been created, it is not possible to change the assigned IAM role or assign a new IAM role.)
   > → To create an instance, select **Instances > Launch Instance** on the EC2 Management console.
   > → For details about the IAM settings, refer to "Chapter 1
   > Configuring the IAM."

   Check the ID of the elastic network interface (ENI) assigned to each created instance.

   [4] ENI ID (Node1)   [5] ENI ID (Node2)
   Write down the ENI ID (eni-xxxxxxxx) of each instance because it is necessary to set up the AWS elastic ip resource later.

Use the following procedure to check the ENI ID assigned to the instance.
1. Select the instance to display its detailed information.
2. Click the target device in **Network Interfaces**.
3. Check **Interface ID** displayed in the pop-up window.
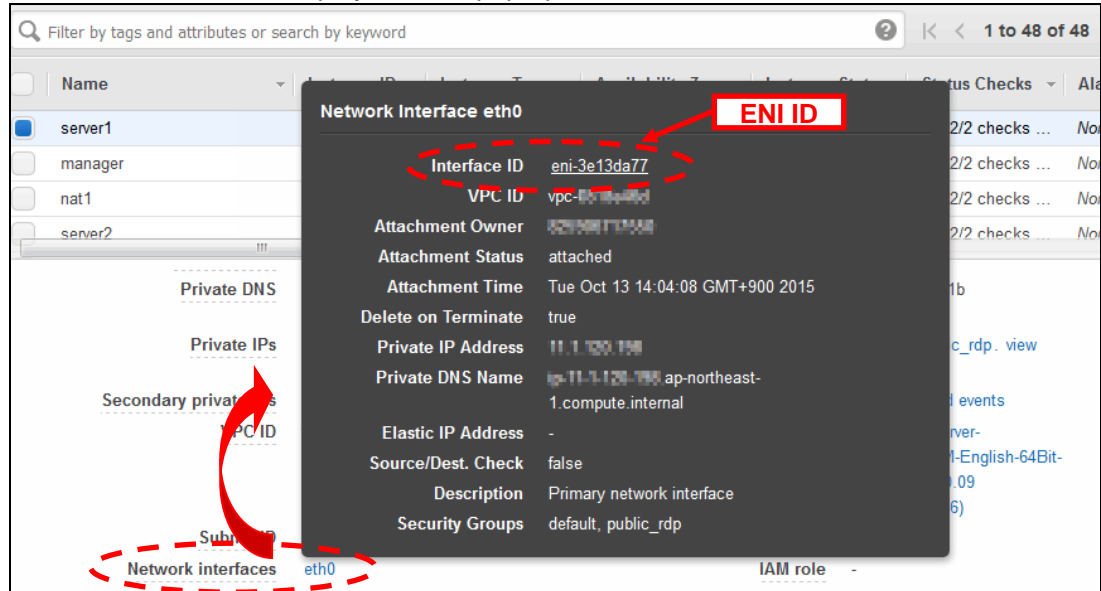
5) Add an EIP.
Add an EIP to access an instance in the VPC from the Internet.
→ To add an EIP, select **Elastic IPs > Allocate New Address** on the EC2 Management console.

[3] EIP Allocation ID

Write down the Allocation ID (eipalloc-xxxxxxxx) of the added EIP because it is necessary to set up the AWS elastic ip resource later.

6) Configure the route table.
Add the routing to the Internet gateway so that the AWS CLI can communicate with the regional endpoint via NAT.

The following routings must be set in the route table (Public-AB) of the public networks (Subnet-1A and Subnet-1B in the above figure).

◇ Route table (Public-AB)

Destination	Target	Remarks
VPC network (Example: 10.0.0.0/16)	local	Existing by default
0.0.0.0/0	**Internet Gateway**	Add (required)

When a failover occurred, the AWS elastic ip resource deassigns the EIP assigned to the active server instance by using the AWS CLI, and assign it to the standby server instance.

Configure other routings according to the environment.

7) Add a mirror disk (EBS).
Add an EBS to be used as the mirror disk (cluster partition or data partition) as needed.
→ To add an EBS, select **Volumes > Create volume** on the EC2 Management console, and then attach the created volume to an instance.

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5-2. Configuring the instance

Log in to each instance of the HA cluster and specify the following settings.
For the Python and AWS CLI versions supported by EXPRESSCLUSTER, refer to the following:
- EXPRESSCLUSTER X 3.3 for Linux Getting Started Guide
  → Chapter 3 Installation requirements for EXPRESSCLUSTER
  →Operation environment for AWS elastic ip resource, AWS virtual ip resource, AWS Elastic IP monitor resource, AWS virtual IP monitor resource, AWS AZ monitor resource

1) Disable SELinux.
Set `permissive` or `disabled` to SELinux to perform communication required by EXPRESSCLUSTER.

Run the following command to check the status of SELinux.
```
$ getenforce
Enforcing     (* Enforcing indictes that SELinux is enabled.)
```
Change the status of SELinux to "`disabled`" by using `/etc/sysconfig/selinux` and restart SELinux. Then run the `getenforce` command to confirm that `Disabled` is returned.

2) Configure a firewall.
Change the firewall setting as needed.
For the port numbers that are used by the EXPRESSCLUSTER components, refer to the following:
- EXPRESSCLUSTER X 3.3 for Linux Getting Started Guide
  → Chapter 5 Notes and Restrictions
    → Before installing EXPRESSCLUSTER

3) Install Python.
Install Python required by EXPRESSCLUSTER.
First, confirm that Python is installed.
If Python has not been installed, install it by using a command such as `yum`.
The installation path of the python commands must be any of the following:
   `/sbin, /bin, /usr/sbin, /usr/bin`

4) Install the AWS CLI.
Install the AWS CLI by running the pip command from a shell.
```
$ pip install awscli
```

For details about the pip command, refer to the following:
https://pip.pypa.io/en/latest/

The installation path of the AWS CLI must be any of the following:
   /sbin, /bin, /usr/sbin, /usr/bin, /usr/local/bin

For details about how to set up the AWS CLI, refer to the following:
http://docs.aws.amazon.com/cli/latest/userguide/installing.html

(If EXPRESSCLUSTER has been installed before installing Python or the AWS CLI, be sure to restart the OS before using EXPRESSCLUSTER.)

5) Register the AWS access key.
Run the following command from the shell.
```
$ sudo aws configure
```

Enter information such as the AWS access key to the inquiries.

The settings to be specified vary depending on whether an IAM role is assigned to the instance or not.

◇ Instance to which an IAM role is assigned.

```
AWS Access Key ID [None]: (Press Enter without entering anything.)
AWS Secret Access Key [None]: (Press Enter without entering anything.)
Default region name [None]: <default region name>
Default output format [None]: text
```
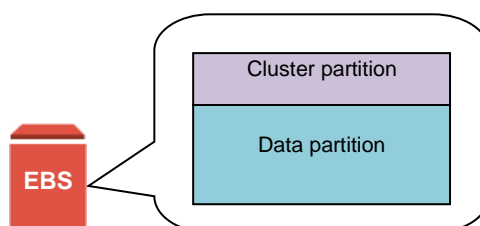
◇ Instance to which an IAM role is not assigned.

```
AWS Access Key ID [None]: <AWS access key>
AWS Secret Access Key [None]: <AWS secrete access key>
Default region name [None]: <default region name>
Default output format [None]: text
```

If you specified incorrect settings, delete the directory `/root/.aws` entirely, and specify the above settings again.

6) Prepare the mirror disk.
If an EBS has been added to be used as the mirror disk, divide the EBS into partitions and use each partition as the cluster partition and data partition.

Figure 5-2 EBS Partitioning Example

For details about the mirror disk partition, refer to the following:
- EXPRESSCLUSTER X 3.3 for Linux Installation & Configuration Guide
    → Chapter 1 Determining a system configuration
        → Partition settings for mirrot disk resource (when using Replicator)

7) Install EXPRESSCLUSTER.
For the installation procedure, refer to "EXPRESSCLUSTER X 3.3 for Linux Installation & Configuration Guide. "
Store the EXPRESSCLUSTER installation media in the environment to which to install EXPRESSCLUSTER.
(To transfer data, use any method such as Remote Desktop and Amazon S3.)

After the installation, restart the OS.

5-3. Setting up EXPRESSCLUSTER

This section describes how to set up EXPRESSCLUSTER by using the WebManeger cluster generation wizard.

For details about how to set up and connect to WebManager, refer to the following:

- EXPRESSCLUSTER X 3.3 for Linux Installation and Configuration Guide
  → Chapter 5 Creating the cluster configuration data

This section describes how to add the following resources:

    Mirror disk resource
    AWS EIP resource
    AWS AZ monitor resource
    AWS EIP monitor resource
    NP resolution (Custom monitor resource)

For the settings other than the above, refer to "EXPRESSCLUSTER X 3.3 for Linux Installation and Configuration Guide".

1) Construct a cluster.

Start the cluster generation wizard to construct a cluster.

◇ Construct a cluster.

Steps

1. Access WebManager. The dialog box below is displayed.
   Click **Start Cluster Generation Wizard**.

2. The dialog box below is displayed.
   Click **Start Standard Cluster Generation Wizard**.

3. The **Cluster Definition** page is displayed.
   Enter a cluster name in **Cluster Name**.
   Select an appropriate language from **Language**. The display language of WebManager will be changed to the language selected here by applying the settings.

4. The **Server Definition** page is displayed.
   The instance connecting to WebManager is displayed as the registered master server.
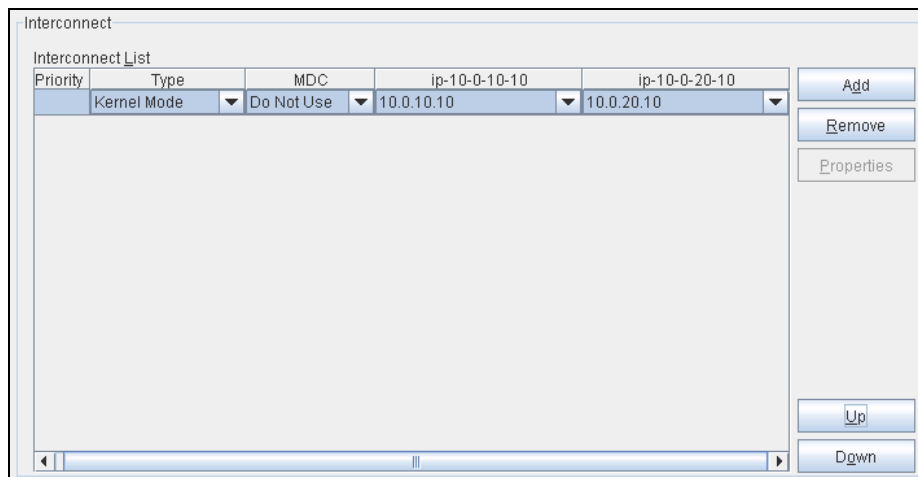   Click **Add** to add other instances (by specifying their private IP addresses).

5. Click **Next**.

6. The **Interconnect** page is displayed.
   Specify the IP address (private IP address of each instance) to be used for interconnect.
   Select mdc1 from **MDC** for the communication path of the mirror disk resource to be created later.
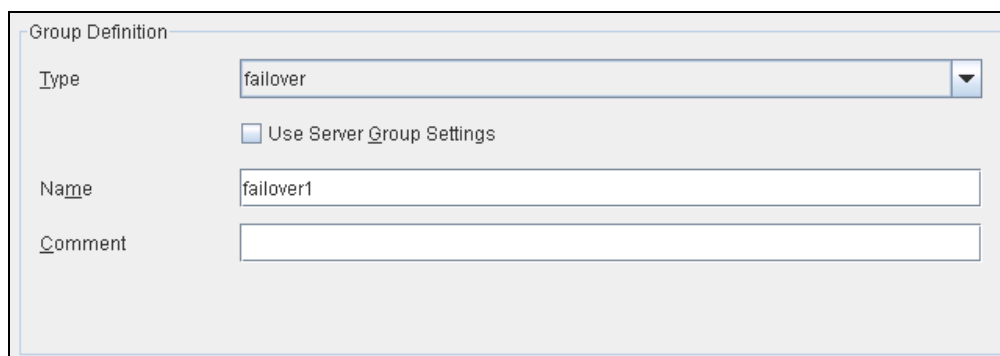
7. Click **Next**.

8. The **NP Resolution** page is displayed.
   However, the NP resolution is not set on this page. The same operation as the NP resolution can be achieved by adding the custom monitor resource to confirm whether listening on port 443 of the regional endpoint is normally performed. (The NP resolution will be set in "3) Add a monitor resource. " described later.)
   Click **Next**.

2) Add a group resource.

◇ Group definition
   Create a failover group.

Steps
1. The **Group Definition** dialog box is displayed.
   Enter the failover group name (failover1) in the **Name** box.

2. Click **Next**.

3. The **Available Servers** page is displayed.
   Click **Next** without specifying anything.

4. The **Group Attribute Settings** page is displayed.
   Click **Next** without specifying anything.

5. The **Group Resource** page is displayed.
   Add a group resource on this page following the procedure below.

◇ Mirror disk resource
   Create the mirror disk resource according the mirror disk (EBS) as needed.
   For details, refer to the following:
   • EXPRESSCLUSTER X 3.3 for Linux Reference Guide
      → Chapter 4, Group resource details
         → Understanding mirror disk resources

   Steps
   1. Click **Add** in **Group Resource List**.

   2. The **Resource Definition of Group(failover1)** window is displayed.
      Select the group resource type (Mirror disk resource) from the **Type** box and enter the group resource name (md) in the **Name** box.

   3. Click **Next**.

   4. The **Dependency** page is displayed.
      Click **Next** without specifying anything.

   5. The **Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** pages are displayed.
      Click **Next**.

   6. Enter the drive letter for the partition set up in "5-2 Configuring the instance" → "6) Prepare the mirror disk." in **Data Partition Drive Letter** and **Cluster Partition Drive Letter**.

   7. Click **Add** for **Available Servers**.

   8. The **Selection of Partition** window is displayed.
      Click **Connect** to obtain partition information.
      Select the data and cluster partitions and click **OK**.

   9. Perform steps 7 and 8 on the other node.

   10. Return to the **Advanced Settings** page and click **Finish** to complete setting.
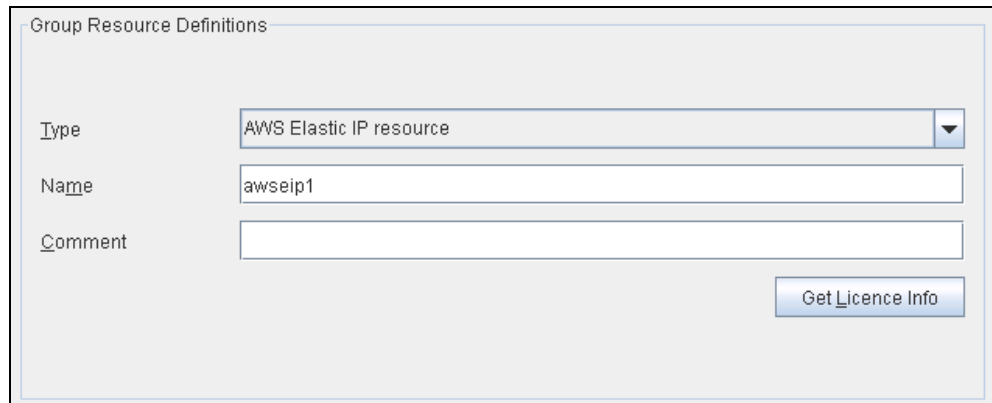

◇ AWS elastic ip resource
   Add an AWS elastic ip resource that controls the VIP by using the AWS CLI.

   For details, refer to the following:
   • EXPRESSCLUSTER X 3.3 for Linux Reference Guide
      → Chapter 4, Group resource details
         → Understanding AWS elastic ip resources

   Steps
   1. Click **Add** in **Group Resource List**.

   2. The **Resource Definition of Group(failover1)** window is displayed.
      Select the group resource type (AWS elastic ip resources) from the **Type** box and enter the group resource name (awseip1) in the **Name** box.

3. Click **Next**.

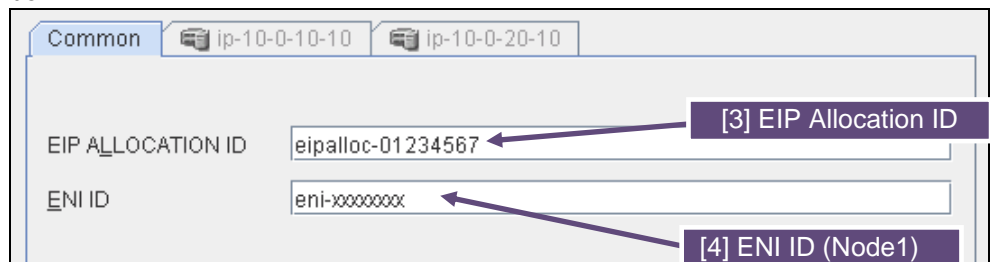4. The **Dependency** page is displayed. Click **Next** without specifying anything.

5. The **Recovery Operation at Activation Failure Detection** and **Recovery Operation at Deactivation Failure Detection** pages are displayed.
   Click **Next**.

6. The **Advanced Settings** page is displayed.
   Enter the allocation ID of the EIP to be assigned in the **EIP ALLOCATION ID** box on the **Common** tab.
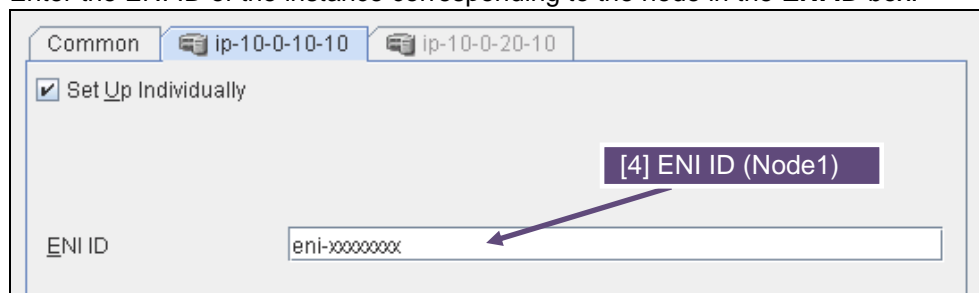   Enter the ENI ID of the active server instance to which the EIP is assigned in the **ENI ID** box.

7. Specify the node settings on each node tab
   Select the **Individually Set Up Servers** check box.
   Enter the ENI ID of the instance corresponding to the node in the **ENI ID** box.

8. Click **Finish** to complete setting.

3) Add a monitor resource.

◇ AWS AZ monitor resource
Create the AWZ AZ monitor resource to check whether the specified AZ is usable by using the monitor command.
For details, refer to the following:
- EXPRESSCLUSTER X 3.3 for Linux Reference Guide
→ Chapter 5, Monitor resource details
→ Understanding AWS AZ monitor resources

Steps
1. Click **Add** in **Monitor Resource List**.

2. Select the monitor resource type (AWS AZ monitor) from the **Type** box and enter the monitor resource name (awsazw1) in the **Name** box.

3. Click **Next**.

4. The **Monitor (common)** page is displayed.
Click **Next** without specifying anything.

5. The **Monitor (special)** page is displayed.
Enter the AZ to be monitored in the **Availability Zone** box on the **Common** tab.
(Specify the AZ of the active server instance.)

6. Specify the node settings on each node tab
   Select the **Individually Set Up Servers** check box.
   Enter the AZ of the instance corresponding to the node in the **Availability Zone** box.

7. Click **Next**.

8. The **Recovery Action** page is displayed.
   Set LocalServer in the **Recovery Target** box.

9. Click **Finish** to complete setting.

◇ AWS elastic ip monitor resource
   This resource is automatically added when the AWS virtual ip resource is added.

The health of the EIP address can be checked by monitoring the communication with the EIP address that is assigned to the active server instance.
For details, refer to the following:
- EXPRESSCLUSTER X 3.3 for Linux Reference Guide
  → Chapter 5, Monitor resource details
    → Understanding AWS elastic ip monitor resources

◇ Custom monitor resource
This resource checks the status of the communication with the EIP address by monitoring the communication with port 443 of the endpoint of the region in which the environment has been constructed.

For the regional endpoints, refer to the following URL:
http://docs.aws.amazon.com/general/latest/gr/rande.html

For details, refer to the following:
- EXPRESSCLUSTER X 3.3 for Linux Reference Guide
  → Chapter 6, Monitor resource details
    → Understanding custom monitor resources

4) Apply the settings and start the cluster.

After the settings are complete, click the **Apply Settings** icon under the menu.
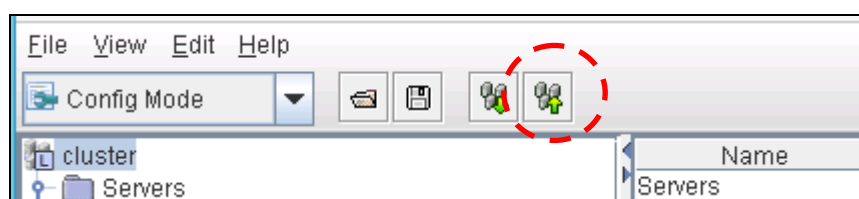
The dialog box to confirm to restart the manager is displayed.
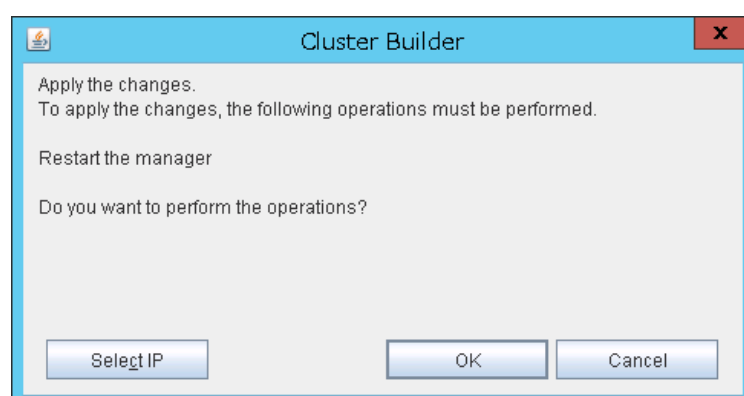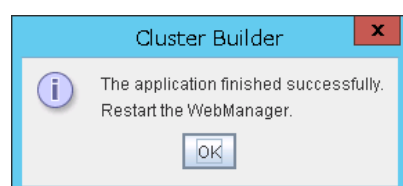
Click **OK**.

Click **OK**.

Change the mode to **Operation Mode** and select **Start Cluster** from the **Service** menu.
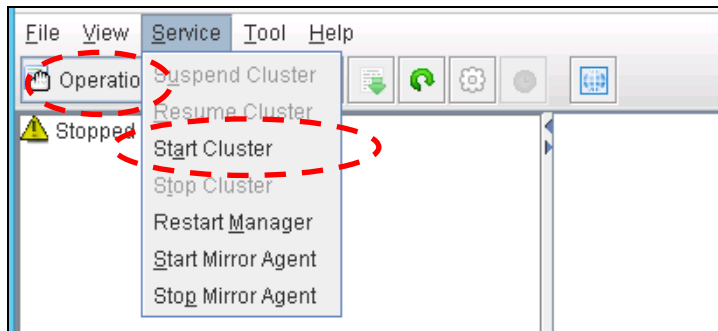
Chapter 6   Configuring the IAM

This chapter describes the Identity & Access Management (IAM) settings in the AWS environment. For the resource and monitor resources such as the AWS virtual ip resource, the AWS CLI is run in a resource to process the resource itself. To run the AWS CLI correctly, it is required to configure the IAM in advance.

There are two methods to grant access permissions to the AWS CLI: the policy to use an IAM role and the policy to use an IAM user. NEC recommends the policy to use an IAM role because it is unnecessary to store the AWS access key ID and AWS secrete access key in each instance in principle, enhancing the security.

The following table describes the advantages and disadvantages of both policies.

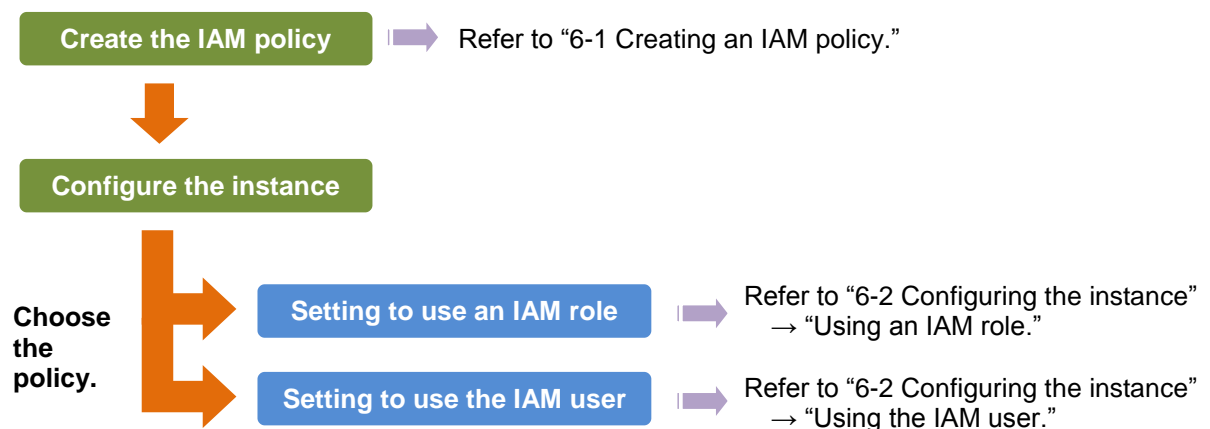|	Advantages	Disadvantages
Policy to use an IAM role	High security Easy to manage key information.	Not available to set access permissions to an individual instance later because the defined IAM role cannot be changed.
Policy to use an IAM user	Available to set access permissions to an individual instance later	High risk of key information disclosure Complicated to manage key information

The procedure to configure the IAM is as follows:

| **Create the IAM policy** | ⇒ Refer to "6-1 Creating an IAM policy." |

Configure the instance

Choose the policy.

| **Setting to use an IAM role** | ⇒ Refer to "6-2 Configuring the instance"
→ "Using an IAM role." |
| **Setting to use the IAM user** | ⇒ Refer to "6-2 Configuring the instance"
→ "Using the IAM user." |

6-1. Creating an IAM policy

Create a policy in which access permissions granted to the actions for the services such as EC2 and S3 of AWS are described. Access permissions need to be granted to the following actions so that the AWS related resources and monitor resources of EXPRESSCLUSTER run the AWS CLI.
The required policies may be changed in future.

◇ AWS virtual ip resource and AWS virtual ip monitor resource

Action	Description
ec2:Describe*	Required to obtain information of a VPC, route table, and network interface.
ec2:ReplaceRoute	Required to update a route table.

◇ AWS elastic ip resource and AWS elastic ip monitor resource

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Action	Description
ec2:Describe*	Required to obtain information of an EIP and network interface.
ec2:AssociateAddress	Required to assign an EIP to an ENI.
ec2:DisassociateAddress	Required to deassign an EIP from an ENI.

◇ AWS AZ monitor resource

Action	Description
ec2:Describe*	Required to obtain information of an AZ.

In the following custom policy example, access permissions are granted to all actions to be used by the AWS-related resources and monitore resources.

```
{
   "Version": "2012-10-17",
   "Statement": [
     {
        "Action": [
          "ec2:Describe*",
          "ec2:ReplaceRoute",
          "ec2:AssociateAddress",
          "ec2:DisassociateAddress"
        ],
        "Effect": "Allow",
        "Resource": "*"
     }
   ]
}
```
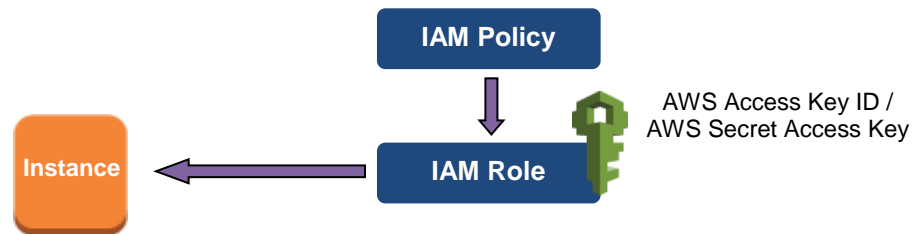
→ To create a custom policy, select **Policies > Create Policy** on the IAM Management console.

6-2. Configuring the instance

Using an IAM role

Create an IAM role and assign the created IAM role to an instance to run the AWS CLI.

1) Create an IAM role. Attach the IAM policy to the created role.
   → To create an IAM role, select **Roles > Create New Role** on the IAM Management console.

2) When creating an instance, specify the created IAM role for **IAM Role**.
   (The IAM role cannot be assigned to the created instance later.)

3) Log on to the instance.

4) Install Python.
   Install Python required by EXPRESSCLUSTER.
   First, confirm that Python is installed.
   If Python has not been installed, install it by using a command such as yum.
   The installation path of the python commands must be any of the following:
       /sbin, /bin, /usr/sbin, /usr/bin

5) Install the AWS CLI.
   Install the AWS CLI by running the pip command from a shell.
   ```
   $ pip install awscli
   ```

   For details about the pip command, refer to the following:
   https://pip.pypa.io/en/latest/

   The installation path of the AWS CLI must be any of the following:
       /sbin, /bin, /usr/sbin, /usr/bin, /usr/local/bin

   For details about how to set up the AWS CLI, refer to the following:
   http://docs.aws.amazon.com/cli/latest/userguide/installing.html

   (If EXPRESSCLUSTER has been installed before installing Python or the AWS CLI, be sure to restart the OS before using EXPRESSCLUSTER.)

6) Run the following command from the shell.
   ```
   $ sudo aws configure
   ```

   Enter information such as the AWS access key to the inquiries.
   The settings to be specified vary depending on whether an IAM role is assigned to the instance or not.

   ```
   AWS Access Key ID [None]: (Press Enter without entering anything.)
   AWS Secret Access Key [None]: (Press Enter without entering anything.)
   Default region name [None]: <default region name>
   ```

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```
Default output format [None]: text
```

If you specified incorrect settings, delete the directory `/root/.aws` entirely, and specify the above settings again.

Using an IAM user

Create an IAM user and store the access key ID and secrete access key of the created user in an instance to run the AWS CLI. It is not required to assign the created IAM role to an instance to be created.
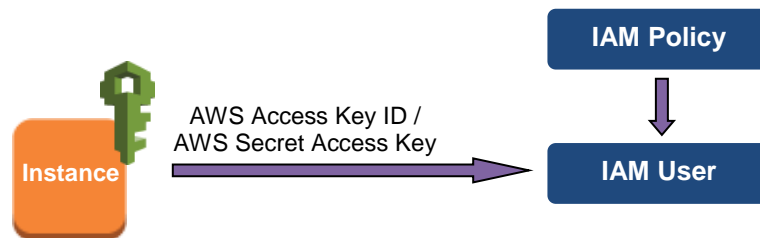
1) Create an IAM user. Attach the IAM policy to the created user.
   → To create an IAM user, select **Users > Create New Users** on the IAM Management console.

2) Log on to the instance.

3) Install Python.
   Install Python required by EXPRESSCLUSTER.
   First, confirm that Python is installed.
   If Python has not been installed, install it by using a command such as yum.
   The installation path of the python commands must be any of the following:
   /sbin, /bin, /usr/sbin, /usr/bin

4) Install the AWS CLI.
   Install the AWS CLI by running the pip command from a shell.

```
$ pip install awscli
```

   For details about the pip command, refer to the following:
   https://pip.pypa.io/en/latest/

   The installation path of the AWS CLI must be any of the following:
   /sbin, /bin, /usr/sbin, /usr/bin, /usr/local/bin

   For details about how to set up the AWS CLI, refer to the following:
   http://docs.aws.amazon.com/cli/latest/userguide/installing.html

   (If EXPRESSCLUSTER has been installed before installing Python or the AWS CLI, be sure to restart the OS before using EXPRESSCLUSTER.)

5) Run the following command from the shell.

```
$ sudo aws configure
```

   Enter the information required to run the AWS CLI to the inquiries. For the AWS access key ID and AWS secrete access key, enter those obtained from the IAM use detailed information window.

```
AWS Access Key ID [None]: <AWS access key>
AWS Secret Access Key [None]: <AWS secrete access key>
Default region name [None]: <default region name>
```

```
Default output format [None]: text
```

If you specified incorrect settings, delete the directory `/root/.aws` entirely, and specify the above settings again.

Chapter 7   Troubleshooting

This chapter describes the points to be checked and solutions if EXPRESSCLUSTER cannot be set up in the AWS environment.

◆ Failed to start a resource or monitor resource related to AWS.
Confirm that the OS has restarted, Python and the AWS CLI are installed, and the AWS CLI has been set up correctly.
If the OS has been restarted when installing EXPRESSCLUSTER, the environment variable settings might be changed by installing Python and the AWS CLI. In this case, restart the OS again.

◆ Failed to start the AWS virtual ip resource.

WebManager message	Activating *awsvip1* resource has failed.(99 : Internal error. (status=*nn*))
Possible cause	Any of the following might be the cause. ◆ Python has not been installed, or the path does not reach python. ◆ The AWS CLI has not been installed, or the path does not reach AWS CLI.
Solution	Confirm that Python and the AWS CLI are installed. The installation path of the python commands must be any of the following: /sbin, /bin, /usr/sbin, /usr/bin The installation path of the AWS CLI must be any of the following: /sbin, /bin, /usr/sbin, /usr/bin, /usr/local/bin

WebManager message	Activating *awsvip1* resource has failed.(5 : Failed in the AWS CLI command.)
Possible cause	Any of the following might be the cause. ◆ The AWS CLI has not been set up. (`aws configure` has not been run.) ◆ The AWS CLI configuration file could not be found. (A user other than root ran aws configure, or A user without sudo ran aws configure.) Search for a credentials file and a config file by the following order (in case of policy for which the IAM user is used). 1) $HOME/.aws follower 2) /root/.aws follower ◆ The specified AWS CLI settings (such as a region, access key, and secrete key) are not correct. ◆ (For an operation using an IAM role) An IAM role has not been set to the instance. ◆ The specified VPC ID or ENI ID is invalid.
Solution	Confirm that the AWS CLI works normally. Correct the above mentioned settings.

WebManager message	(For EXPRESSCLUSTER internal version 3.3.3-1 or later) Activating *awsvip1* resource has failed.(5 : The vpc ID '*vpc-xxxxxxx*' does not exist)
Possible cause	The specified VPC ID might not be correct or might not exist.
Solution	Specify a correct VPC ID.

WebManager message	(For EXPRESSCLUSTER internal version 3.3.3-1 or later)

	Activating *awsvip1* resource has failed.(5 : The networkInterface ID '*eni-xxxxxxx*' does not exist)
Possible cause	The specified ENI ID might not be correct or might not exist.
Solution	Specify a correct ENI ID.

WebManager message	Activating *awsvip1* resource has failed.(6 : Timeout occurred.)
Possible cause	The AWS CLI command might not be able to communicate with the regional endpoint.
Solution	Check the following: ◆ The instance for NAT is running. ◆ The routing for the NAT instance has been set up. ◆ The packet is not excluded by filtering.

WebManager message	Activating *awsvip1* resource has failed.(7 : The VIP address *vvv.www.xxx.yyy* belongs to a VPC subnet.)
Possible cause	The specified VIP address is not appropriate because it is within of the VPC CIDR range.
Solution	Specify an IP address out of the VPC CIDR range as the VIP address.

◆ The AWS virtual ip resource is running normally, but `ping` cannot reach the VIP address.

WebManager message	-
Possible cause	**Source/Dest. Check** of the ENI set to the AWS virtual ip resource is enabled.
Solution	Disable **Source/Dest. Check** of the ENI set to the AWS virtual ip resource.

◆ The AWS virtual ip monitor resource enters the error state.

WebManager message	Detected an error in monitoring *awsvipw1*. (8 : The routing for VIP *vvv.www.xxx.yyy* was changed.)
Possible cause	In the route table, the target of the VIP address corresponding to the AWS virtual ip resource has been changed to another ENI ID for some reason.
Solution	When an error is detected, the AWS virtual ip resource is restarted automatically and the target is updated to a correct ENI ID. Check whether another HA cluster uses the same VIP address mistakenly and so on.

◆ Failed to start the AWS elastic ip resource.

WebManager message	Activating *awseip1* resource has failed.(99 : Internal error. (status=*nn*))
Possible cause	Any of the following might be the cause. ◆ Python has not been installed, or the path does not reach `python`. ◆ The AWS CLI has not been installed, or the path does not reach AWS CLI.
Solution	Confirm that Python and the AWS CLI are installed. The installation path of the python commands must be any of the following: /sbin, /bin, /usr/sbin, /usr/bin The installation path of the AWS CLI must be any of the following: /sbin, /bin, /usr/sbin, /usr/bin, /usr/local/bin

WebManager message	Activating *awseip1* resource has failed.(5 : Failed in the AWS CLI command.)
Possible cause	Any of the following might be the cause. ◆ The AWS CLI has not been set up. (`aws configure` has not been run.) ◆ The AWS CLI configuration file could not be found. (A user other than root ran aws configure, or A user without sudo ran aws configure.) Search for a credentials file and a config file by the following order (in case of policy for which the IAM user is used). 1) $HOME/.aws follower 2) /root/.aws follower ◆ The specified AWS CLI settings (such as a region, access key, and secrete key) are not correct. ◆ (For an operation using an IAM role) An IAM role has not been set to the instance. ◆ The specified EIP Allocation ID or ENI ID is invalid.
Solution	Confirm that the AWS CLI works normally. Correct the above mentioned settings.

WebManager message	(For EXPRESSCLUSTER internal version 3.3.3-1 or later) Activating *awseip1* resource has failed.(5 : The allocation ID '*eipalloc-xxxxxxxx*' does not exist)
Possible cause	The specified EIP Allocation ID might not be correct or might not exist.
Solution	Specify a correct EIP Allocation ID.

WebManager message	(For EXPRESSCLUSTER internal version 3.3.3-1 or later) Activating *awseip1* resource has failed.(5 : The networkInterface ID '*eni-xxxxxxxx*' does not exist)
Possible cause	The specified ENI ID might not be correct or might not exist.
Solution	Specify a correct ENI ID.

WebManager message	Activating *awseip1* resource has failed.(6 : Timeout occurred.)
Possible cause	The AWS CLI command might not be able to communicate with the regional endpoint.
Solution	Confirm that a public IP is assigned to each instance. Confirm that the AWS CLI works normally in each instance.

◆ The AWS elastic ip monitor resource enters the error state.

WebManager message	Detected an error in monitoring *awseipw1*. (7 : The EIP address does not exist. (EIP ALLOCATION ID=*eipalloc-xxxxxxxx*))
Possible cause	The specified ENI ID and elastic IP have been deassociated for some reason.
Solution	When an error is detected, the AWS elastic ip resource is restarted automatically and the specified ENI ID and elastic IP are associated. Check whether another HA cluster uses the same EIP allocation ID mistakenly and so on.

◆ The AWS AZ monitor resource enters the warning or error state.

WebManager message	[Warning] Warn monitoring *awsazw1*. (105 : Failed in the AWS CLI command.) [Error] Detected an error in monitoring *awsazw1*. (5 : Failed in the AWS

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	CLI command.)
Possible cause	Any of the following might be the cause. ◆ The AWS CLI has not been set up. (`aws configure` has not been run.) ◆ The AWS CLI configuration file could not be found. (A user other than root ran aws configure, or A user without sudo ran aws configure.) Search for a credentials file and a config file by the following order (in case of policy for which the IAM user is used). 1) $HOME/.aws follower 2) /root/.aws follower ◆ The specified AWS CLI settings (such as a region, access key, and secrete key) are not correct. ◆ (For an operation using an IAM role) An IAM role has not been set to the instance. ◆ The specified AZ is invalid.
Solution	Confirm that the AWS CLI works normally. Correct the above mentioned settings.

WebManager message	(For EXPRESSCLUSTER internal version 3.3.3-1 or later) [Warning] Warn monitoring *awsazw1*. (105 : Invalid availability zone: [*ap-northeast-1x*]) [Error] Detected an error in monitoring *awsazw1*. (5 : Invalid availability zone: [*ap-northeast-1x*])
Possible cause	The specified AZ might not be correct or might not exist.
Solution	Specify a correct AZ.

WebManager message	[Warning] Warn monitoring *awsazw1*. (106 : Timeout occurred.) [Error] Detected an error in monitoring *awsazw1*. (6 : Timeout occurred.)
Possible cause	The AWS CLI command might not be able to communicate with the regional endpoint because the route table of the NAT setting is incorrect and so on.
Solution	Check the following: ◆ The NAT instance is running. ◆ The routing for the NAT instance has been set up. ◆ The packet is not excluded by filtering.