EXPRESSCLUSTER® X 4.1

HA Cluster Configuration Guide
for Microsoft Azure
(Linux)

April 10, 2019
1st Edition

EXPRESSCLUSTER X

Revision History

Edition	Revised Date	Description
1st	Apr 10, 2019	New guide

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Contents

Preface

Who Should Use This Guide

The *HA Cluster Configuration Guide for Microsoft Azure (Linux)* is intended for administrators who want to build a cluster system, and for system engineers and maintenance personnel who provide user support.
The software and setup examples introduced in this guide are for reference only, and the software is not guaranteed to run.

Scope of application

This guide covers the following product versions.

- EXPRESSCLUSTER X 4.1 for Linux (Internal version: 4.1.0-1)
- CentOS 7.5
- Microsoft Azure portal: Environment as of January 31, 2019
- Azure CLI 2.0

If the product versions that you use differ from the above, some display and configuration contents may differ from those described in this guide.
The display and configuration contents may also change in the future. Therefore, for the latest information, see the website or manual of each product and service.

How This Guide is Organized

Chapter 1	Overview: Describes the functional overview.
Chapter 2	Operating Environments: Describes the tested operating environment of this function.
Chapter 3	Cluster Creation Procedure: Describes the procedure to create an HA cluster using Azure DNS.
Chapter 4	Cluster Creation Procedure: Describes the procedure to create an HA cluster using an public load balancer.
Chapter 5	Cluster Creation Procedure: Describes the procedure to create an HA cluster using an internal load balancer.
Chapter 6	Error Messages: Describes the error messages and solutions.
Chapter 7	Notes and Restrictions: Describes the notes and restrictions on creating and operating a cluster.

EXPRESSCLUSTER X Documentation Set

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

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

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

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

Maintenance Guide
This guide is intended for administrators and for system administrators who want to build, operate, and maintain EXPRESSCLUSTER-based cluster systems. The guide describes maintenance-related topics for EXPRESSCLUSTER.

Hardware Feature Guide
This guide is intended for administrators and for system engineers who want to build EXPRESSCLUSTER-based cluster systems. The guide describes features to work with specific hardware, serving as a supplement to the *Installation and Configuration Guide*.

Legacy Feature Guide
This guide is intended for administrators and for system engineers who want to build EXPRESSCLUSTER-based cluster systems. The guide describes EXPRESSCLUSTER X 4.0 WebManager and Builder.

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 text boxes, list boxes, menu selections, buttons, labels, icons, etc.	Click **Start**. **Properties** dialog box
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.	`# clpstat`
Monospace (Courier)	Indicates path names, commands, system output (message, prompt, etc.), directory, file names, functions and parameters.	`/Linux`
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.	**`# ping`** *<IP address>*

Contacting NEC

For the latest product information, visit our website below:

https://www.nec.com/en/global/prod/expresscluster/

Chapter 1 Overview

1.1 Functional overview

This guide describes how to configure an HA cluster based on EXPRESSCLUSTER X (hereinafter referred to as “EXPRESSCLUSTER”) using Azure Resource Manager on a Microsoft Azure cloud service.

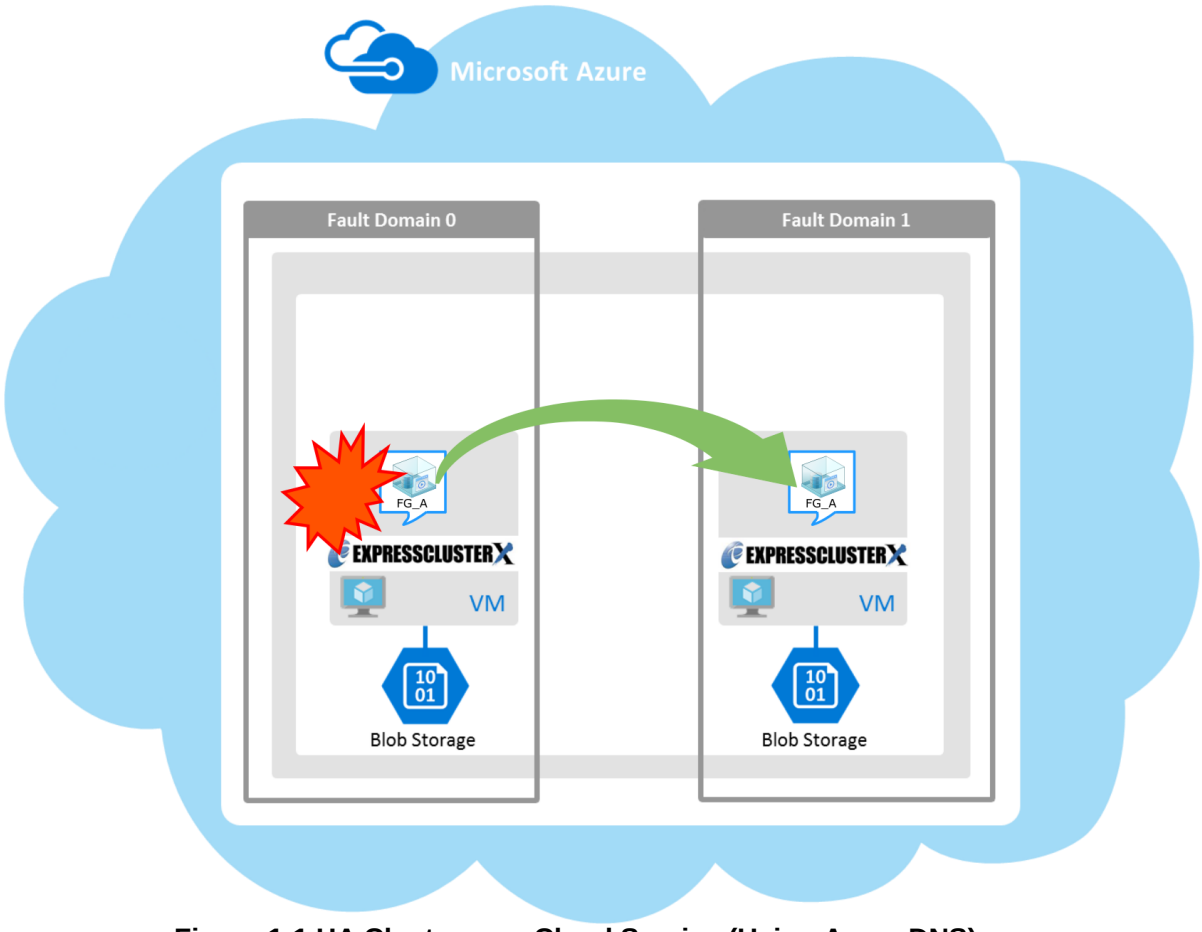


Figure 1-1 HA Cluster on a Cloud Service (Using Azure DNS)

Operational availability can be increased by clustering virtual machines (VMs in Figure 1-1) using a Microsoft Azure region and availability set in a Microsoft Azure environment.

- Microsoft Azure region
  Physical and logical units called a Microsoft Azure region are provided.
  It is possible to build all nodes in a single region (such as Japan East or Japan West). However, if all nodes are built in a single region, there is a possibility for nodes to go down due to a network failure or natural disaster, causing interruption to the flow of business. Distributing nodes into multiple regions can improve the operational availability.
- Availability set
  Microsoft Azure allows each node to be deployed in a logical group called an *availability set*. Locating each node in an availability set minimizes the impact of planned maintenance or unplanned maintenance due to a physical hardware failure of the Microsoft Azure platform. This guide describes the configuration using an availability set.
  For details about an availability set, see the following website:
  Manage the availability of Linux virtual machines:
  https://docs.microsoft.com/en-us/azure/virtual-machines/linux/manage-availability

1.2 Basic configuration

This guide assumes two types of HA clusters. One is an HA cluster using Azure DNS of the Resource Manager deployment model. The other is an HA cluster using a load balancer of the Resource Manager deployment model. (Both HA clusters are configured as a unidirectional standby cluster.) The following table describes the EXPRESSCLUSTER resources to be selected depending on the Microsoft Azure deployment model in use.

Purpose	EXPRESSCLUSTER resource to use
Accessing the cluster by using a DNS name (Azure DNS needs to be installed)	Azure DNS resource
Accessing the cluster by using a virtual IP address(global IP address) (Use public load balancer)	Azure probe port resource
Accessing the cluster by using a virtual IP address(private IP address) (Use internal load balancer)	Azure probe port resource

HA cluster using Azure DNS

In this configuration, two virtual machines are deployed the same resource group so that the cluster can be accessed by using the same DNS name. The EXPRESSCLUSER Azure DNS resource uses Azure DNS to enable access with a DNS name. For details about Azure DNS, see the following website:
Azure DNS: https://azure.microsoft.com/en-us/services/dns/

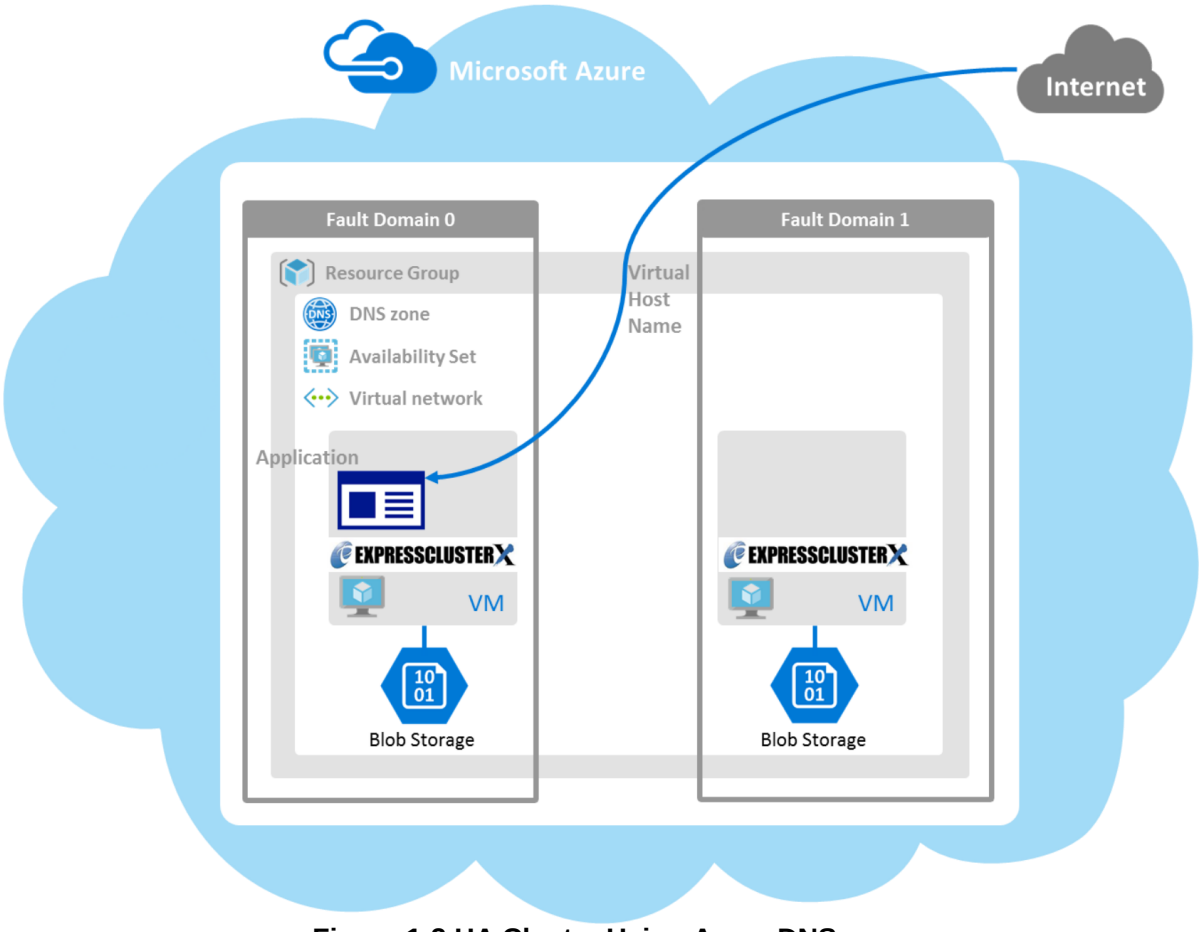


Figure 1-2 HA Cluster Using Azure DNS

These two virtual machines use the same availability set to minimize the impact of planned maintenance or unplanned maintenance due to a physical hardware failure of the Microsoft Azure platform.
The cluster in Figure 1-2 is accessed by using the DNS name of the Azure DNS zone. EXPRESSCLUSTER manages record sets and DNS A records of the Azure DNS zone to find an IP address according to the DNS name. A client need not be conscious about the switching of virtual machines upon failover occurrence or group migration.

The following table describes the EXPRESSCLUSTER resources and monitor resources required for a HA cluster configuration using Azure DNS.

Resource or monitor resource type	Description	Setting
Azure DNS resource	Manages the record sets (A records) of the Azure DNS zone to find an IP address according to the DNS name.	Required
Azure DNS monitor resource	Monitors that the results of name resolution are normal in relation to the Azure DNS record set.	Required
IP monitor resource	Monitors whether communication with the Microsoft Azure Service Management API is possible, and also monitors health of communication with an external network.	When an public load balancer is used, required to monitor communication between clusters that are configured with virtual machines, and also to monitor health of communication with an internal network.
Custom monitor resource	Monitors communication between clusters that are configured with virtual machines, and also monitors health of communication with an internal network.	When an public load balancer is used, required to monitor whether communication with the Microsoft Azure Service Management API is possible, and also to monitor health of communication with an external network.
Multi target monitor resource	Monitors the statuses of both the IP monitor resource and custom monitor resource. If the statuses of both monitor resources are abnormal, a script in which a process for network partition resolution (NP resolution) is described is executed.	When an public load balancer is used, required to monitor health of communication between an internal network and external network.
Other resources and monitor resources	Depends on the configuration of application, such as a mirror disk, that is used in an HA cluster.	Optional

HA cluster using a load balancer

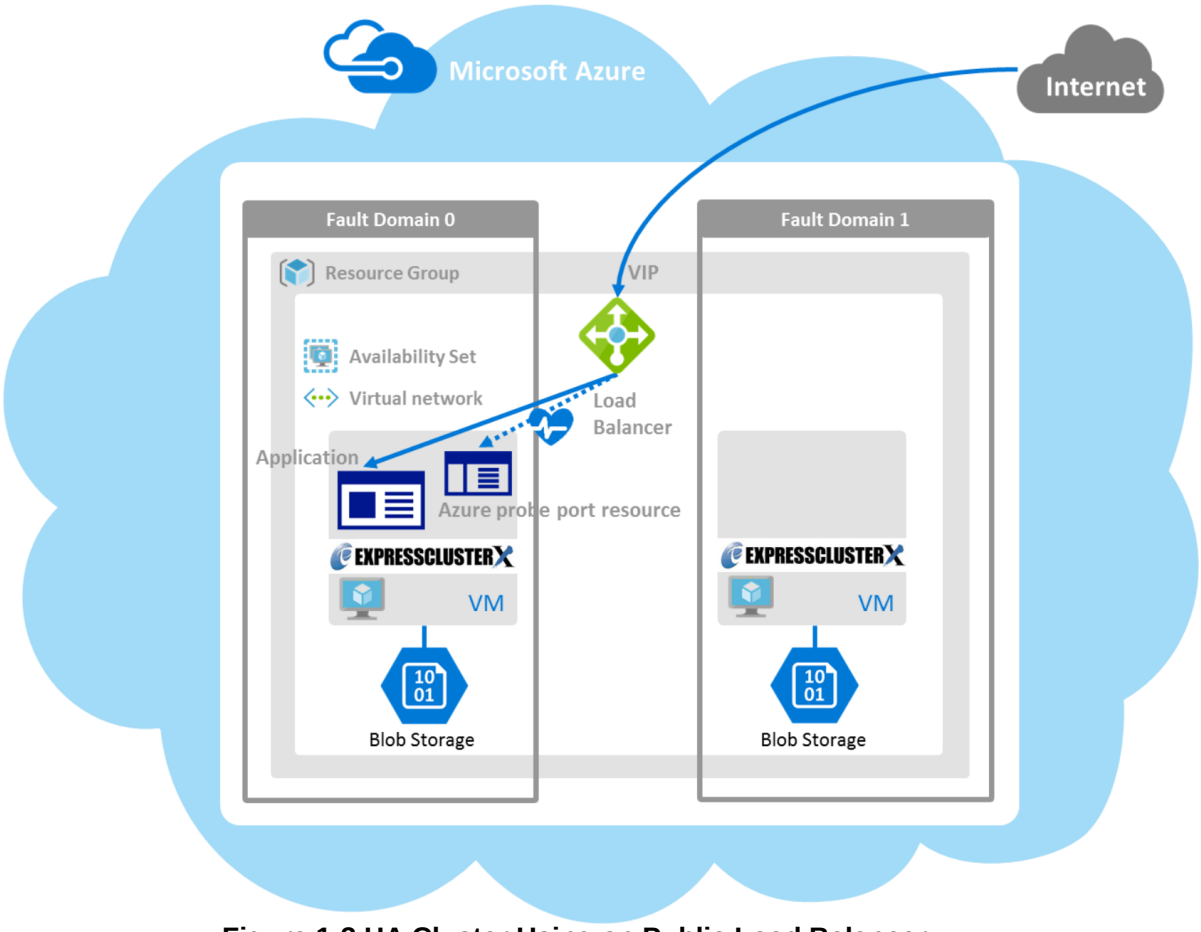


Figure 1-3 HA Cluster Using an Public Load Balancer

A client application can connect a virtual machine on an availability set in a Microsoft Azure environment to a cluster node by using frontend IP address. By using a VIP (Virtual IP), a client need not be conscious about the switching of virtual machines upon failover occurrence or group migration.

A cluster built in a Microsoft Azure environment in Figure 1-3 is accessed by specifying a global IP address of the Microsoft Azure Load Balancer (Load Balancer in Figure 1-3).
Active and standby nodes of a cluster are switched by using probes of Microsoft Azure Load Balancer. To use Microsoft Azure Load Balancer probes, use a probe port provided by the EXPRESSCLUSTER Azure probe port resource.
Activating the Azure probe port resource starts a probe port control process in standby for alive monitoring (access to a probe port) from Microsoft Azure Load Balancer.
Deactivating the Azure probe port resource stops a probe port control process in standby for alive monitoring (access to a probe port) from Microsoft Azure Load Balancer.

The Azure probe port resource also supports the Microsoft Azure internal load balancer (Internal Load Balancing: ILB). For the internal load balancer, a Microsoft Azure private IP address is used as a VIP.

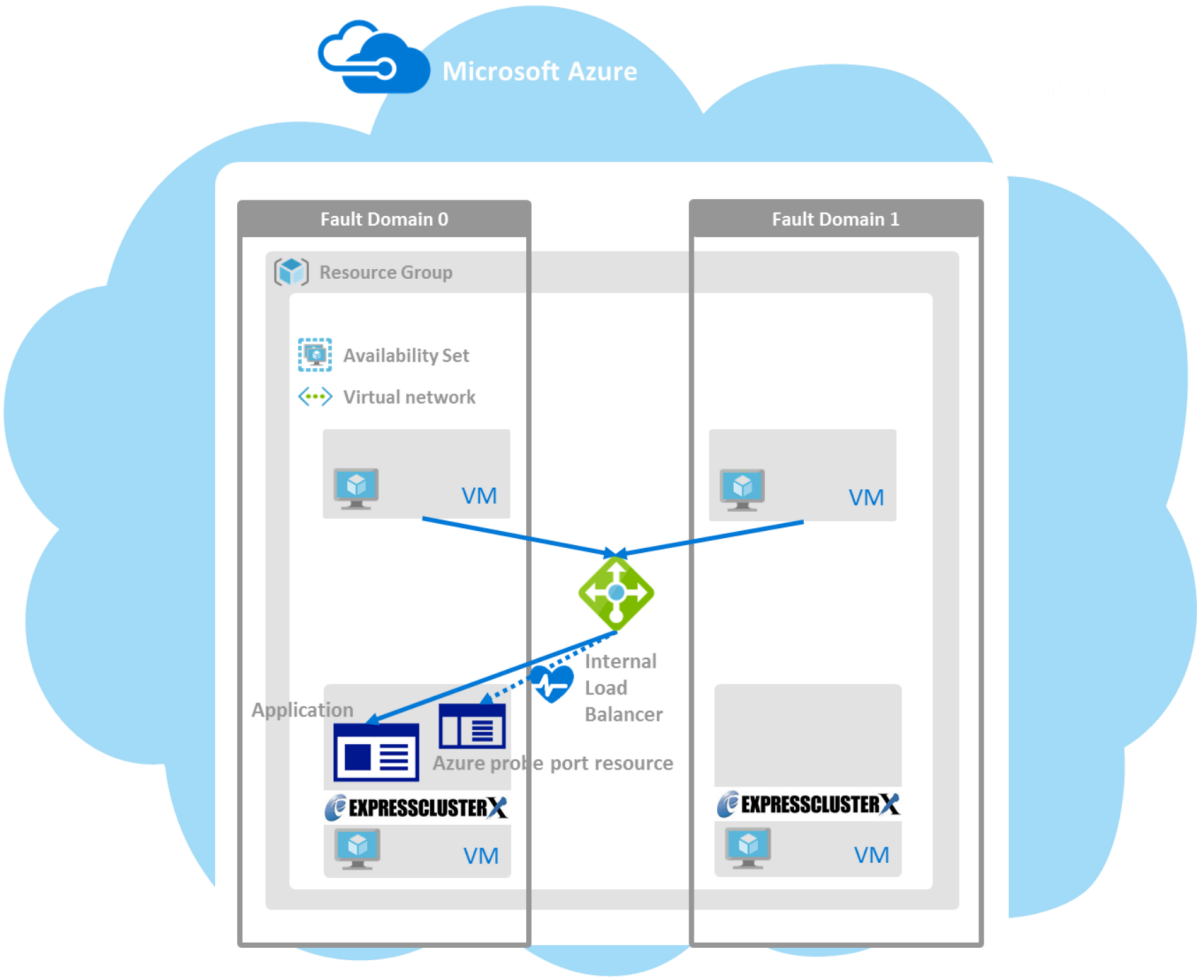


Figure 1-4 HA Cluster Using the Internal Load Balancer

The following are examples of two HA cluster configurations using a load balancer. Select a load balancer to use depending on your purpose.

Purpose	Load balancer to use	Creating procedure
Disclosing operations outside the Microsoft Azure network	Public load balancer	See " Chapter 4 Cluster Creation Procedure (for an HA Cluster Using an Public Load Balancer)" in this guide.
Publishing operations within the Microsoft Azure network	Internal load balancer (ILB)	See " Chapter 5 Cluster Creation Procedure (for an HA Cluster Using an Internal Load Balancer)" in this guide.

The following table describes the EXPRESSCLUSTER resources and monitor resources required for a HA cluster using a load balancer.

Resource or monitor resource type	Description	Setting
Azure probe port resource	Provides a mechanism to wait for alive monitoring from a load balancer on a specific port of a node in which operations are running.	Required
Azure probe port monitor resource	Performs alive monitoring of a probe port control process, which starts upon activation of the Azure probe port resource, for a node in which the Azure probe port resource is running.	Required
Azure load balance monitor resource	Monitors whether a port with the same number as a probe port is open for a node in which the Azure probe port resource is not running.	Required
IP monitor resource	Monitors whether communication with the Microsoft Azure Service Management API is possible, and also monitors health of communication with an external network.	When an public load balancer is used, required to monitor communication between clusters that are configured with virtual machines, and also to monitor health of communication with an external network.
Custom monitor resource	Monitors communication between clusters that are configured with virtual machines, and also monitors health of communication with an internal network.	When an public load balancer is used, required to monitor whether communication with the Microsoft Azure Service Management API is possible, and also to monitor health of communication with an external network.
Multi target monitor resource	Monitors the statuses of both the IP monitor resource and custom monitor resource. If the statuses of both monitor resources are abnormal, a script in which a process for network partition resolution (NP resolution) is described is executed.	When anpublic load balancer is used, required to monitor health of communication between an internal network and external network.
PING network partition resolution resource	When an internal load balancer (ILB) is used, monitors health of communication between subnets by checking whether to communicate with a device that is always on and can return a response to ping (ping device).	When an internal load balancer (ILB) is used, required to monitor health of communication between subnets.
Other resources and monitor resources	Depends on the configuration of application, such as a mirror disk, that is used in an HA cluster.	Optional

1.3 Network partition resolution

Virtual machines configuring an HA cluster mutually performs alive monitoring through a heartbeat communication. If the virtual machines exist in different subnets, an undesirable event, such as an application starting more than once, occurs if a heartbeat ceases. To prevent a service from starting more than once, it is necessary to identify whether other virtual machines went down or whether the applicable virtual machine was isolated from a network (network partitioning: NP).

The network partition resolution feature (NP resolution) sends ping to or checks a LISTEN port of a device that is always on and can return a response to ping etc. (access destination). If there is no reply, this feature judges that the device entered the NP status and executes the specified action (such as a warning, recovery action, and server shutdown).

The access destination in the following table are used as ping devices for Microsoft Azure.
(*) A private IP address of an internal load balancer (ILB) cannot be used because it does not reply to ping.

Scope of disclosure	access destination	Procedure	EXPRESSCLUSTER resources, monitor resources, and commands to be used for NP resolution
Outside the Microsoft Azure Virtual network	Microsoft Azure Service Management API (management.core.windows.net)	Checking a LISTEN port	• Custom monitor resource • clpazure_port_checker command
	each cluster server	Ping	• IP monitor resource
Inside the Microsoft Azure Virtual network	Servers, excluding a cluster server, that exist within the Microsoft Azure network(*)	Ping	• PING network partition resolution resource
	Web servers that exist within the Microsoft Azure network	HTTP	• HTTP network partition resolution resource

For details about NP resolution, see the following:

- Chapter 5, “Network partition resolution resources details” in the *Reference Guide*.

Setting the NP resolution destination

You need to examine the NP resolution destination and method depending on the location of clients accessing a cluster system and the condition for connecting to an on-premise environment (for example, using a dedicated line).

How to judge the network partition status

EXPRESSCLUSTER provides the `clpazure_port_checker` command to check the TCP port listening status. Use this command as **Script created with this product** of the custom monitor resource or multi target monitor resource.
For details about the `clpazure_port_checker` command, see the following subsections.

Checking the TCP port listening status (`clpazure_port_checker` command)

clpazure_port_checker — Checks whether a LISTEN port exists among TCP ports of the specified server.

Command line

clpazure_port_checker -h *hostname* -p *port*

Description

This command checks whether a LISTEN port exists among TCP ports of the server specified for an argument.

If there is no response five seconds (fixed) after the command execution, it is judged that an error (timeout) has occurred.

In case of an error, an error message is output to the standard output.

Executing this command from the custom monitor resource makes it possible to judge the network partition status.

For the configuration example of network partition resolution using this command, see "3.3 Configuring the EXPRESSCLUSTER settings" and "5.3 Configuring the EXPRESSCLUSTER settings."

Options

-h *hostname*	Specify the determining server as *hostname* (by using an FQDN name or IP address). This option cannot be omitted.
-p *port*	Specify the determining port number as *port* (by using a port number or service name). This option cannot be omitted.

Return values

0	Normal
1	Error (communication error)
2	Error (timeout)
3	Error (invalid argument or internal error)

1.4 Differences between on-premises and Microsoft Azure

The following table describes the functional differences of EXPRESSCLUSTER between on-premises and Microsoft Azure. "Y" indicates that the relevant function can be used and "N" indicates that the relevant function cannot be used.

Function	On-premise	Microsoft Azure
Creating a shared disk type cluster	Y	N
Creating a mirror disk type cluster	Y	Y
Creating a hybrid disk type cluster	Y	N
Using the floating IP resource	Y	N
Using the virtual IP resource	Y	N
Using the Azure probe port resource	N	Y
Using the Azure DNS resource	N	Y

For the procedure to create a 2-node cluster using a mirror disk on an on-premise or Microsoft Azure environment, see the following subsections.
The difference of the procedure to create a cluster between an on-premise environment and Microsoft Azure environment is whether or not configuring the Microsoft Azure settings in advance is required.

HA cluster using Azure DNS

For Microsoft Azure, execute steps 1 to 6 in the following table after logging in to the Microsoft Azure portal (https://portal.azure.com/).
For Microsoft Azure, execute steps 7 to 18 after logging in to each virtual machine.

Step No.	Procedure	On-premise	Microsoft Azure
Before installing EXPRESSCLUSTER			
1	Creating a resource group	Not required	See "3.2 Configuring Microsoft Azure" in this guide.
2	Creating a virtual network	Not required	See "3.2 Configuring Microsoft Azure" in this guide.
3	Creating a virtual machine	Not required	See "3.2 Configuring Microsoft Azure" in this guide.
4	Setting a private IP address	Not required	See "3.2 Configuring Microsoft Azure" in this guide.
5	Adding Blob storage	Not required	See "3.2 Configuring Microsoft Azure" in this guide.
6	Creating a DNS zone	Not required	See "3.2 Configuring Microsoft Azure" in this guide.
7	Setting up the DNS server	See the manual provided with an OS or DNS server such as *Red Hat Enterprise Linux 7 Network Guide*.	Not required
8	Setting a partition for the mirror disk resource	See the following: • "Settings after configuring hardware" in Chapter 1, "Determining a system configuration" in the *Installation and Configuration Guide* • "Understanding mirror disk resources" in the *Reference Guide*.	See "3.2 Configuring Microsoft Azure" in this guide.

Step No.	Procedure	On-premise	Microsoft Azure
9	Adjusting the OS startup time	See “Settings after configuring hardware" in Chapter 1, “Determining a system configuration” in the *Installation and Configuration Guide*.	Same as "On-premise"
10	Checking the network setting		
11	Checking the root file system		
12	Checking the firewall setting		
13	Synchronizing the server time		
14	Checking the SELinux setting		
15	Installing the Azure CLI	Not required	See "3.2 Configuring Microsoft Azure” in this guide.
16	Registering the service principal	Not required	See "3.2 Configuring Microsoft Azure” in this guide.
17	Installing EXPRESSCLUSTER	See Chapter 3, “Installing EXPRESSCLUSTER" in the *Installation and Configuration Guide*.	Same as "On-premise"
After installing EXPRESSCLUSTER			
18	Registering the EXPRESSCLUSER license	See Chapter 4, “Registering the license" in the *Installation and Configuration Guide*.	Same as "On-premise"
19	Creating a cluster: Setting the heartbeat method	See “Creating the configuration data of a 2-node cluster" in Chapter 5, “Creating the cluster configuration data” in the *Installation and Configuration Guide*.	The COM heartbeat, BMC heartbeat, and disk heartbeat cannot be used.
20	Creating a cluster: Setting the NP resolution processing	The network partition resolution resource is used. See the following: • “Creating the configuration data of a 2-node cluster" in Chapter 5, “Creating the cluster configuration data” in the *Installation and Configuration Guide*. • Chapter 5, “Network partition resolution resources details” in the *Reference Guide*.	See "3.3 Configuring the EXPRESSCLUSTER settings” in this guide.
21	Creating a cluster: Creating a failover group and monitor resource	See “Creating the configuration data of a 2-node cluster" in Chapter 5, “Creating the cluster configuration data” in the *Installation and Configuration Guide*.	In addition to the references for on-premises, see the following: ➢ "Understanding Azure DNS resources" in the *Reference Guide*. ➢ "Understanding Azure DNS monitor resources" in the *Reference Guide*. ➢ "3.3 Configuring the EXPRESSCLUSTER settings” in this guide.

HA cluster using a load balancer

For Microsoft Azure, execute steps 1 to 5, and 7 to 8 in the following table after logging in to the Microsoft Azure portal (https://portal.azure.com/).
For Microsoft Azure, execute steps 6, and 9 to 16 after logging in to each virtual machine.

Step No.	Procedure	On-premise	Microsoft Azure
Before installing EXPRESSCLUSTER			
1	Creating a resource group	Not required	See either of the following depending on the load balancer to use: • "4.2 Configuring Microsoft Azure" in this guide • "5.2 Configuring Microsoft Azure" in this guide
2	Creating a virtual network	Not required	See either of the following depending on the load balancer to use: • "4.2 Configuring Microsoft Azure" in this guide • "5.2 Configuring Microsoft Azure" in this guide
3	Creating a virtual machine	Not required	See either of the following depending on the load balancer to use: • "4.2 Configuring Microsoft Azure" in this guide • "5.2 Configuring Microsoft Azure" in this guide
4	Setting a private IP address	Not required	See either of the following depending on the load balancer to use: • "4.2 Configuring Microsoft Azure" in this guide • "5.2 Configuring Microsoft Azure" in this guide
5	Adding Blob storage	Not required	See either of the following depending on the load balancer to use: • "4.2 Configuring Microsoft Azure" in this guide • "5.2 Configuring Microsoft Azure" in this guide
6	Setting a partition for the mirror disk resource	See the following: • “Settings after configuring hardware" in Chapter 1, “Determining a system configuration” in the *Installation and Configuration Guide*. • “Understanding mirror disk resources" in the *Reference Guide*.	See either of the following depending on the load balancer to use: • "4.2 Configuring Microsoft Azure" in this guide • "5.2 Configuring Microsoft Azure" in this guide
7	Creating and configuring a load balancer	Not required	See either of the following depending on the load balancer to use: • "4.2 Configuring Microsoft Azure" in this guide

Step No.	Procedure	On-premise	Microsoft Azure
			• "5.2 Configuring Microsoft Azure" in this guide
8	Setting the inbound security rules	Not required	• "4.2 Configuring Microsoft Azure" in this guide
9	Adjusting the OS startup time	See “Settings after configuring hardware" in Chapter 1, “Determining a system configuration” in the *Installation and Configuration Guide*.	Same as "On-premise"
10	Checking the network setting		
11	Checking the root file system		
12	Checking the firewall setting		
13	Synchronizing the server time		
14	Checking the SELinux setting		
15	Installing EXPRESSCLUSTER	See Chapter 3, “Installing EXPRESSCLUSTER" in the *Installation and Configuration Guide*.	Same as "On-premise”
After installing EXPRESSCLUSTER			
16	Registering the EXPRESSCLUSER license	See Chapter 4, “Registering the license" in the *Installation and Configuration Guide*.	Same as "On-premise"
17	Creating a cluster: Setting the heartbeat method	See “Creating the configuration data of a 2-node cluster" in Chapter 5, “Creating the cluster configuration data” in the *Installation and Configuration Guide*.	The COM heartbeat, BMC heartbeat, and DISK heartbeat cannot be used.
18	Creating a cluster: Setting the NP resolution processing	The network partition resolution resource is used. See the following: • “Creating the configuration data of a 2-node cluster" in Chapter 5, “Creating the cluster configuration data” in the *Installation and Configuration Guide*. • Chapter 5, “Network partition resolution resources details” in the *Reference Guide*.	See either of the following depending on the load balancer to use: • See "4.3 Configuring the EXPRESSCLUSTER settings“ in this guide. • See "5.3 Configuring the EXPRESSCLUSTER settings“ in this guide.
19	Creating a cluster: Creating a failover group and monitor resource	See “Creating the configuration data of a 2-node cluster" in Chapter 5, “Creating the cluster configuration data” in the *Installation and Configuration Guide*.	See the following in addition to the description of "On-premise." • “Understanding Azure probe port resources” in the *Reference Guide*. • “Understanding Azure probe port monitor resources" in the *Reference Guide*. • “Understanding Azure load balance monitor resources" in the *Reference Guide*.

Step No.	Procedure	On-premise	Microsoft Azure
			See either of the following depending on the load balancer to use: • See "4.3 Configuring the EXPRESSCLUSTER settings“ in this guide. • See "5.3 Configuring the EXPRESSCLUSTER settings“ in this guide.

Chapter 2 Operating Environments

2.1 HA cluster using Azure DNS

See the following:

- "*Getting Started Guide*" > "Chapter 3, Installation requirements for EXPRESSCLUSTER" > "Operation environment for Azure DNS resource and Azure DNS monitor resource"

x86_64

OS	CentOS 7.5
EXPRESSCLUSTER	EXPRESSCLUSTER X 4.1 for Linux (Internal version: 4.1.0-1)
Microsoft Azure deployment model	Resource Manager
Location	Japan East
Mirror disk size	Disk size: 20 GB (1 GB for a cluster partition and 19 GB for a data partition)
Azure CLI	Azure CLI 2.0
Python	2.7

The Azure CLI and Python must be installed because Azure DNS resource use them.
Since Python 2.7 is required when using Azure CLI 2.0.

For details about the Azure CLI, see the following website:
Get started with Azure CLI:
https://docs.microsoft.com/en-us/cli/azure/get-started-with-azure-cli?view=azure-cli-latest
Install the Azure classic CLI:
https://docs.microsoft.com/en-us/cli/azure/install-classic-cli?view=azure-cli-latest

Python is bundled with Linux OS.
Since Azure CLI 1.0 (Azure classic CLI) running on Python 2.6 has been unrecommended, install Python by using the package manager of each distribution (e.g. APT, yum, and zipper) if Python 2.7 is not bundled.

Azure DNS must be installed because the Azure DNS resource use it. For details about Azure DNS, see the following website:
Azure DNS: https://azure.microsoft.com/en-us/services/dns/

2.2 HA cluster using a load balancer

See the following:

- “Operation environment for Azure probe port resource, Azure probe port monitor resource, Azure load balance monitor resource" in Chapter 3, “Installation requirements for EXPRESSCLUSTER” in the *Getting Started Guide*.

Chapter 3 Cluster Creation Procedure (for an HA Cluster Using Azure DNS)

3.1 Creation example

This guide introduces the procedure for creating a 2-node unidirectional standby cluster using EXPRESSCLUSTER. This procedure is intended to create a mirror disk type configuration in which node1 is used as an active server.
The following tables describe the parameters that do not have a default value and the parameters whose values are to be changed from the default values.

- Microsoft Azure settings (common to node1 and node2)

Setting item	Setting value
Resource group setting	
Resource group	TestGroup1
Region	Japan East
Virtual network setting	
Name	Vnet1
Address space	10.5.0.0/24
Subnet Name	Vnet1-1
Subnet Address range	10.5.0.0/24
Resource group	TestGroup1
Location	Japan East
DNS zone setting	
Name	cluster1.zone
Resource group	TestGroup1
Resource group location	Japan East
Record set	test-record1

- Microsoft Azure settings (specific to each of node1 and node2)

Setting item	Setting value	
	node1	node2
Virtual machine setting		
Disk type	Standard HDD	
User name	testlogin	
Password	PassWord_123	
Resource group	TestGroup1	
Region	Japan East	
Network security group setting		
Name	NetSecGroup1	
Availability set setting		
Name	AvailabilitySet1	
Update domains	5	
Fault domains	2	
Diagnostics storage account setting		
Name	Automatically generated (testgroup1diag679)	
Replication	Locally-redundant storage (LRS)	
IP configuration setting		
IP address	10.5.0.110	10.5.0.111
Blob storage setting		
Name	Node1Blob1	Node2Blob1
Source type	None (empty disk)	
Account type	Standard HDD	

- EXPRESSCLUSTER settings (cluster properties)

Setting item	Setting value	
	node1	node2
Cluster Name	Cluster1	
Server Name	node1	node2
Timeout Tab: Heartbeat Timeout	120	

- EXPRESSCLUSTER settings (failover group)

Resource name	Setting item	Setting value
Mirror disk resource	Name	md
	Details Tab: Mount Point	/mnt/md
	Details Tab: Data Partition Device Name	/dev/sdc2
	Details Tab: Cluster Partition Device Name	/dev/sdc1
	Details Tab: File System	ext4
	Mirror Tab: Execute the initial mirror construction	On
	Mirror Tab: Execute initial mkfs	On
Azure DNS resource	Name	azuredns1
	Record Set Name	test-record1
	Zone Name	cluster1.zone
	IP Address	(node1) 10.5.0.110 (node2) 10.5.0.111
	Resource Group Name	TestGroup1
	User URI	http://azure-test
	Tenant ID	xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx
	File Path of Service Principal	/root/examplecert.pem
	Azure CLI File Path	/usr/bin/az

- EXPRESSCLUSTER settings (monitor resource)

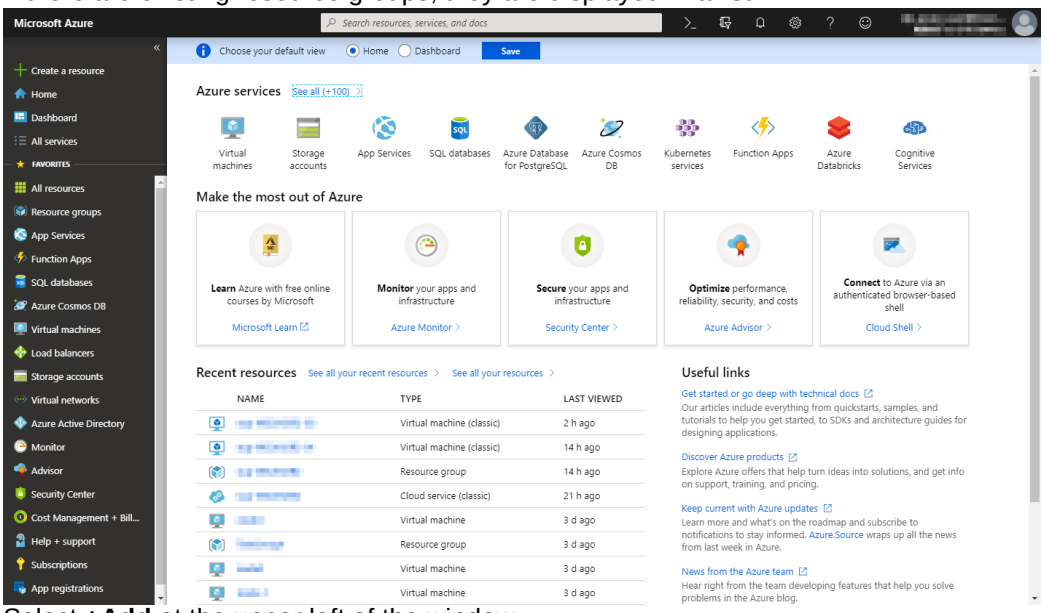
Monitor resource name	Setting item	Setting value
Mirror disk monitor resource	-	-
Azure DNS monitor resource	Name	azurednsw1
Custom monitor resource	Name	genw1
	Script created with this product	On
	Monitor Type	Synchronous
	Normal Return Value	0
	Recovery Action	Execute only the final action
	Recovery Target	LocalServer
IP monitor resource	Name	ipw1
	Server to monitor	node1
	IP Address	10.5.0.111
	Recovery Action	Execute only the final action
	Recovery Target	LocalServer
IP monitor resource	Name	ipw2
	Server to monitor	node2
	IP Address	10.5.0.110
	Recovery Action	Execute only the final action
	Recovery Target	LocalServer
Multi target monitor resource	Name	mtw1
	Monitor resource list	genw1 ipw1 ipw2
	Recovery Action	Execute only the final action
	Recovery Target	LocalServer

3.2 Configuring Microsoft Azure

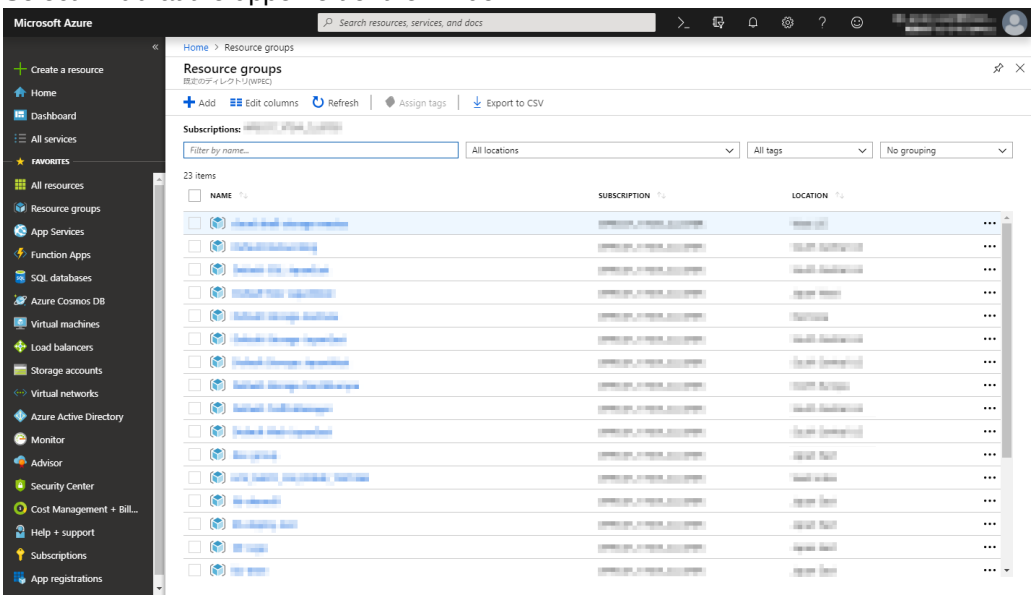
1) Creating a resource group

Log in to the Microsoft Azure portal (https://portal.azure.com/) and create a resource group following the steps below.

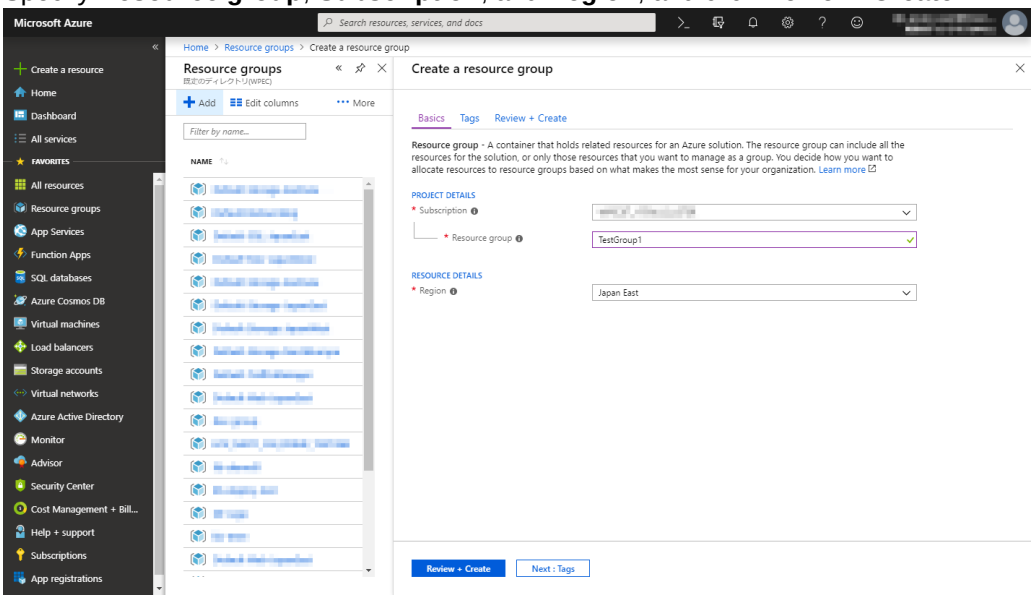
1. Select **Resource groups** or the resource group icon in the menu on the left side of the window. If there are existing resource groups, they are displayed in a list.



2. Select **+Add** at the upper left of the window.



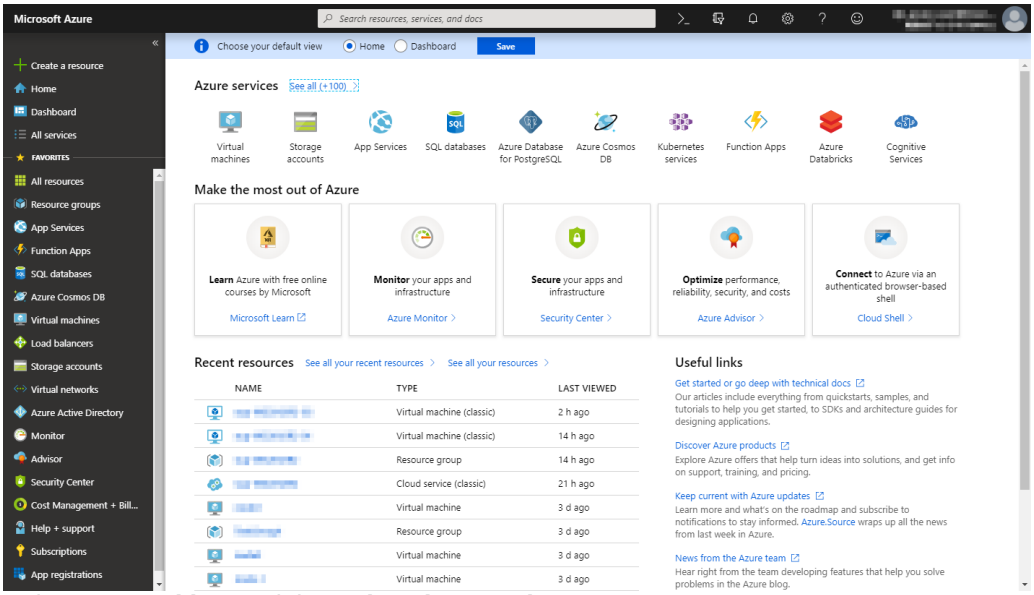
3. Specify **Resource group**, **Subscription**, and **Region**, and click **Review+Create**.



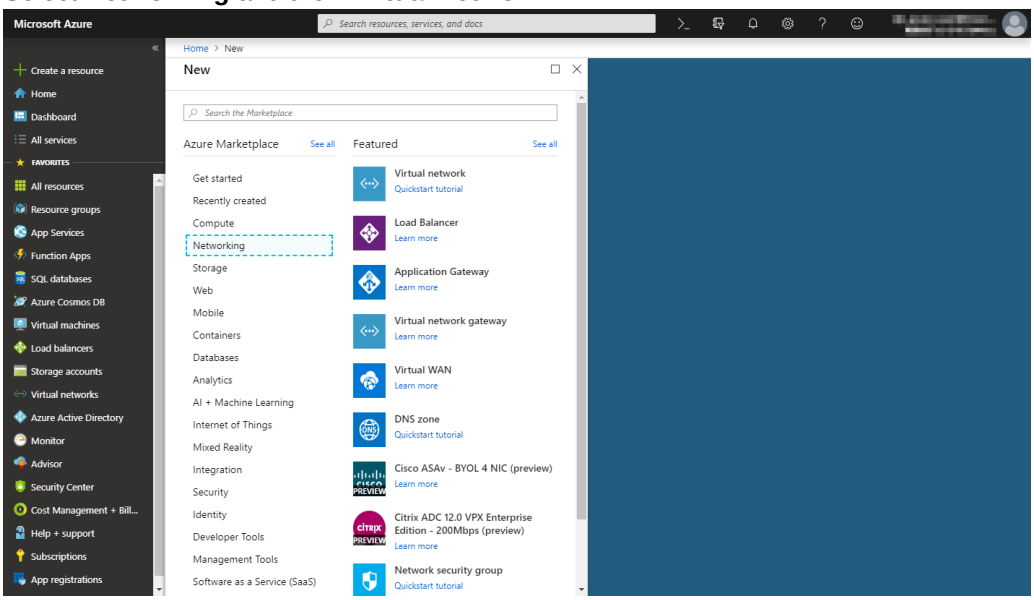
2) Creating a virtual network

Log in to the Microsoft Azure portal (https://portal.azure.com/) and create a virtual network following the steps below.

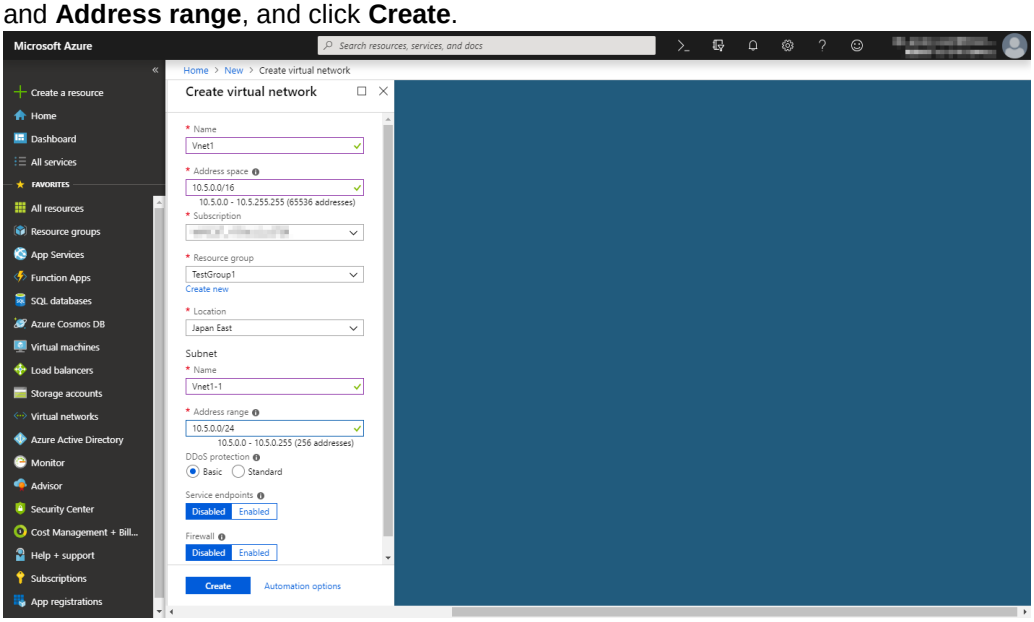
1. Select **+Create a resource** or the **+** icon in the menu on the left side of the window.



2. Select **Networking** and then **Virtual network**.



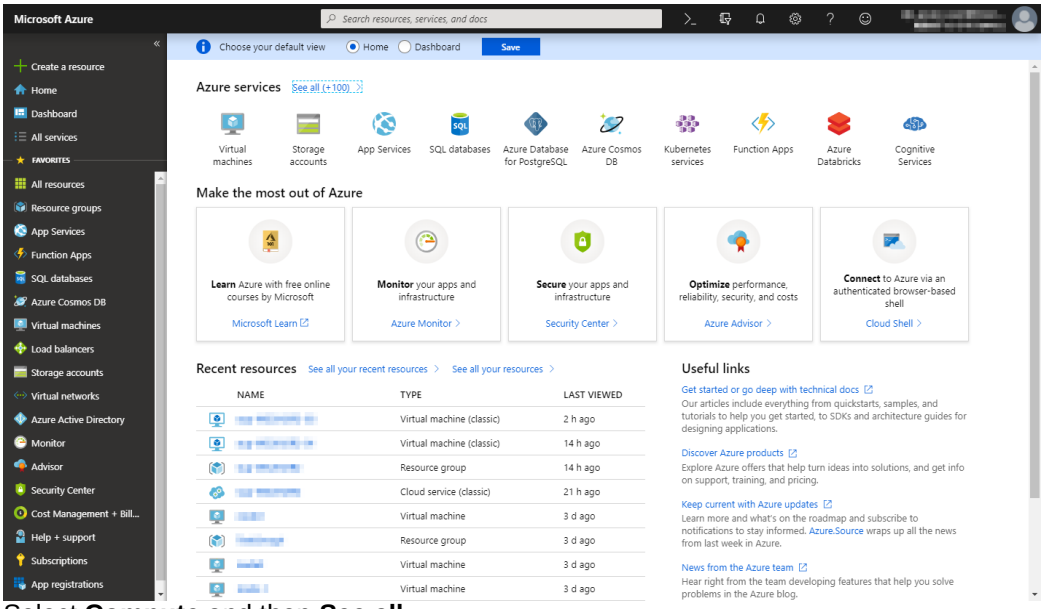
3. Specify **Name**, **Address space**, **Subscription**, **Resource group**, **Location**, **Name** of Subnet, and **Address range**, and click **Create**.



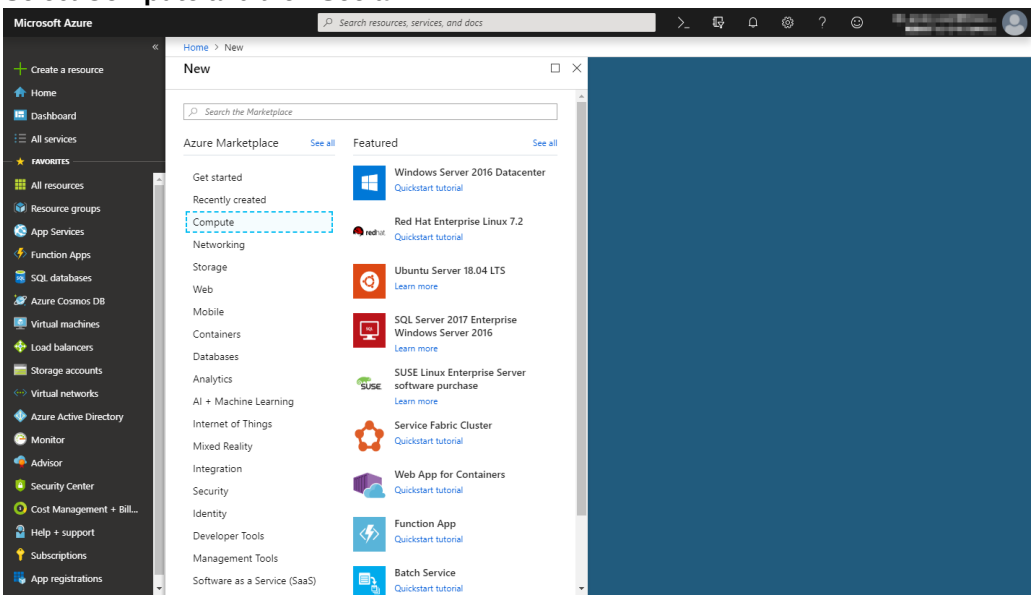
3) Creating a virtual machine

Log in to the Microsoft Azure portal (https://portal.azure.com/) and create virtual machines and disks following the steps below.
Create as many virtual machines as required to create a cluster. Create node1 and then node2.

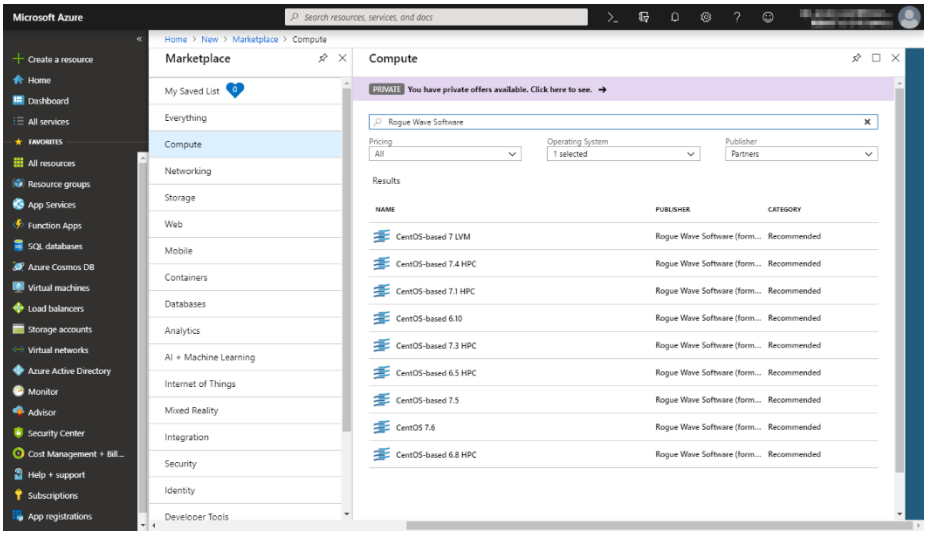
1. Select **+Create a resource** or the **+** icon in the menu on the left side of the window.



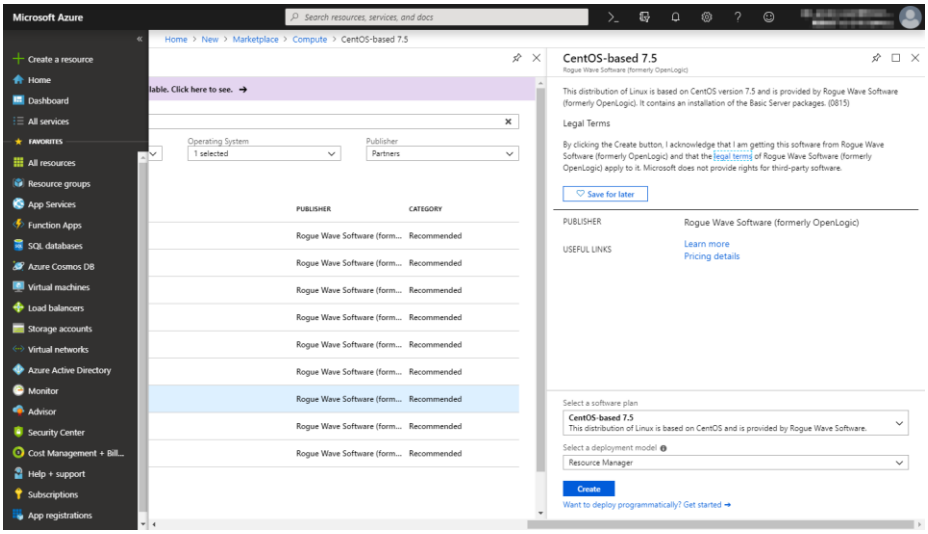
2. Select **Compute** and then **See all**.



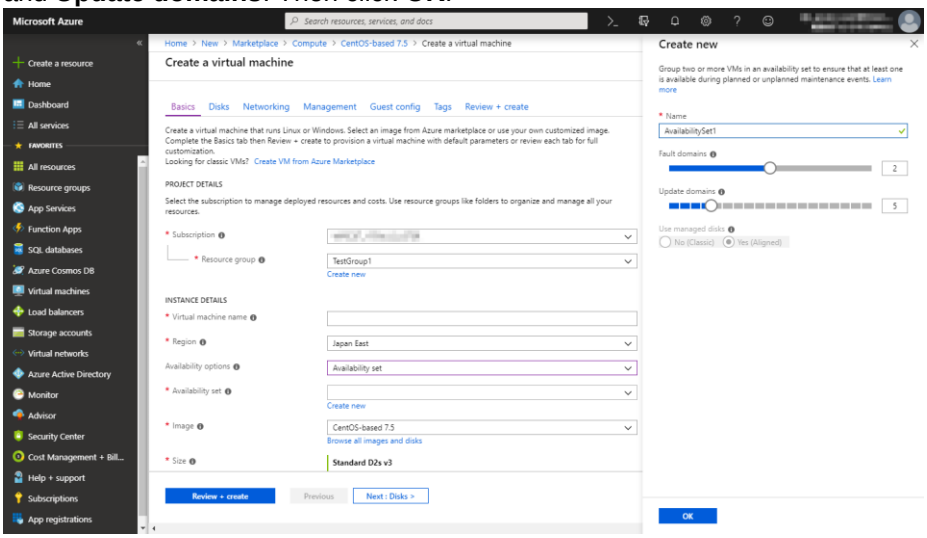
3. Select **CentOS-based 7.5**.

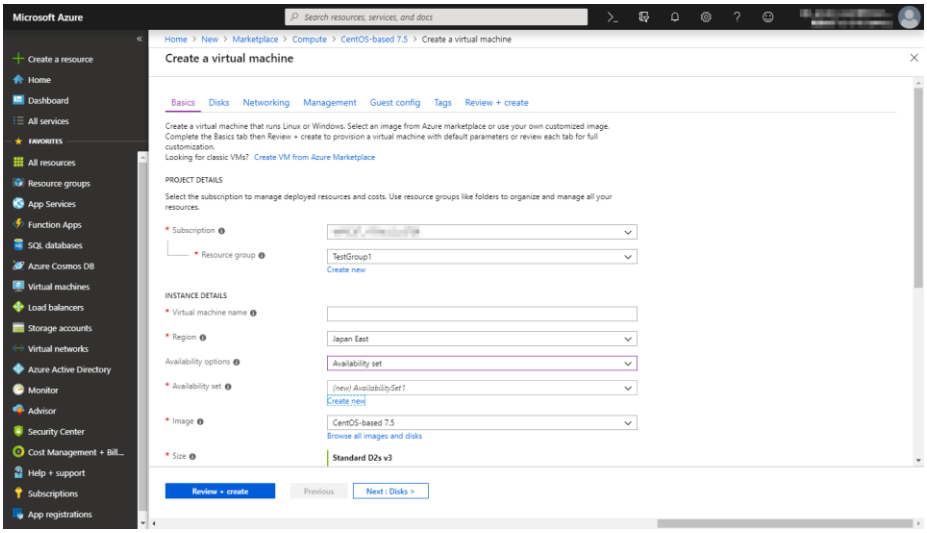


4. Confirm that **Resource Manager** is selected for **Select a deployment model** at the bottom of the window, and click **Create**.

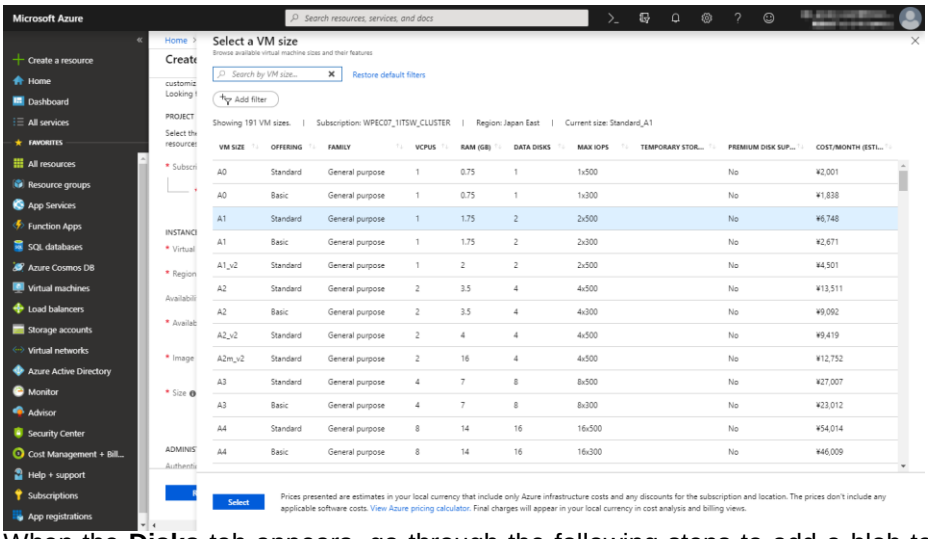


5. When the **Basics** tab appears, specify the settings of **Subscription**, **Resource group**, **Virtual machine name**, **Region**, **Image**, **Size**, **Username**, **Password**, and **Confirm password**. Select **Availability set** from **Availability options**, and click **Create new** under the **Availability set** field. When the **Create new** blade appears, specify the settings of **Name**, **Fault domains**, and **Update domains**. Then click **OK**.

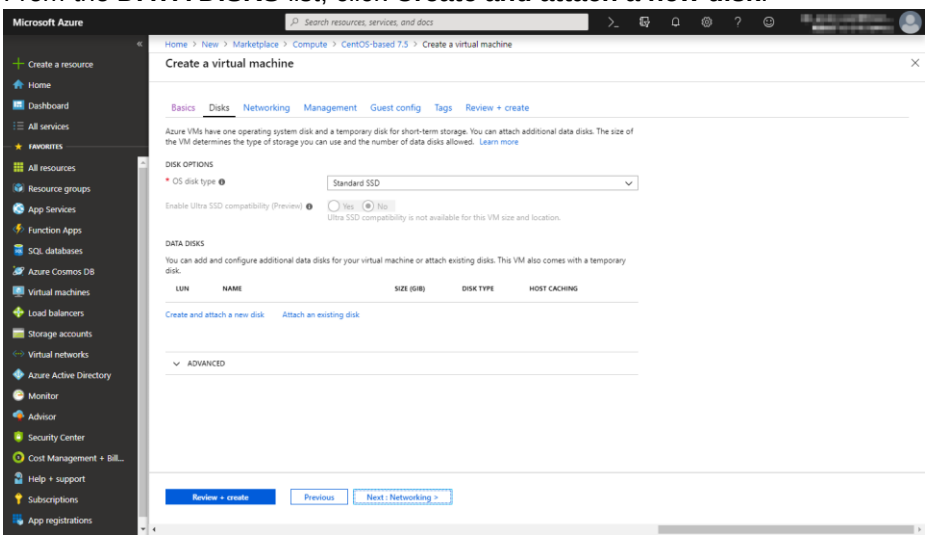




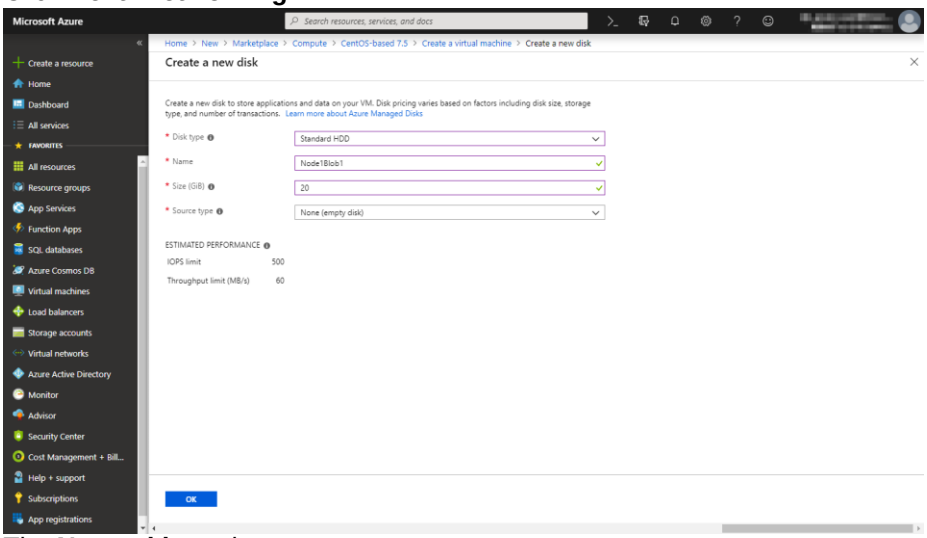
6. Click **Change size** to display the **Select a VM size** blade.
From the list, choose a size (**A1** - **Standard** in this guide) suitable for your virtual machine and click **Select**.
Regarding the **Virtual machine name**, node1 is for node1, and node2 is for node2.
Click **Next: Disks >**



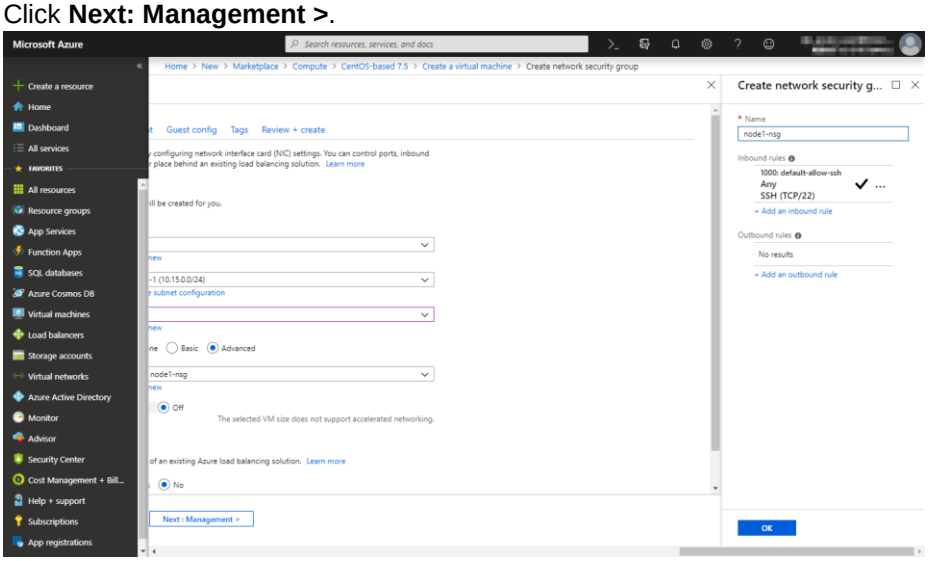
7. When the **Disks** tab appears, go through the following steps to add a blob to be used for a mirror disk (cluster partition or data partition).
From the **DATA DISKS** list, click **Create and attach a new disk**.



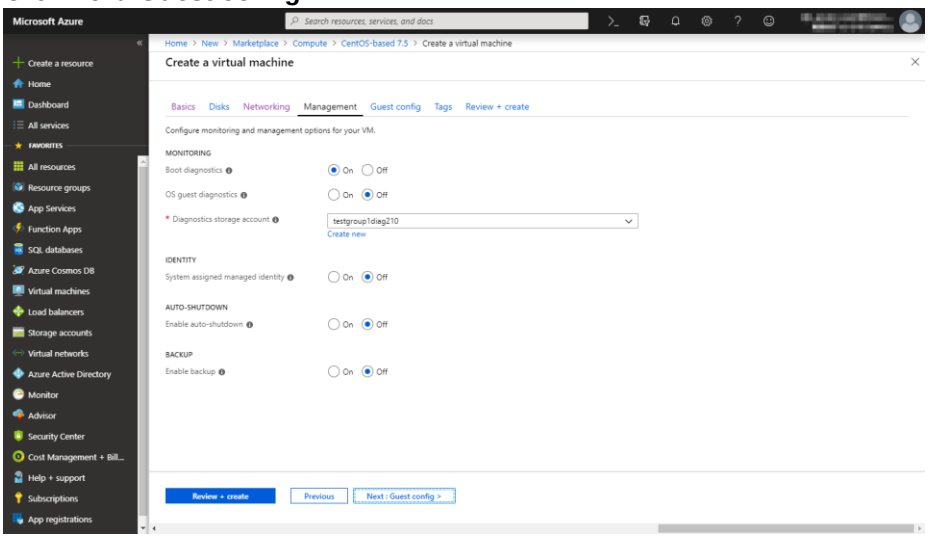
8. The **Create a new disk** blade appears.
Specify the settings of **Disk type**, **Name**, **Size (GiB)**, and **Source type**. Then click **OK**.
Click **Next: Networking >**

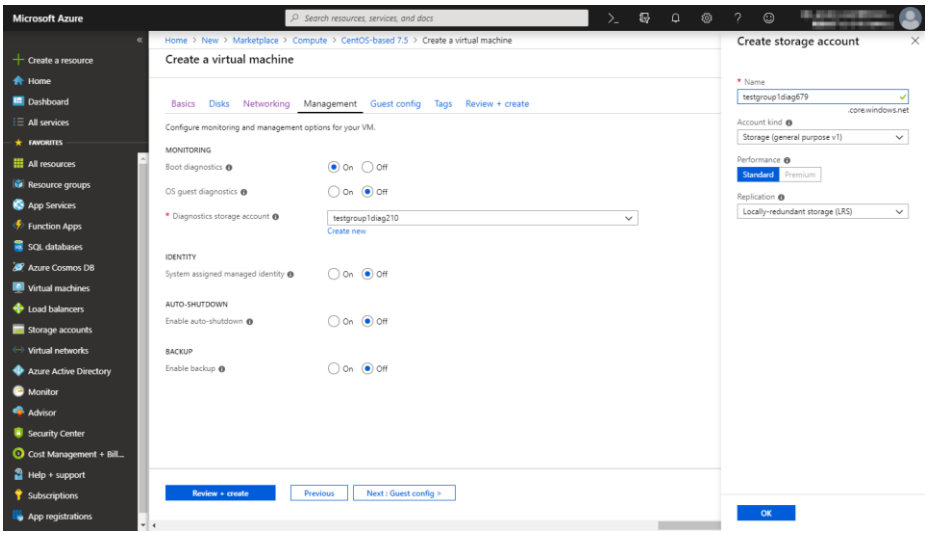


9. The **Networking** tab appears.
Specify the settings of **Virtual network**, **Subnet**, **Network security group**, and **Configure network security group**.
Click **Create new** under the **Configure network security group** field to display the **Create network security group** blade. Specify the setting of **Name** and then click **OK**.
Click **Next: Management >**.

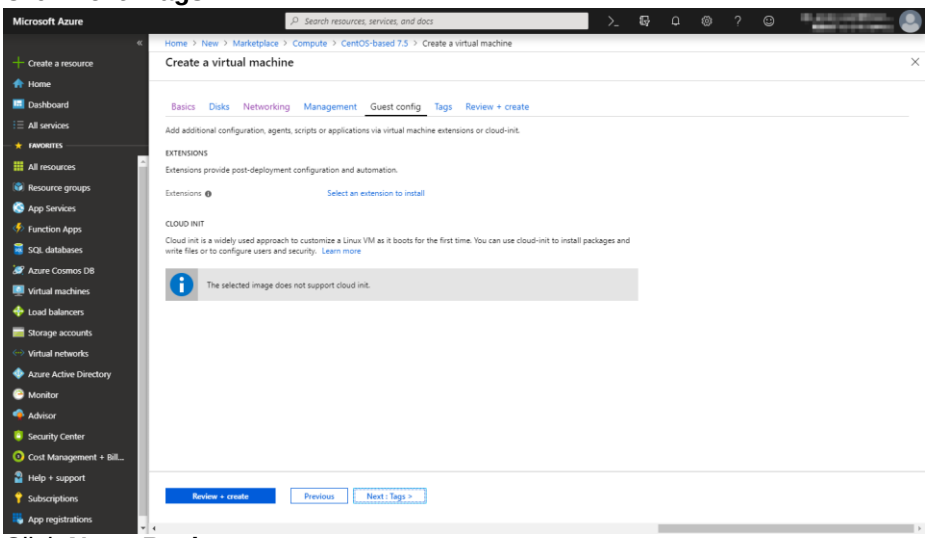


10. The **Management** tab appears.
Click **Create new** under the **Diagnostics storage account** field to display the **Create storage account** blade.
Specify the settings of **Name**, **Account kind**, and **Replication**. Then click **OK**.
In the **Diagnostics storage account** field, the default value is automatically generated and entered.
Click Next: **Guest config >**.

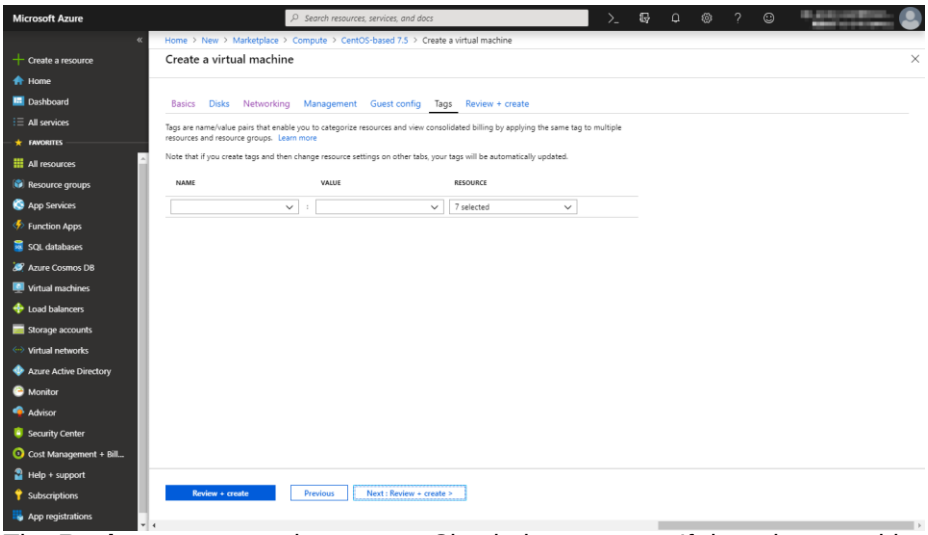




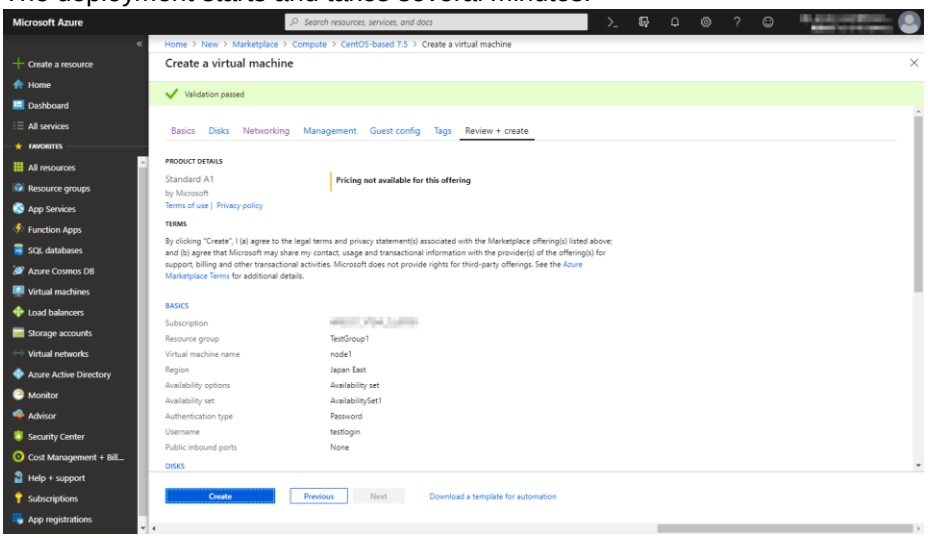
11. Click **Next: Tags >**.



12. Click **Next: Review + create >**.



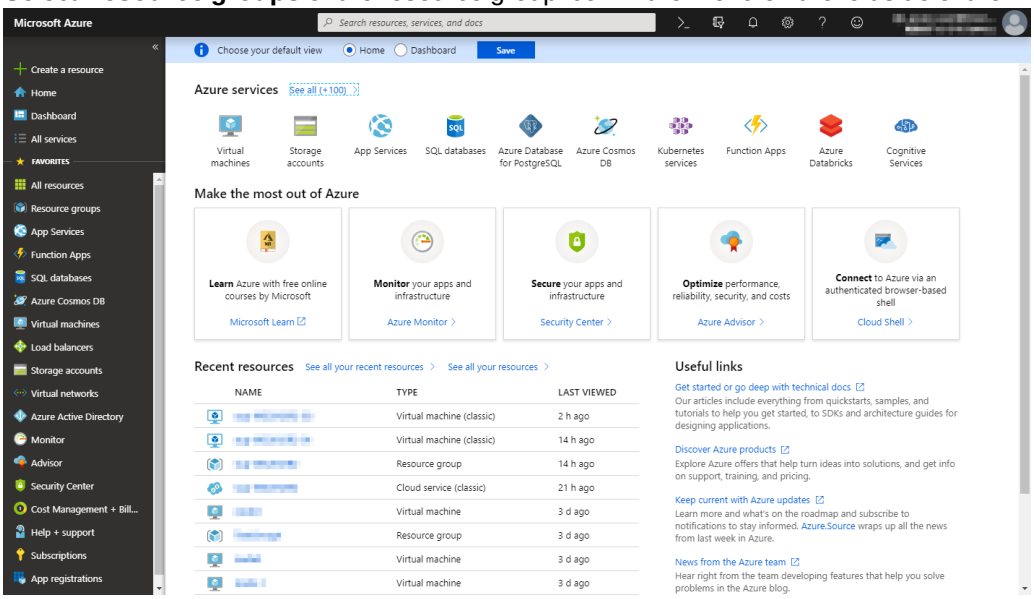
13. The **Review + create** tab appears. Check the contents. If there is no problem, click **Create**. The deployment starts and takes several minutes.



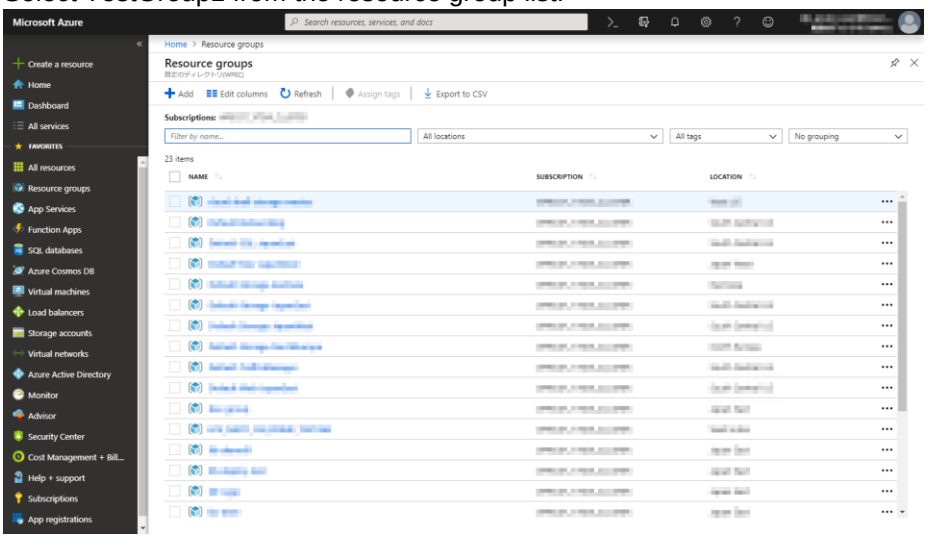
4) Setting a private IP address

Log in to the Microsoft Azure portal (https://portal.azure.com/) and change the private IP address setting following the steps below. Since an IP address is initially set to be assigned dynamically, change the setting so that an IP address is assigned statically. Change the settings of node1 and then node2.

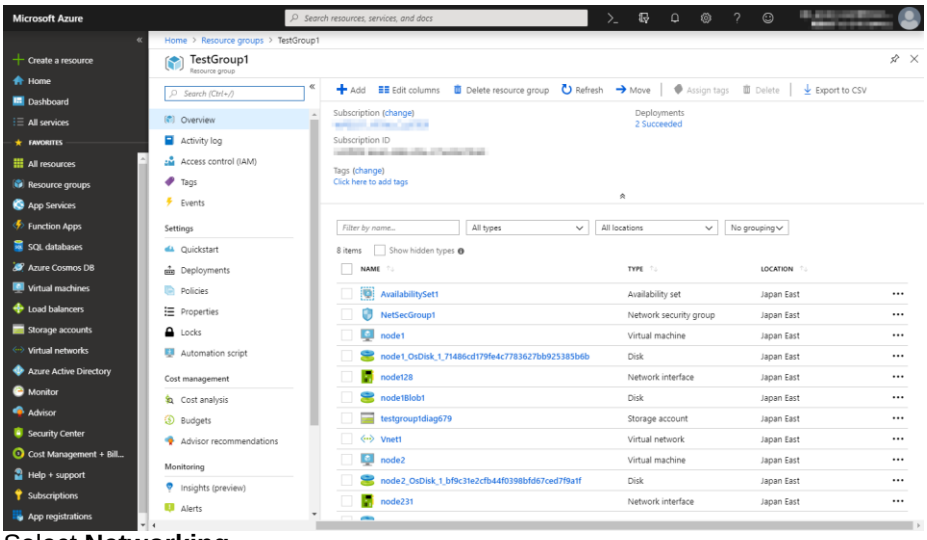
1. Select **Resource groups** or the resource group icon in the menu on the left side of the window.



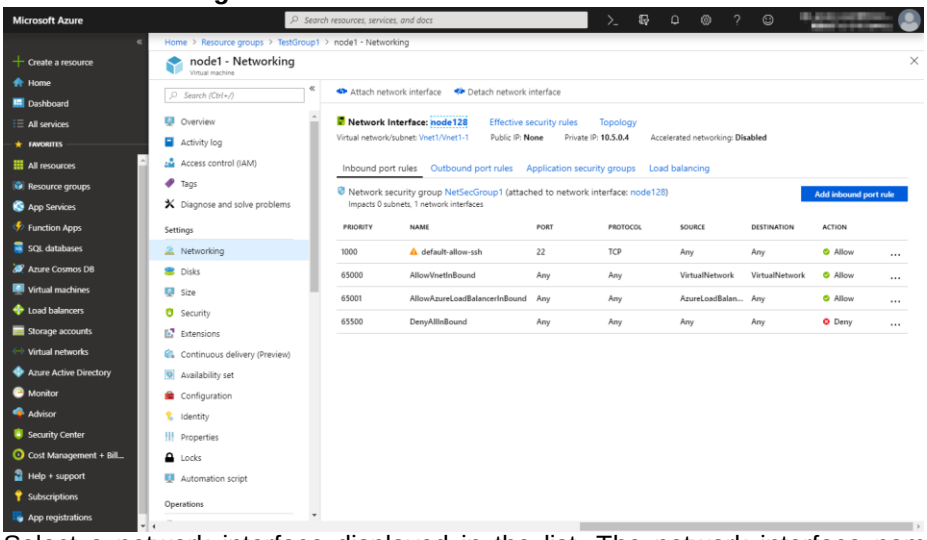
2. Select TestGroup1 from the resource group list.



3. The summary of TestGroup1 is displayed. Select virtual machine node1 or node2 from the item list.

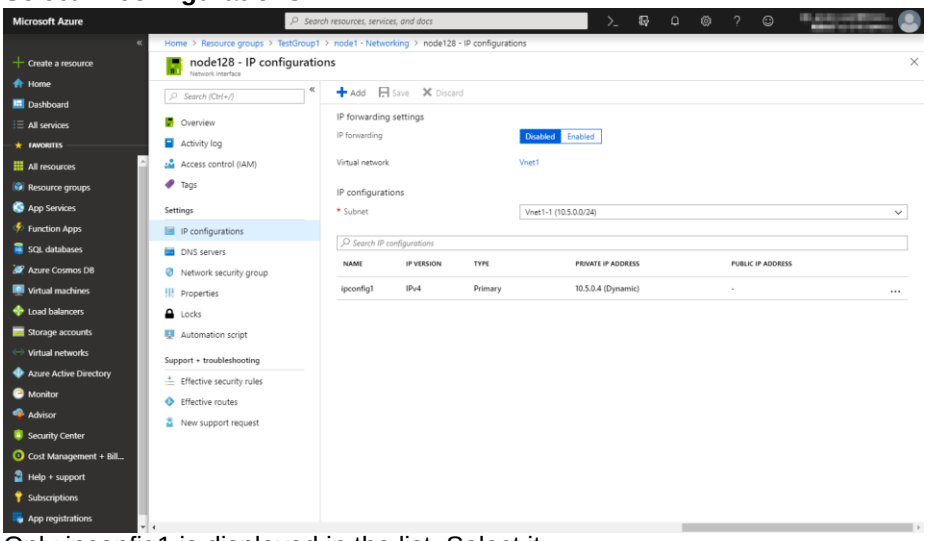


4. Select **Networking**.

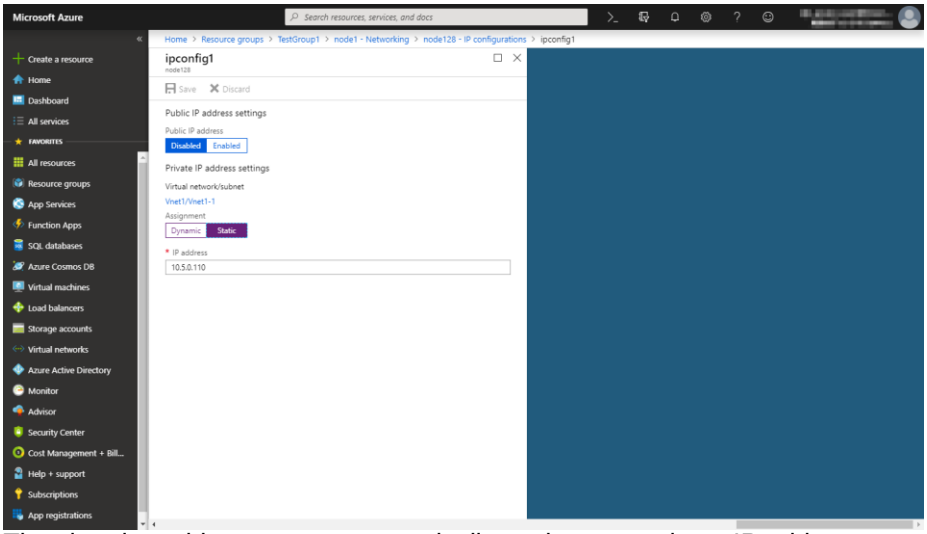


5. Select a network interface displayed in the list. The network interface name is generated automatically.

6. Select **IP configurations**.



7. Only ipconfig1 is displayed in the list. Select it.
8. Select **Static** for **Assignment** under **Private IP address settings**. Enter the IP address to be assigned statically in the **IP address** text box and click **Save** at the top of the window. The IP address of node1 is 10.5.0.110. The IP address of node2 is 10.5.0.111.

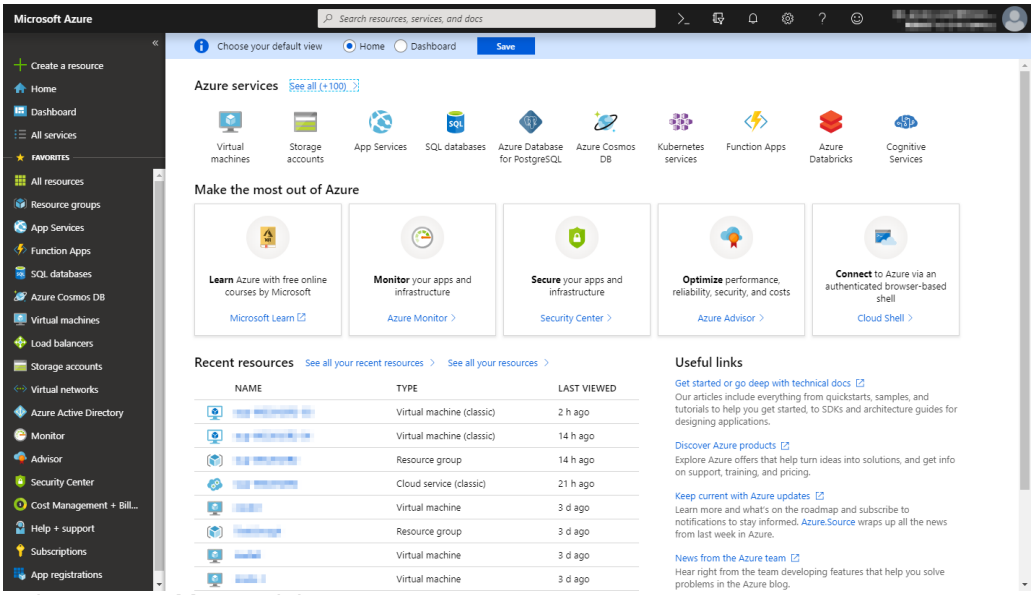


9. The virtual machines restart automatically so that new private IP addresses can be used.

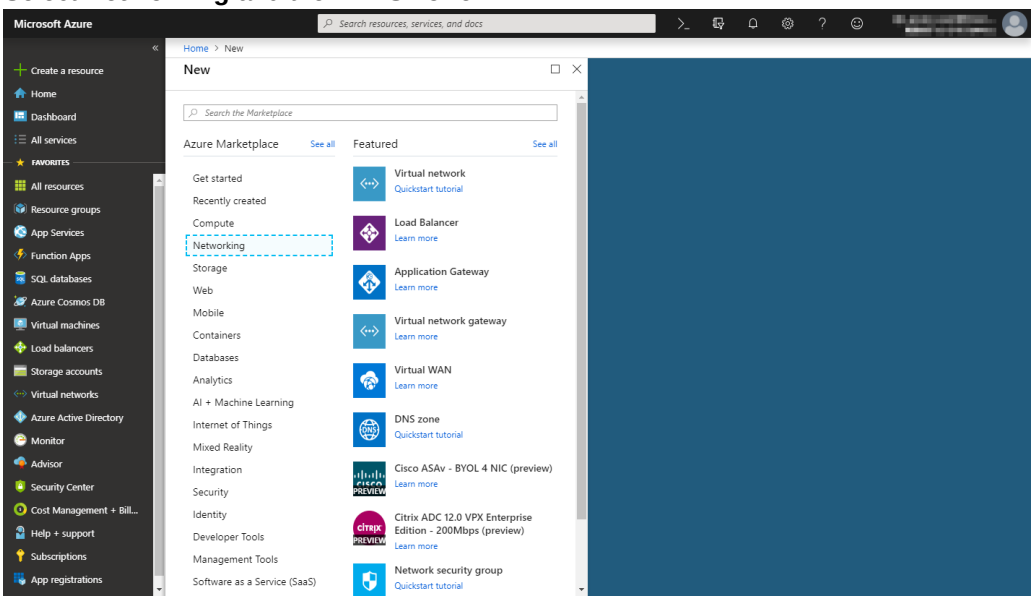
5) Creating a DNS zone

Log in to the Microsoft Azure portal (https://portal.azure.com/) and configure the DNS zone following the steps below.

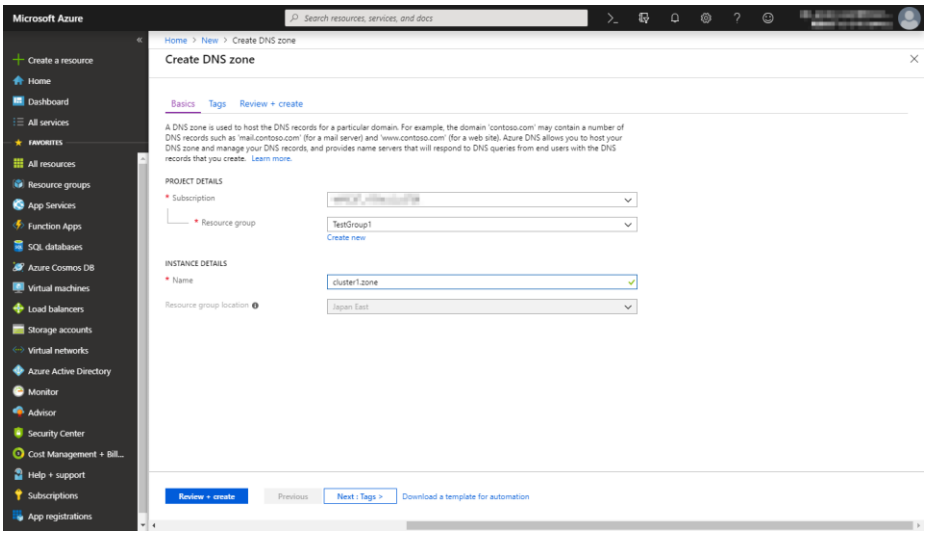
1. Select **+Create a resource** or the **+** icon in the menu on the left side of the window.



2. Select **Networking** and then **DNS zone**.



3. The **Create DNS zone** blade is displayed. Specify **Name**, **Subscription**, and **Resource group**, and click **Review+create**.



6) Configuring virtual machines

Log in to the created node1 and node2 and specify the settings following the procedure below.
Set a partition for the mirror disk resource. Create a file system in the added Blob storage.
Secure an area in the added disk by using the fdisk command and then create a file system.
For details about the partition for the mirror disk resource, see “4.Partition settings for mirror disk resource (when using Replicator)" in “Settings after configuring hardware” in Chapter 1, “Determining a system configuration” in the *Installation and Configuration Guide*.

1. Check the partition list. In the following example, the last line shows the added disk.
   $ cat /proc/partitions
   major minor #blocks name

   8 16 73400320 sdb
   8 17 73398272 sdb1
   8 0 31459328 sda
   8 1 31456256 sda1
   8 32 20971520 sdc
2. Create a cluster partition and data partition in the added disk by using the fdisk command. Allocate 1 GB (1*1024*1024*1024 bytes) or more to a cluster partition. (If the size is specified as just 1 GB, the actual size will be larger than 1 GB depending on the disk geometry difference. This is not a problem.) Also, do not create a file system in a cluster partition. The following is an example of creating one partition including all areas of /dev/sdc.
   $ sudo fdisk /dev/sdc
   Device contains neither a valid DOS partition table, nor Sun, SGI or OSF disklabel
   Building a new DOS disklabel with disk identifier 0xe3c83b13.
   Changes will remain in memory only, until you decide to write them.
   After that, of course, the previous content won't be recoverable.

   Warning: invalid flag 0x0000 of partition table 4 will be corrected by w(rite)

   The device presents a logical sector size that is smaller than the physical sector size. Aligning to a physical sector (or optimal I/O) size boundary is recommended, or performance may be impacted.

   WARNING: DOS-compatible mode is deprecated. It's strongly recommended to switch off the mode (command 'c') and change display units to sectors (command 'u').

   Command (m for help): n
   Command action
   e extended
   p primary partition (1-4)
   p
   Partition number (1-4): 1
   First cylinder (1-2610, default 1):
   Using default value 1

   Last cylinder, +cylinders or +size{K,M,G} (1-2610, default 2610): +1G

   Command (m for help): p

   Disk /dev/sdc: 21.5 GB, 21474836480 bytes
   255 heads, 63 sectors/track, 2610 cylinders
   Units = cylinders of 16065 * 512 = 8225280 bytes
   Sector size (logical/physical): 512 bytes / 4096 bytes
   I/O size (minimum/optimal): 4096 bytes / 4096 bytes
   Disk identifier: 0xe29ed566

   Device Boot Start End Blocks Id System
   /dev/sdc1 1 132 1060256+ 83 Linux

```
  Partition 1 does not end on cylinder boundary.
  Partition 1 does not start on physical sector boundary.

Command (m for help): n
Command action
  e   extended
  p   primary partition (1-4)
p
Partition number (1-4): 2
First cylinder (132-2610, default 132):
Using default value 132
Last cylinder, +cylinders or +size{K,M,G} (132-2610, default 2610):
Using default value 2610
Command (m for help): p

Disk /dev/sdc: 21.5 GB, 21474836480 bytes
255 heads, 63 sectors/track, 2610 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes
Sector size (logical/physical): 512 bytes / 4096 bytes
I/O size (minimum/optimal): 4096 bytes / 4096 bytes
Disk identifier: 0xe29ed566

  Device Boot      Start         End      Blocks   Id  System
  /dev/sdc1               1         132     1060256+  83  Linux
  Partition 1 does not end on cylinder boundary.
  Partition 1 does not start on physical sector boundary.
  /dev/sdc2             132        2610    19904537   83  Linux

Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.
Syncing disks.
```

3. If you select **Execute initial mkfs** when creating the cluster configuration data by using Cluster WebUI, EXPRESSCLUSTER creates a file system automatically. Note that existing data in the partition will be lost.

7) Adjusting the OS startup time, checking the network setting, checking the root file system, checking the firewall setting, synchronizing the server time, and checking the SELinux setting.

For each procedure, see “Settings after configuring hardware." in Chapter 1, “Determining a system configuration” in the *Installation and Configuration Guide*.

8) Installing the Azure CLI

Install the Azure CLI.
The procedure to install the Azure CLI from an npm package is described.
For details about this procedure and other procedures, see the following websites:
Install the Azure CLI:
https://docs.microsoft.com/en-us/cli/azure/install-azure-cli?view=azure-cli-latest

Log in to the created node1 and node2 and install the Azure CLI following the procedure below.
Be sure to use the following installation procedure. If the Azure CLI is installed in other ways, Azure DNS resource will not work properly.

```
$ sudo yum check-update; sudo yum install -y gcc libffi-devel python-devel openssl-devel
$ curl -L https://aka.ms/InstallAzireCli | bash -
$ exec -l $SHELL
```

9) Creating a service principal

Create a service principal using the Azure CLI.
Azure DNS resource performs login to Microsoft Azure and DNS zone registration and monitoring.
When logging in to Microsoft Azure, Azure login with a service principal is used.
Please note that certificates have an expiration date.
For more details, see the --years option of az ad sp create-for-rbac.
https://docs.microsoft.com/en-us/cli/azure/ad/sp?view=azure-cli-latest#az-ad-sp-create-for-rbac

For details about a service principal and procedure, see the following websites:
Sign in with Azure CLI:
https://docs.microsoft.com/en-us/cli/azure/authenticate-azure-cli?view=azure-cli-latest
Create an Azure service principal with Azure CLI:
https://docs.microsoft.com/en-us/cli/azure/create-an-azure-service-principal-azure-cli?view=azure-cli-latest

1. Log in with an organizational account.
   ```
   $ az login -u <account_name> -p <password>
   ```
2. Create and register a service principal. Write down the displayed name and tenant because it is necessary to set them in the Azure environment configuration file. In the following example, a service principal is created in `/root/examplecert.pem`.
   ```
   $ az ad sp create-for-rbac --create-cert
   {
     "appId": "xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx",
     "displayName": "azure-test",
     "fileWithCertAndPrivateKey": " /root/examplecert.pem",
     "name": "http://azure-test",
     "password": null,
     "tenant": "xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx"
   }
   ```
3. Log out.
   ```
   $ az logout --u <account_name>
   ```
4. Check whether login to Microsoft Azure using the created service principal is possible.
   ```
   $ az login --service-principal -u <name_value_in_step_2> --tenant
   <tenant_value_in_step_2>                                          -p
   <fileWithCertAndPrivateKey_value_in_step_2>
   The following is displayed upon successful sign-in.
   [
     {
       "cloudName": "AzureCloud",
       "id": "xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx",
       "isDefault": true,
       "name": "xxxxxxxxxx",
       "state": "Enabled",
       "tenantId": "xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx",
       "user": {
         "name": "http://azure-test",
         "type": "servicePrincipal"
       }
     }
   ]
   ```
5. Log out.
   ```
   $ az logout --username <name_value_in_step_4>
   ```

When changing the role of the created service principal from the default "Contributor" to another role, select a role that has access permissions to all of the following operations as the Actions properties. If the role is changed to a role that does not satisfy this condition, monitoring by the Azure DNS monitor resource, which are set up later, will fail due to an error.

Microsoft.Network/dnsZones/A/write
Microsoft.Network/dnsZones/A/delete
Microsoft.Network/dnsZones/NS/read

10) Installing EXPRESSCLUSTER

For the installation procedure, see the *Installation and Configuration Guide*.
After installation is complete, restart the OS.

11) Registering the EXPRESSCLUSER license

For the license registration procedure, see the *Installation and Configuration Guide*.

3.3 Configuring the EXPRESSCLUSTER settings

For the Cluster WebUI setup and connection procedures, see Chapter 5, “Creating the cluster configuration data" in the *Installation and Configuration Guide*.

This section describes the procedure to add the following resources and monitor resources:

- Mirror disk resource
- Azure DNS resource
- Azure DNS monitor resource
- Custom monitor resource (for NP resolution)
- IP monitor resource (for NP resolution)
- Multi target monitor resource (for NP resolution)

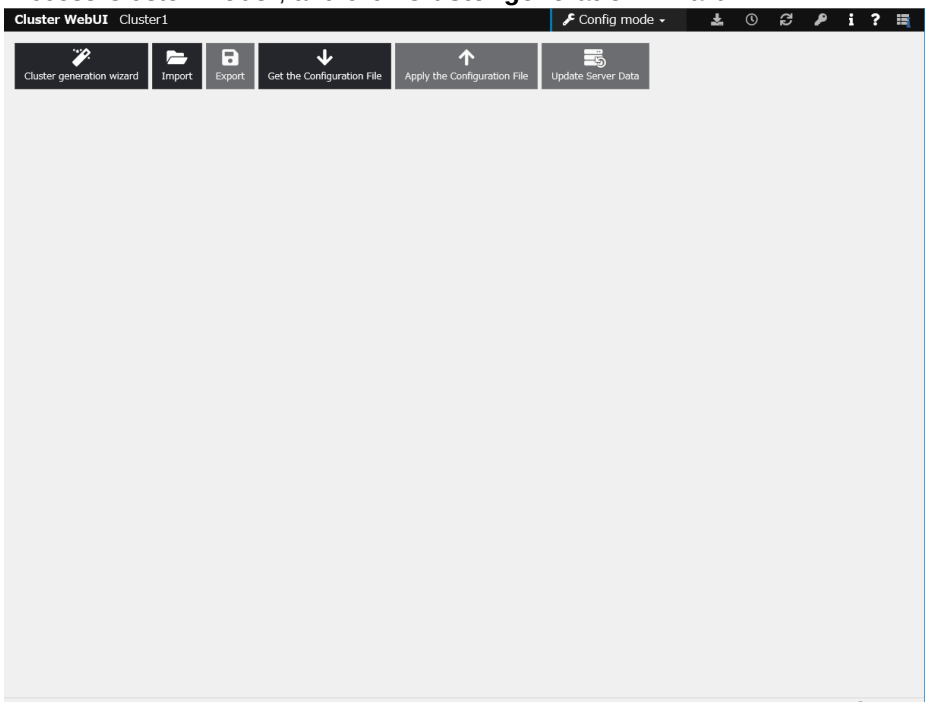
For the settings of other resources and monitor resources, see the *Installation and Configuration Guide* and the *Reference Guide*.

1) Creating a cluster

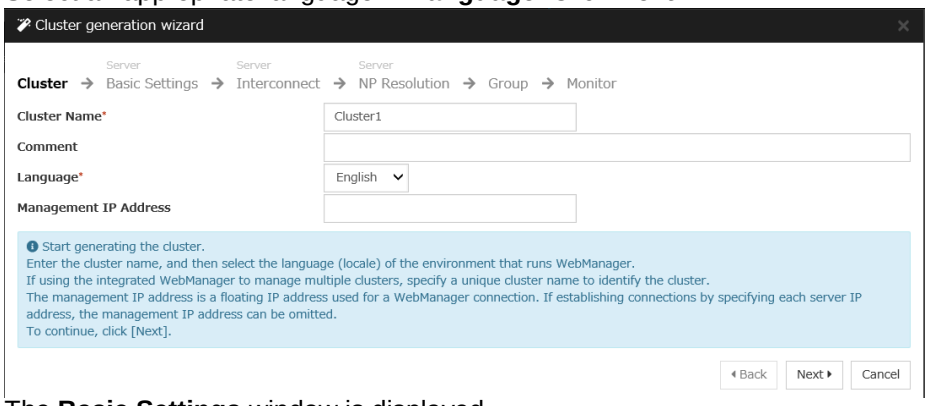
Start the cluster generation wizard to create a cluster.

◆ Creating a cluster

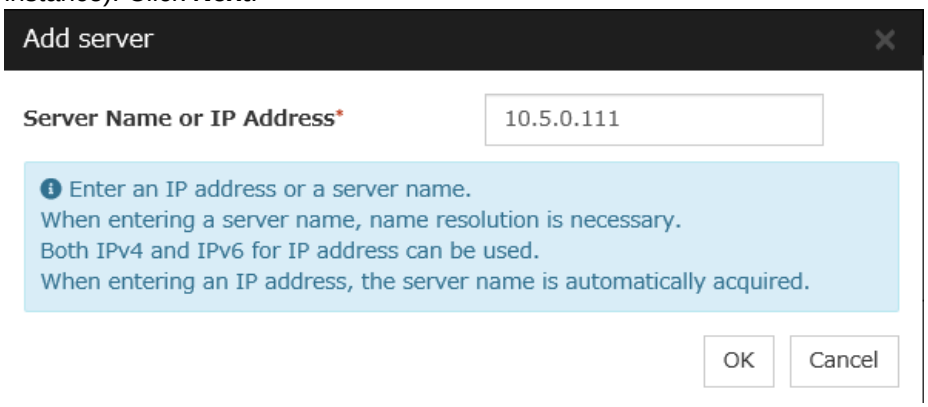
1. .Access Cluster WebUI, and click C**luster generation wizard**.

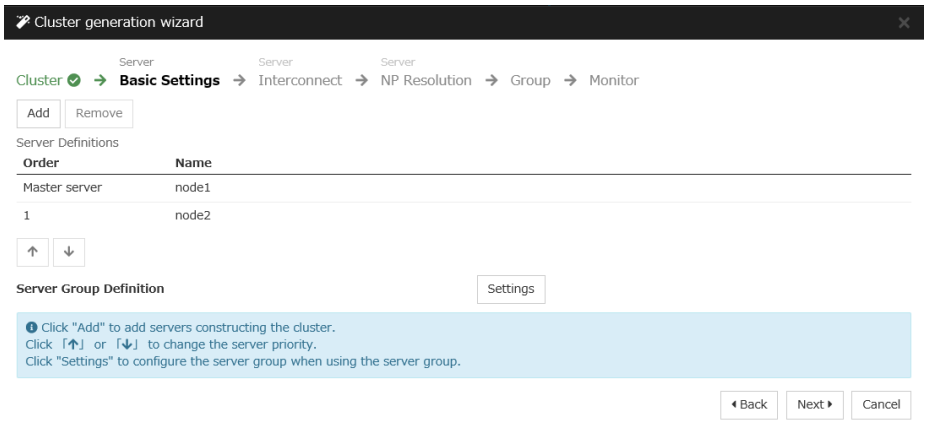


2. The **Cluster** window on the **Cluster Generation Wizard** is displayed.
   Enter a desired name in **Cluster Name**.
   Select an appropriate language in **Language**. Click **Next**.

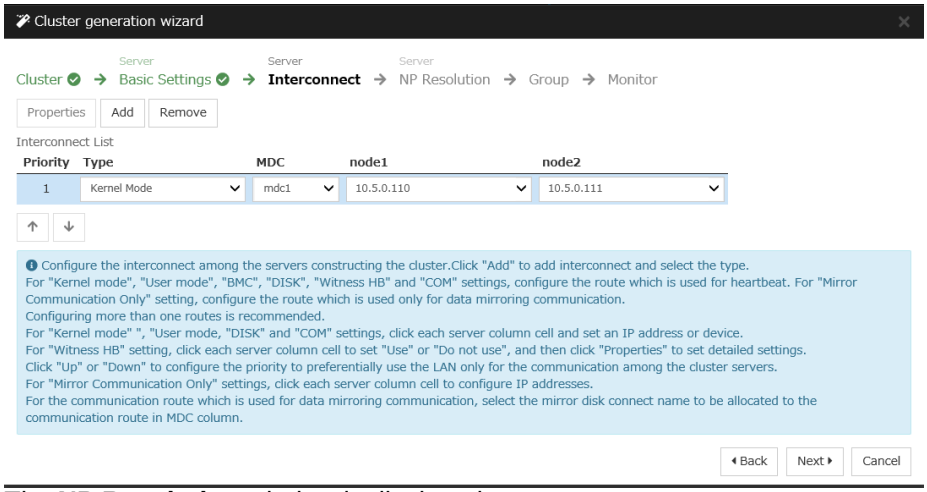


3. The **Basic Settings** window is displayed.
   The instance connected to Cluster WebUI is displayed as a registered master server.
   Click **Add** to add the remaining instances (by specifying the private IP address of each instance). Click **Next**.

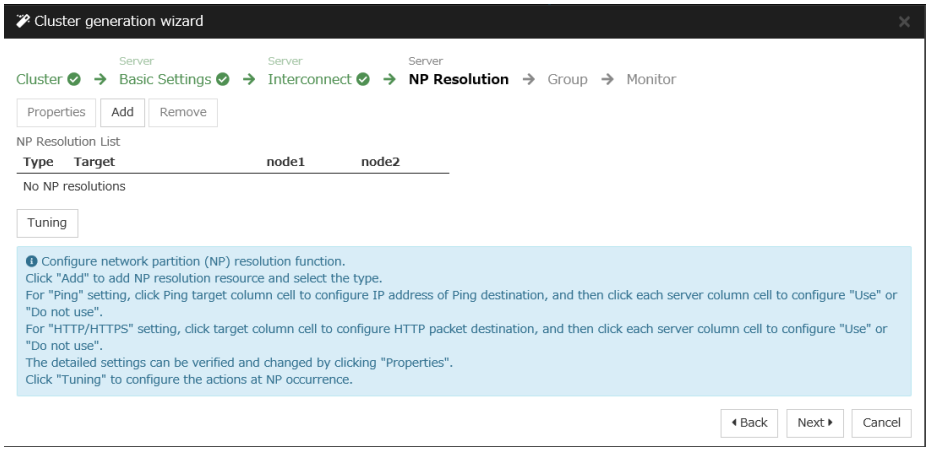




4. The **Interconnect** window is displayed.
   Specify the IP addresses (IP address of each instance) to be used for interconnect. In addition, select mdc1 for **MDC** as a communication path of a mirror disk resource to be created later. Click **Next**.



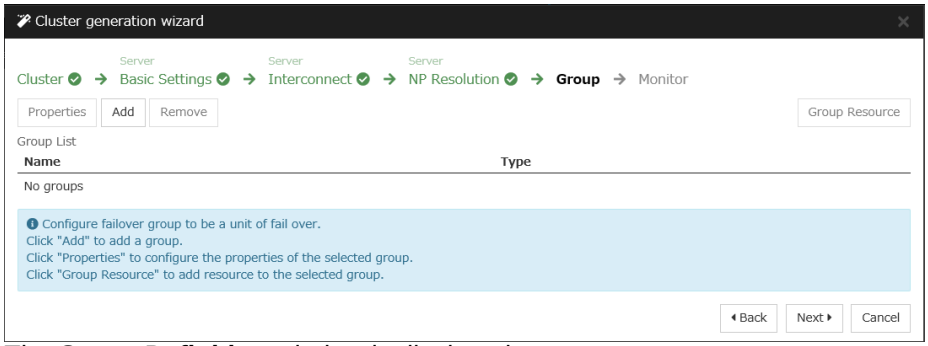
5. The **NP Resolution** window is displayed.
   Note that NP resolution is not configured on this window. The equivalent feature is achieved by adding the IP monitor resource, custom monitor resource, and multi target monitor resource. Configure NP resolution in "3) **Adding a monitor resource**."
   You need to examine the NP resolution destination and method depending on the location of clients accessing a cluster system and the condition for connecting to an on-premise environment (for example, using a dedicated line). Additionally, you can use network partition resolution resources for NP resolution.
   Click **Next**.



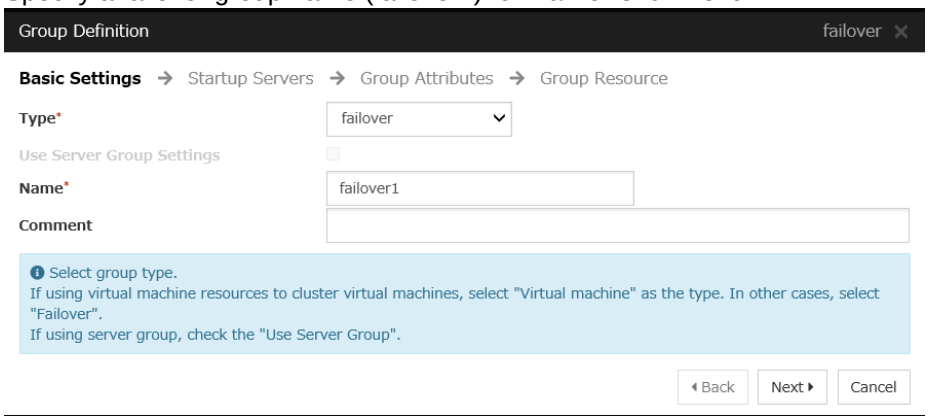
2) Adding a group resource

◆ Defining a group
Create a failover group.

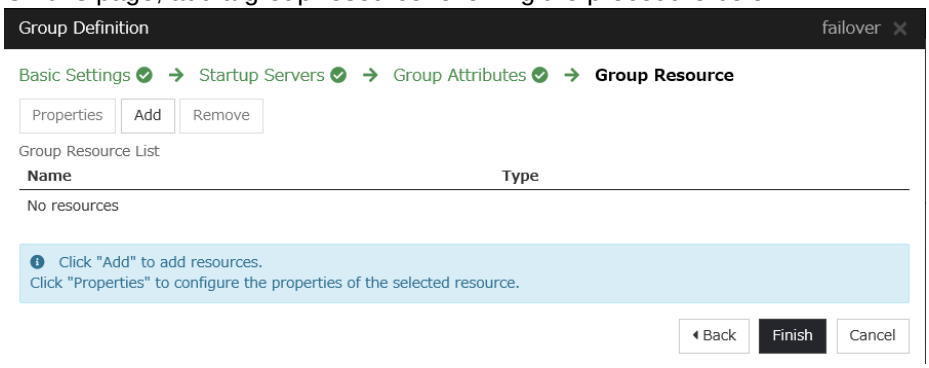
1. The **Group List** window s displayed.
Click **Add**.



2. The **Group Definition** window is displayed.
Specify a failover group name (failover1) for **Name**. Click **Next**.

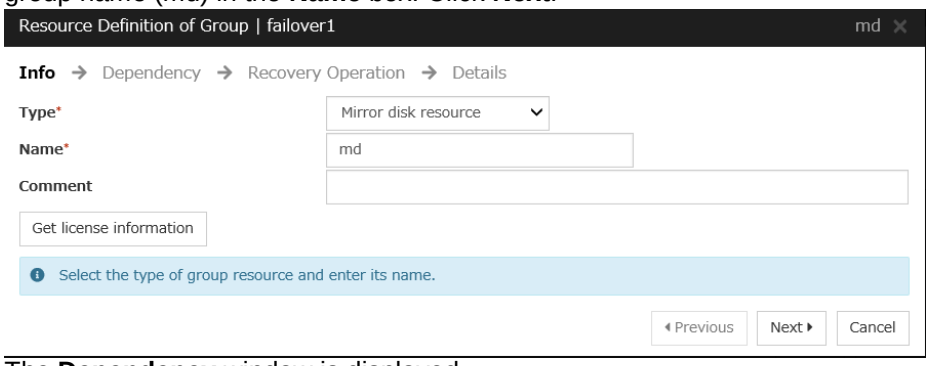


3. The **Startup Servers** window is displayed.
   Click **Next** without specifying anything.
4. The **Group Attributes** window is displayed.
   Click **Next** without specifying anything.
5. The **Group Resource** window is displayed.
   On this page, add a group resource following the procedure below.



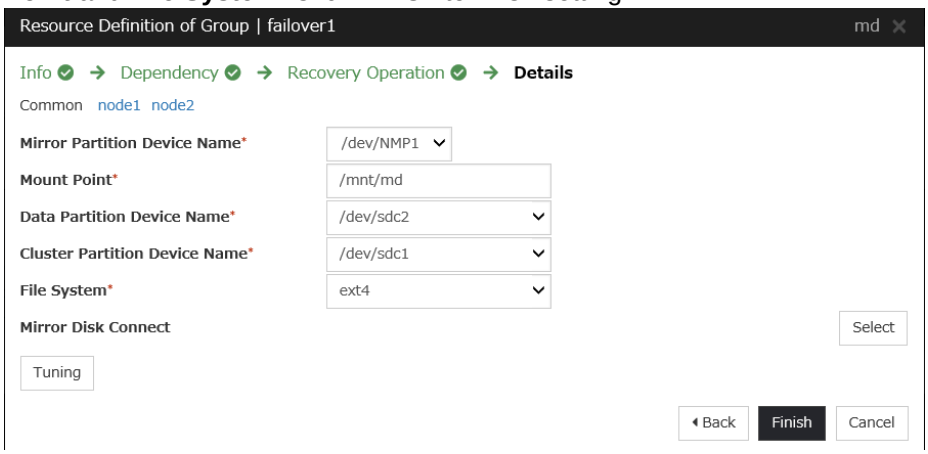
◆ Mirror disk resource
Create a mirror disk resource.
For details, see “Understanding mirror disk resources" in the *Reference Guide*.

1. Click **Add** on the **Group Resource List** page.
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 name (md) in the **Name** box. Click **Next**.



3. The **Dependency** window is displayed.
   Click **Next** without specifying anything.
4. The **Recovery Operation** window is displayed.
   Click **Next**.

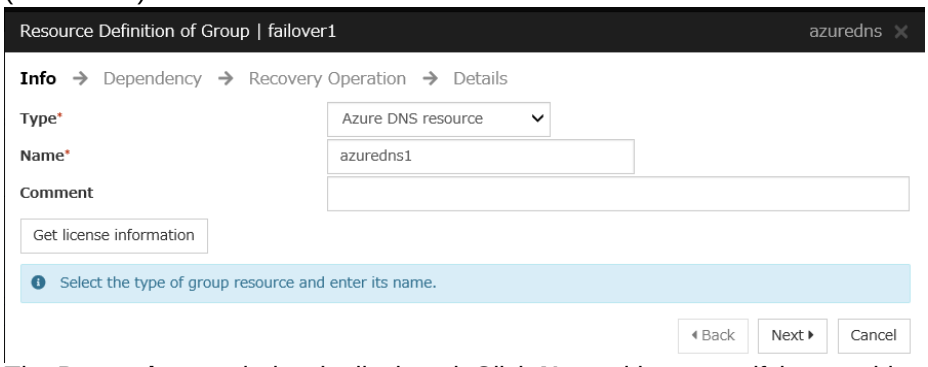
5. The **Details** window is displayed.
   Enter the device name of the partition created in "6) **Configuring virtual machines**" in **Data Partition Device Name** and **Cluster Partition Device Name**. Specify **Mount Point** and **File System**. Click **Finish** to finish setting.



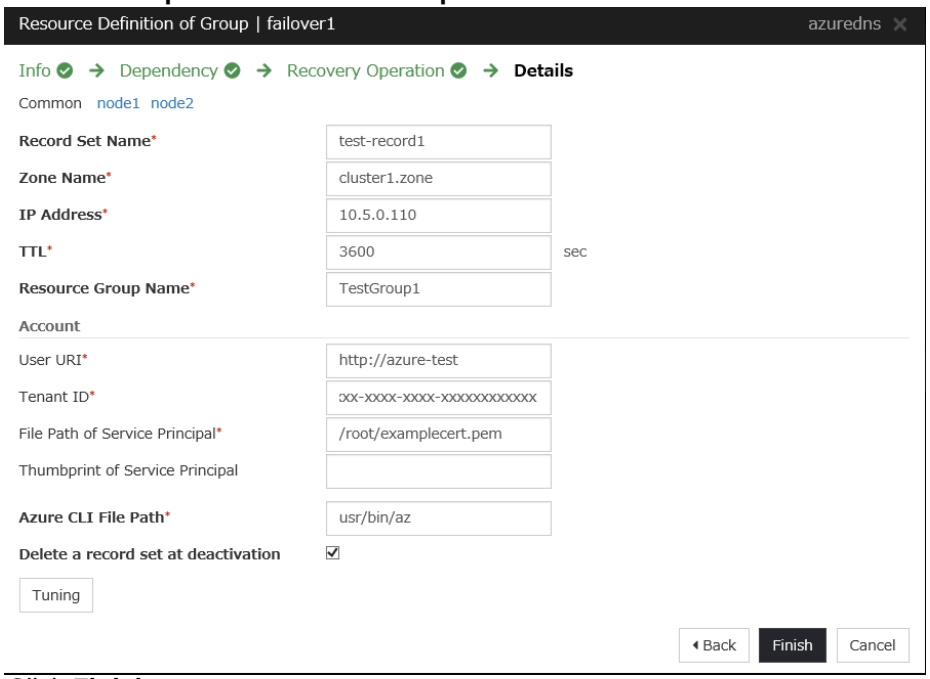
◆ Azure DNS resource
Provides a mechanism to register or unregister a record to or from Azure DNS.

For details about the Azure DNS resource, see “Understanding Azure DNS resources” in the *Reference Guide*.

1. Click **Add** on the **Group Resource List** page.
2. The **Resource Definition of Group | failover1** window is displayed. Select the group resource type (Azure DNS resource) from the **Type** box and enter the group name (azuredns1) in the **Name** box. Click **Next**.



3. The **Dependency** window is displayed. Click **Next** without specifying anything.
4. The **Recovery Operation** window is displayed. Click **Next**.
5. Enter the values for each of the following: **Record Set Name**, **Zone Name**, **IP Address**, **Resource Group Name**, **User URI**, **Tenant ID**, **File Path of Service Principal**, **Thumbprint of Service Principal , Azure CLI File Path**. When using the IP address of each server, enter the IP address in the tab for each server. When setting up the servers separately, enter any IP address of the servers in the **Common** tab and then make settings for other servers. Only when using Azure CLI 1.0 (Azure classic CLI), enter **Thumbprint of Service Principal**.



6. Click **Finish**.

3) Adding a monitor resource

- Azure DNS monitor resource
  The mechanism to check the record sets registered to the Azure DNS and whether the name resolution is available is provided.

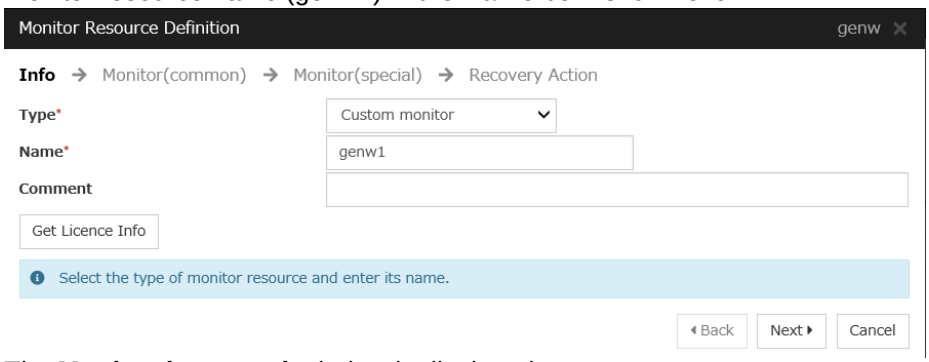
  For details about Azure DNS monitor resources, see "*Reference Guide*" > "Understanding Azure DNS monitor resources."

  Adding one Azure DNS resource creates one Azure DNS monitor resource automatically.

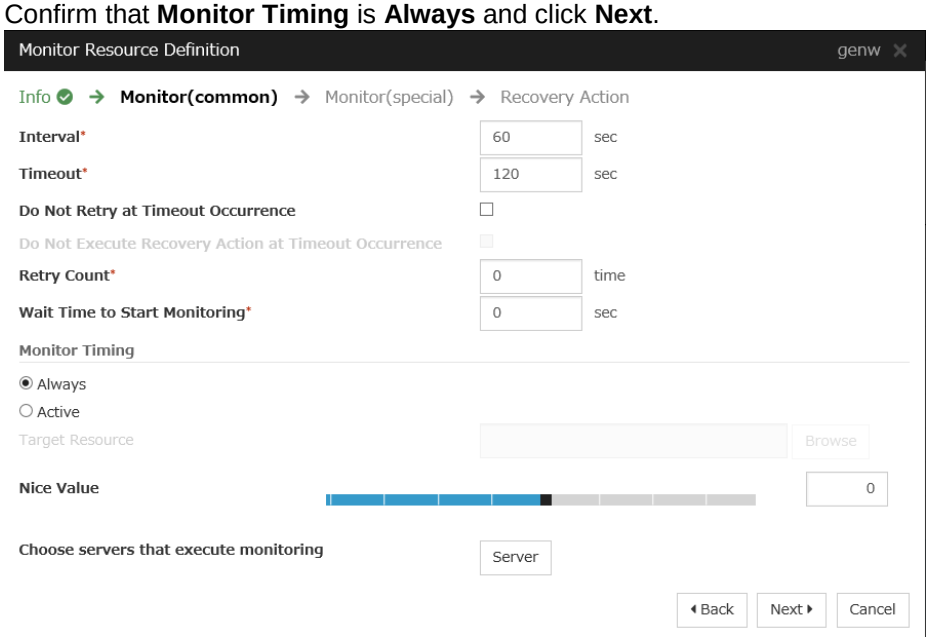
- Custom monitor resource
  Sets a script to monitor whether communication with the Microsoft Azure Service Management API is possible, and also to monitor health of communication with an external network.

  For details about the custom monitor resource, see “Understanding custom monitor resources." in the *Reference Guide*.

1. Click **Add** on the **Monitor Resource List** page.
2. Select the monitor resource type (Custom monitor) from the **Type** box and enter the monitor resource name (genw1) in the **Name** box. Click **Next**.



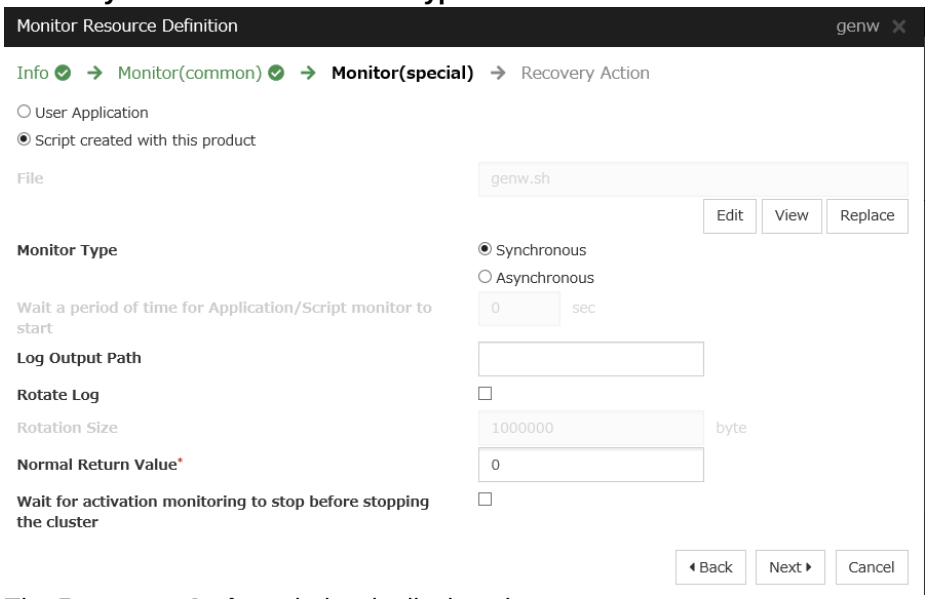
3. The **Monitor (common)** window is displayed.
   Confirm that **Monitor Timing** is **Always** and click **Next**.



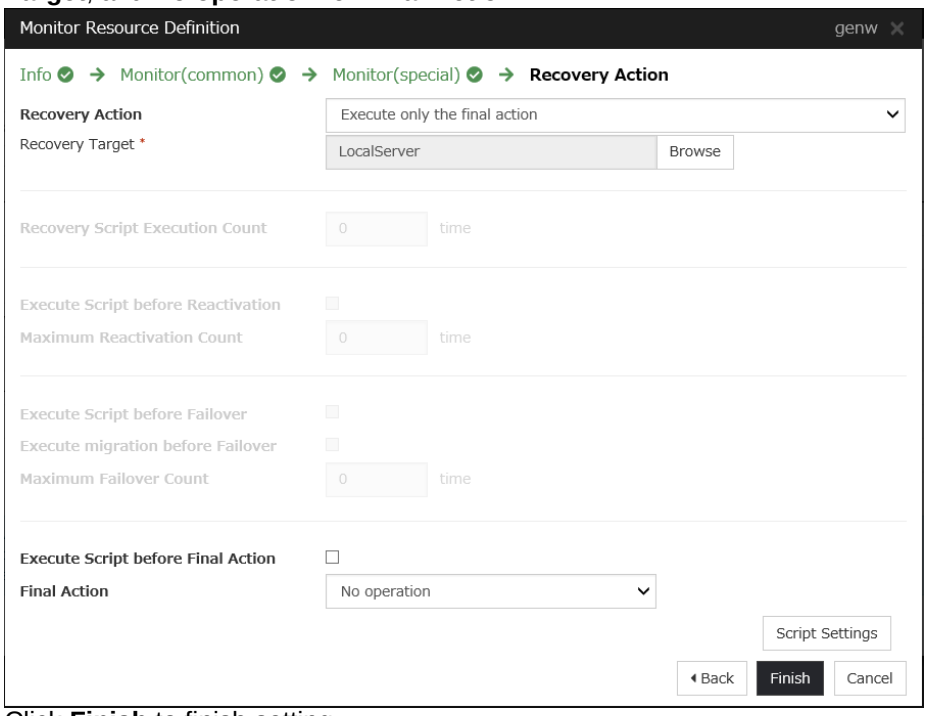
4. The **Monitor (special)** window is displayed.
   Select **Script created with this product**.
   The following shows the sample of a script to be created.

   #! /bin/sh
   <EXPRESSCLUSTER-installation-path>/bin/clpazure_port_checker –h management.core.windows.net -p 443
   exit $?

   Select **Synchronous** for **Monitor Type**. Click **Next**.



5. The **Recovery Action** window is displayed.
   Select **Execute only the final action** for **Recovery Action**, **LocalServer** for **Recovery Target**, and **No operation** for **Final Action**.

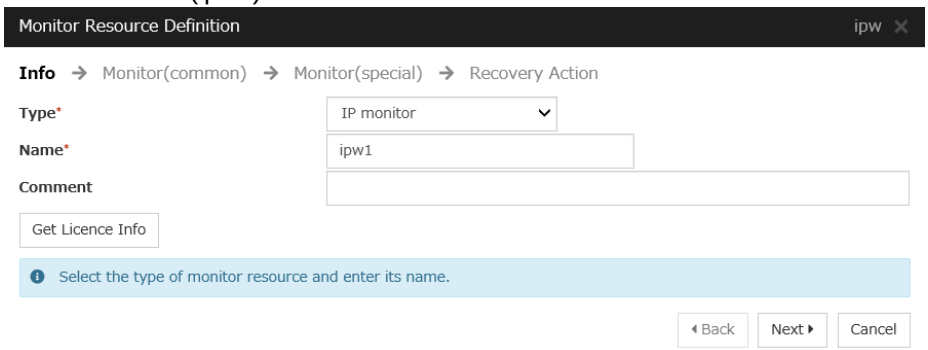


6. Click **Finish** to finish setting.

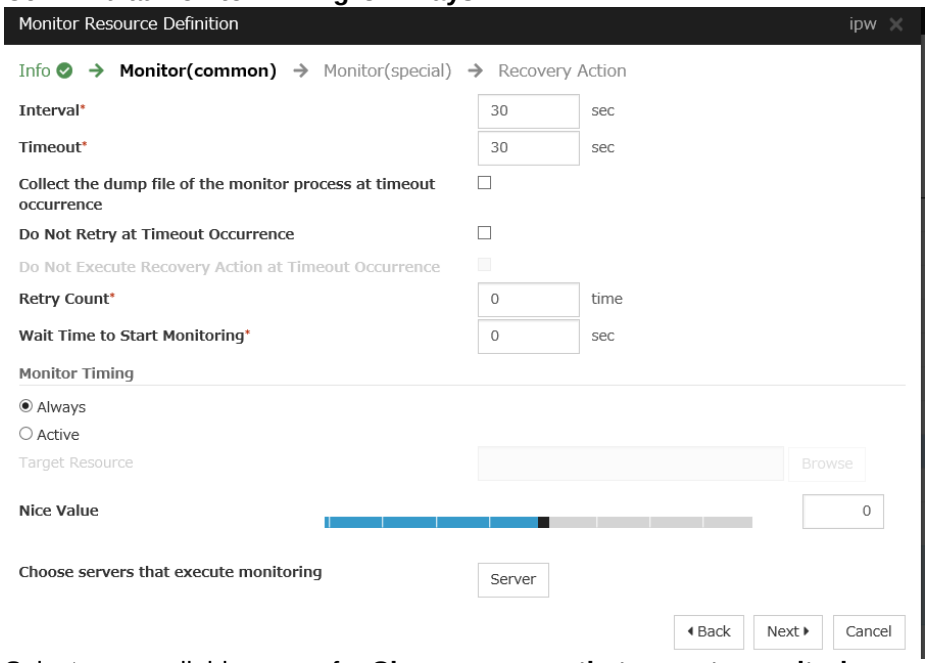
◆ IP monitor resource
Creates an IP monitor resource to monitor communication between clusters that are configured with virtual machines, and also to monitor whether communication with an internal network is health.

For details about the IP monitor resource, see “Understanding IP monitor resources” in the *Reference Guide*.

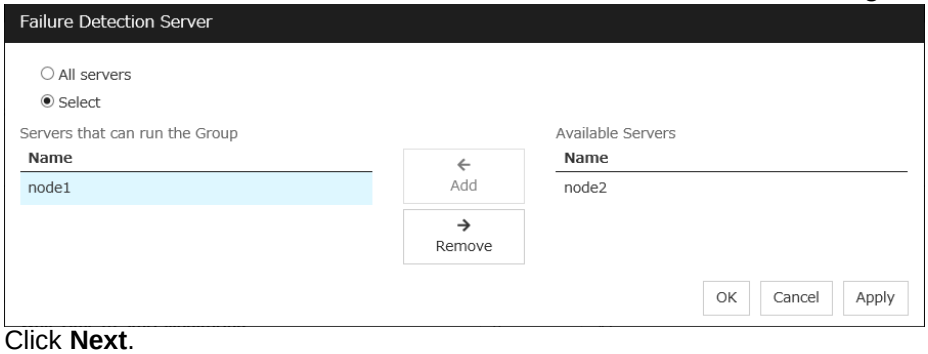
1. Click **Add** on the **Monitor Resource List** page.
2. Select the monitor resource type (IP monitor) from the **Type** box and enter the monitor resource name (ipw1) in the **Name** box. Click **Next**.



3. The **Monitor (common)** window is displayed.
Confirm that **Monitor Timing** is **Always**.

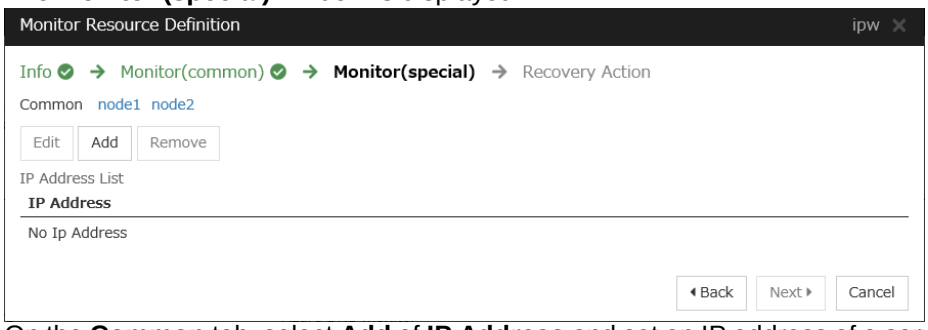


Select one available server for **Choose servers that execute monitoring**.

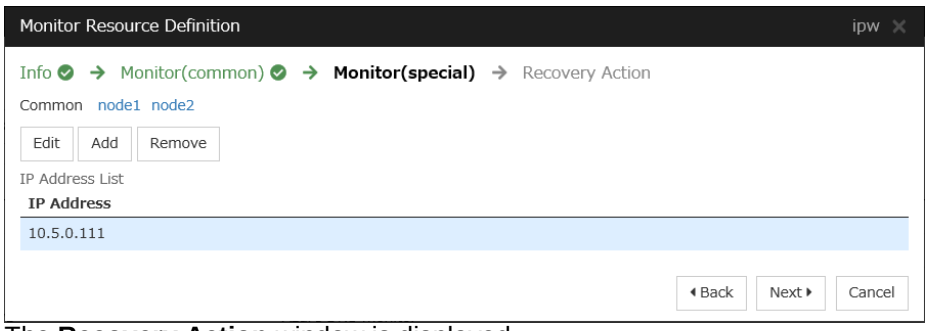


Click **Next**.

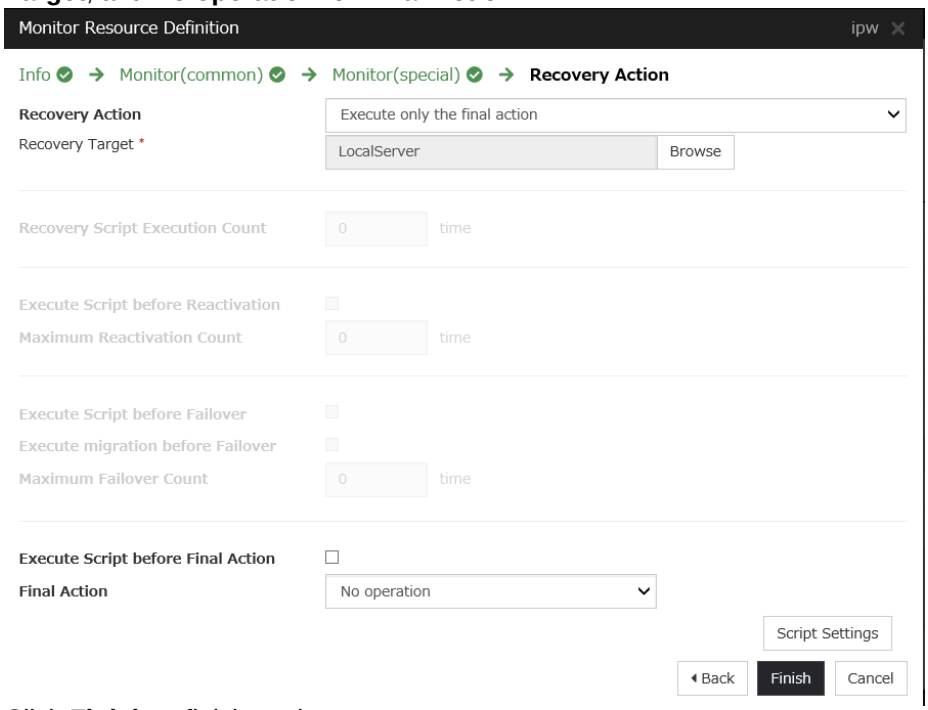
4. The **Monitor (special)** window is displayed.



On the **Common** tab, select **Add** of **IP Address** and set an IP address of a server other than the server selected in step 3. Click **Next**.



5. The **Recovery Action** window is displayed.
Select **Execute only the final action** for **Recovery Action**, **LocalServer** for **Recovery Target**, and **No operation** for **Final Action**.



6. Click **Finish** to finish setting.

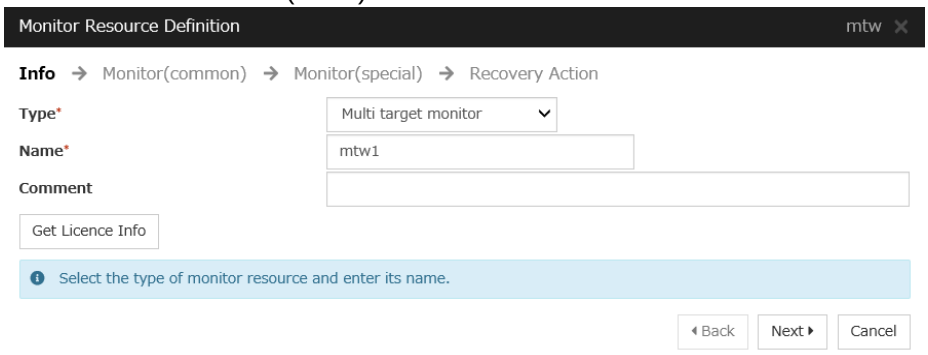
7. Then, create a monitor resource on the other server. Click **Add** on the **Monitor Resource List** page.
8. Select the monitor resource type (IP monitor) from the **Type** box and enter the monitor resource name (ipw2) in the **Name** box. Click **Next**.
9. The **Monitor (common)** window is displayed.
   Confirm that **Monitor Timing** is **Always**.
   Select one available server for **Choose servers that execute monitoring**.
   Click **Next**.
10. The **Monitor (special)** window is displayed.
    On the **Common** tab, select **Add** of **IP Address** and set an IP address of a server other than the server selected in step 9. Click **Next**.
11. The **Recovery Action** window is displayed.
    Select **Execute only the final action** for **Recovery Action**, **LocalServer** for **Recovery Target**, and **No operation** for **Final Action**.
12. Click **Finish** to finish setting.

◆ Multi target monitor resource

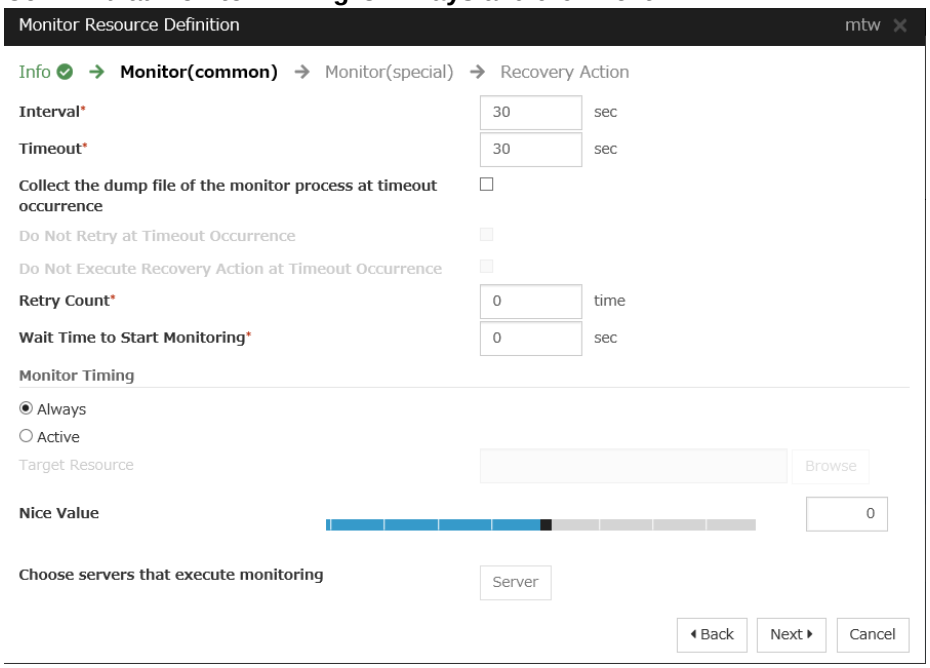
Creates a multi target monitor resource to check the statuses of both the custom monitor resource monitoring communication to Microsoft Azure Service Management API and the IP monitor resource between clusters that are configured with virtual machines. If the statuses of both monitor resources are abnormal, execute the script in which the processing for NP resolution is described.

For details about the multi target monitor resource, see “Understanding multi target monitor resources" in the *Reference Guide*.

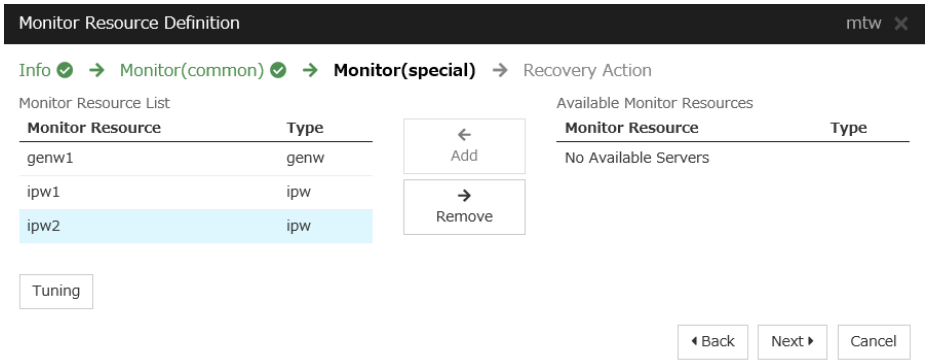
1. Click **Add** on the **Monitor Resource List** page.
2. Select the monitor resource type (Multi target monitor) from the **Type** box and enter the monitor resource name (mtw1) in the **Name** box. Click **Next**.



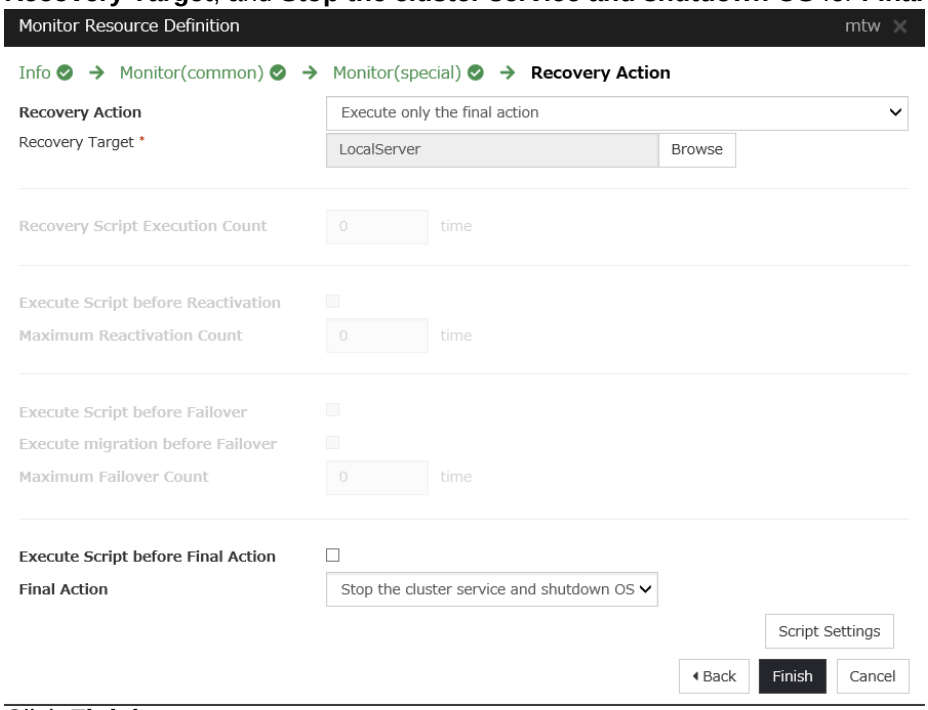
3. The **Monitor (common)** window is displayed.
   Confirm that **Monitor Timing** is **Always** and click **Next**.



4. The **Monitor (special)** window is displayed.
   From **Available Monitor Resources**, select the custom monitor resource (genw1) for checking communication with Service Management API and two IP monitor resources (ipw1 and ipw2) that are set to both servers. Then, click **Add** to add them to **Monitor Resource List**. Click **Next**.



5. The **Recovery Action** window is displayed.
   Specify **Execute only the final action** for **Recovery Action**, **LocalServer** for **Recovery Target**, and **Stop the cluster service and shutdown OS** for **Final Action**.



6. Click **Finish**.

4) Setting the cluster properties

For details about the cluster properties, see “Cluster properties" in the *Reference Guide*.

◆ Cluster properties

Configure the settings in **Cluster Properties** to link Microsoft Azure and EXPERSSCLUSTER.

1. Enter **Config Mode** from Cluster WebUI, click the property icon of a cluster name.

2. Select the **Timeout** tab. For **Timeout** of **Heartbeat**, specify a value calculated by “A+B+C” as described below.

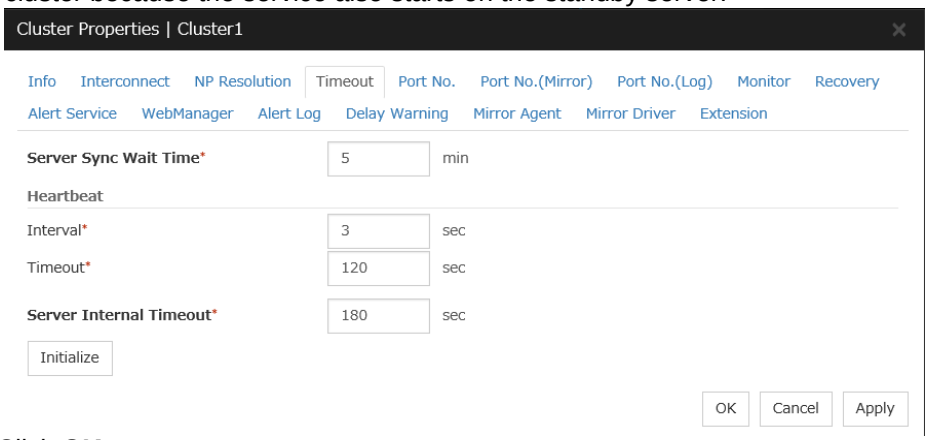
   A: **Interval** of the monitor resource being monitored by the multi target monitor resource for NP resolution x (**Retry Count**+1)

   * Among three monitor resources, select the monitor resource whose calculation result is the largest.

   B: **Interval** of the multi target monitor resource x (**Retry Count**+1)

   C: 30 seconds (Waiting time for heartbeat not to time out before the multi target monitor resource detects an error. The time can be changed accordingly.

Note: If **Timeout** of **Heartbeat** is shorter than the time that it took for the multi target monitor resource to detect an error, a heartbeat timeout will be detected before starting the NP resolution processing. In this case, the same service may start doubly in the cluster because the service also starts on the standby server.



3. Click **OK**.

5) Applying the settings and starting the cluster

1. Click **Apply the Configuration File** on the **File** in the config mode of Cluster WebUI. If the upload succeeds, the message saying “The application finished successfully.”
2. Select the **Operation Mode** on the drop down menu of the toolbar in Cluster WebUI to switch to the operation mode.
3. The procedure depends on the resource used. For details, refer to the following:*Installation and Configuration Guide* → How to create a cluster

3.4 Verifying the created environment

Verify whether the created environment works properly by generating a monitoring error to fail over a failover group.
If the cluster is running normally, the verification procedure is as follows:

1. Start the failover group (failover1) on the active node (node1). In the Status tab on the Cluster WebUI, confirm that **Group Status** of failover1 of node1 is **Normal**.
2. Log in to the Microsoft Azure portal, select cluster1.zone on the **DNS zone** blade, and then select **Summary**. Check the DNS servers displayed on the upper right of the window (name server 1, name server 2, name server 3, and name server 4 in the window example).
3. Confirm that the relevant record set exists in the DNS servers checked in the above step by executing the nslookup command as follows:
   $ nslookup test-record1.cluster1.zone <*DNS_servers_checked_in_the_above_step*>
4. On the Microsoft Azure portal, delete an A record from the DNS zone. This causes azurednsw1 to detect a monitoring error. On the **DNS zone** blade, select cluster1.zone and then **Summary**.
5. Select the record you want to delete and click **Delete**. When the deletion confirmation dialog box is displayed, select **Yes**.
6. When the time specified for **Interval** of azurednsw1 elapses, the failover group (failover1) enters an error status and fails over to node2. In the Status tab on the Cluster WebUI, confirm that **Group Status** of failover1 of node2 is **Normal**.
7. Confirm that the relevant record set exists in the DNS servers checked in the above step by executing the nslookup command as follows:
   $ nslookup test-record1.cluster1.zone <*DNS_servers_checked_in_the_above_step*>

Verifying the failover operation when an A record is deleted from the DNS server is now complete. Verify the operations in case of other failures if necessary.

Chapter 4 Cluster Creation Procedure (for an HA Cluster Using an Public Load Balancer)

4.1 Creation example

This guide introduces the procedure for creating a 2-node unidirectional standby cluster using EXPRESSCLUSTER on Microsoft Azure. This procedure is intended to create a mirror disk type configuration in which node1 is used as an active server.
The following tables describe the parameters that do not have a default value and the parameters whose values are to be changed from the default values.

- Microsoft Azure settings (common to node1 and node2)

Setting item	Setting value
Resource group setting	
Resource group	TestGroup1
Region	Japan East
Virtual network setting	
Name	Vnet1
Address space	10.5.0.0/24
Subnet Name	Vnet1-1
Subnet Address range	10.5.0.0/24
Resource group	TestGroup1
Location	Japan East
Load balancer setting	
Name	TestLoadBalancer
Type	Public
Public IP address: Name	TestLoadBalancerPublicIP
Public IP address: Assignment	Static
Resource group	TestGroup1
Region	Japan East
Backend pool: Name	TestBackendPool
Associated to	Availability set
Target virtual machine	node1 node2
Network IP configuration	10.5.0.110 10.5.0.111
Health probe: Name	TestHealthProbe
Health probe: Port	26001
Load balancing rule: Name	TestLoadBalancingRule
Load balancing rule: Port	80 (Port number offering the operation)
Load balancing rule: Backend port	8080 (Port number offering the operation)
Inbound security rule setting	
Name	TestHTTP
Protocol	TCP
Destination Port range	8080 (Port number offering the operation)

- Microsoft Azure settings (specific to each of node1 and node2)

Setting item	Setting value	
	node1	node2
Virtual machine setting		
Disk type	Standard HDD	
User name	testlogin	
Password	PassWord_123	
Resource group	TestGroup1	
Region	Japan East	
Network security group setting		
Name	NetSecGroup1	
Availability set setting		
Name	AvailabilitySet1	
Update domains	5	
Fault domains	2	
Diagnostics storage account setting		
Name	Automatically generated (testgroup1diag679)	
Replication	Locally-redundant storage (LRS)	
IP configuration setting		
IP address	10.5.0.110	10.5.0.111
Blob storage setting		
Name	Node1Blob1	Node2Blob1
Source type	None (empty disk)	
Account type	Standard HDD	

- EXPRESSCLUSTER settings (cluster properties)

Setting item	Setting value	
	node1	node2
Cluster Name	Cluster1	
Server Name	node1	node2
Timeout Tab: Heartbeat timeout	120	

- EXPRESSCLUSTER settings (failover group)

Resource name	Setting item	Setting value
Mirror disk resource	Name	md
	Details Tab: Mount Point	/mnt/md
	Details Tab: Data Partition Device Name	/dev/sdc2
	Details Tab: Cluster Partition Device Name	/dev/sdc1
	Details Tab: File System	ext4
	Mirror Tab: Execute the initial mirror construction	On
	Mirror Tab: Execute initial mkfs	On
Azure probe port resource	Name	azurepp1
	Probe port	26001 (Value specified for Port of Health probe)

- EXPRESSCLUSTER settings (monitor resource)

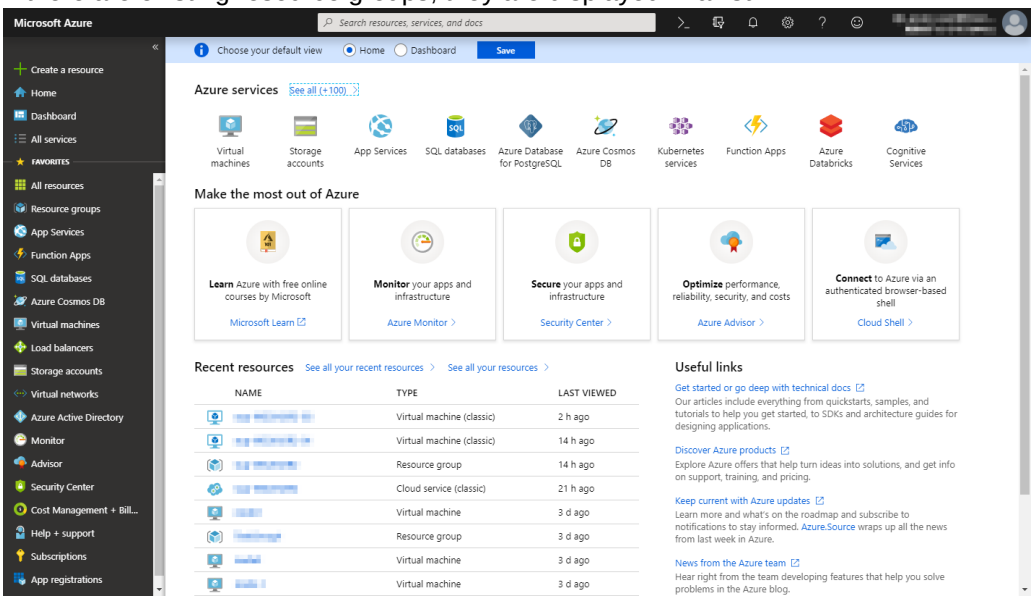
Monitor resource name	Setting item	Setting value
Mirror disk monitor resource	-	-
Azure probe port monitor resource	Name	azureppw1
	Recovery Target	azurepp1
Azure load balance monitor resource	Monitor resource name	aurelbw1
	Recovery Target	azurepp1
Custom monitor resource	Name	genw1
	Script created with this product	On
	Monitor Type	Synchronous
	Normal Return Value	0
	Recovery Action	Execute only the final action
	Recovery Target	LocalServer
IP monitor resource	Name	ipw1
	Server to monitor	node1
	IP Address	10.5.0.111
	Recovery Action	Execute only the final action
	Recovery Target	LocalServer
IP monitor resource	Name	ipw2
	Server to monitor	node2
	IP Address	10.5.0.110
	Recovery Action	Execute only the final action
	Recovery Target	LocalServer
Multi target monitor resource	Name	mtw1
	Monitor resource list	genw1 ipw1 ipw2
	Recovery Action	Execute only the final action
	Recovery Target	LocalServer
	Execute Script before Final Action	On
	Timeout	30

4.2 Configuring Microsoft Azure

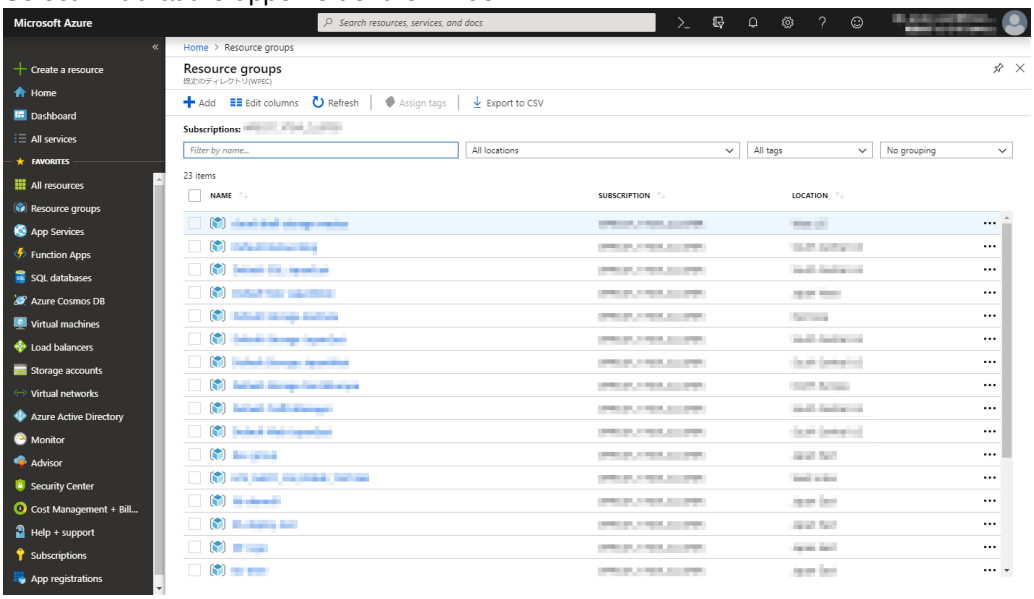
1) Creating a resource group

Log in to the Microsoft Azure portal (https://portal.azure.com/) and create a resource group following the steps below.

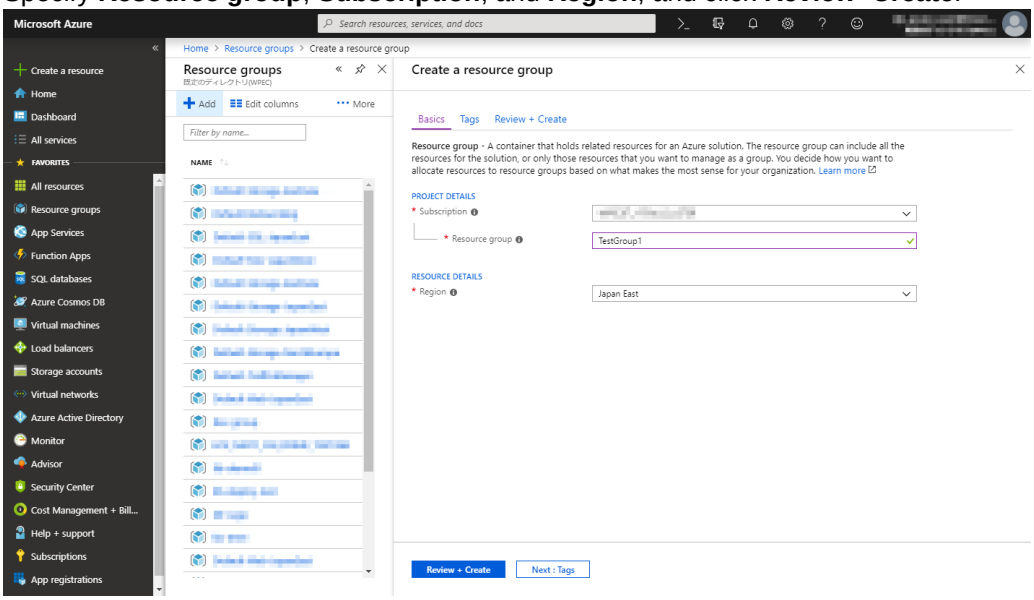
1. Select **Resource groups** or the resource group icon in the menu on the left side of the window. If there are existing resource groups, they are displayed in a list.



2. Select **+Add** at the upper left of the window.



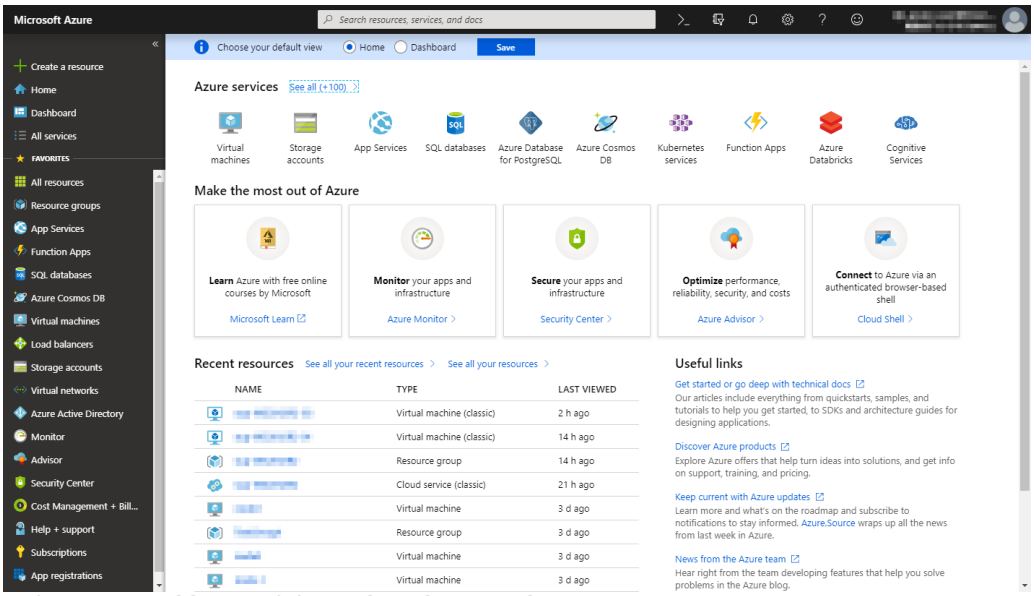
3. Specify **Resource group**, **Subscription**, and **Region**, and click **Review+Create**.



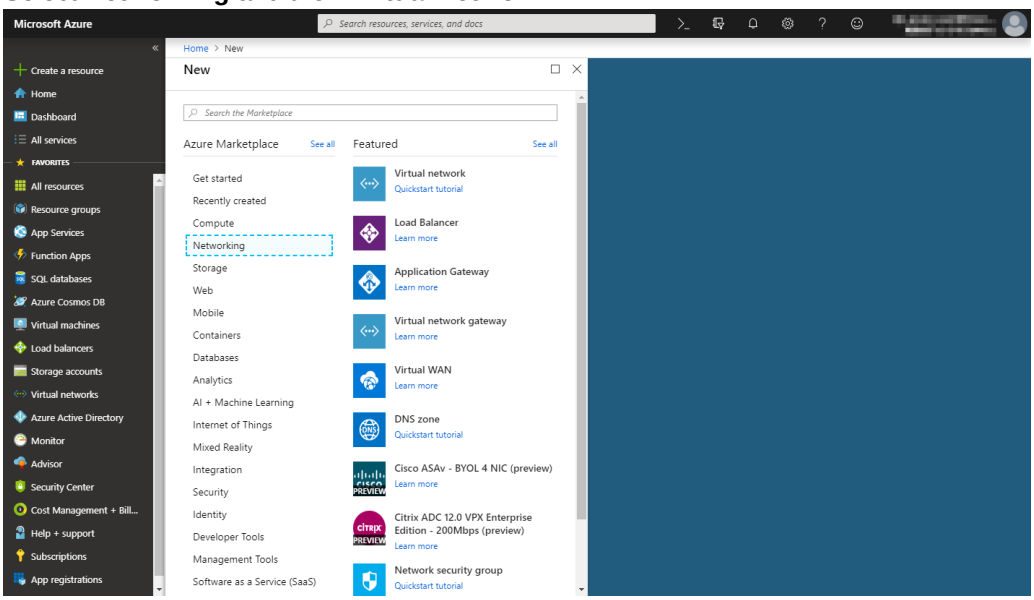
2) Creating a virtual network

Log in to the Microsoft Azure portal (https://portal.azure.com/) and create a virtual network following the steps below.

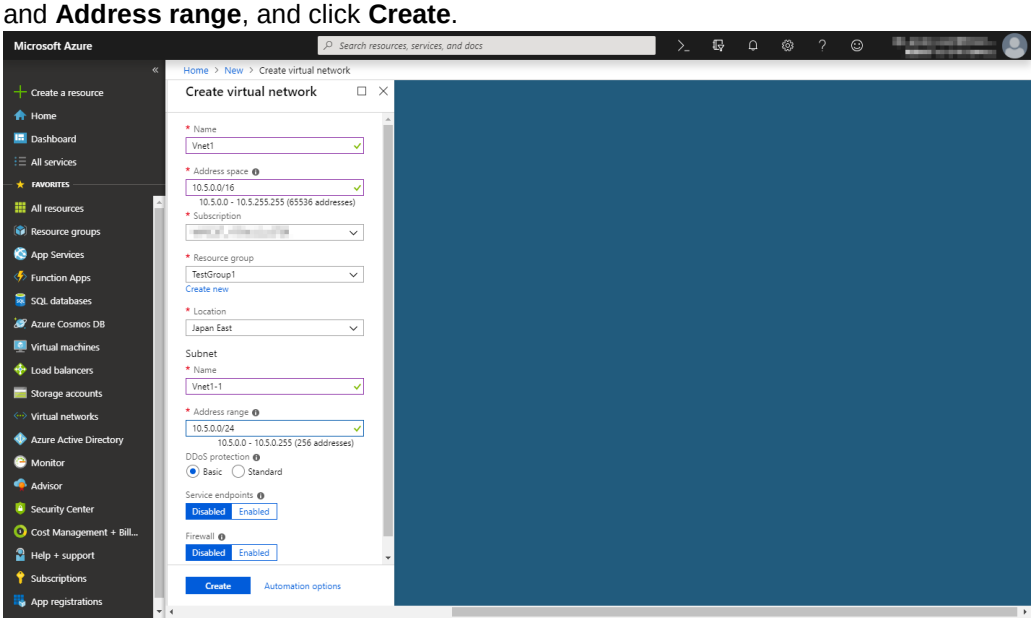
1. Select **+Create a resource** or the **+** icon in the menu on the left side of the window.



2. Select **Networking** and then **Virtual network**.



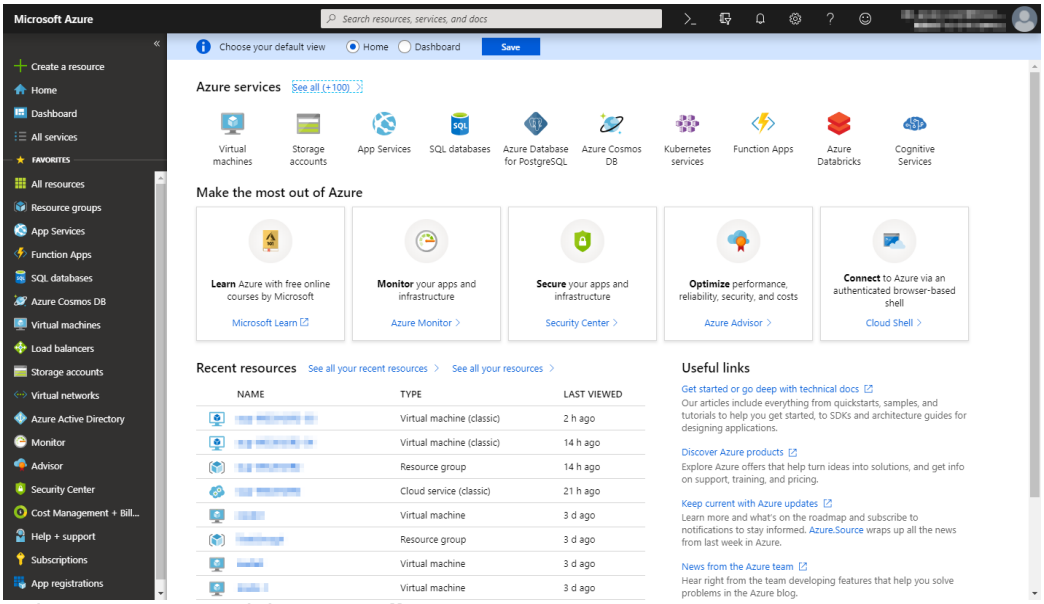
3. Specify **Name**, **Address space**, **Subscription**, **Resource group**, **Location**, **Name** of Subnet, and **Address range**, and click **Create**.



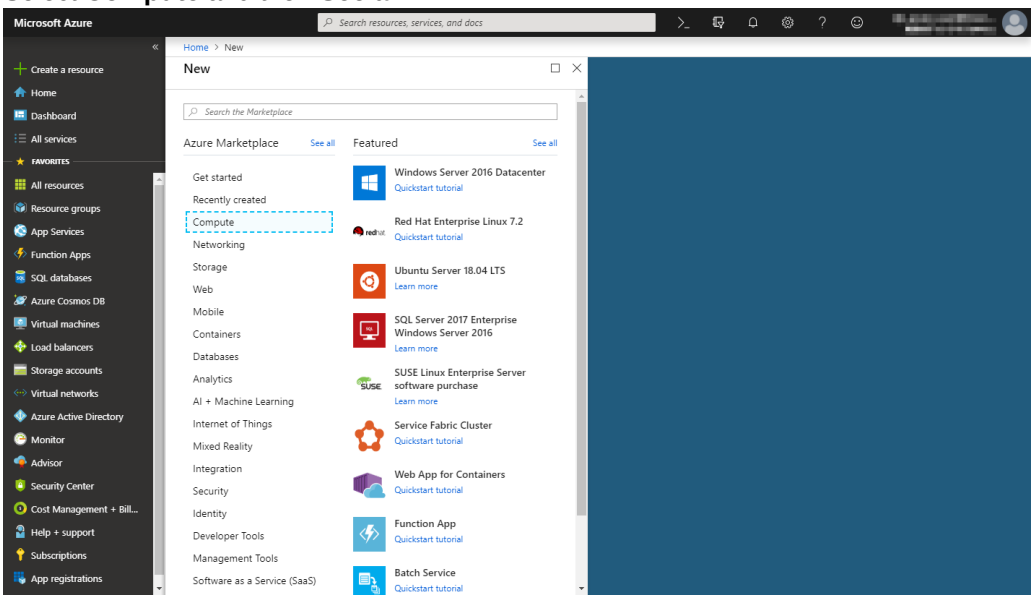
3) Creating a virtual machine

Log in to the Microsoft Azure portal (https://portal.azure.com/) and create virtual machines and disks following the steps below.
Create as many virtual machines as required to create a cluster. Create node1 and then node2.

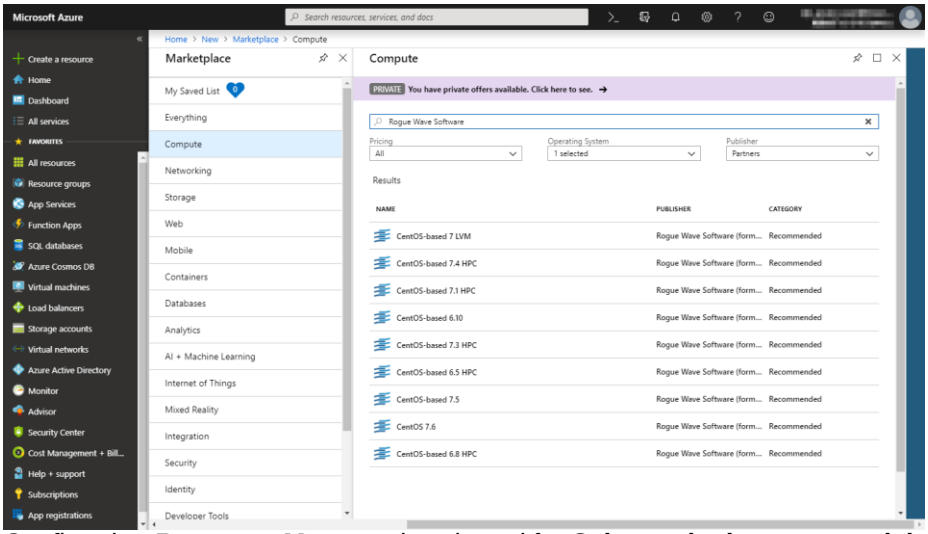
1. Select **+Create a resource** or the **+** icon in the menu on the left side of the window.



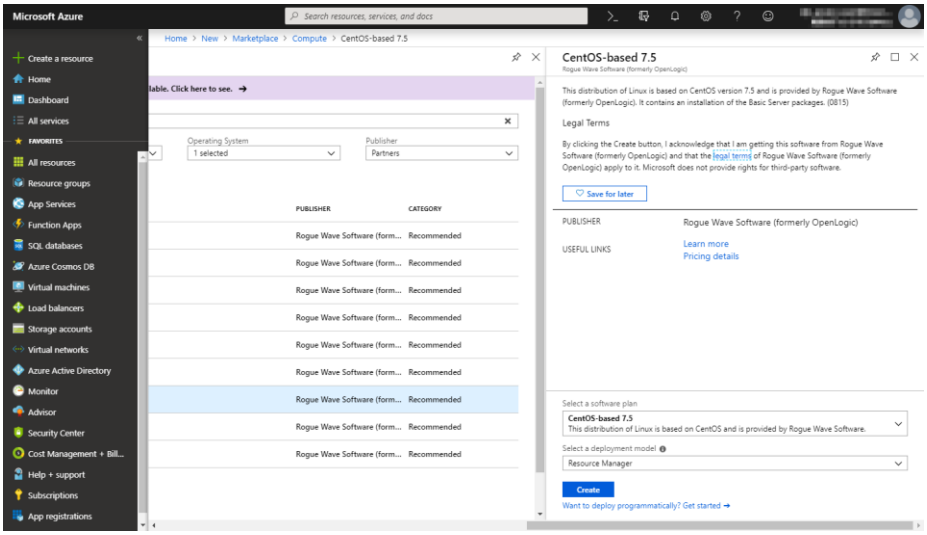
2. Select **Compute** and then **See all**.



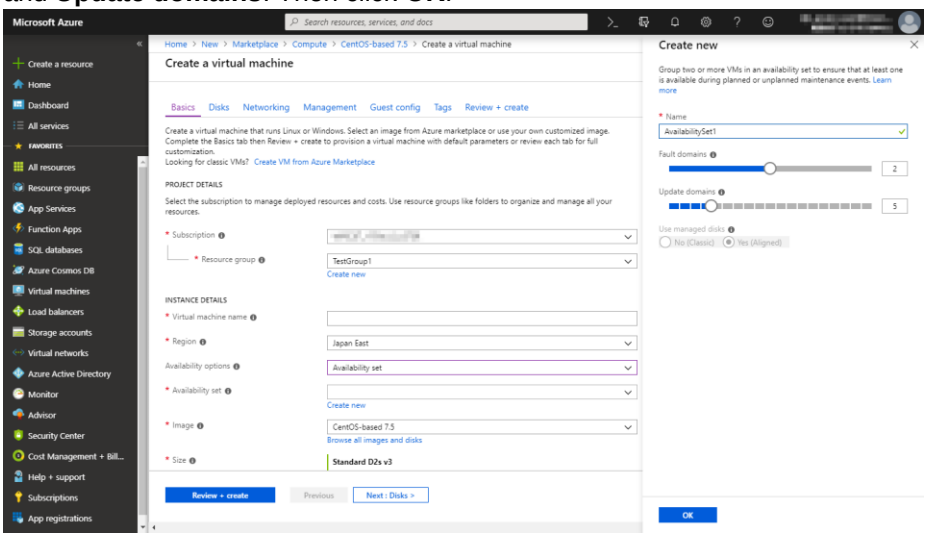
3. Select **CentOS-based 7.5.**

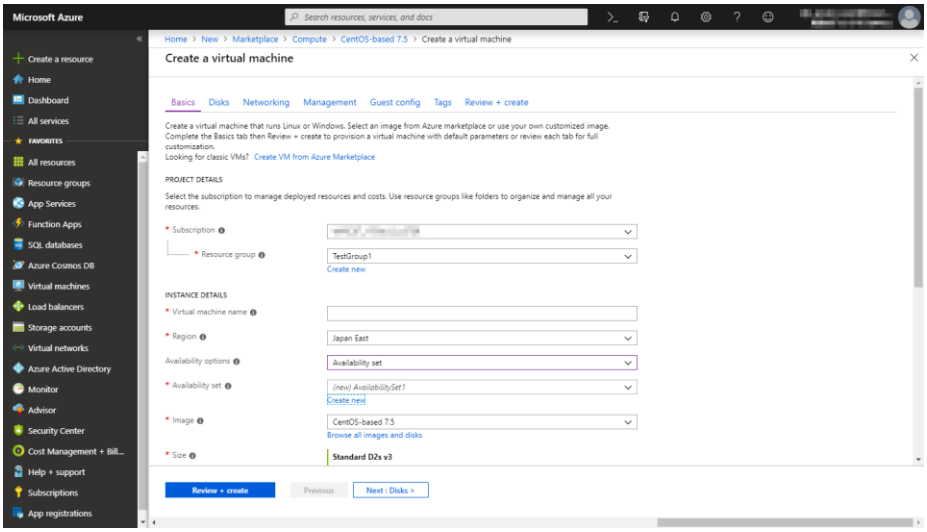


4. Confirm that **Resource Manager** is selected for **Select a deployment model** at the bottom of the window, and click **Create**.

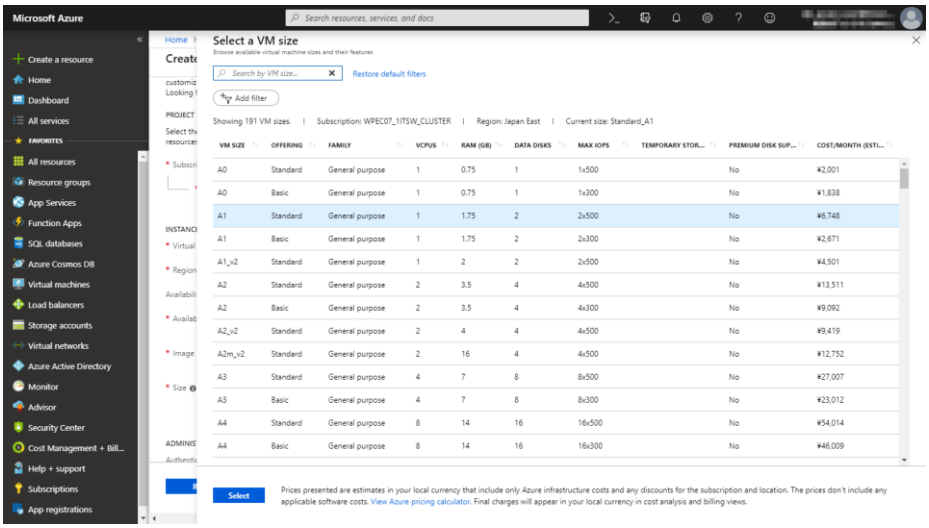


5. When the **Basics** tab appears, specify the settings of **Subscription**, **Resource group**, **Virtual machine name**, **Region**, **Image**, **Size**, **Username**, **Password**, and **Confirm password**. Select **Availability set** from **Availability options**, and click **Create new** under the **Availability set** field. When the **Create new** blade appears, specify the settings of **Name**, **Fault domains**, and **Update domains**. Then click **OK**.

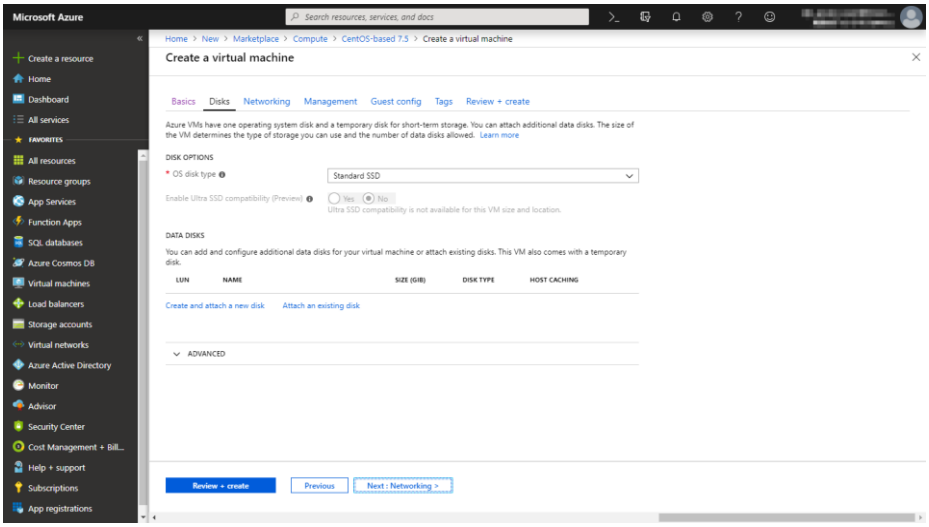




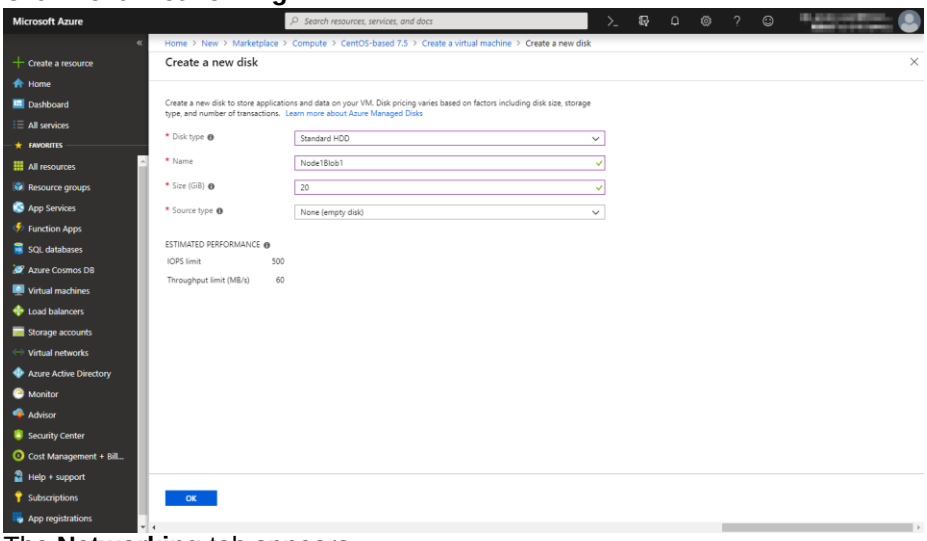
6. Click **Change size** to display the **Select a VM size** blade.
From the list, choose a size (**A1** - **Standard** in this guide) suitable for your virtual machine and click **Select**.
Regarding the **Virtual machine name**, node1 is for node1, and node2 is for node2.
Click **Next: Disks >**



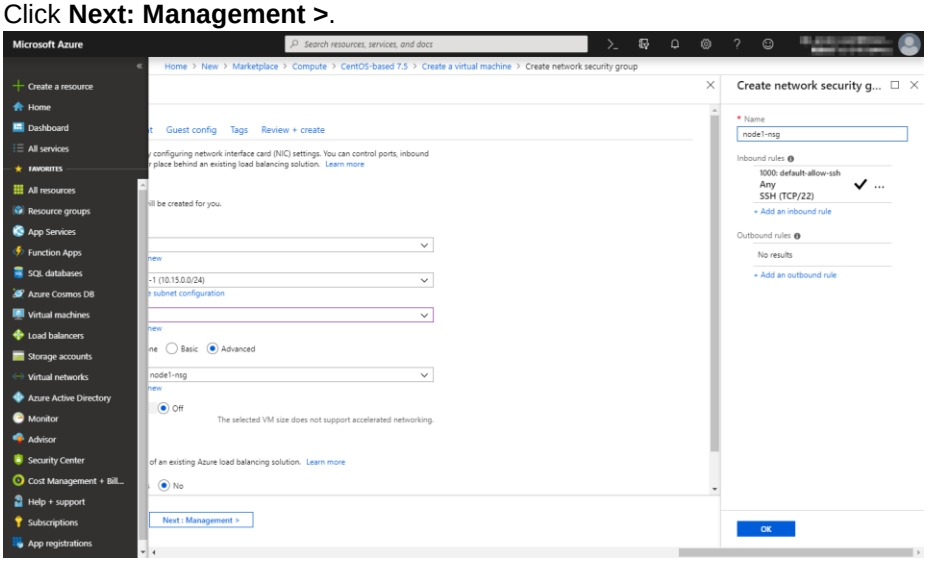
7. When the **Disks** tab appears, go through the following steps to add a blob to be used for a mirror disk (cluster partition or data partition).
From the **DATA DISKS** list, click **Create and attach a new disk**.



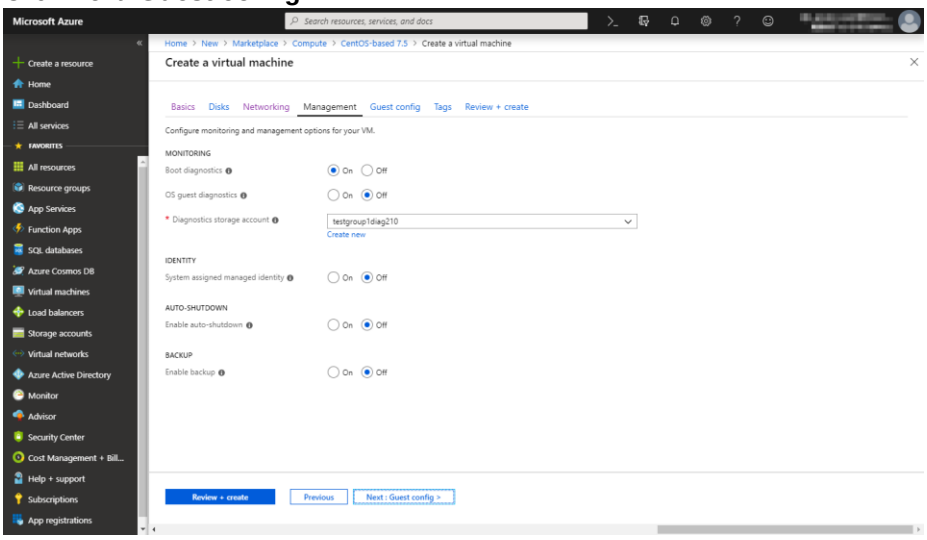
8. The **Create a new disk** blade appears.
Specify the settings of **Disk type**, **Name**, **Size (GiB)**, and **Source type**. Then click **OK**.
Click **Next: Networking >**.

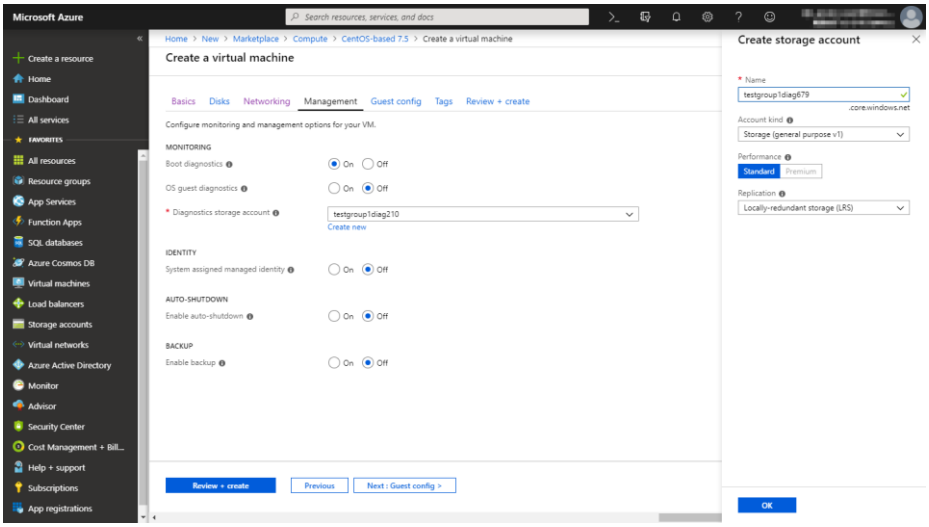


9. The **Networking** tab appears.
Specify the settings of **Virtual network**, **Subnet**, **Network security group**, and **Configure network security group**.
Click **Create new** under the **Configure network security group** field to display the **Create network security group** blade. Specify the setting of **Name** and then click **OK**.
Click **Next: Management >**.

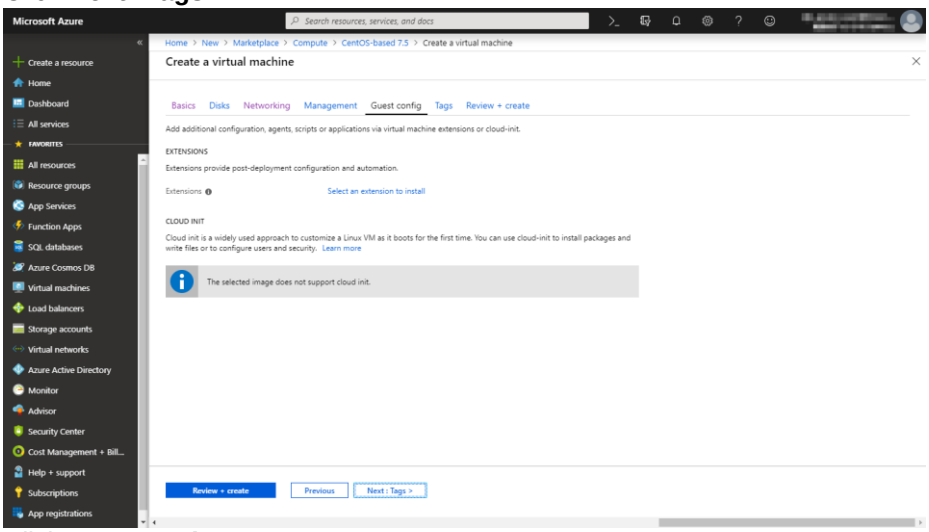


10. The **Management** tab appears.
Click **Create new** under the **Diagnostics storage account** field to display the **Create storage account** blade.
Specify the settings of **Name**, **Account kind**, and **Replication**. Then click **OK**.
In the **Diagnostics storage account** field, the default value is automatically generated and entered.
Click Next: **Guest config >**.

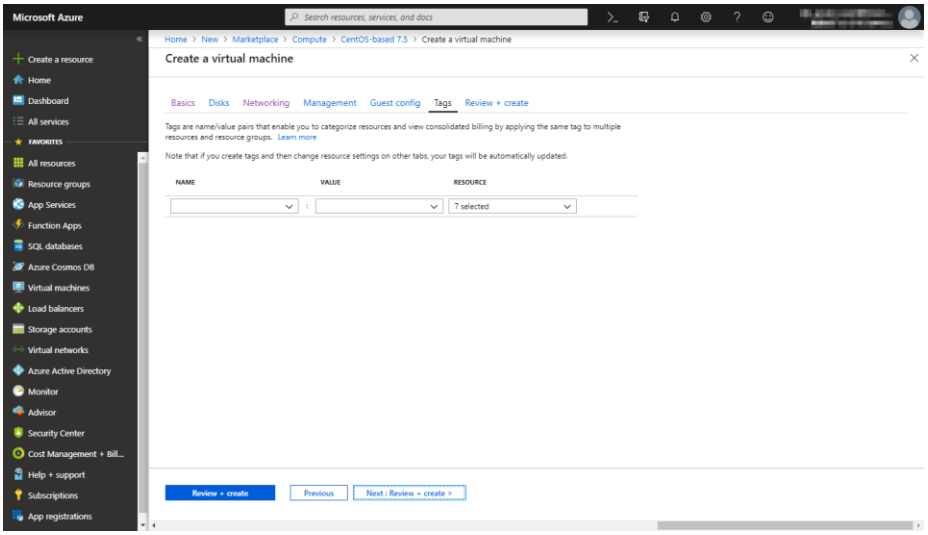




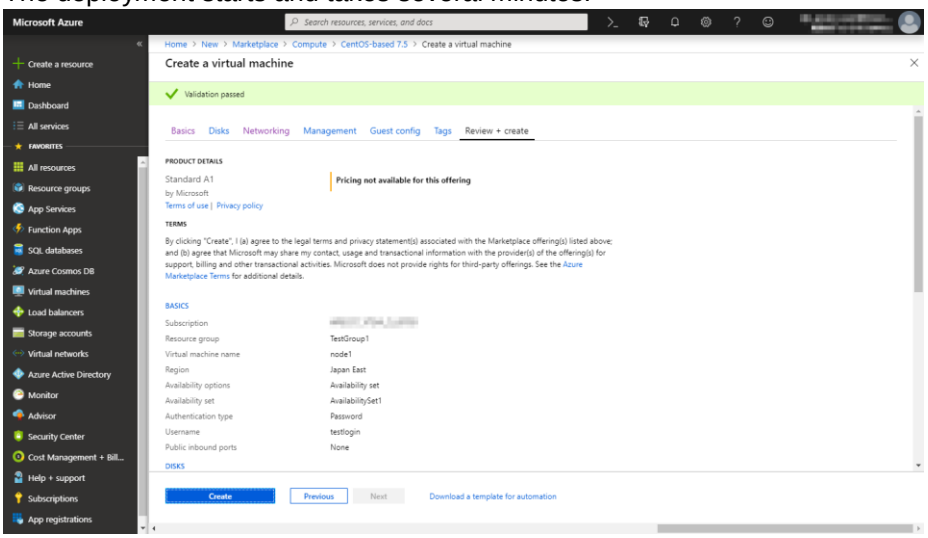
11. Click **Next: Tags >**.



12. Click **Next: Review + create >**.



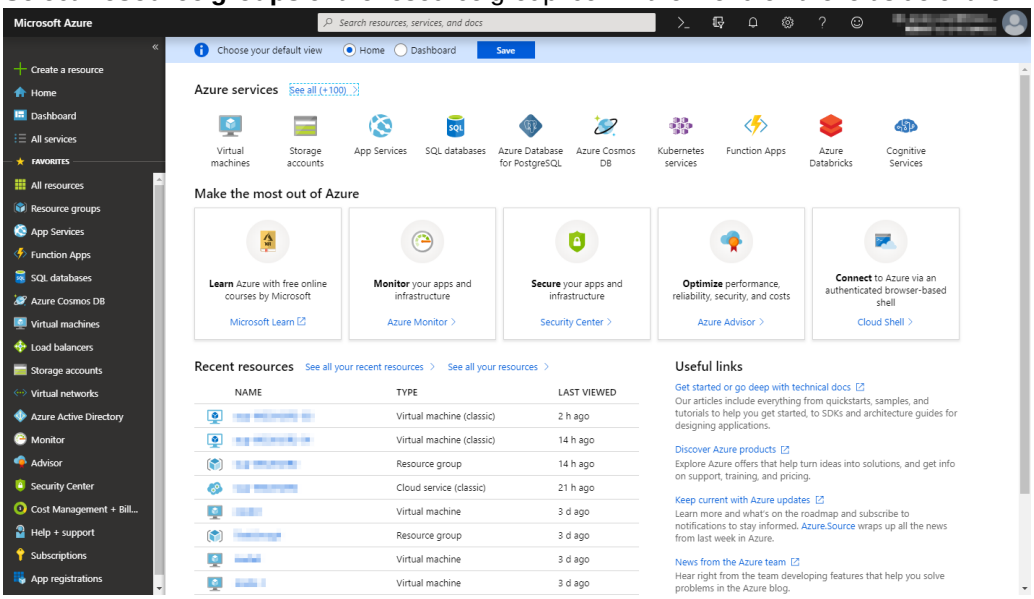
13. The **Review + create** tab appears. Check the contents. If there is no problem, click **Create**. The deployment starts and takes several minutes.



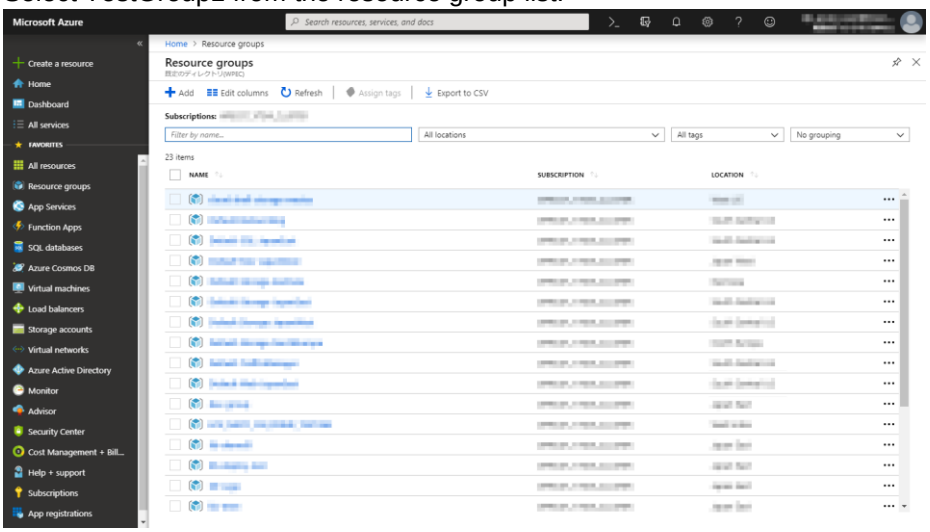
4) Setting a private IP address

Log in to the Microsoft Azure portal (https://portal.azure.com/) and change the private IP address setting following the steps below. Since an IP address is initially set to be assigned dynamically, change the setting so that an IP address is assigned statically. Change the settings of node1 and then node2.

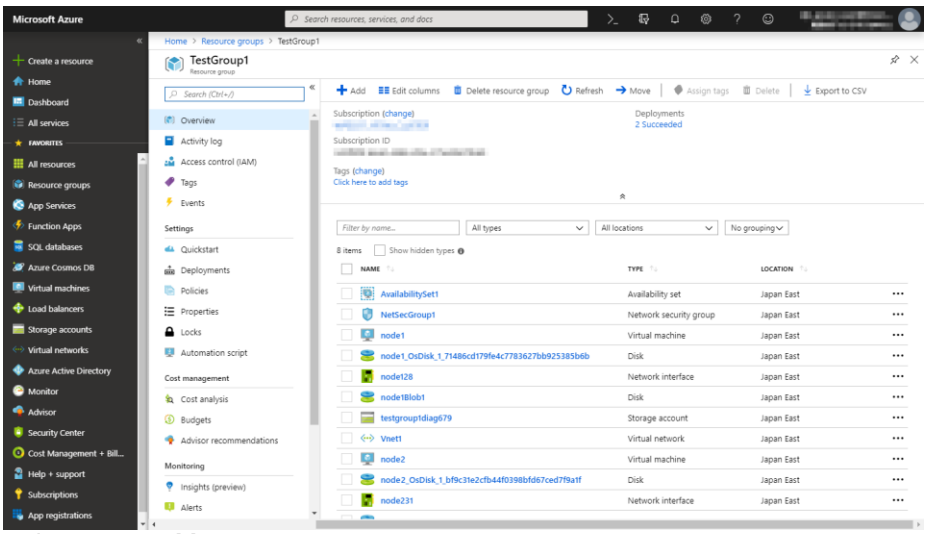
1. Select **Resource groups** or the resource group icon in the menu on the left side of the window.



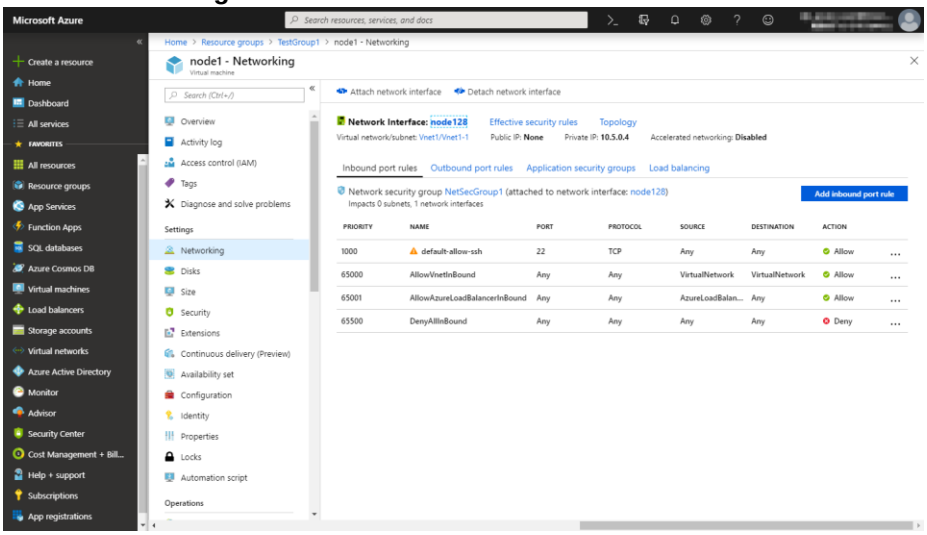
2. Select TestGroup1 from the resource group list.



3. The summary of TestGroup1 is displayed. Select virtual machine node1 or node2 from the item list.

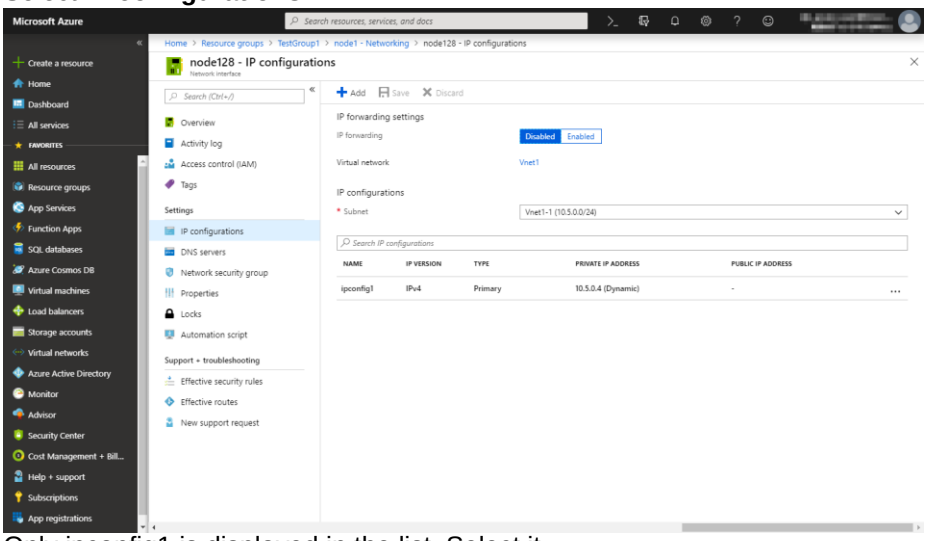


4. Select **Networking**.

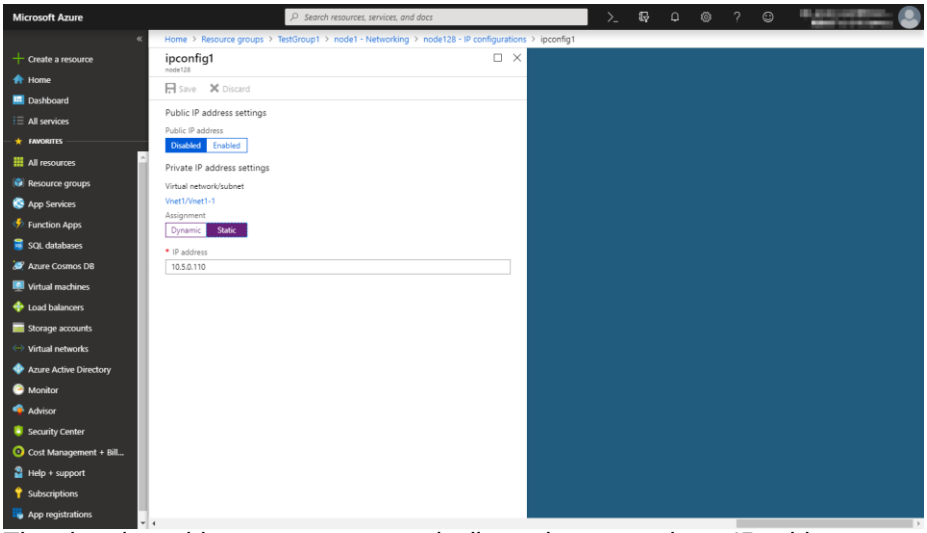


5. Select a network interface displayed in the list. The network interface name is generated automatically.

6. Select **IP configurations**.



7. Only ipconfig1 is displayed in the list. Select it.
8. Select **Static** for **Assignment** under **Private IP address settings**. Enter the IP address to be assigned statically in the **IP address** text box and click **Save** at the top of the window. The IP address of node1 is 10.5.0.110. The IP address of node2 is 10.5.0.111.



9. The virtual machines restart automatically so that new private IP addresses can be used.

5) Configuring virtual machines

Log in to the created node1 and node2 and specify the settings following the procedure below.
Set a partition for the mirror disk resource. Create a file system in the added Blob storage.
Secure an area in the added disk by using the fdisk command and then create a file system.
For details about the partition for the mirror disk resource, see “4.Partition settings for mirror disk resource (when using Replicator)." in “Settings after configuring hardware” in Chapter 1, “Determining a system configuration”.in the *Installation and Configuration Guide*.

1. Check the partition list. In the following example, the last line shows the added disk.
   $ cat /proc/partitions
   major minor #blocks name

8	16	73400320	sdb
8	17	73398272	sdb1
8	0	31459328	sda
8	1	31456256	sda1
8	32	20971520	sdc

2. Create a cluster partition and data partition in the added disk by using the fdisk command. Allocate 1 GB (1*1024*1024*1024 bytes) or more to a cluster partition. (If the size is specified as just 1 GB, the actual size will be larger than 1 GB depending on the disk geometry difference. This is not a problem.) Also, do not create a file system in a cluster partition. The following is an example of creating one partition including all areas of /dev/sdc.
   $ sudo fdisk /dev/sdc
   Device contains neither a valid DOS partition table, nor Sun, SGI or OSF disklabel
   Building a new DOS disklabel with disk identifier 0xe3c83b13.
   Changes will remain in memory only, until you decide to write them.
   After that, of course, the previous content won't be recoverable.

   Warning: invalid flag 0x0000 of partition table 4 will be corrected by w(rite)

   The device presents a logical sector size that is smaller than the physical sector size. Aligning to a physical sector (or optimal I/O) size boundary is recommended, or performance may be impacted.

   WARNING: DOS-compatible mode is deprecated. It's strongly recommended to switch off the mode (command 'c') and change display units to sectors (command 'u').

   Command (m for help): n
   Command action
   e extended
   p primary partition (1-4)
   p
   Partition number (1-4): 1
   First cylinder (1-2610, default 1):
   Using default value 1

   Last cylinder, +cylinders or +size{K,M,G} (1-2610, default 2610): +1G

   Command (m for help): p

   Disk /dev/sdc: 21.5 GB, 21474836480 bytes
   255 heads, 63 sectors/track, 2610 cylinders
   Units = cylinders of 16065 * 512 = 8225280 bytes
   Sector size (logical/physical): 512 bytes / 4096 bytes
   I/O size (minimum/optimal): 4096 bytes / 4096 bytes
   Disk identifier: 0xe29ed566

Device	Boot	Start	End	Blocks	Id	System
/dev/sdc1		1	132	1060256+	83	Linux

```
   Partition 1 does not end on cylinder boundary.
   Partition 1 does not start on physical sector boundary.

Command (m for help): n
Command action
   e   extended
   p   primary partition (1-4)
p
Partition number (1-4): 2
First cylinder (132-2610, default 132):
Using default value 132
Last cylinder, +cylinders or +size{K,M,G} (132-2610, default 2610):
Using default value 2610
Command (m for help): p

Disk /dev/sdc: 21.5 GB, 21474836480 bytes
255 heads, 63 sectors/track, 2610 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes
Sector size (logical/physical): 512 bytes / 4096 bytes
I/O size (minimum/optimal): 4096 bytes / 4096 bytes
Disk identifier: 0xe29ed566

   Device Boot      Start         End      Blocks   Id  System
   /dev/sdc1            1         132     1060256+  83  Linux
   Partition 1 does not end on cylinder boundary.
   Partition 1 does not start on physical sector boundary.
   /dev/sdc2          132        2610    19904537   83  Linux

Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.
Syncing disks.
```

3. If you select **Execute initial mkfs** when creating the cluster configuration data by using Cluster WebUI, EXPRESSCLUSTER creates a file system automatically. Note that existing data in the partition will be lost.

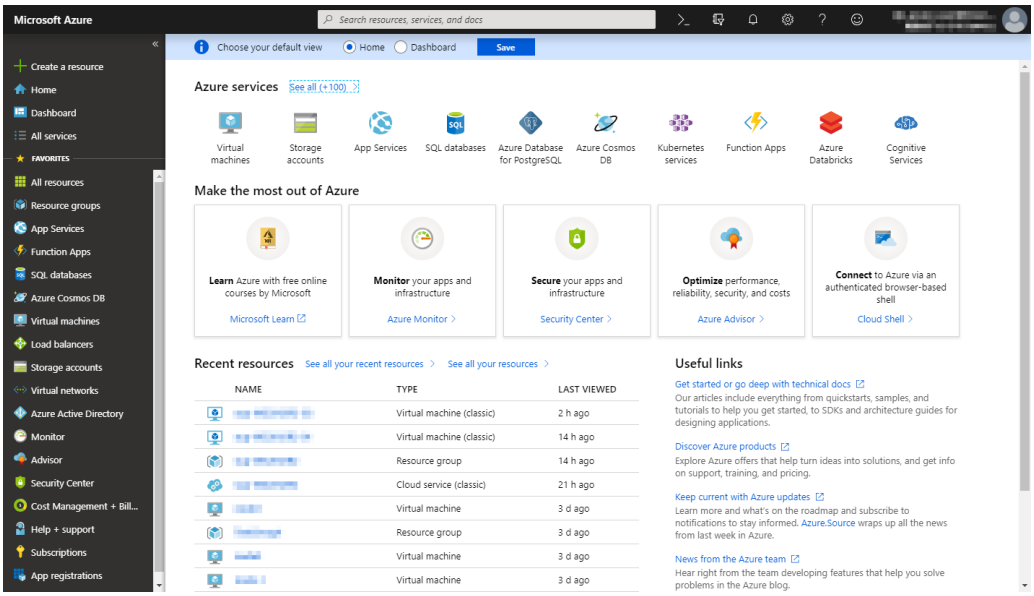
6) Configuring a load balancer

Log in to the Microsoft Azure portal (https://portal.azure.com/) and add a load balancer following the steps below.

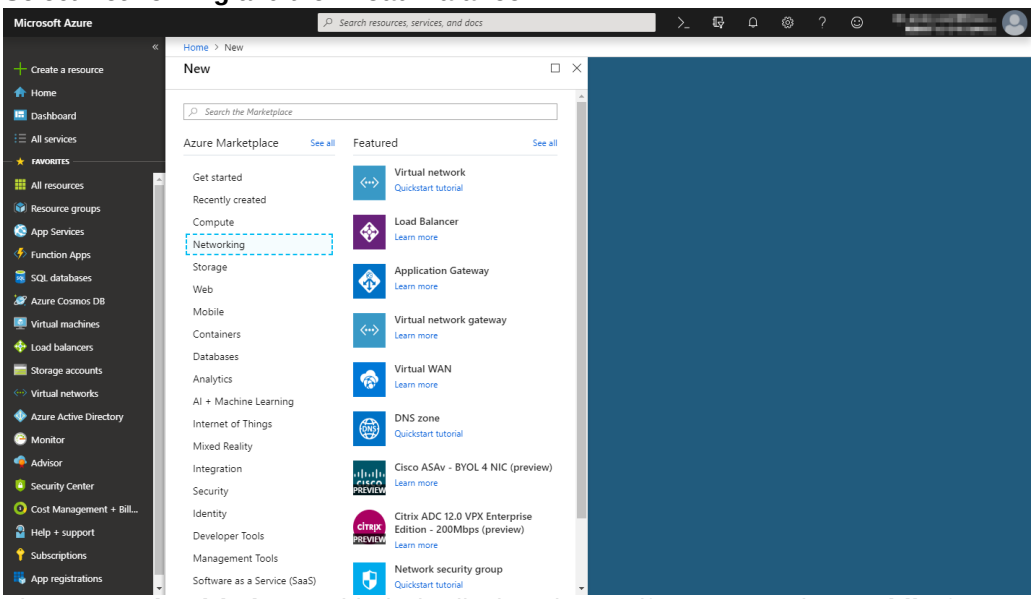
For details, see the following websites:

- Load Balancer:
  https://docs.microsoft.com/en-us/azure/load-balancer/

1. Select **+Create a resource** or the **+** icon in the menu on the left side of the window.

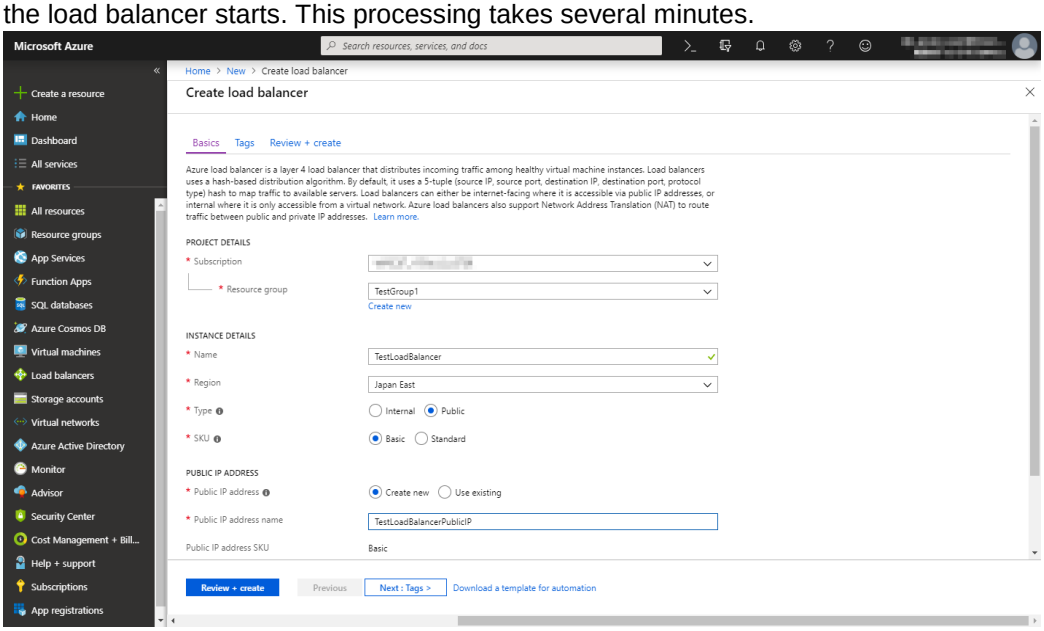


2. Select **Networking** and then **Load Balancer**.



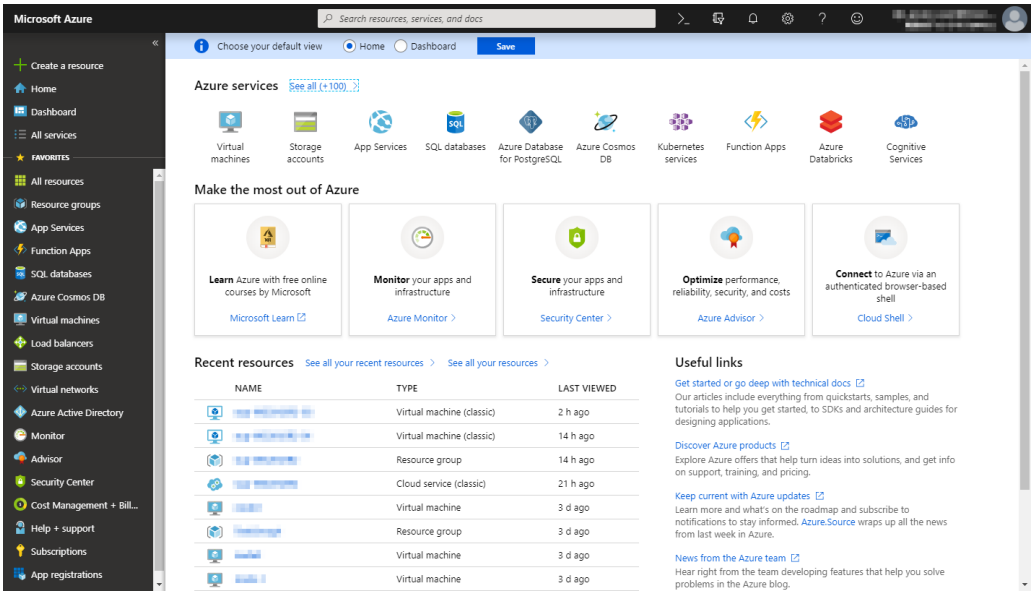
3. The **Create load balancer** blade is displayed. Specify **Name**. Select **Public** for **Type** and **Basic** for **SKU**, respectively.
4. Specify **Create new**, **Name** and **Assignment** for **Public IP address**.

5. Specify **Subscription**, **Resource group**, and **Region**, and click **Review+create**. Deploying the load balancer starts. This processing takes several minutes.

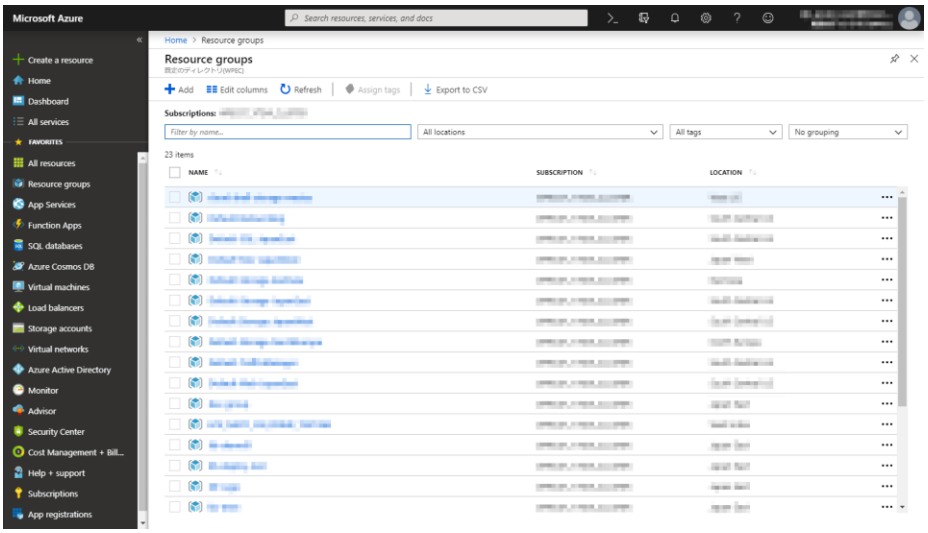


7) Configuring a load balancer (configuring a backend pool)

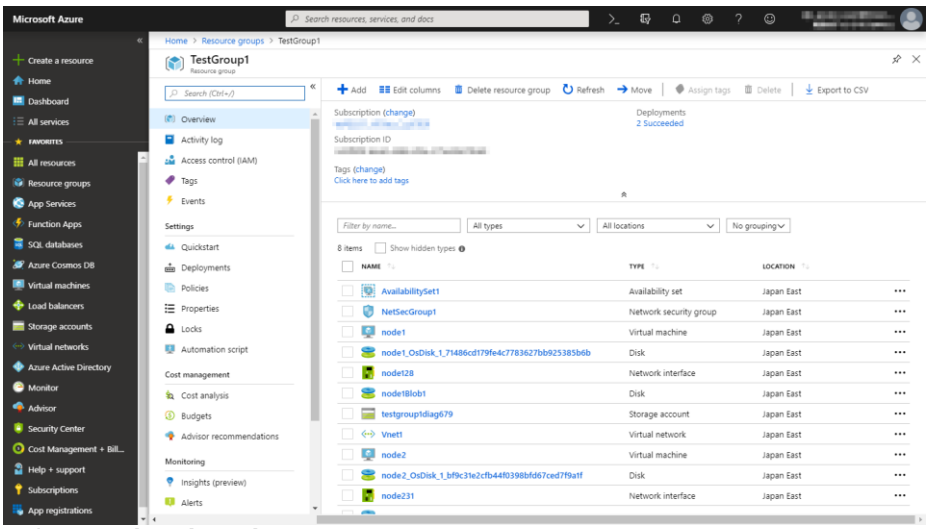
1. Associate a virtual machine registered to the availability set to the load balancer. After the load balancer has been deployed, select **Resource groups** or the resource group icon in the menu on the left side of the window.



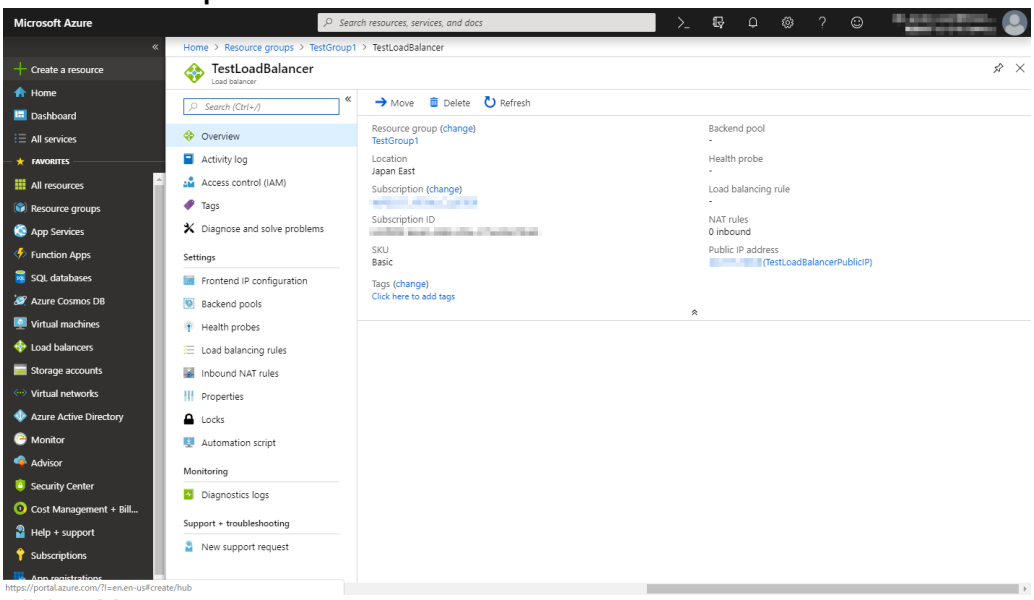
2. Select the resource group to which the created load balancer belongs from the resource group list.



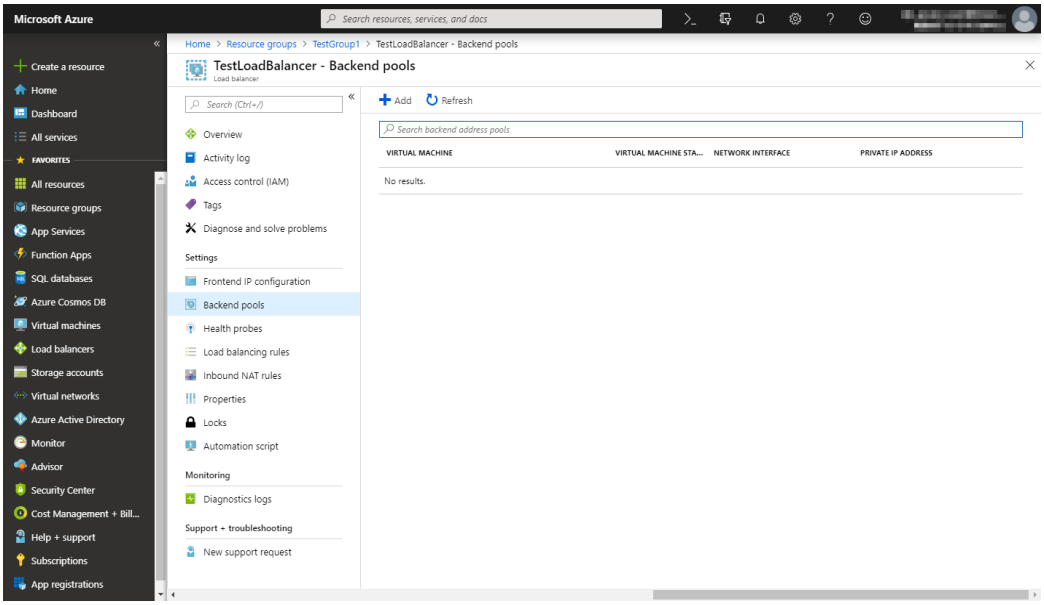
3. The summary of the selected resource group is displayed. Select the created load balancer from the item list.



4. Select **Backend pools**.



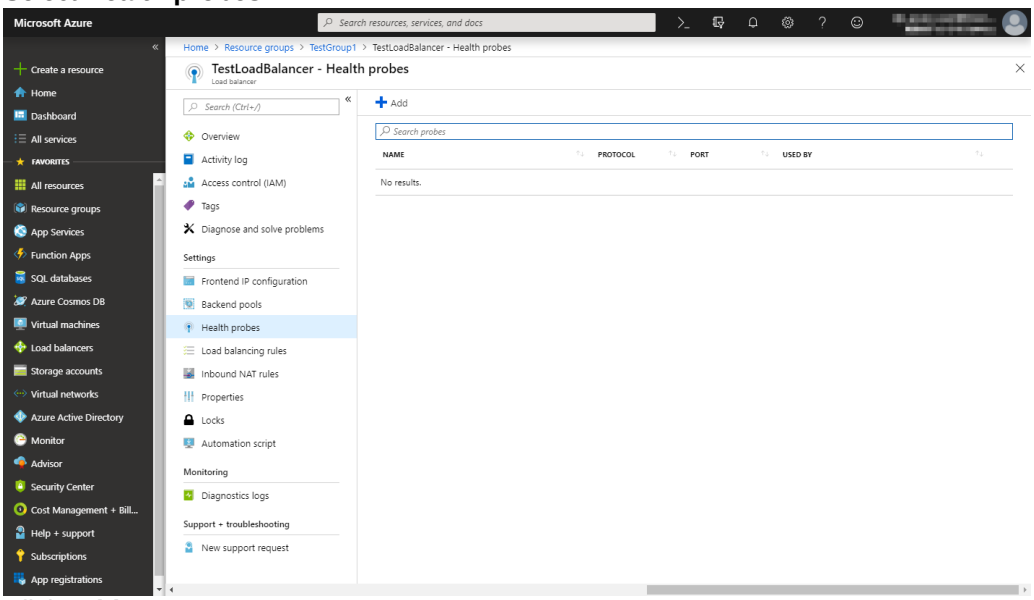
5. Click **Add**.



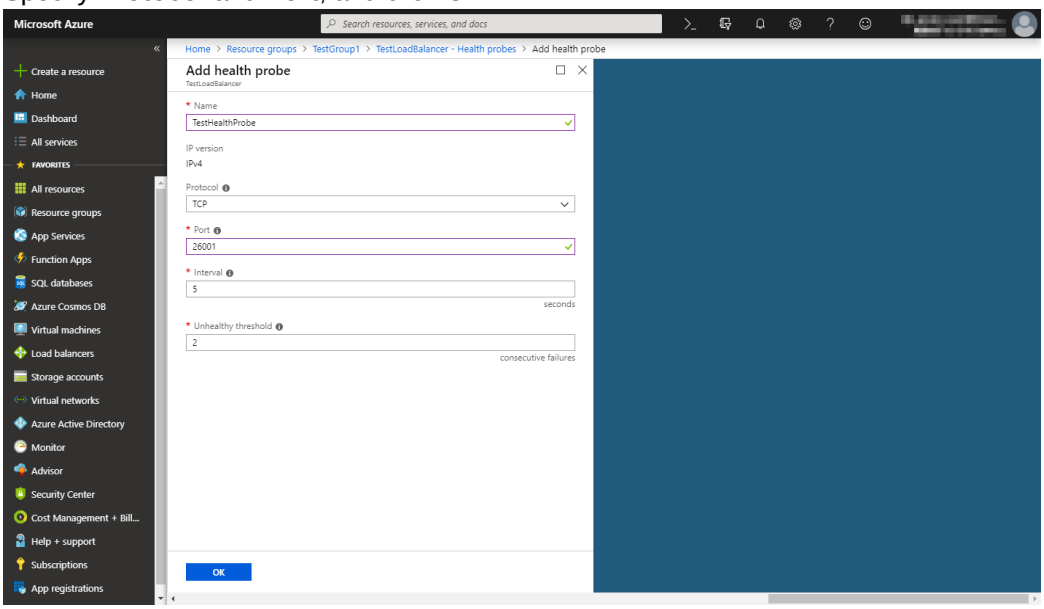
6. The **Add backend pool** blade is displayed. Specify **Name**.
7. For **Associated to**, select **Availability set**.
8. Specify **Availability set**.
9. Click **Add a target network IP configuration**.
10. Specify the target virtual machine for **Target virtual machine** and **Network IP configuration**.
11. Repeat steps 9 and 10 as many times as the number of target virtual machines.
12. Click **OK**.

8) Configuring a load balancer (configuring a health probe)

1. Select **Health probes**.

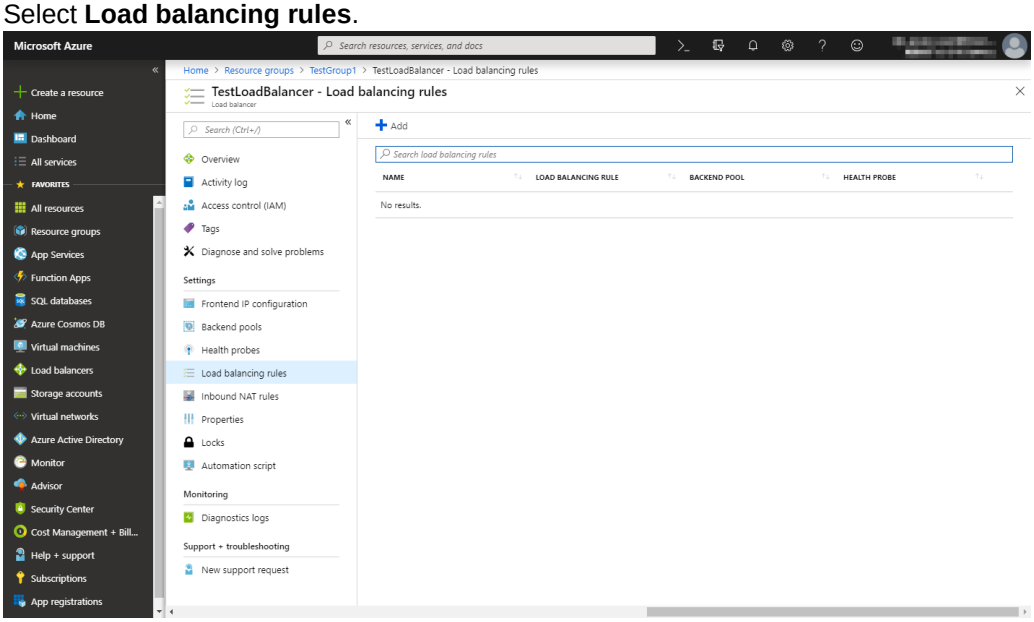


2. Click **Add**.
3. The **Add health probe** blade is displayed. Specify **Name**.
4. Specify **Protocol** and **Port**, and click **OK**.

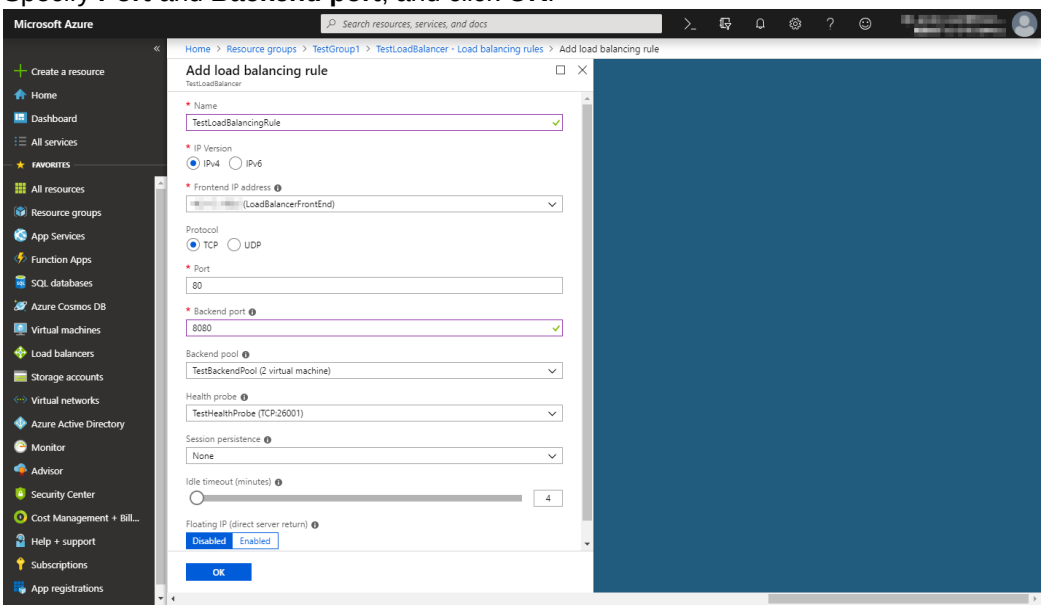


9) Configuring a load balancer (setting the load balancing rules)

1. Select **Load balancing rules**.



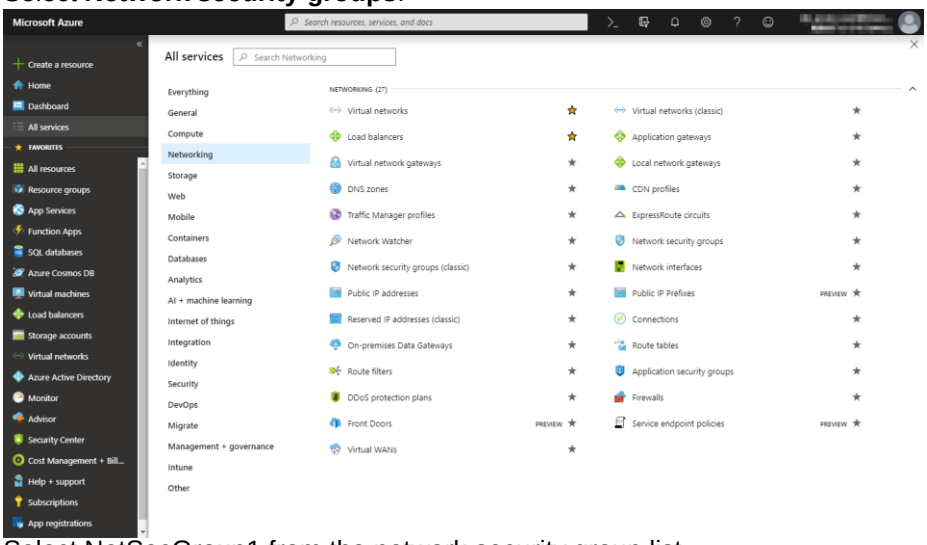
2. Click **Add**.
3. The **Add load balancing rule** blade is displayed. Specify **Name**.
4. Specify **Port** and **Backend port**, and click **OK**.



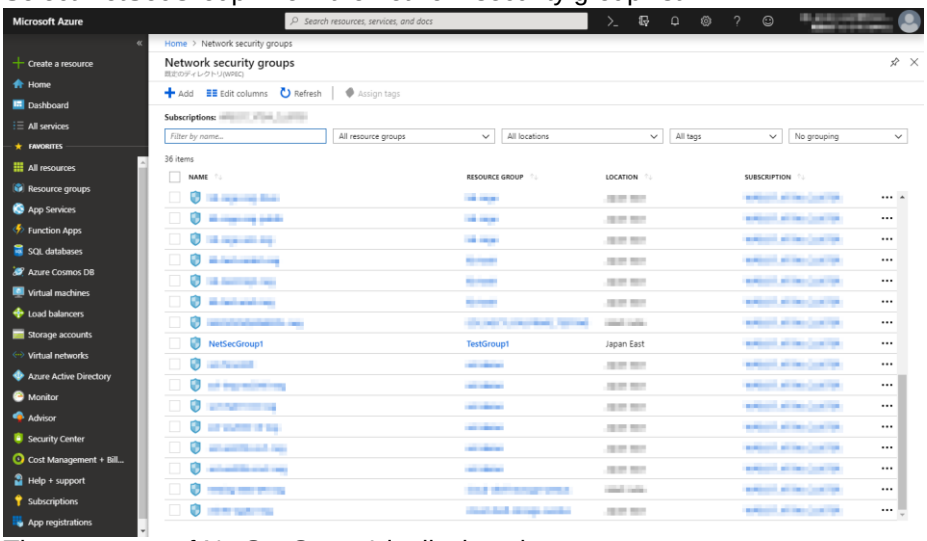
10) Setting the inbound security rules

Log in to the Microsoft Azure portal (https://portal.azure.com/) and set the inbound security rules following the steps below.

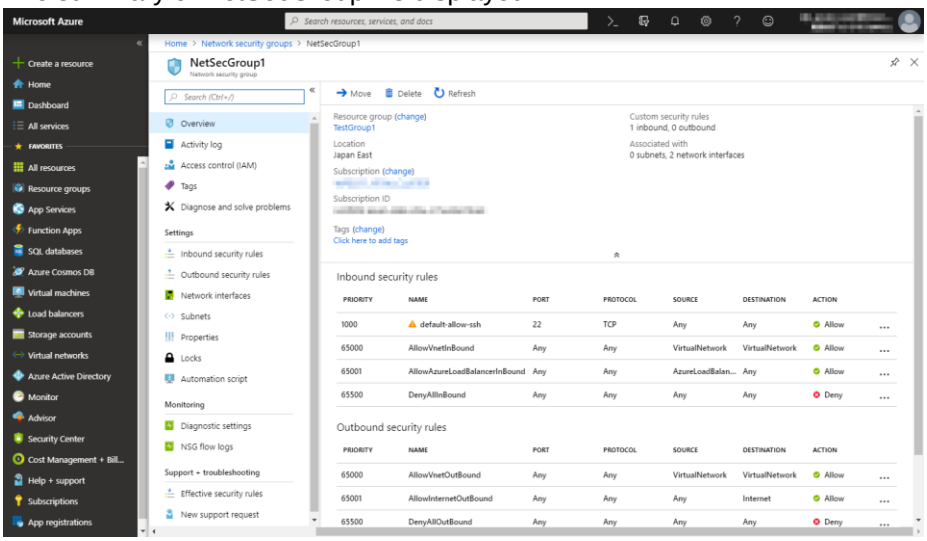
1. Select **All services** in the menu on the left side of the window.
2. Select **Network security groups**.



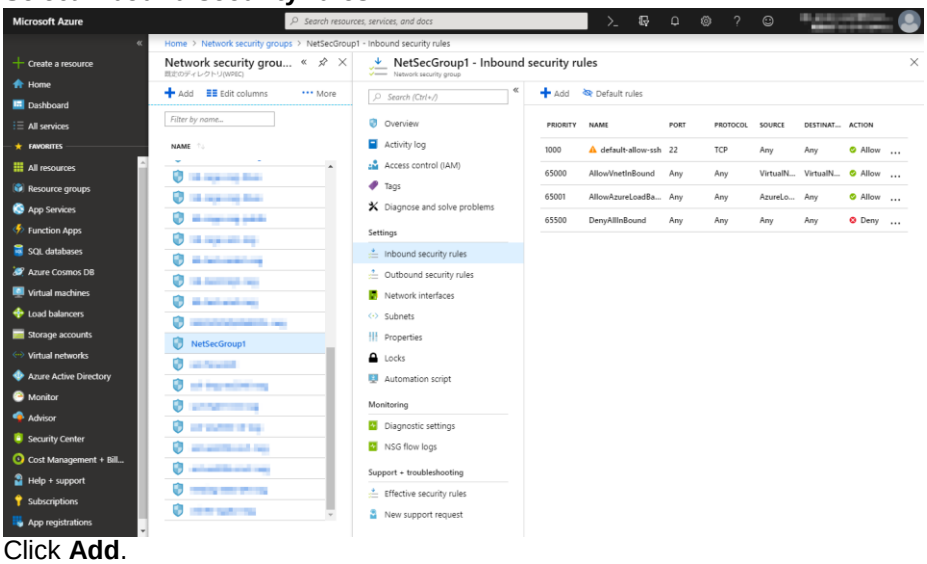
3. Select NetSecGroup1 from the network security group list.



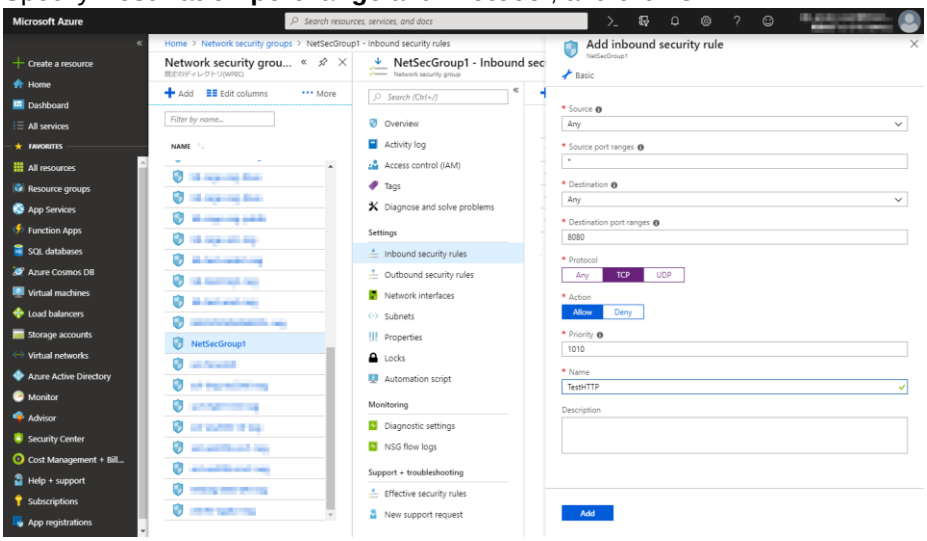
4. The summary of NetSecGroup1 is displayed.



5. Select **Inbound security rules**.

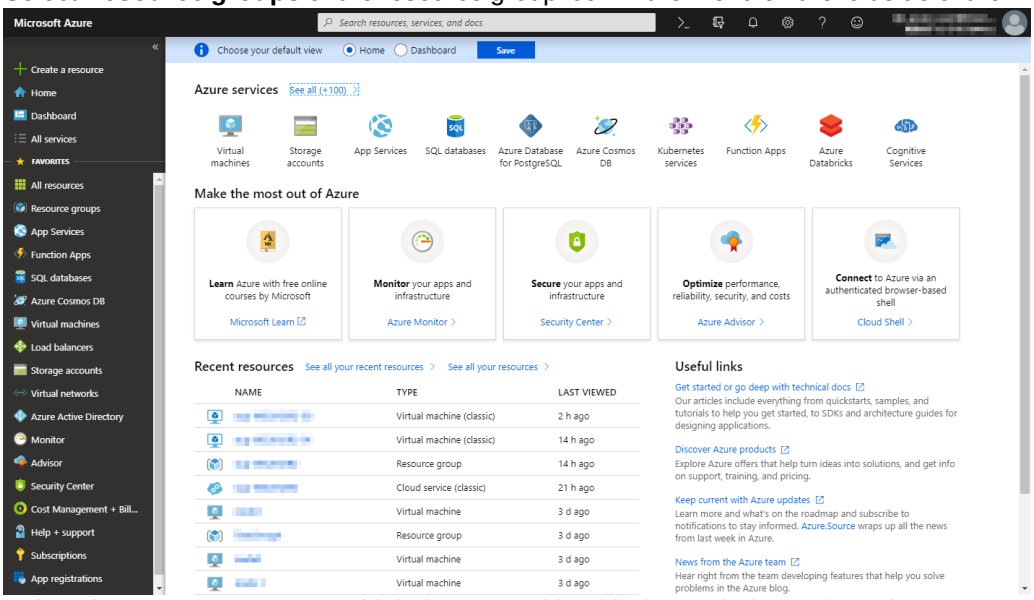


6. Click **Add**.
7. The **Add inbound security rule** blade is displayed. Specify **Name**.
8. Specify **Destination port range** and **Protocol**, and click **OK**.

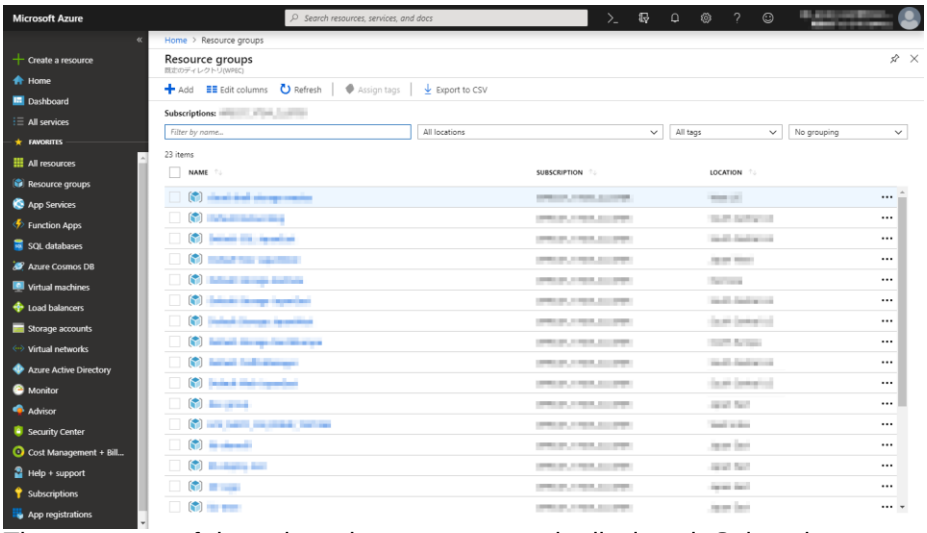


Then, check *<Load_balancer_frontend_IP(public_IP_address)>* specified in the script before recovery action of the multi target monitor resource that is set in "3) Adding a monitor resource." Write down the confirmatory result.

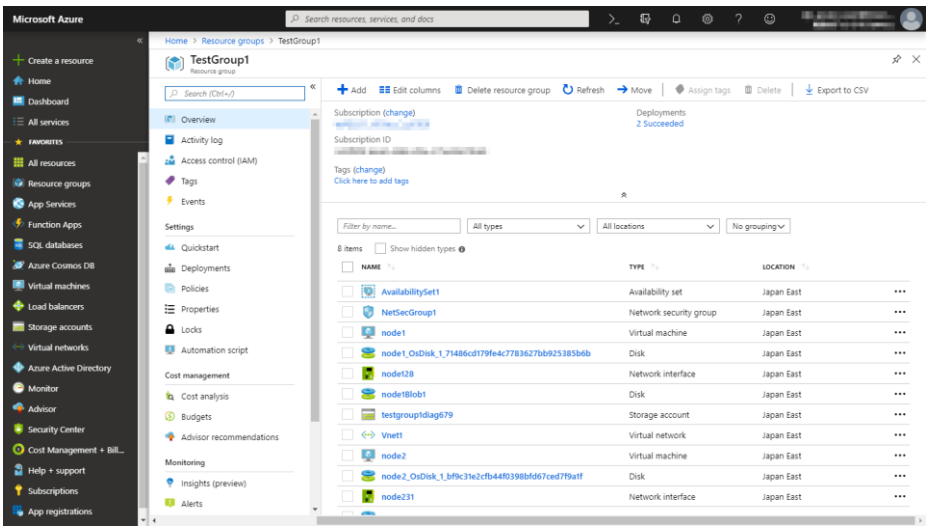
1. Select **Resource groups** or the resource group icon in the menu on the left side of the window.



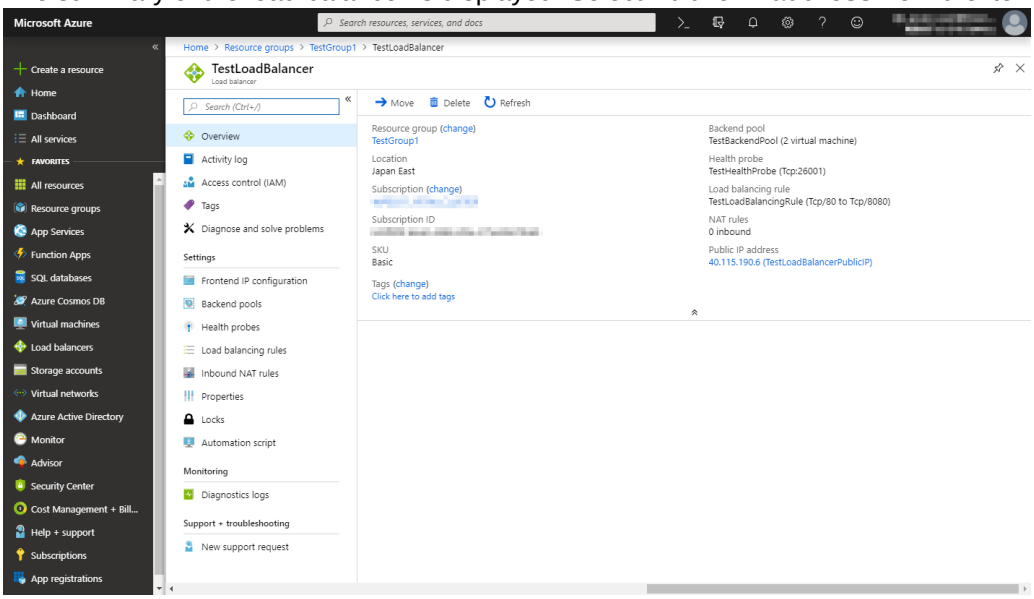
2. Select the resource group to which the created load balancer belongs from the resource group list.



3. The summary of the selected resource group is displayed. Select the created load balancer from the item list.



4. The summary of the load balancer is displayed. Select **Public IP address** from the item list.



11) Adjusting the OS startup time, checking the network setting, checking the root file system, checking the firewall setting, synchronizing the server time, and checking the SELinux setting.

For each procedure, see “Settings after configuring hardware" in Chapter 1, “Determining a system configuration” in the *Installation and Configuration Guide*.

12) Installing EXPRESSCLUSTER

For the installation procedure, see the *Installation and Configuration Guide*.
After installation is complete, restart the OS.

13) Registering the EXPRESSCLUSER license

For the license registration procedure, see the *Installation and Configuration Guide*.

4.3 Configuring the EXPRESSCLUSTER settings

For the Cluster WebUI setup and connection procedures, see Chapter 5, “Creating the cluster configuration data" in the *Installation and Configuration Guide*.

This section describes the procedure to add the following resources and monitor resources:

- Mirror disk resource
- Azure probe port resource
- Azure probe port monitor resource
- Azure load balance monitor resource
- Custom monitor resource (for NP resolution)
- IP monitor resource (for NP resolution)
- Multi target monitor resource (for NP resolution)

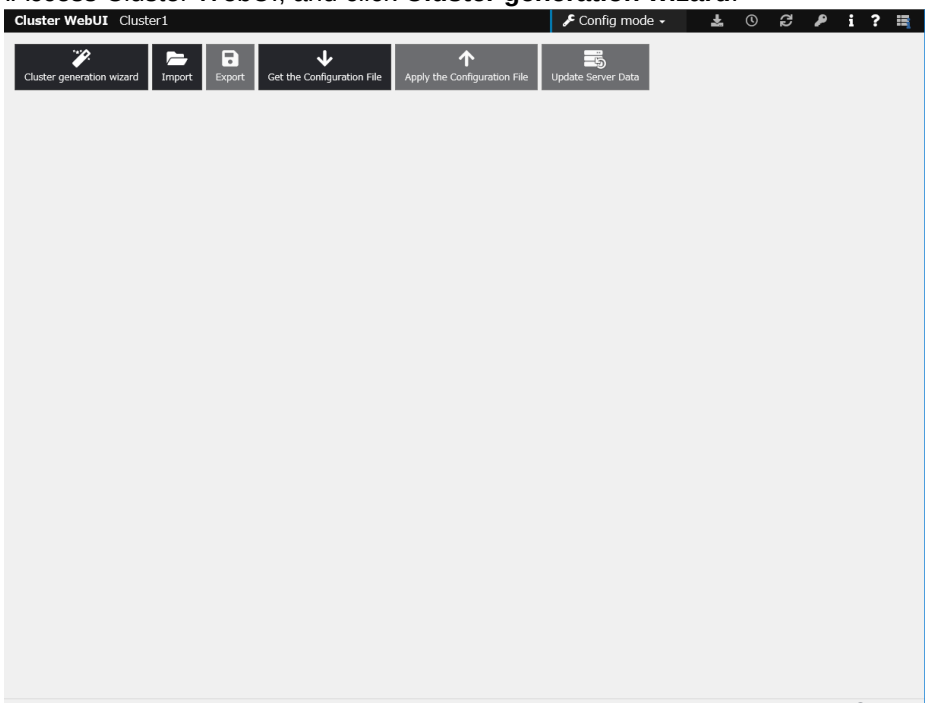
For the settings of other resources and monitor resources, see the *Installation and Configuration Guide* and the *Reference Guide*.

1) Creating a cluster

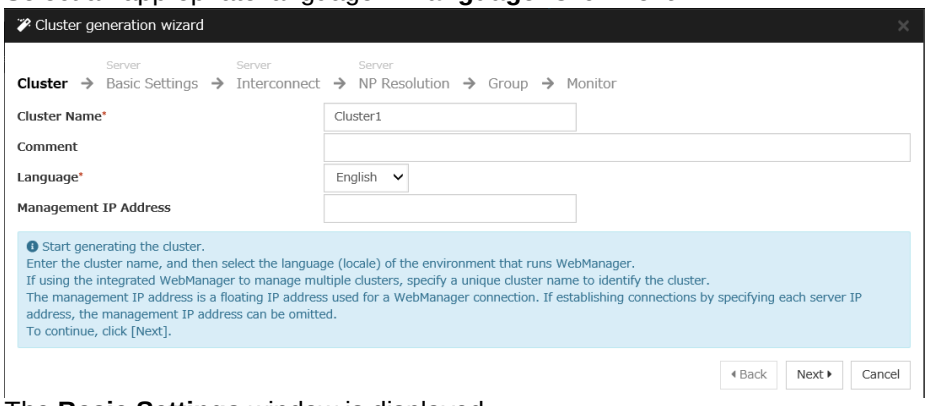
Start the cluster generation wizard to create a cluster.

◆ Creating a cluster

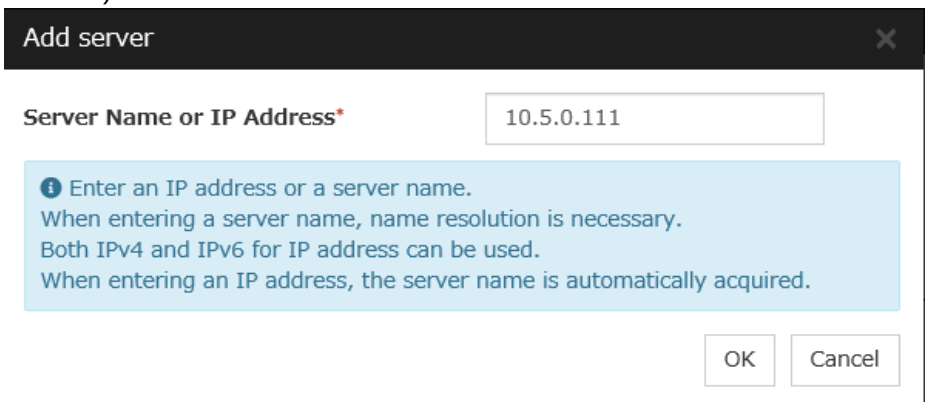
1. .Access Cluster WebUI, and click C**luster generation wizard**.

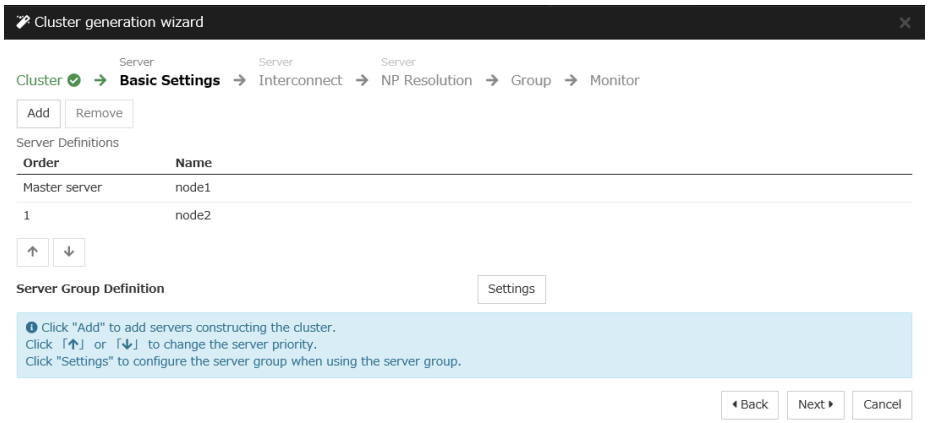


2. The **Cluster** window on the **Cluster Generation Wizard** is displayed.
   Enter a desired name in **Cluster Name**.
   Select an appropriate language in **Language**. Click **Next**.

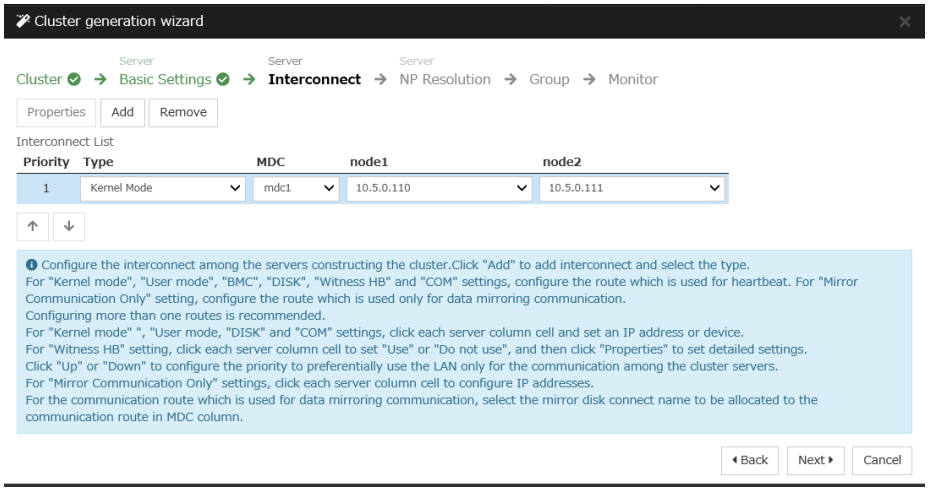


3. The **Basic Settings** window is displayed.
   The instance connected to Cluster WebUI is displayed as a registered master server.
   Click **Add** to add the remaining instances (by specifying the private IP address of each instance). Click **Next**.

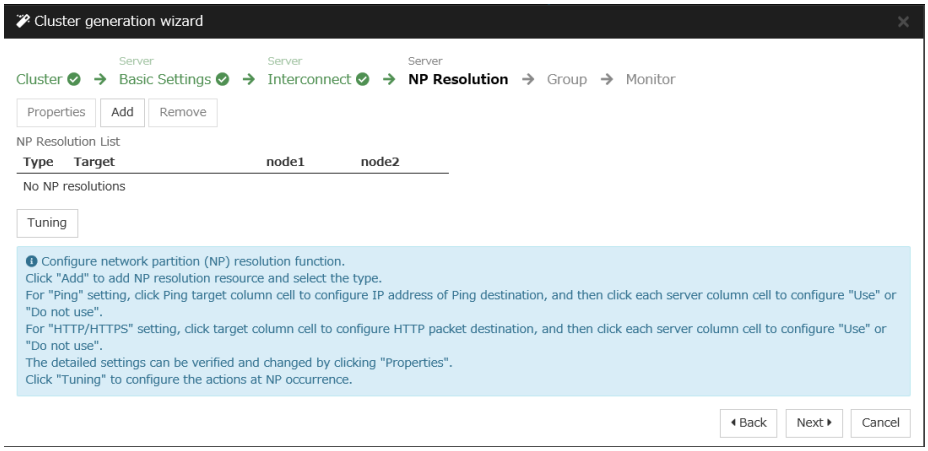




4. The **Interconnect** window is displayed.
   Specify the IP addresses (IP address of each instance) to be used for interconnect. In addition, select mdc1 for **MDC** as a communication path of a mirror disk resource to be created later. Click **Next**.



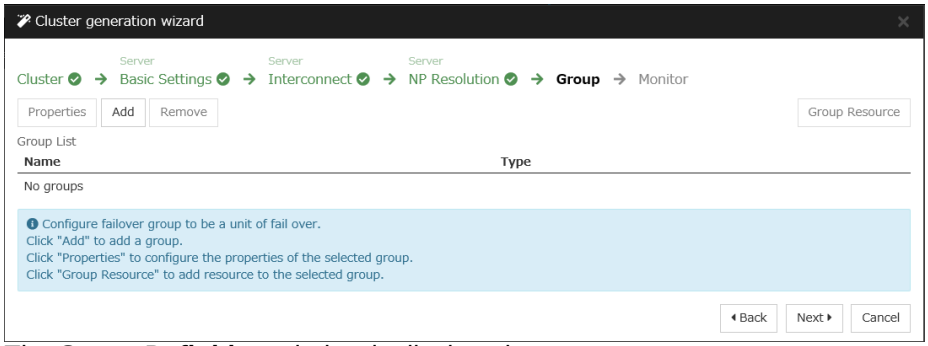
5. The **NP Resolution** window is displayed.
   Note that NP resolution is not configured on this window. The equivalent feature is achieved by adding the IP monitor resource, custom monitor resource, and multi target monitor resource. Configure NP resolution in "3) Adding a monitor resource."
   You need to examine the NP resolution destination and method depending on the location of clients accessing a cluster system and the condition for connecting to an on-premise environment (for example, using a dedicated line). Additionally, you can use network partition resolution resources for NP resolution.
   Click **Next**.



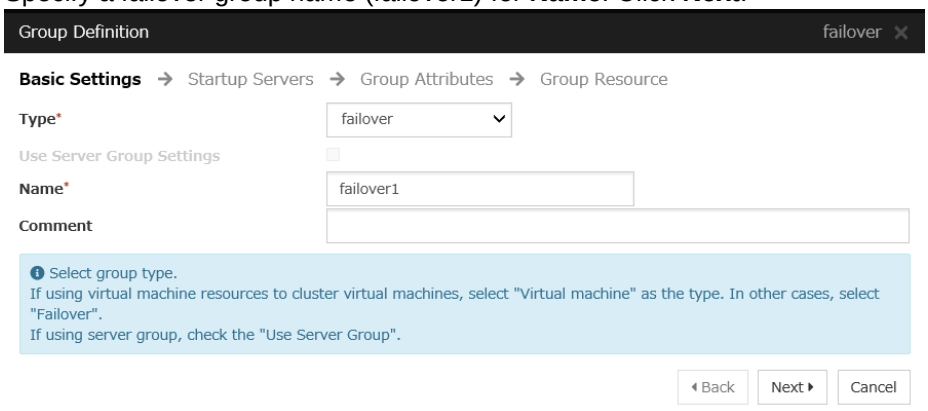
2) Adding a group resource

◆ Defining a group
Create a failover group.

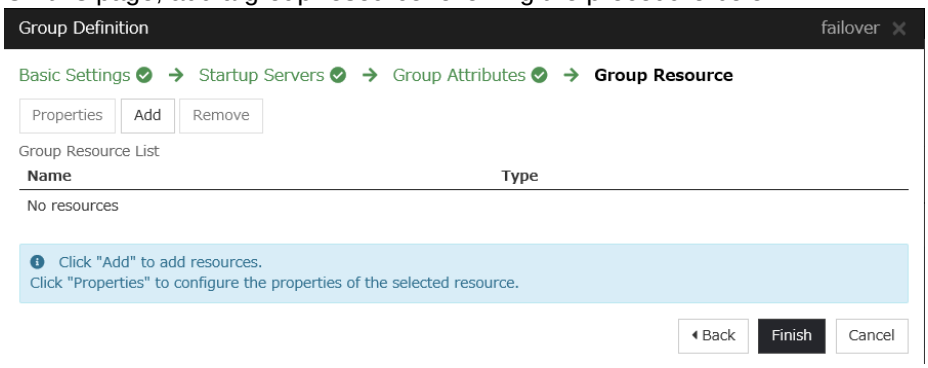
1. The **Group List** window s displayed.
Click **Add**.



2. The **Group Definition** window is displayed.
Specify a failover group name (failover1) for **Name**. Click **Next**.



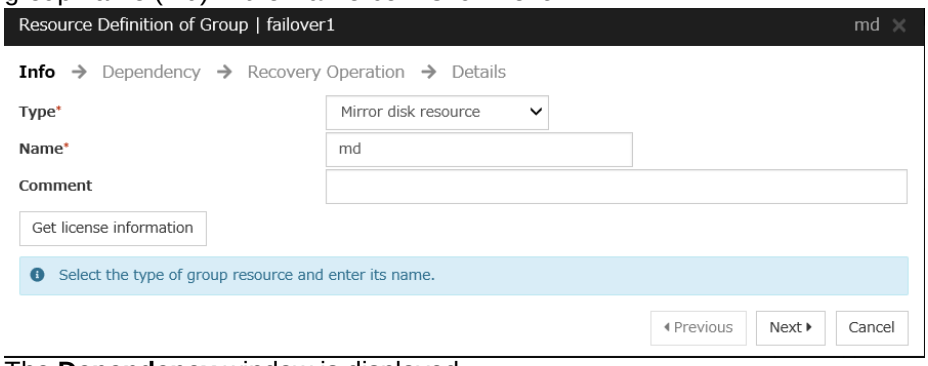
3. The **Startup Servers** window is displayed.
Click **Next** without specifying anything.
4. The **Group Attributes** window is displayed.
Click **Next** without specifying anything.
5. The **Group Resource** window is displayed.
On this page, add a group resource following the procedure below.



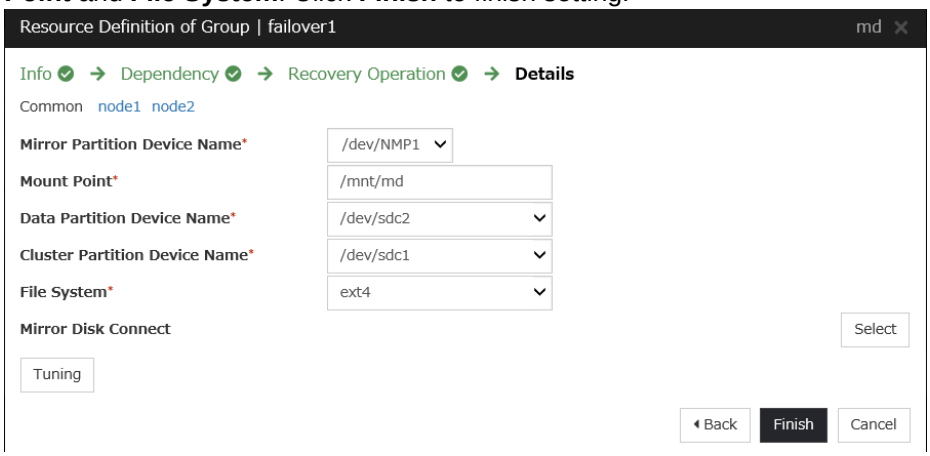
◆ Mirror disk resource

Create a mirror disk resource.
For details, see “Understanding mirror disk resources" in Chapter 4, “Group resource details” in the *Reference Guide*.

1. Click **Add** on the **Group Resource List** page.
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 name (md) in the **Name** box. Click **Next**.



3. The **Dependency** window is displayed.
   Click **Next** without specifying anything.
4. The **Recovery Operation** window is displayed.
   Click **Next**.
5. The **Details** window is displayed.
   Enter the device name of the partition created in "5) **Configuring virtual machines**" in **Data Partition Device Name** and **Cluster Partition Device Name**. Specify **Mount Point** and **File System**. Click **Finish** to finish setting.

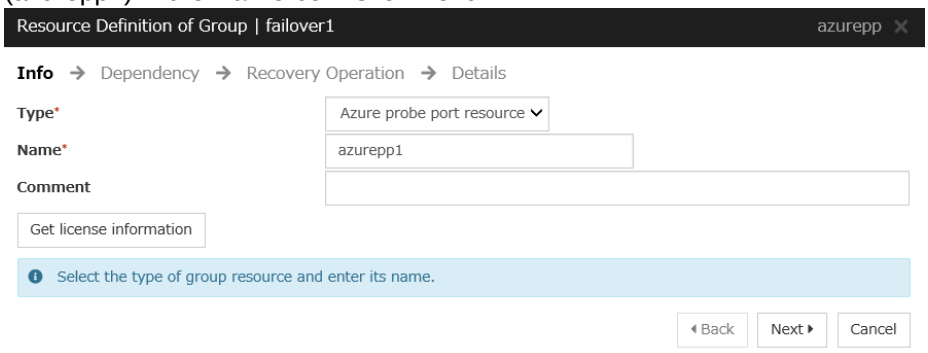


◆ Azure probe port resource

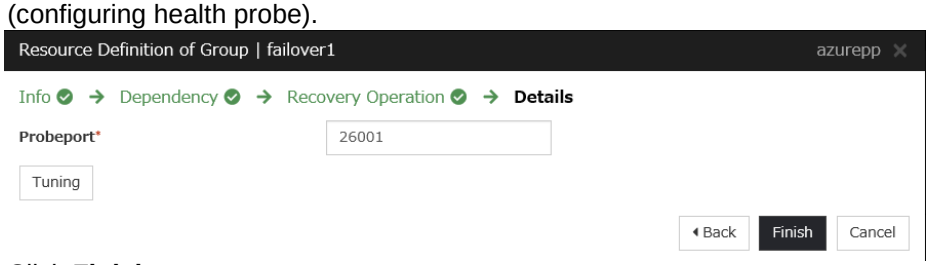
When EXPRESSCLUSTER is used on Microsoft Azure, EXPRESSCLUSTER provides a mechanism to wait for alive monitoring from a load balancer on a port specific to a node in which operations are running.

For details about the Azure probe port resources", see “Understanding Azure probe port resources" in Chapter 4, “Group resource details” in the *Reference Guide*.

1. Click **Add** on the **Group Resource List** page.
2. The **Resource Definition of Group | failover1** window is displayed. Select the group resource type (Azure probe port resource) from the **Type** box and enter the group name (azurepp1) in the **Name** box. Click **Next**.



3. The **Dependency** window is displayed. Click **Next** without specifying anything.
4. The **Recovery Operation** window is displayed. Click **Next**.
5. For **Probeport**, enter the value specified for **Port** when configuring a load balancer (configuring health probe).



6. Click **Finish**.

3) Adding a monitor resource

◆ Azure probe port monitor resource

The port monitoring mechanism for alive monitoring is provided for the node in which the Microsoft Azure probe port resource is running.

For details about the Azure probe port monitor resource, see “Understanding Azure probe port monitor resources" in the *Reference Guide*.

Adding one Azure probe port monitor resource creates one Azure probe port monitor resource automatically.

◆ Azure load balance monitor resource

The mechanism to monitor whether the port with the same port number as the probe port is open or not is provided for the node in which the Microsoft Azure probe port resource is not running.

For details about the Azure load balance resource, see “Understanding Azure load balance monitor resources" in the *Reference Guide*.

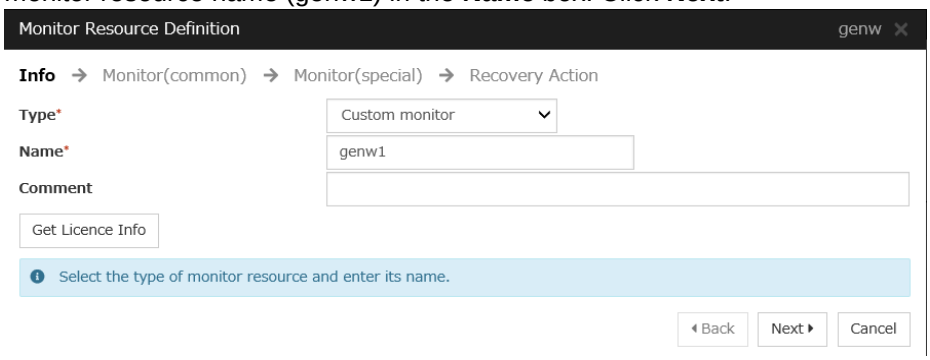
Adding one Azure probe port resource creates one Azure load balance monitor resource automatically.

◆ Custom monitor resource

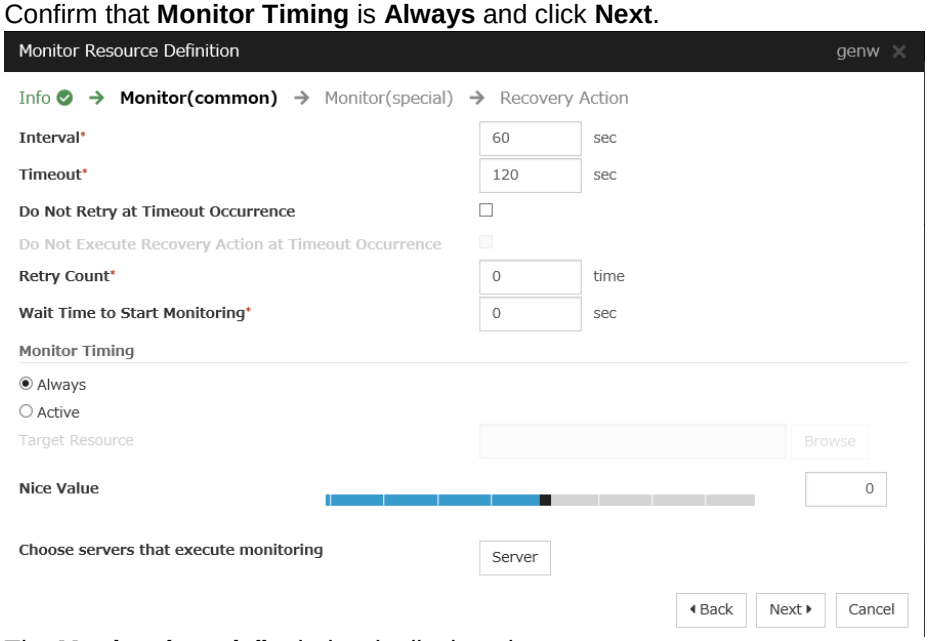
Sets a script to monitor whether communication with Microsoft Azure Service Management API is possible, and also monitors health of communication with an external network.

For details about the custom monitor resource, see “Understanding custom monitor resources" in the *Reference Guide*.

1. Click **Add** on the **Monitor Resource List** page.
2. Select the monitor resource type (Custom monitor) from the **Type** box and enter the monitor resource name (genw1) in the **Name** box. Click **Next**.



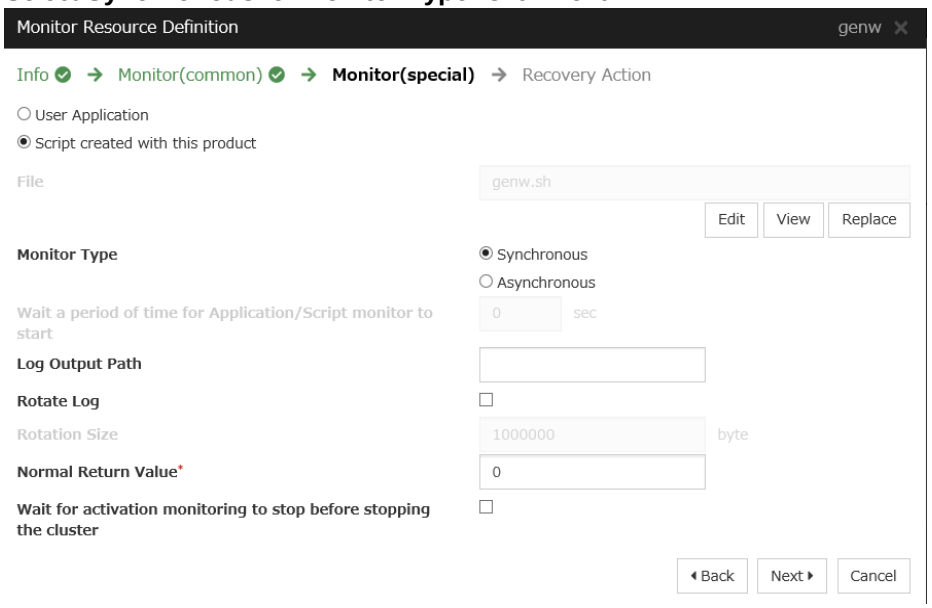
3. The **Monitor (common)** window is displayed.
   Confirm that **Monitor Timing** is **Always** and click **Next**.



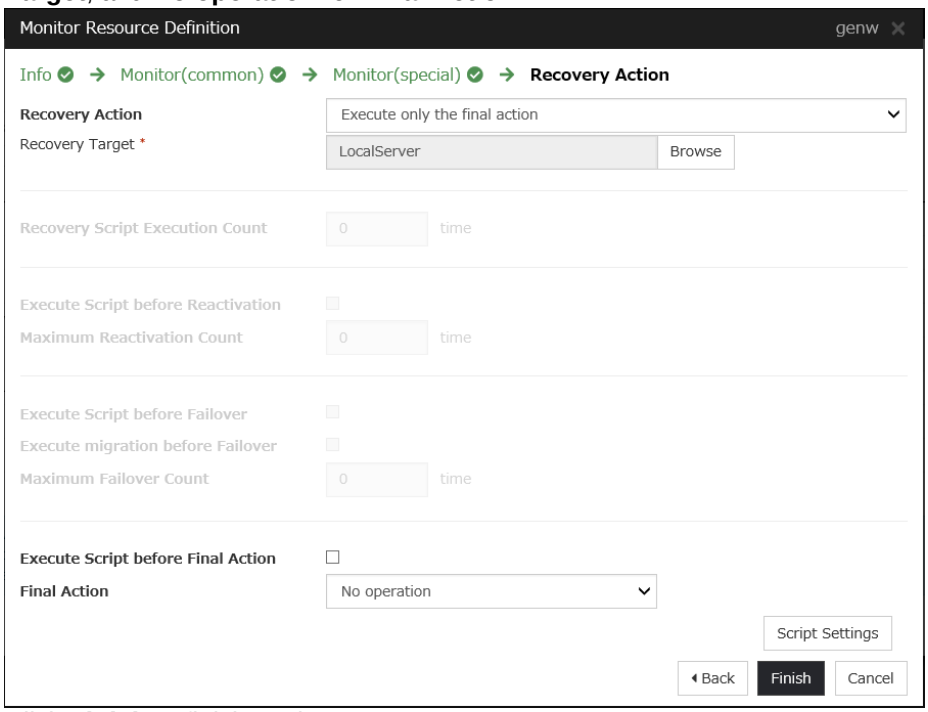
4. The **Monitor (special)** window is displayed.
   Select **Script created with this product**.
   The following shows the sample of a script to be created.

   #! /bin/sh
   <EXPRESSCLUSTER_installation_path>/bin/clpazure_port_checker –h management.core.windows.net -p 443exit $?

   Select **Synchronous** for **Monitor Type**. Click **Next**.



5. The **Recovery Action** window is displayed.
   Select **Execute only the final action** for **Recovery Action**, **LocalServer** for **Recovery Target**, and **No operation** for **Final Action**.



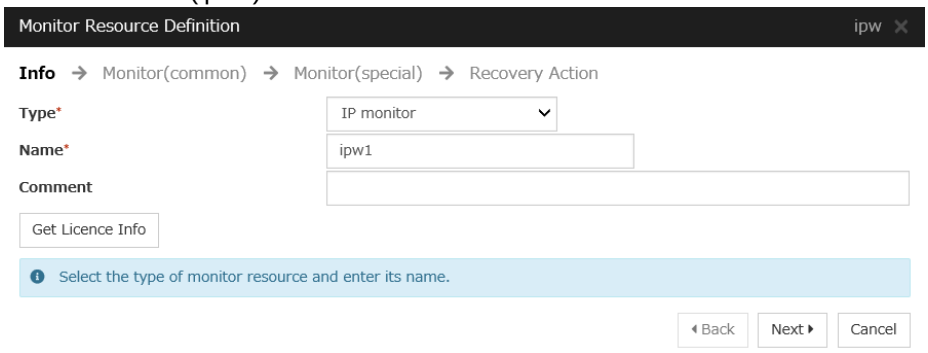
6. Click **Finish** to finish setting.

◆ IP monitor resource

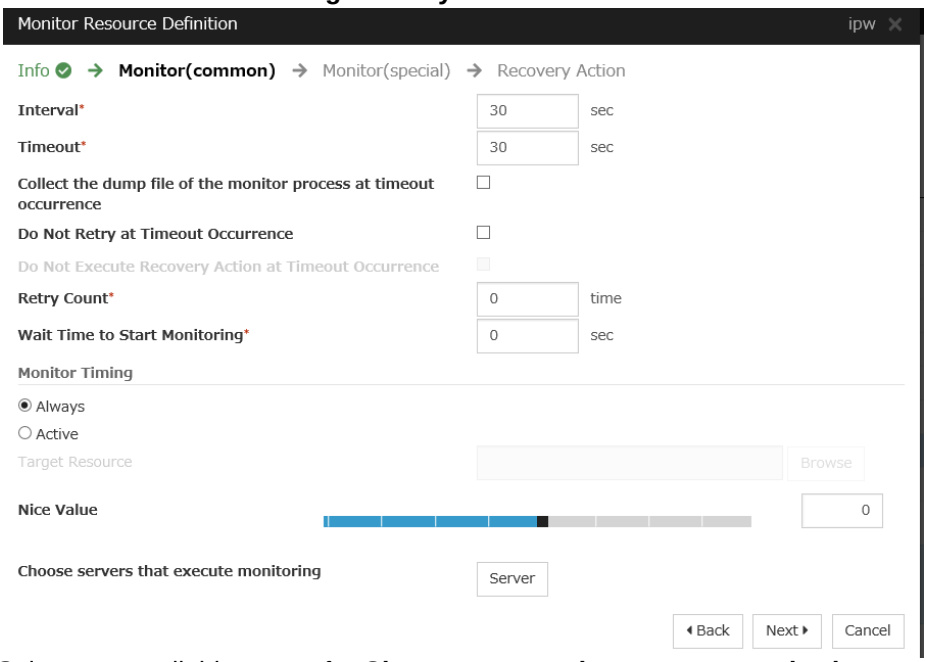
Creates an IP monitor resource to monitor communication between clusters that are configured with virtual machines, and also to monitor whether communication with an internal network is health.

For details about the IP monitor resource, see “Understanding IP monitor resources” in the *Reference Guide*.

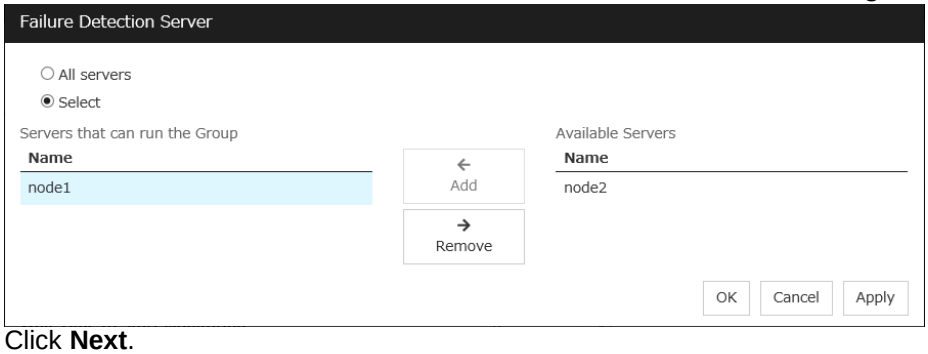
1. Click **Add** on the **Monitor Resource List** page.
2. Select the monitor resource type (IP monitor) from the **Type** box and enter the monitor resource name (ipw1) in the **Name** box. Click **Next**.



3. The **Monitor (common)** window is displayed.
Confirm that **Monitor Timing** is **Always**.

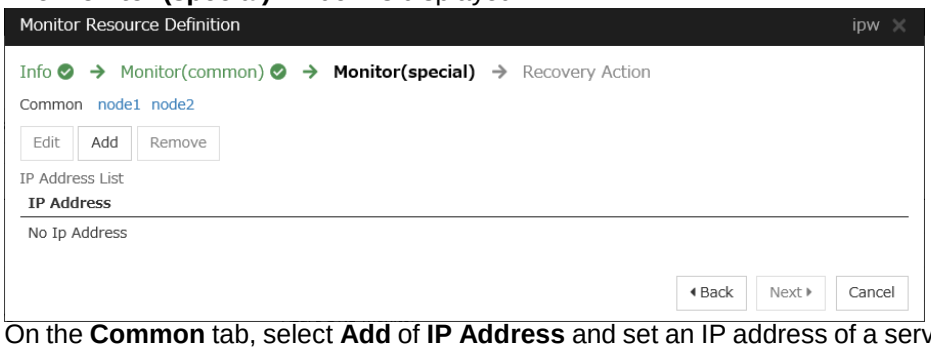


Select one available server for **Choose servers that execute monitoring**.

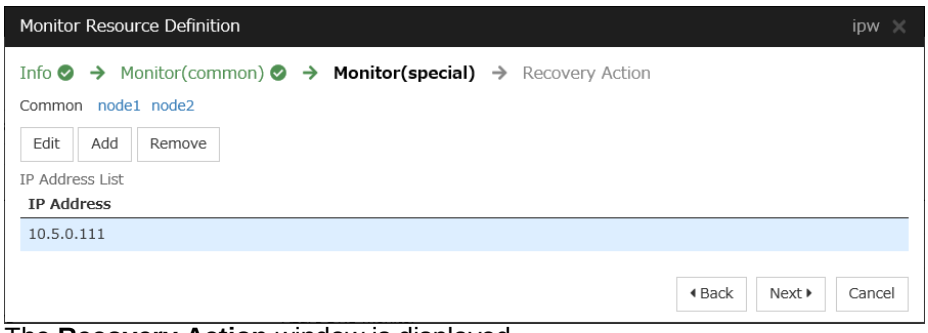


Click **Next**.

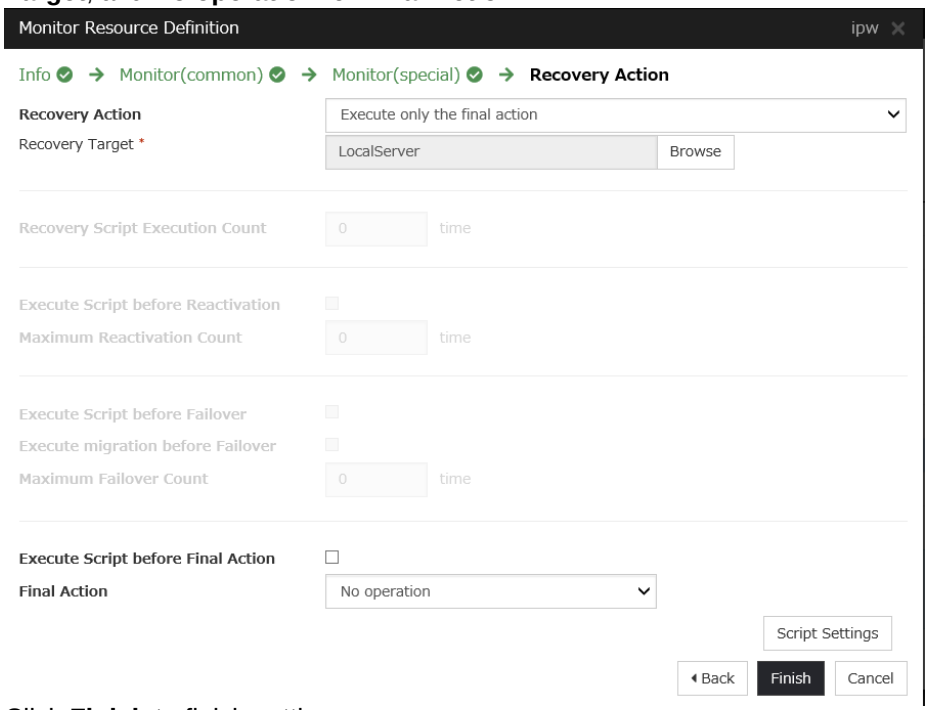
4. The **Monitor (special)** window is displayed.



On the **Common** tab, select **Add** of **IP Address** and set an IP address of a server other than the server selected in step 3. Click **Next**.



5. The **Recovery Action** window is displayed.
Select **Execute only the final action** for **Recovery Action**, **LocalServer** for **Recovery Target**, and **No operation** for **Final Action**.



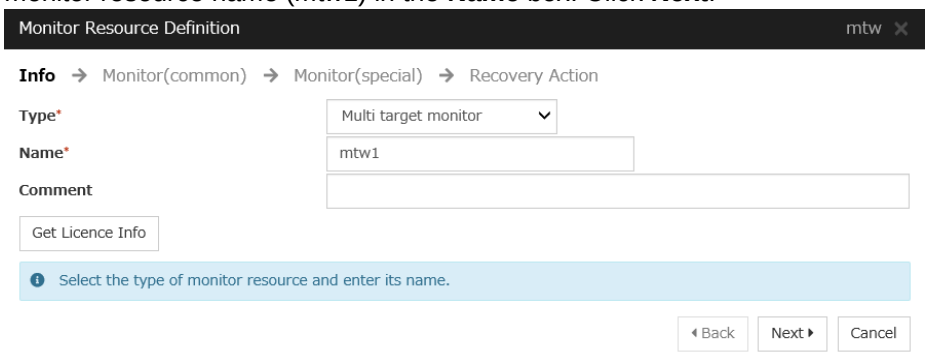
6. Click **Finish** to finish setting.

7. Then, create a monitor resource on the other server. Click **Add** on the **Monitor Resource List** page.
8. Select the monitor resource type (ip monitor) from the **Type** box and enter the monitor resource name (ipw2) in the **Name** box. Click **Next**.
9. The **Monitor (common)** window is displayed.
   Confirm that **Monitor Timing** is **Always**.
   Select one available server for **Choose servers that execute monitoring**.
   Click **Next**.
10. The **Monitor (special)** window is displayed.
    On the **Common** tab, select **Add** of **IP Address** and set an IP address of a server other than the server selected in step 9. Click **Next**.
11. The **Recovery Action** window is displayed.
    Select **Execute only the final action** for **Recovery Action**, **LocalServer** for **Recovery Target**, and **No operation** for **Final action**.
12. Click **Finish** to finish setting.

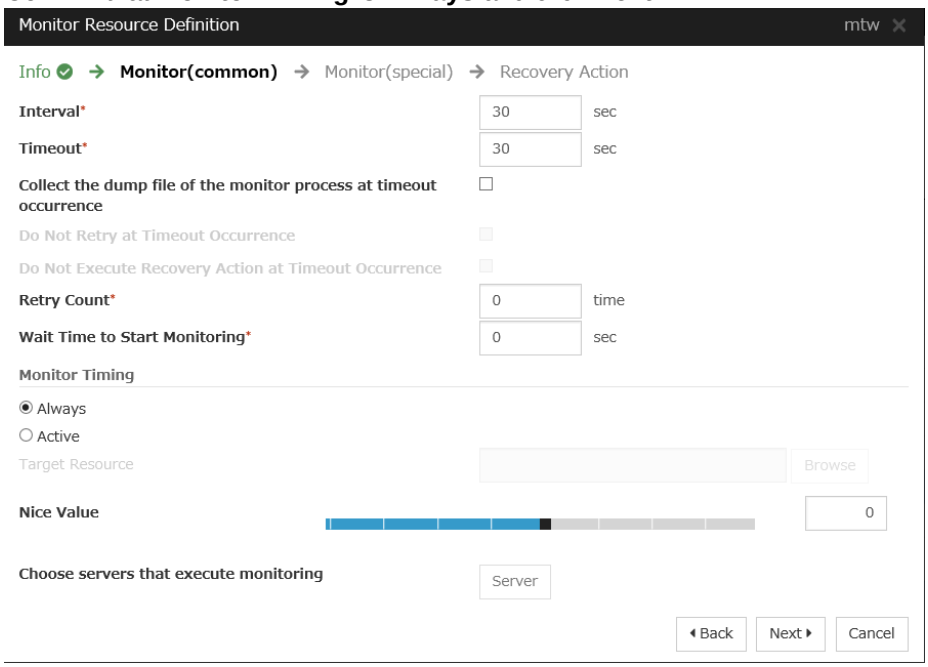
◆ Multi target monitor resource
Creates a multi target monitor resource to check the statuses of the custom monitor resource and IP monitor resource. The custom monitor resource monitors communication to Microsoft Azure Service Management API. The IP monitor resource monitors communication between clusters that are configured with virtual machines.
If their statuses are abnormal, execute the script in which the processing for NP resolution is described.

For details about the multi target monitor resource, see “Understanding multi target monitor resources" in the *Reference Guide*.

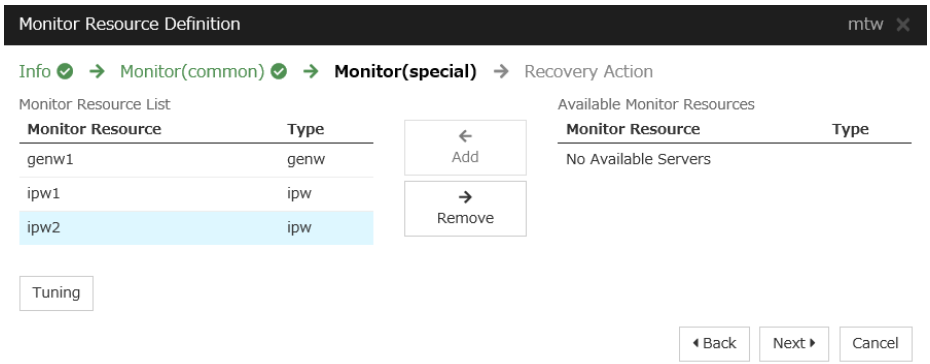
1. Click **Add** on the **Monitor Resource List** page.
2. Select the monitor resource type (Multi target monitor) from the **Type** box and enter the monitor resource name (mtw1) in the **Name** box. Click **Next**.



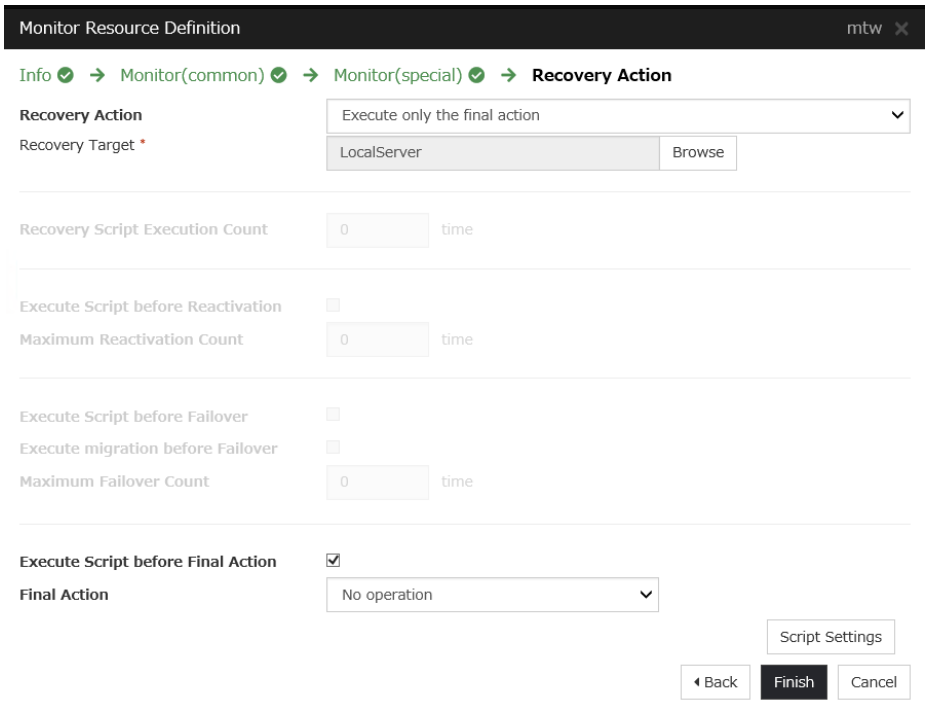
3. The **Monitor (common)** window is displayed.
Confirm that **Monitor Timing** is **Always** and click **Next**.



4. The **Monitor (special)** window is displayed.
   From **Available Monitor Resources**, select the custom monitor resource (genw1) for checking communication with Service Management API and two IP monitor resources (ipw1 and ipw2) that are set to both servers. Then, click **Add** to add them to **Monitor Resource List**. Click **Next**.



5. The **Recovery Action** window is displayed.
   Select **Execute only the final action** for **Recovery action**, **LocalServer** for **Recovery Target**, and **No operation** for **Final action**, and select the **Execute Script before Final Action** check box.
   Click **Script Settings** and create a script to be executed when the multi target monitor resource detects an error.



6. The script editing dialog box is displayed.
   Select **Script created with this product** and click **Edit** to edit the script. The following shows the sample of a script to be created.
   Specify the following by referring to "3.1 Creation example." The ports differ depending on operations.
   - **Load balancing rule > Backend port** of the load balancer
   - **Load balancing rule > Port** of the load balancer

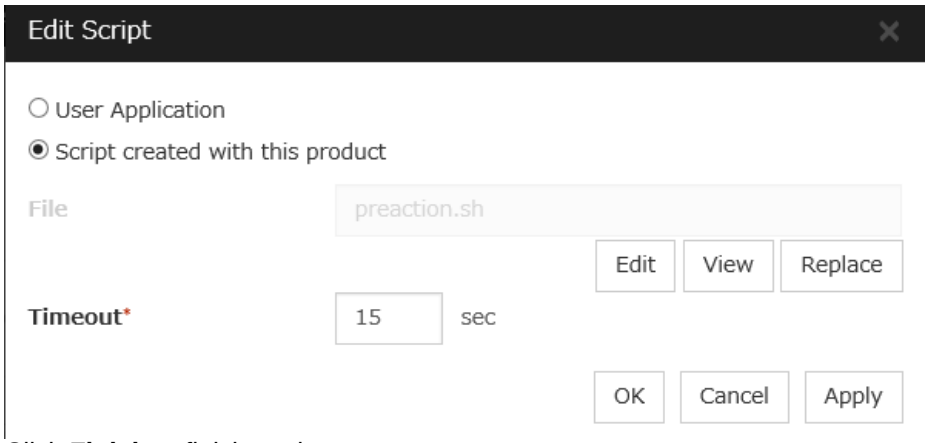
   Set the public IP address that you wrote down in "10) Setting the inbound security rules" to the following:
   - **Frontend IP** (public IP address) of the load balancer

   ---
   #! /bin/sh

```
<EXPRESSCLUSTER_installation_path>/bin/clpazure_port_checker -h 127.0.0.1 -p
<Backend_port_of_the_load_balancer_of_Load_balancing_rule>
if [ $? -ne 0 ]
then
  clpdown
  exit 0
fi

<EXPRESSCLUSTER_installation_path>/bin/clpazure_port_checker -h
<Frontend_IP(public_IP_address)_of_the_load_balancer> -p
<Port_of_the_load_balancer_of_Load_balancing_rule>
if [ $? -ne 0 ]
then
  clpdown
  exit 0
fi
-----
```

For **Timeout**, specify a value larger than the timeout value of `clpazure_port_checker` (fixed to five seconds). In the case of the above sample script, it is recommended to set a value larger than 10 seconds in order to execute `clpazure_port_checker` twice.
Click **OK**.



7. Click **Finish** to finish setting.

4) Setting the cluster properties

For details about the cluster properties, see “Cluster properties" in the *Reference Guide*.

◆ Cluster properties

Configure the settings in **Cluster Properties** to link Microsoft Azure and EXPERSSCLUSTER.

1. Enter **Config Mode** from Cluster WebUI, click the property icon of the cluster name.

2. Select the **Timeout** tab. For **Timeout** of **Heartbeat**, specify a value calculated by “A+B+C” as described below.

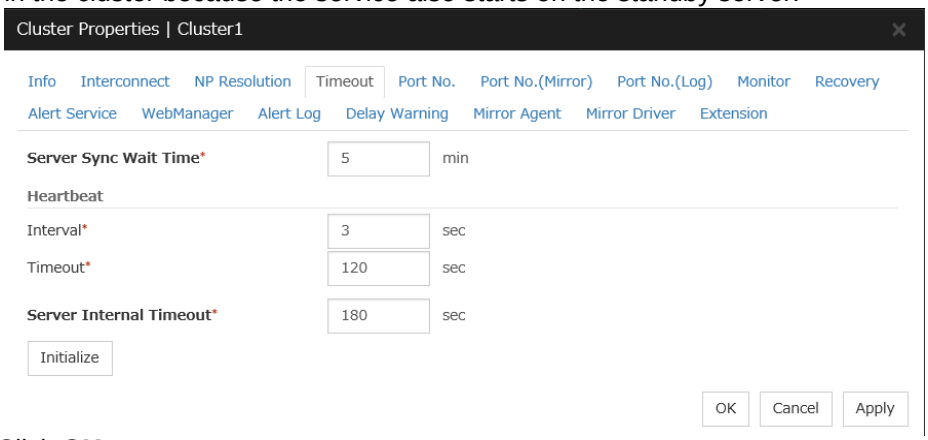
   A: **Interval** of the monitor resource being monitored by the multi target monitor resource for NP resolution x (**Retry Count**+1)

   * Among three monitor resources, select the monitor resource whose calculation result is the largest.

   B: **Interval** of the multi target monitor resource x (**Retry Count**+1)

   C: 30 seconds (Waiting time for heartbeat not to time out before the multi target monitor resource detects an error. The time can be changed accordingly.

Note: If **Timeout** of **Heartbeat** is shorter than the time that the multi target monitor resource requires to detect an error, a heartbeat timeout will be detected before starting the NP resolution processing. In this case, the same service may start doubly in the cluster because the service also starts on the standby server.



3. Click **OK**.

5) Applying the settings and starting the cluster

1. Click **Apply the Configuration File** on the **File** in the config mode of Cluster WebUI. If the upload succeeds, the message saying “The application finished successfully.”
2. Select the **Operation Mode** on the drop down menu of the toolbar in Cluster WebUI to switch to the operation mode.
3. The procedure depends on the resource used. For details, refer to the following:*Installation and Configuration Guide* → How to create a cluster

4.4 Verifying the created environment

Verify whether the created environment works properly by generating a (dummy) monitoring error to fail over a failover group.
If the cluster is running normally, the verification procedure is as follows:

1. Start the failover group (failover1) on the active node (node1). In the Status tab on the Cluster WebUI, confirm that **Group Status** of failover1 of node1 is **Normal**.
2. Change **Operation Mode** to **Verification Mode** from the Cluster WebUI pull-down menu.
3. In the Status tab on the Cluster WebUI, click the **Enable dummy failure** icon of azureppw1 of Monitors.
4. After the Azure probe port resource (azurepp1) activated three times, the failover group (failover1) becomes abnormal and fails over to node2. In the Status tab on the Cluster WebUI, confirm that **Group Status** of failover1 of node2 is **Normal**.
   Also, confirm that access to the frontend IP and port of the Azure load balancer is normal after the failover.

Verifying the failover operation in case of a dummy failure is now complete. Verify the operations in case of other failures if necessary.

Chapter 5 Cluster Creation Procedure (for an HA Cluster Using an Internal Load Balancer)

5.1 Creation example

This guide introduces the procedure for creating a 2-node unidirectional standby cluster using EXPRESSCLUSTER. This procedure is intended to create a mirror disk type configuration in which node1 is used as an active server.
The following tables describe the parameters that do not have a default value and the parameters whose values are to be changed from the default values.

- Microsoft Azure settings (common to node1 and node2)

Setting item	Setting value
Resource group setting	
Resource group	TestGroup1
Region	Japan East
Virtual network setting	
Name	Vnet1
Address space	10.5.0.0/24
Subnet Name	Vnet1-1
Subnet Address range	10.5.0.0/24
Resource group	TestGroup1
Location	Japan East
Load balancer setting	
Name	TestLoadBalancer
Type	Internal
Virtual network	Vnet1
Subnet	Vnet1-1
IP address assignment	Static
Private IP address	10.5.0.200
Resource group	TestGroup1
Region	Japan East
Backend pool: Name	TestBackendPool
Associated to	Availability set
Target virtual machine	node1 node2
Network IP configuration	10.5.0.110 10.5.0.111
Health probe: Name	TestHealthProbe
Health probe: Port	26001
Load balancing rule: Name	TestLoadBalancingRule
Load balancing rule: Port	80 (Port number offering the operation)
Load balancing rule: Backend port	8080 (Port number offering the operation)

- Microsoft Azure settings (specific to each of node1 and node2)

Setting item	Setting value	
	node1	node2
Virtual machine setting		
Disk type	Standard HDD	
User name	testlogin	
Password	PassWord_123	

Resource group	TestGroup1	
Region	Japan East	
Network security group setting		
Name	NetSecGroup1	
Availability set setting		
Name	AvailabilitySet1	
Update domains	5	
Fault domains	2	
Diagnostics storage account setting		
Name	Automatically generated (testgroup1diag679)	
Performance	Standard	
Replication	Locally-redundant storage (LRS)	
IP configuration setting		
IP address	10.5.0.110	10.5.0.111
Blob storage setting		
Name	Node1Blob1	Node2Blob1
Source type	None (empty disk)	
Account type	Standard HDD	

- EXPRESSCLUSTER settings (cluster properties)

Setting item	Setting value	
	node1	node2
Cluster Name	Cluster1	
Server Name	node1	node2
NP Resolution Tab: Type	Ping	
NP Resolution Tab: Ping Target	10.5.0.5	
NP Resolution Tab: <server> column	Use	Use

- EXPRESSCLUSTER settings (failover group)

Resource name	Setting item	Setting value
Mirror disk resource	Name	md
	Details Tab: Mount Point	/mnt/md
	Details Tab: Data Partition Device Name	/dev/sdc2
	Details Tab: Cluster Partition Device Name	/dev/sdc1
	Details Tab: File System	ext4
	Mirror Tab: Execute the initial mirror construction	On
	Mirror Tab: Execute initial mkfs	On
Azure probe port resource	Name	azurepp1
	Probe port	26001 (Value specified for **Port** of **Health probe**)

- EXPRESSCLUSTER settings (monitor resource)

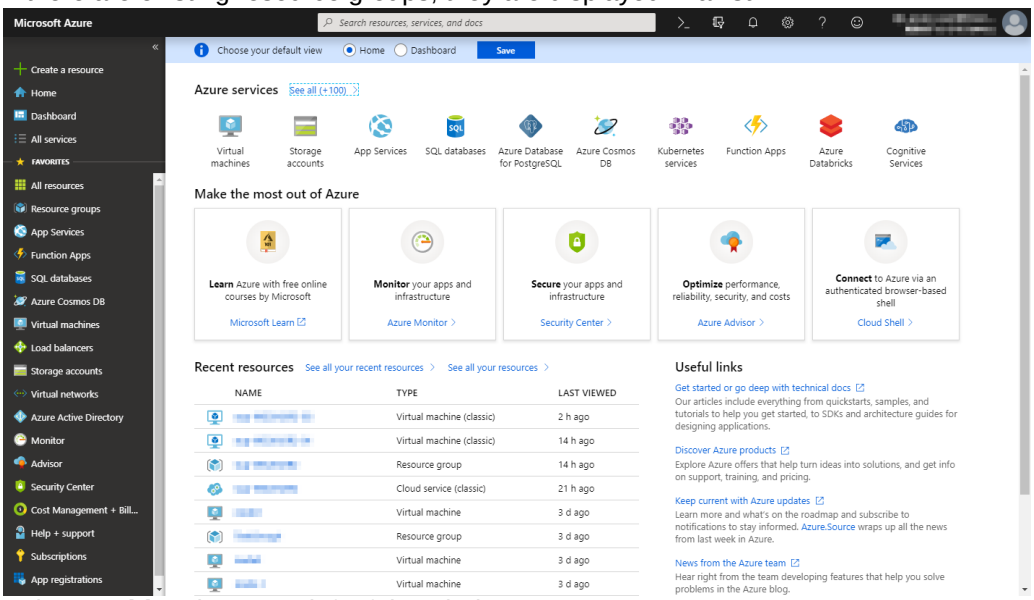
Monitor resource name	Setting item	Setting value
Mirror disk monitor resource	-	-
Azure probe port monitor resource	Name	azureppw1
	Recovery Target	azurepp1
Azure load balance monitor resource	Name	aurelbw1
	Recovery Target	azurepp1

5.2 Configuring Microsoft Azure

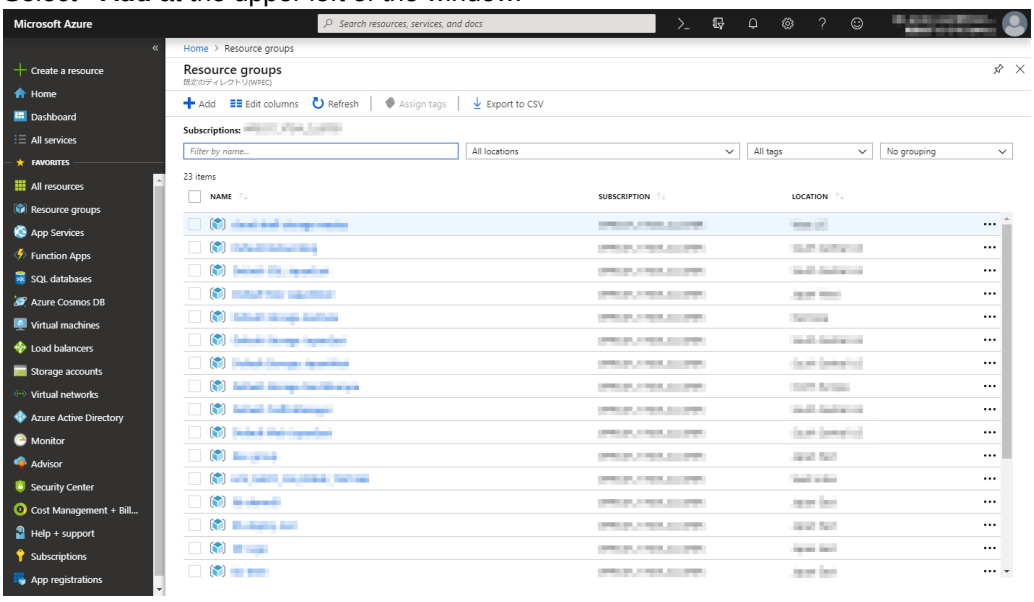
1) Creating a resource group

Log in to the Microsoft Azure portal (https://portal.azure.com/) and create a resource group following the steps below.

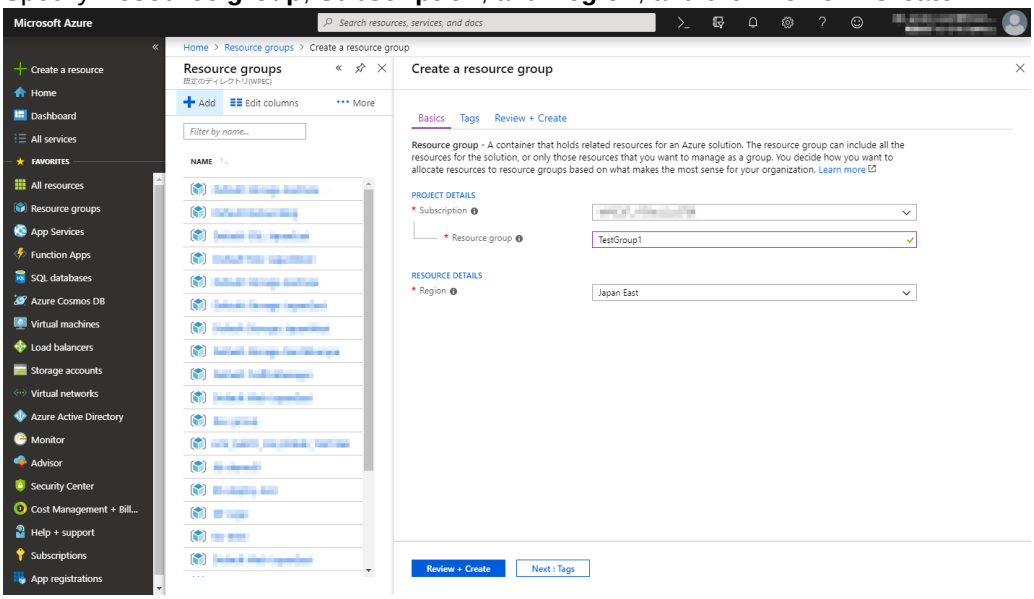
1. Select **Resource groups** or the resource group icon in the menu on the left side of the window. If there are existing resource groups, they are displayed in a list.



2. Select **+Add** at the upper left of the window.



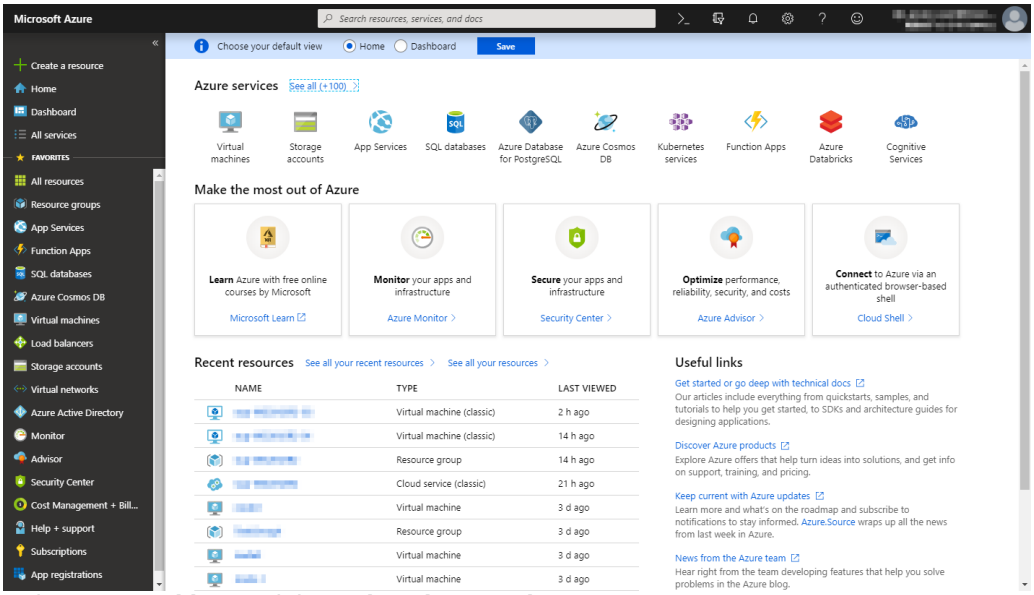
3. Specify **Resource group**, **Subscription**, and **Region**, and click **Review+Create**.



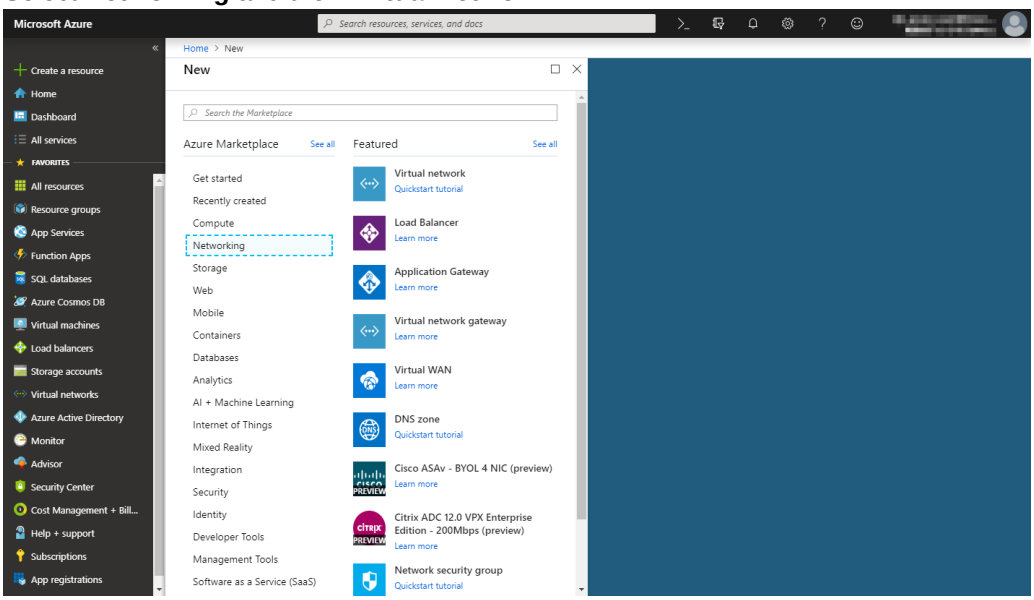
2) Creating a virtual network

Log in to the Microsoft Azure portal (https://portal.azure.com/) and create a virtual network following the steps below.

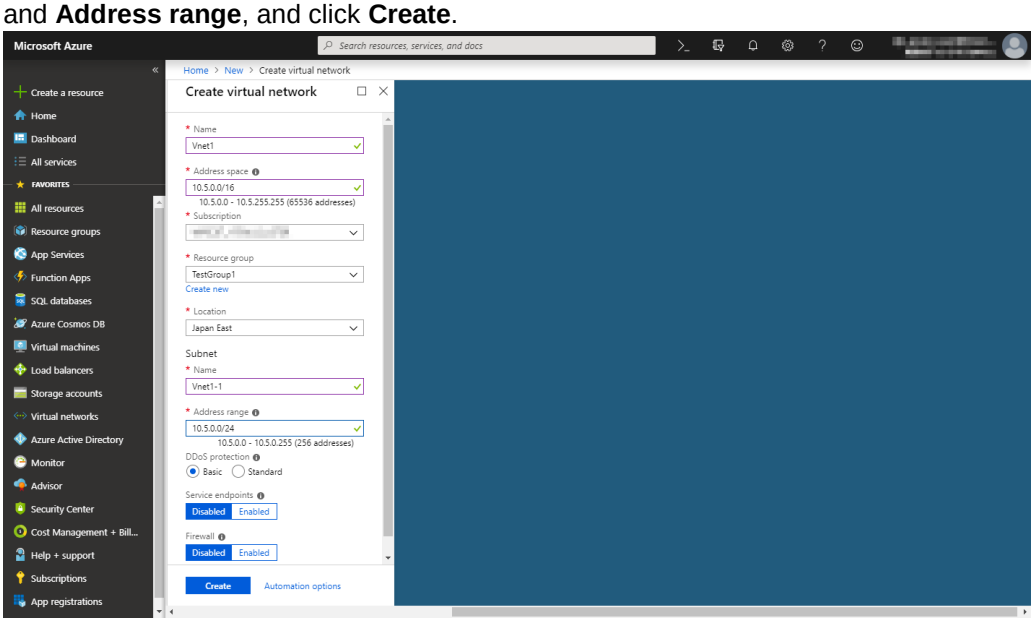
1. Select **+Create a resource** or the **+** icon in the menu on the left side of the window.



2. Select **Networking** and then **Virtual network**.



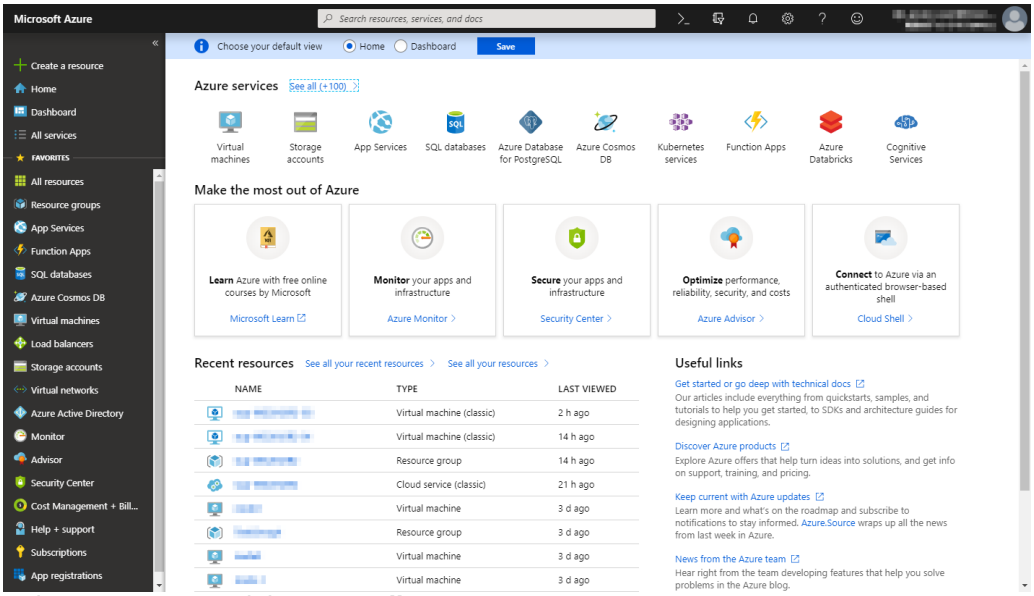
3. Specify **Name**, **Address space**, **Subscription**, **Resource group**, **Location**, **Name** of Subnet, and **Address range**, and click **Create**.



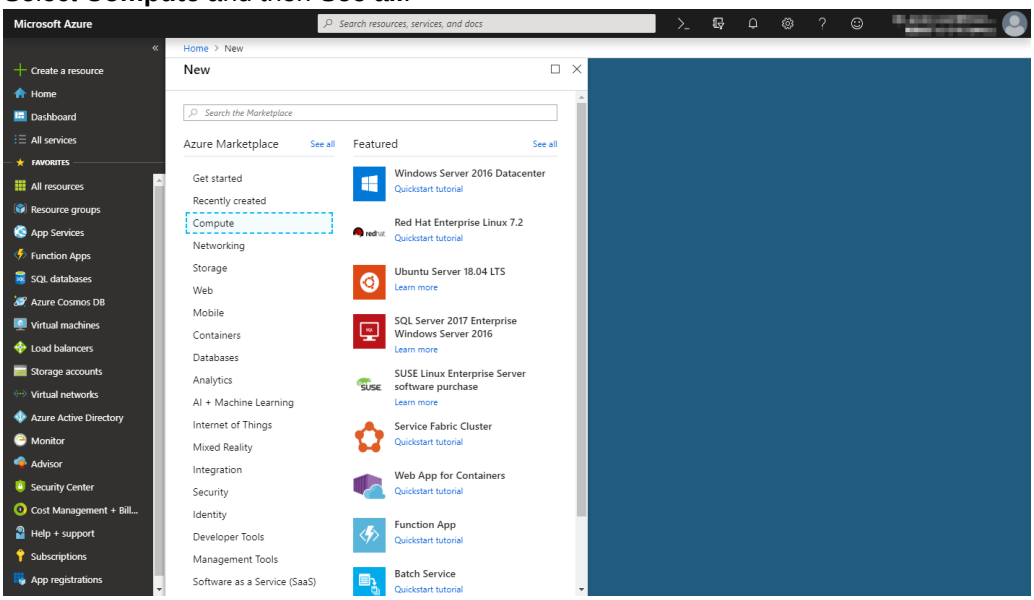
3) Creating a virtual machine

Log in to the Microsoft Azure portal (https://portal.azure.com/) and create virtual machines and disks following the steps below.
Create as many virtual machines as required to create a cluster. Create node1 and then node2.

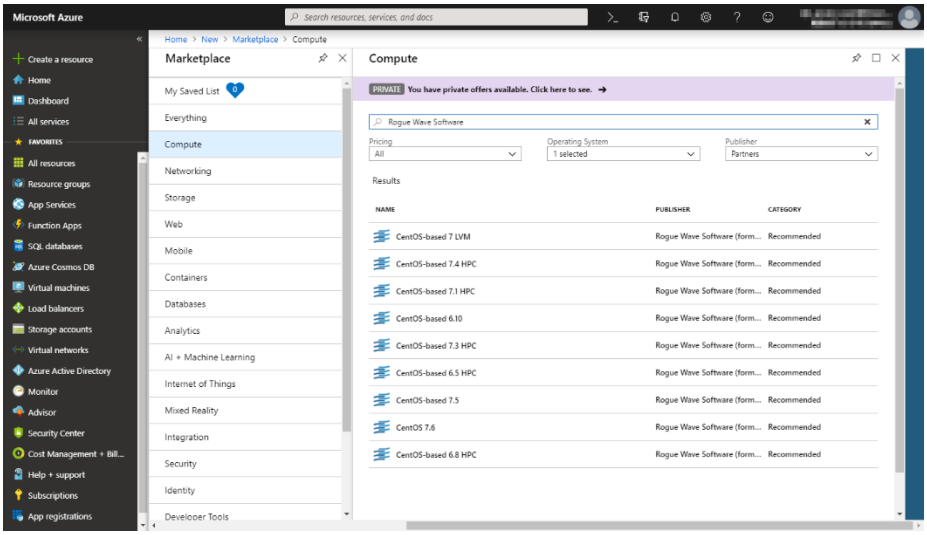
1. Select **+Create a resource** or the **+** icon in the menu on the left side of the window.



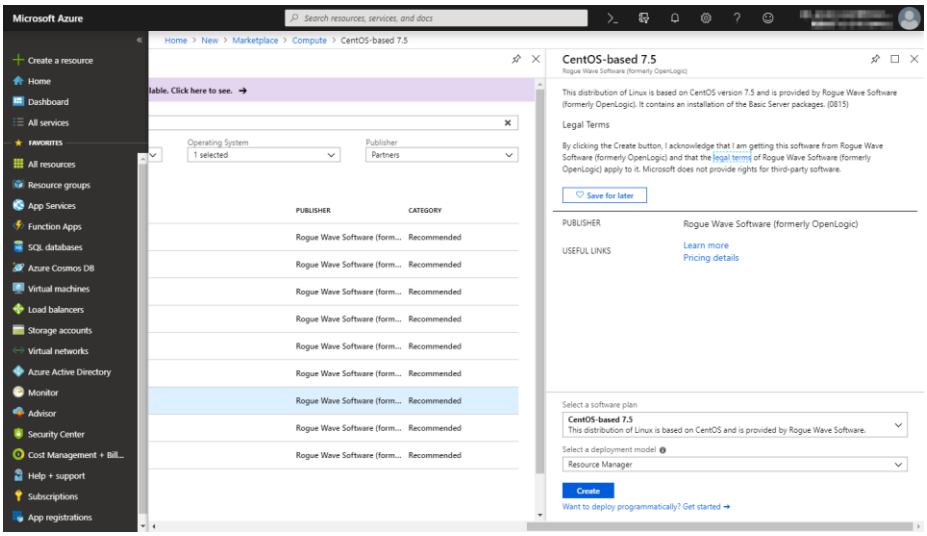
2. Select **Compute** and then **See all**.



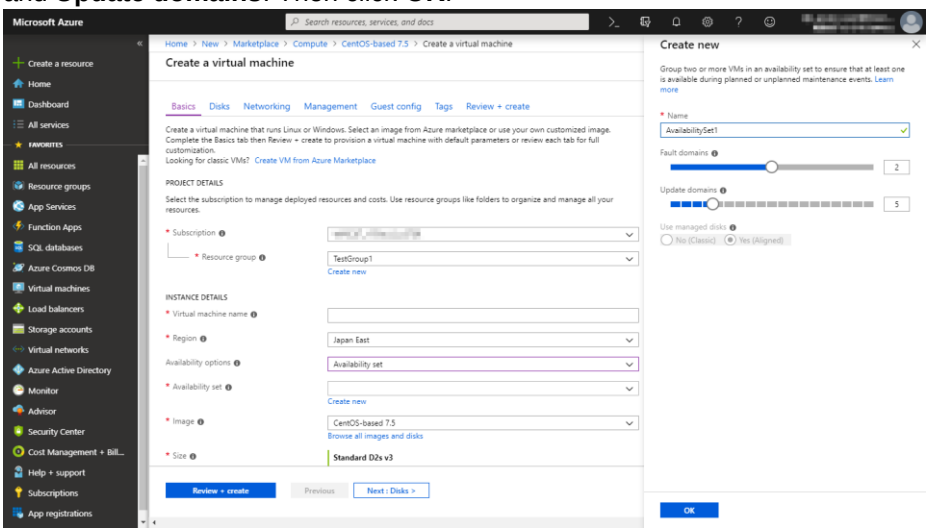
3. Select **CentOS-based 7.5**.

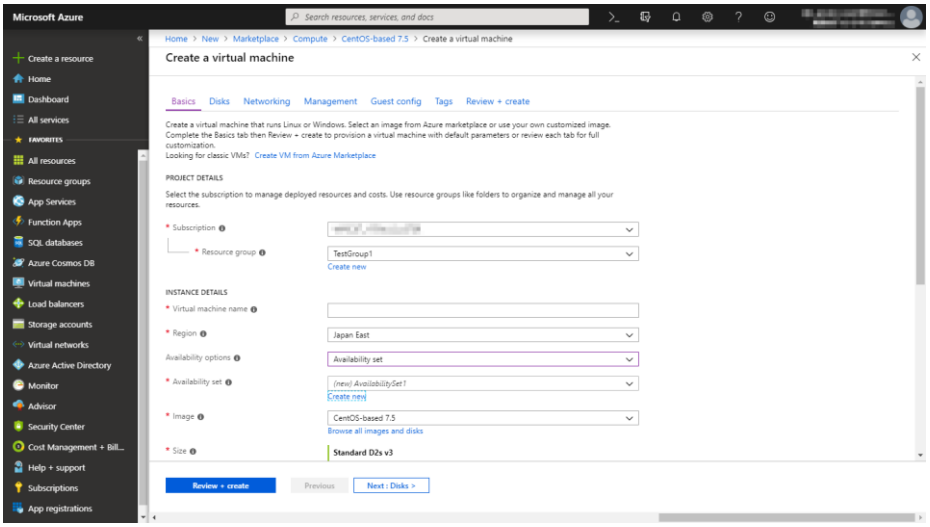


4. Confirm that **Resource Manager** is selected for **Select a deployment model** at the bottom of the window, and click **Create**.

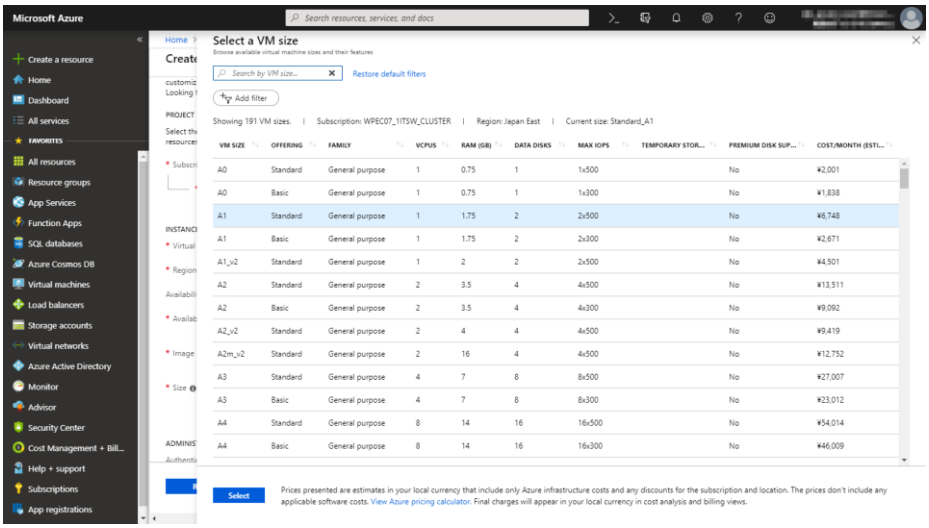


5. When the **Basics** tab appears, specify the settings of **Subscription**, **Resource group**, **Virtual machine name**, **Region**, **Image**, **Size**, **Username**, **Password**, and **Confirm password**. Select **Availability set** from **Availability options**, and click **Create new** under the **Availability set** field. When the **Create new** blade appears, specify the settings of **Name**, **Fault domains**, and **Update domains**. Then click **OK**.

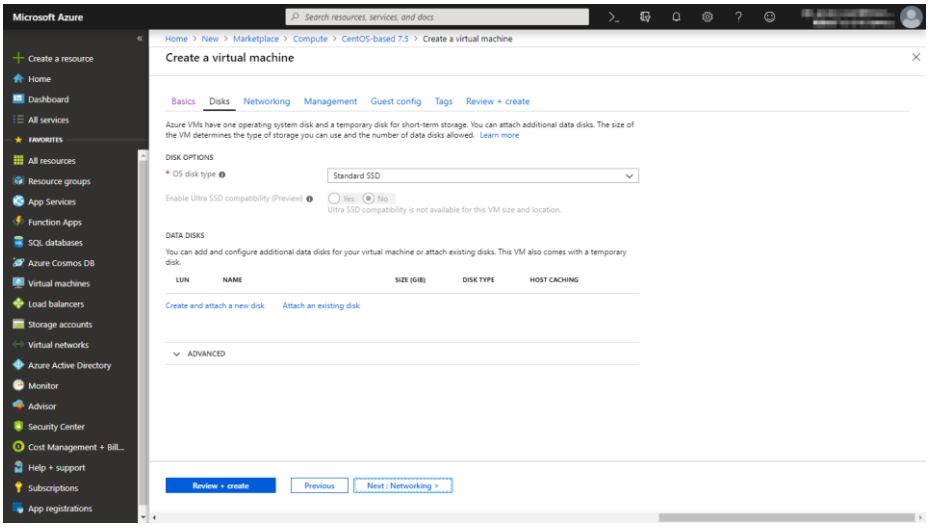




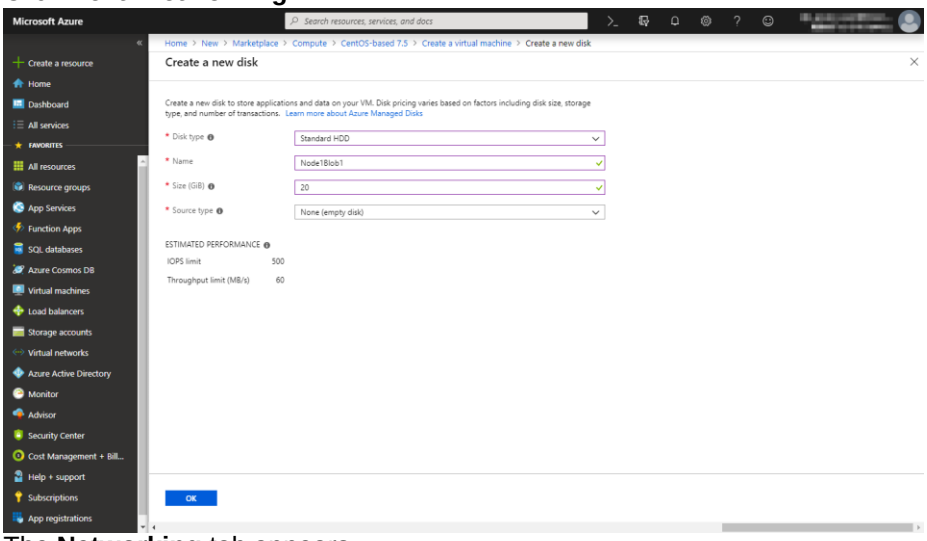
6. Click **Change size** to display the **Select a VM size** blade.
From the list, choose a size (**A1** - **Standard** in this guide) suitable for your virtual machine and click **Select**.
Regarding the **Virtual machine name**, node1 is for node1, and node2 is for node2.
Click **Next: Disks >**



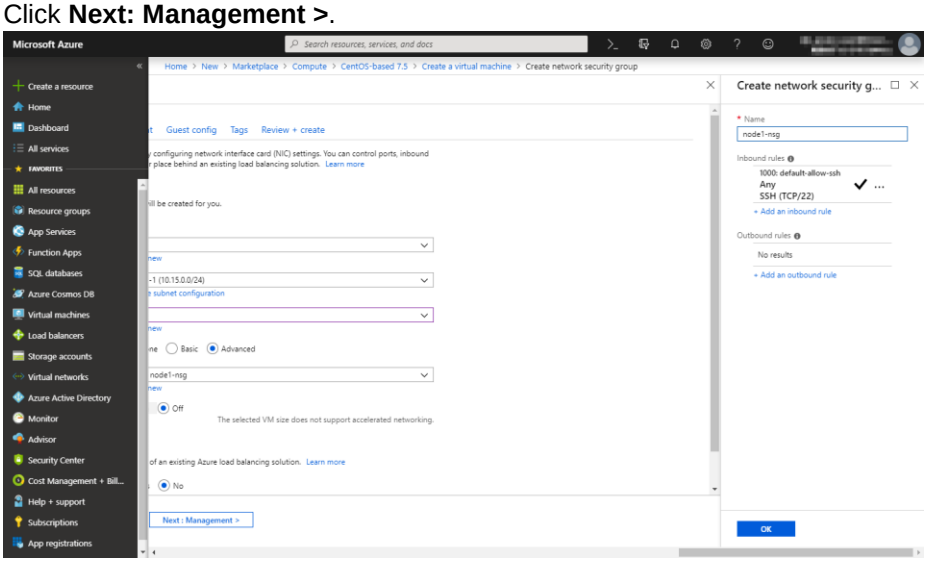
7. When the **Disks** tab appears, go through the following steps to add a blob to be used for a mirror disk (cluster partition or data partition).
From the **DATA DISKS** list, click **Create and attach a new disk**.



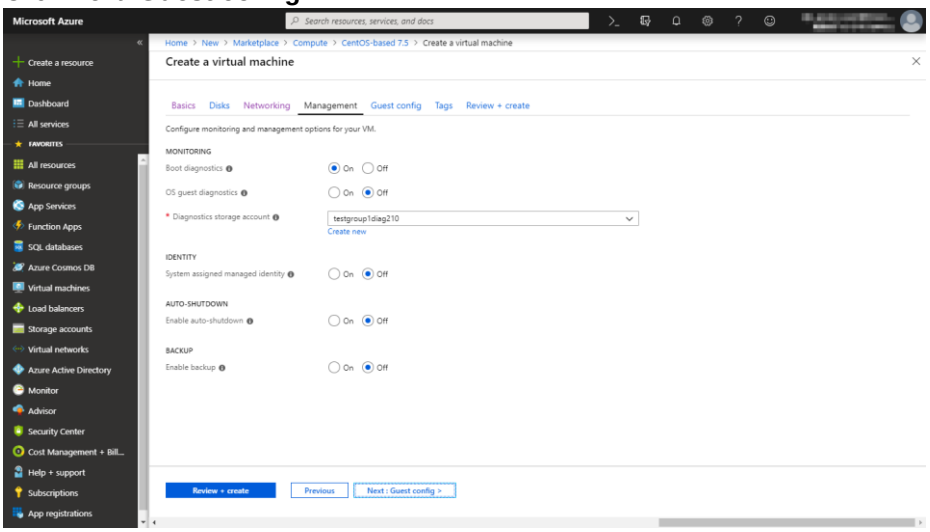
8. The **Create a new disk** blade appears.
   Specify the settings of **Disk type**, **Name**, **Size (GiB)**, and **Source type**. Then click **OK**.
   Click **Next: Networking >**

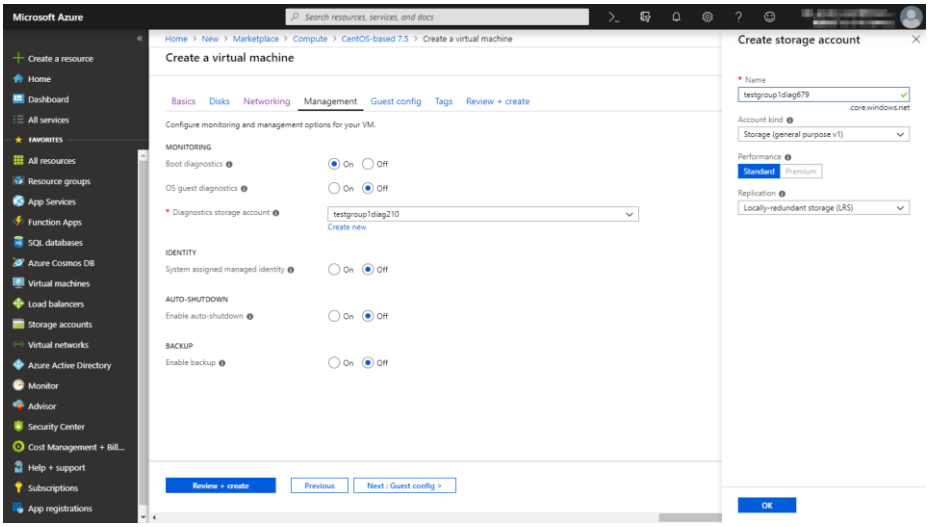


9. The **Networking** tab appears.
   Specify the settings of **Virtual network**, **Subnet**, **Network security group**, and **Configure network security group**.
   Click **Create new** under the **Configure network security group** field to display the **Create network security group** blade. Specify the setting of **Name** and then click **OK**.
   Click **Next: Management >**.

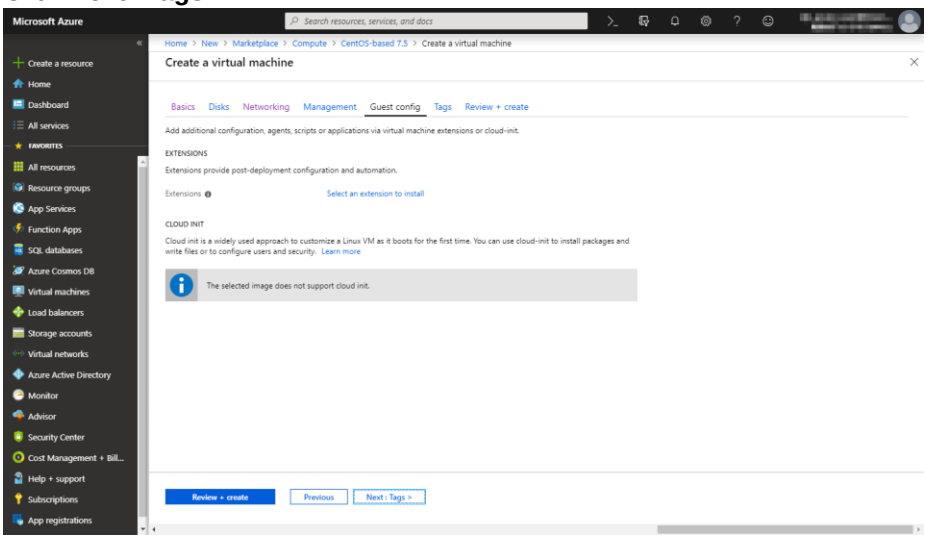


10. The **Management** tab appears.
Click **Create new** under the **Diagnostics storage account** field to display the **Create storage account** blade.
Specify the settings of **Name**, **Account kind**, and **Replication**. Then click **OK**.
In the **Diagnostics storage account** field, the default value is automatically generated and entered.
Click Next: **Guest config >**

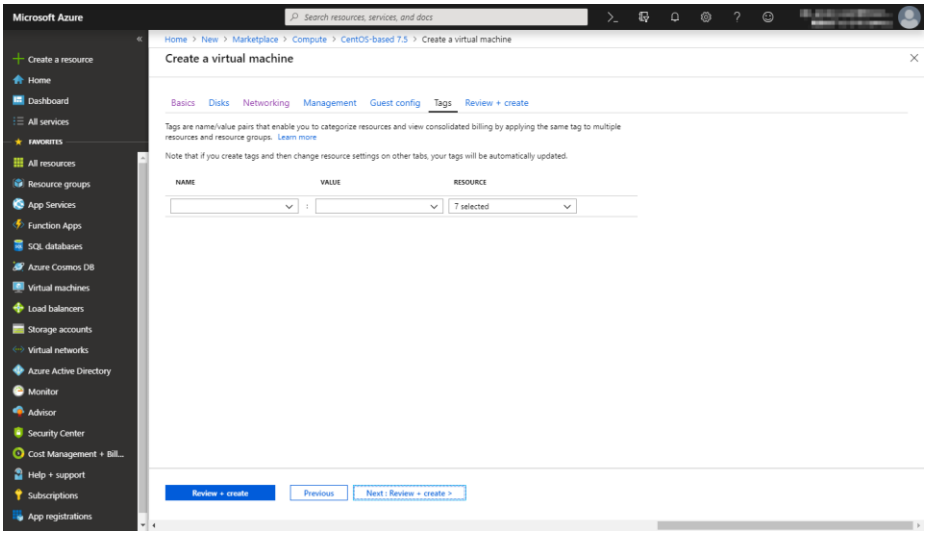




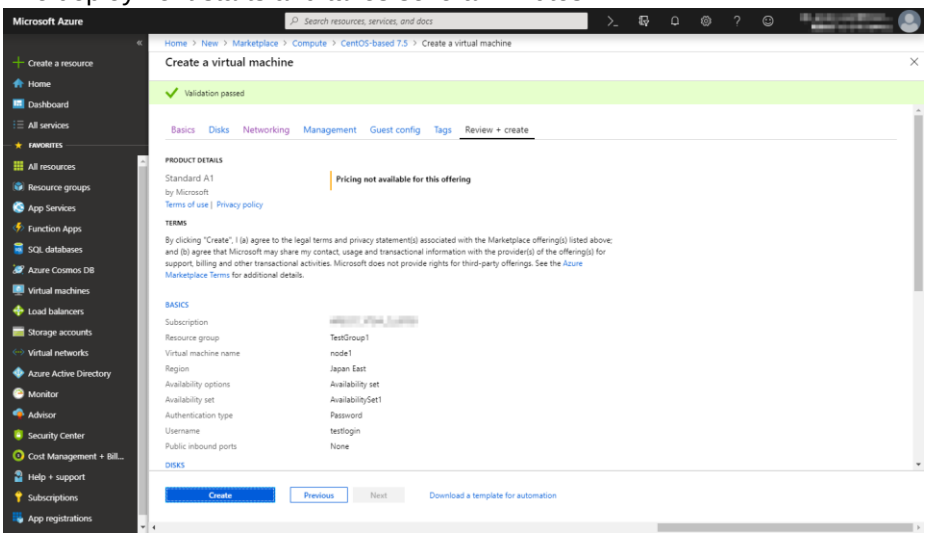
11. Click **Next: Tags >**.



12. Click **Next: Review + create >**



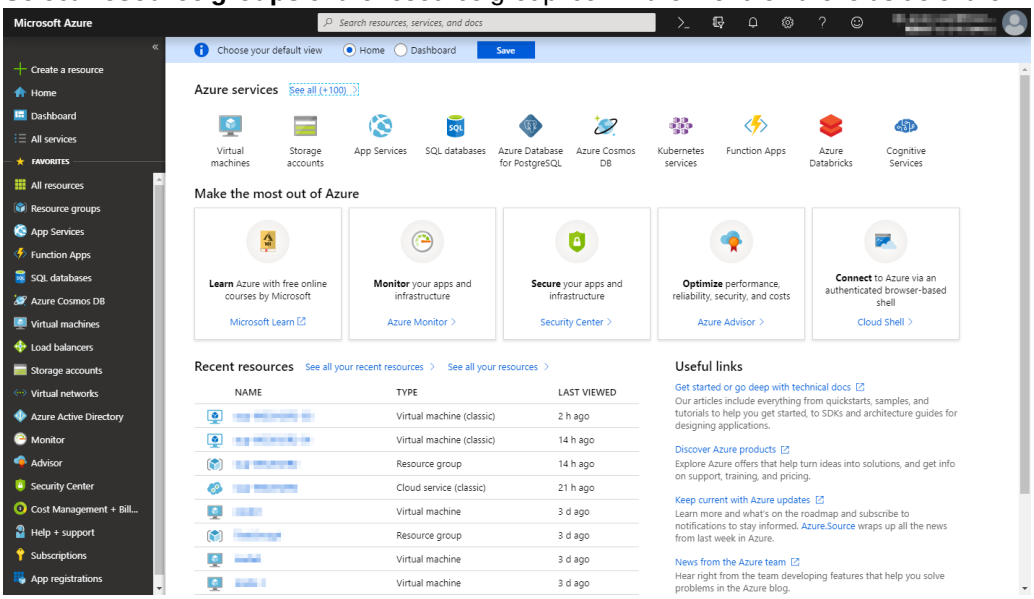
13. The **Review + create** tab appears. Check the contents. If there is no problem, click **Create**. The deployment starts and takes several minutes.



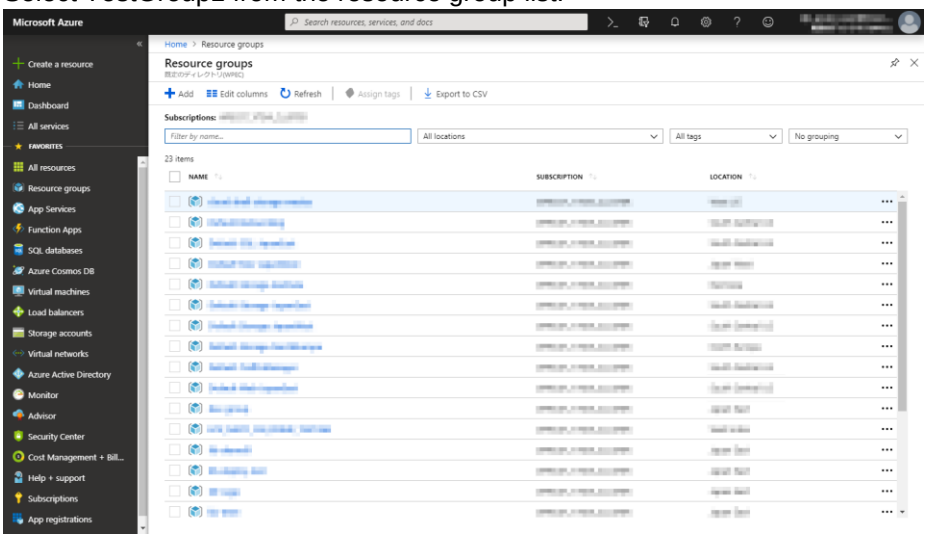
4) Setting a private IP address

Log in to the Microsoft Azure portal (https://portal.azure.com/) and change the private IP address setting following the steps below. Since an IP address is initially set to be assigned dynamically, change the setting so that an IP address is assigned statically. Change the settings of node1 and then node2.

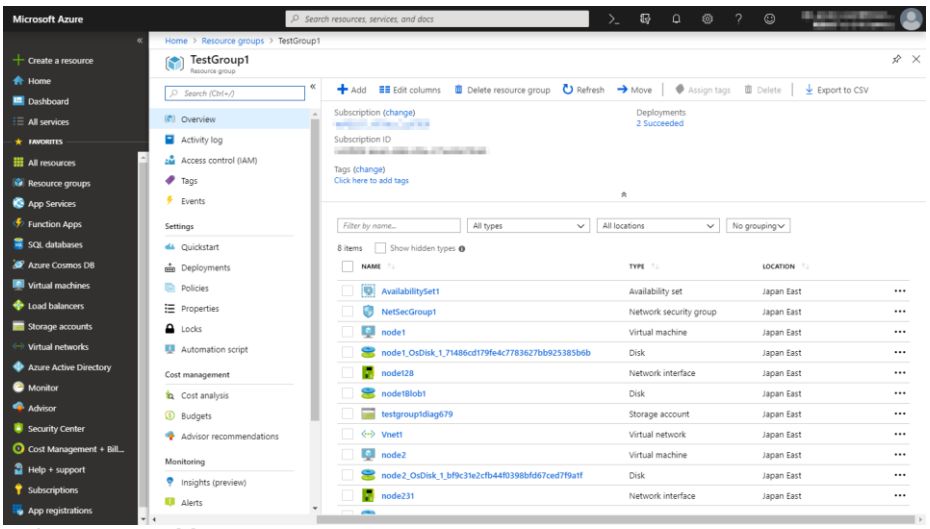
1. Select **Resource groups** or the resource group icon in the menu on the left side of the window.



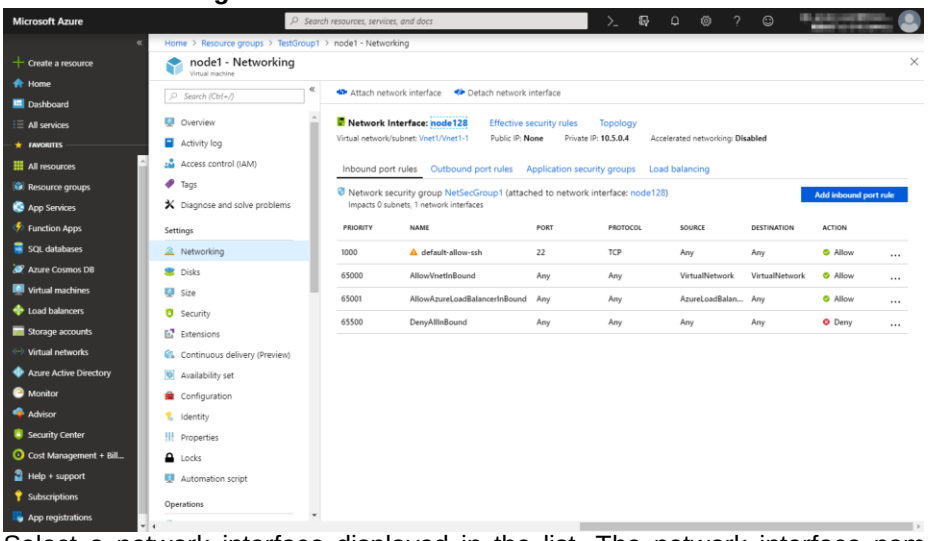
2. Select TestGroup1 from the resource group list.



3. The summary of TestGroup1 is displayed. Select virtual machine node1 or node2 from the item list.

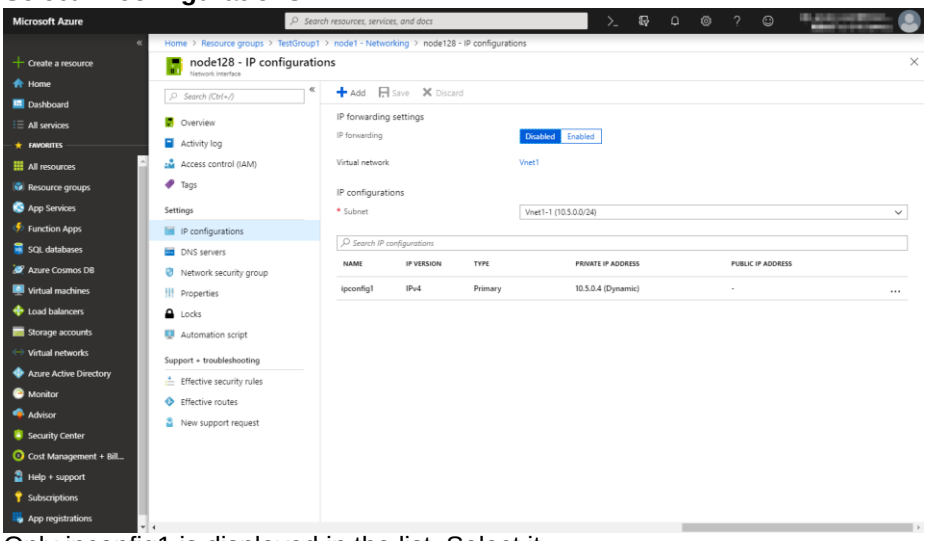


4. Select **Networking**.

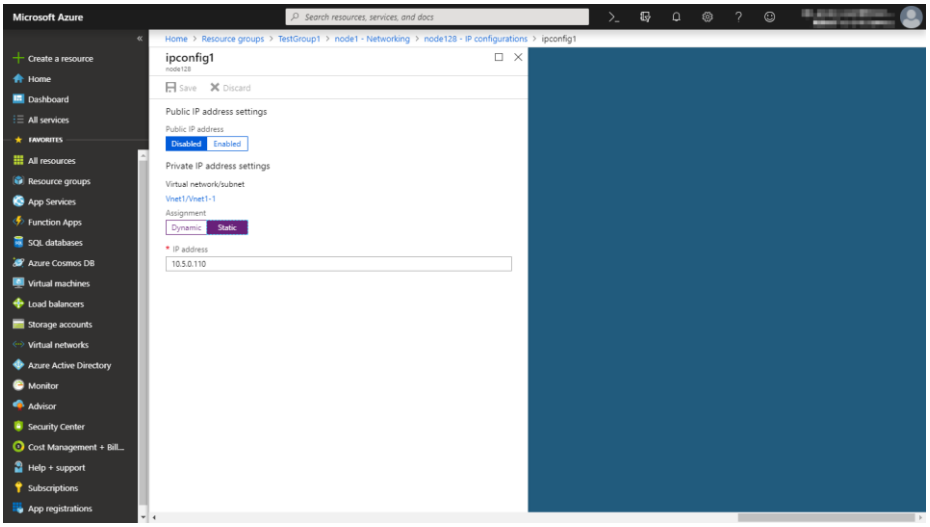


5. Select a network interface displayed in the list. The network interface name is generated automatically.

6. Select **IP configurations**.



7. Only ipconfig1 is displayed in the list. Select it.
8. Select **Static** for **Assignment** under **Private IP address settings**. Enter the IP address to be assigned statically in the **IP address** text box and click **Save** at the top of the window. The IP address of node1 is 10.5.0.110. The IP address of node2 is 10.5.0.111.



9. The virtual machines restart automatically so that new private IP addresses can be used.

5) Configuring virtual machines

Log in to the created node1 and node2 and specify the settings following the procedure below.
Set a partition for the mirror disk resource. Create a file system in the added Blob storage.
Secure an area in the added disk by using the fdisk command and then create a file system.
For details about the partition for the mirror disk resource, see “Settings after configuring hardware” in “4.Partition settings for mirror disk resource (when using Replicator)" in Chapter 1, “Determining a system configuration” in the *Installation and Configuration Guide*

1. Check the partition list. In the following example, the last line shows the added disk.
   $ cat /proc/partitions
   major minor #blocks name

8	16	73400320	sdb
8	17	73398272	sdb1
8	0	31459328	sda
8	1	31456256	sda1
8	32	20971520	sdc

2. Create a cluster partition and data partition in the added disk by using the fdisk command. Allocate 1 GB (1*1024*1024*1024 bytes) or more to a cluster partition. (If the size is specified as just 1 GB, the actual size will be larger than 1 GB depending on the disk geometry difference. This is not a problem.) Also, do not create a file system in a cluster partition. The following is an example of creating one partition including all areas of /dev/sdc.

```
$ sudo fdisk /dev/sdc
Device contains neither a valid DOS partition table, nor Sun, SGI or OSF disklabel
Building a new DOS disklabel with disk identifier 0xe3c83b13.
Changes will remain in memory only, until you decide to write them.
After that, of course, the previous content won't be recoverable.

Warning: invalid flag 0x0000 of partition table 4 will be corrected by w(rite)

The device presents a logical sector size that is smaller than the physical sector size. Aligning to a physical sector (or optimal I/O) size boundary is recommended, or performance may be impacted.

WARNING: DOS-compatible mode is deprecated. It's strongly recommended to switch off the mode (command 'c') and change display units to sectors (command 'u').

Command (m for help): n
Command action
   e extended
   p primary partition (1-4)
p
Partition number (1-4): 1
First cylinder (1-2610, default 1):
Using default value 1

Last cylinder, +cylinders or +size{K,M,G} (1-2610, default 2610): +1G

Command (m for help): p

Disk /dev/sdc: 21.5 GB, 21474836480 bytes
255 heads, 63 sectors/track, 2610 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes
Sector size (logical/physical): 512 bytes / 4096 bytes
I/O size (minimum/optimal): 4096 bytes / 4096 bytes
Disk identifier: 0xe29ed566

  Device Boot      Start         End      Blocks   Id  System
```

```
  /dev/sdc1               1         132     1060256+  83  Linux
  Partition 1 does not end on cylinder boundary.
  Partition 1 does not start on physical sector boundary.

Command (m for help): n
Command action
  e   extended
  p   primary partition (1-4)
p
Partition number (1-4): 2
First cylinder (132-2610, default 132):
Using default value 132
Last cylinder, +cylinders or +size{K,M,G} (132-2610, default 2610):
Using default value 2610
Command (m for help): p

Disk /dev/sdc: 21.5 GB, 21474836480 bytes
255 heads, 63 sectors/track, 2610 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes
Sector size (logical/physical): 512 bytes / 4096 bytes
I/O size (minimum/optimal): 4096 bytes / 4096 bytes
Disk identifier: 0xe29ed566

  Device Boot      Start         End      Blocks   Id  System
  /dev/sdc1               1         132     1060256+  83  Linux
  Partition 1 does not end on cylinder boundary.
  Partition 1 does not start on physical sector boundary.
  /dev/sdc2             132        2610    19904537   83  Linux

Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.
Syncing disks.
```

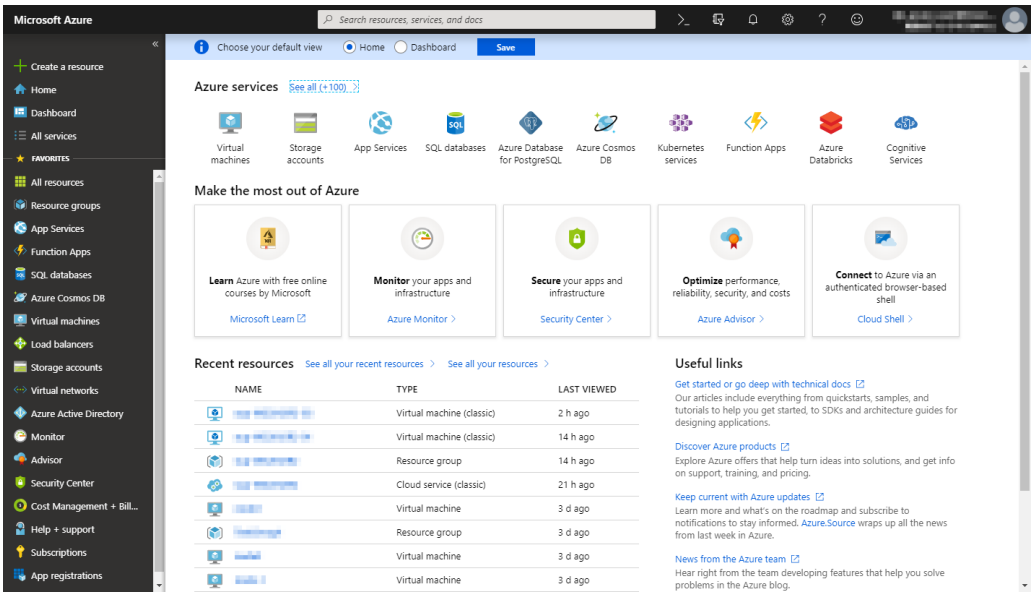
3. If you select **Execute initial mkfs** when creating the cluster configuration data by using Cluster WebUI, EXPRESSCLUSTER creates a file system automatically. Note that existing data in the partition will be lost.

6) Configuring a load balancer

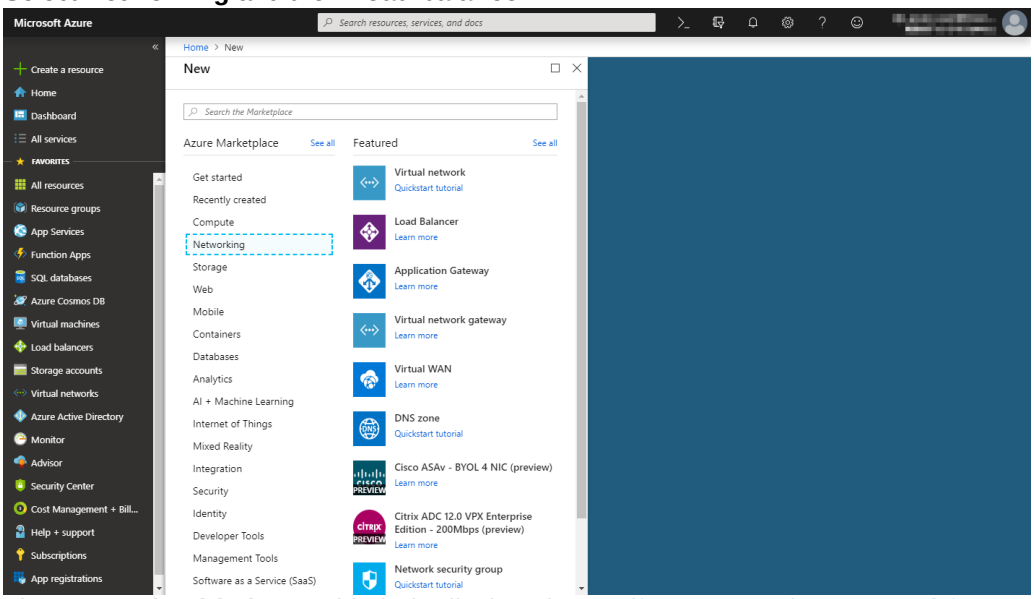
Log in to the Microsoft Azure portal (https://portal.azure.com/) and add an internal load balancer following the steps below.
For details, see the following websites:

- Load Balancer:
  https://docs.microsoft.com/en-us/azure/load-balancer/

1. Select **+Create a resource** or the **+** icon in the menu on the left side of the window.

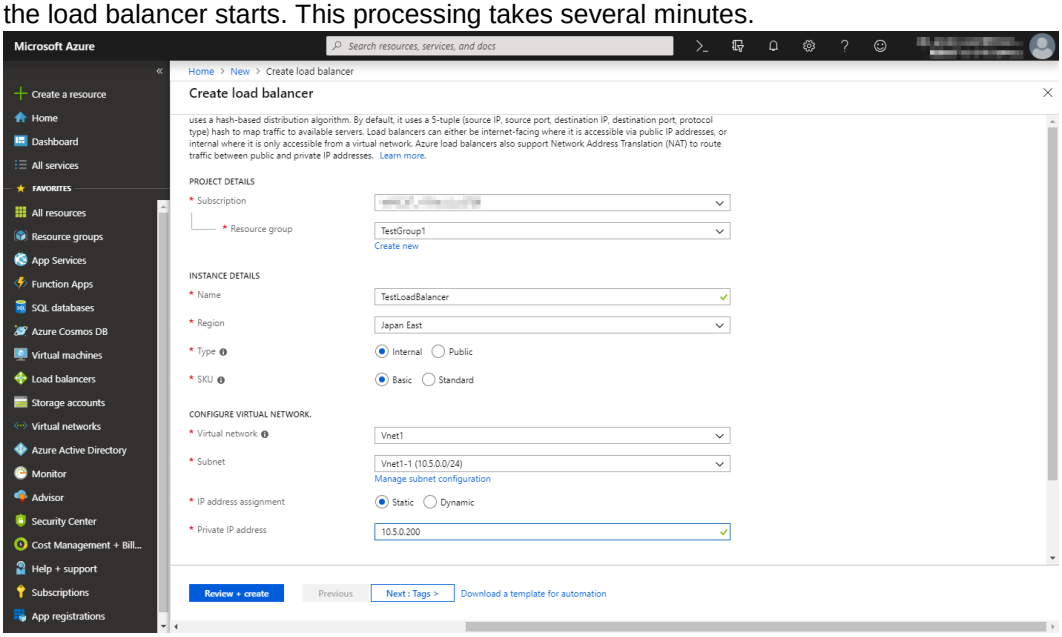


2. Select **Networking** and then **Load balancer**.



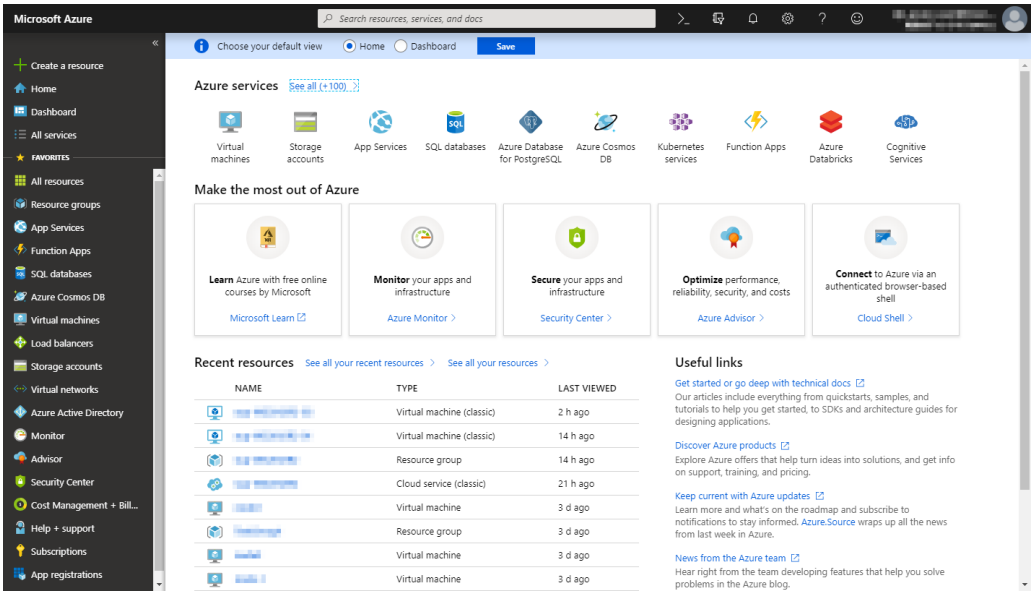
3. The **Create load balancer** blade is displayed. Specify **Name**. Select **Internal** for **Type** and **Basic** for **SKU**, respectively.
4. For **Virtual network** and **Subnet**, select the virtual network and subnet created in "2) Creating a virtual network."

5. Specify **Subscription**, **Resource group**, and **Region**, and click **Review+create**. Deploying the load balancer starts. This processing takes several minutes.

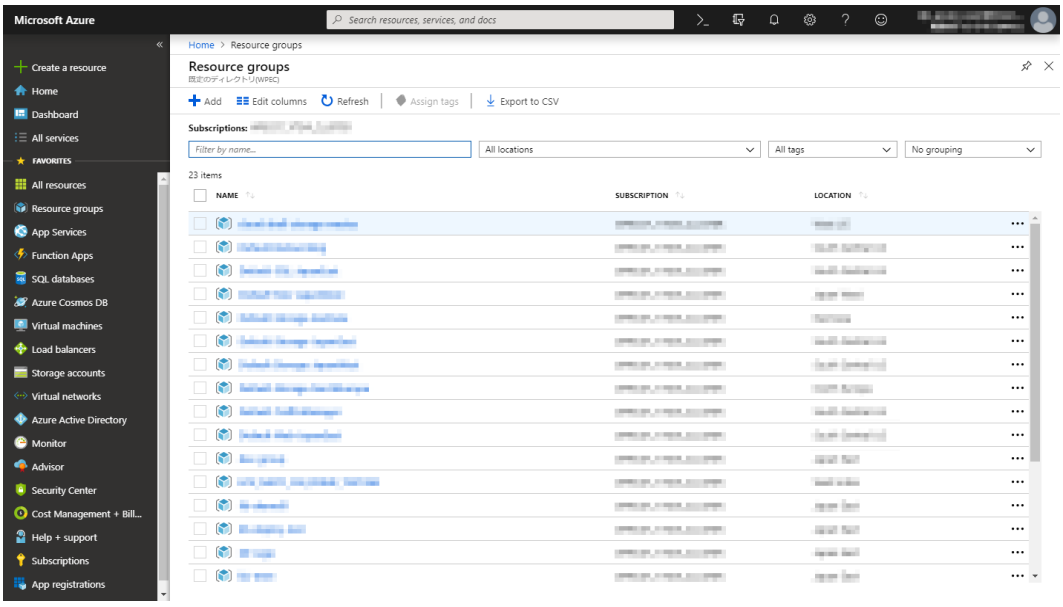


7) Configuring a load balancer (configuring a backend pool)

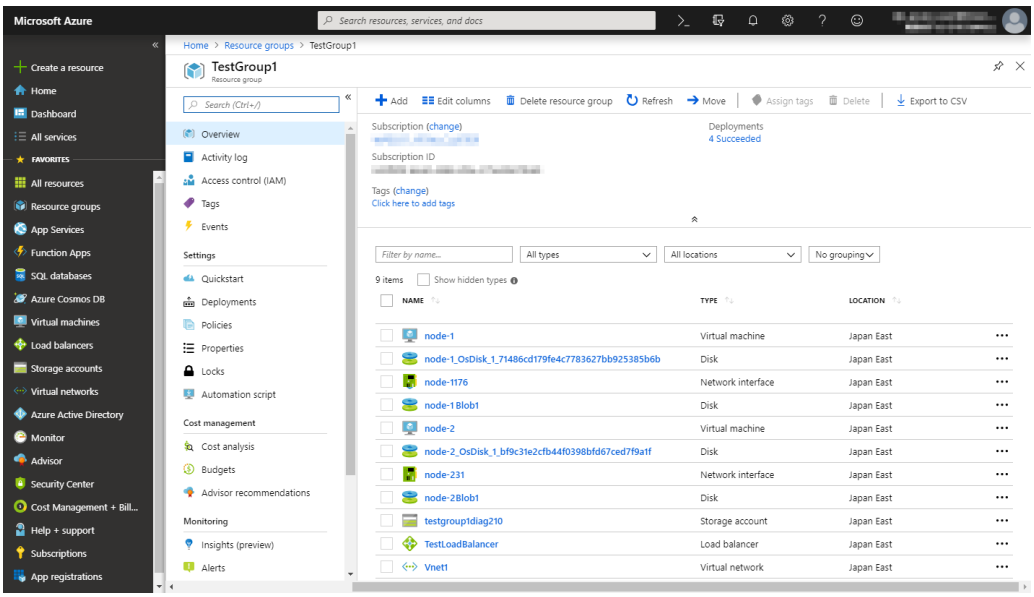
1. Associate a virtual machine registered to the availability set to the load balancer. After the load balancer has been deployed, select **Resource groups** or the resource group icon in the menu on the left side of the window.



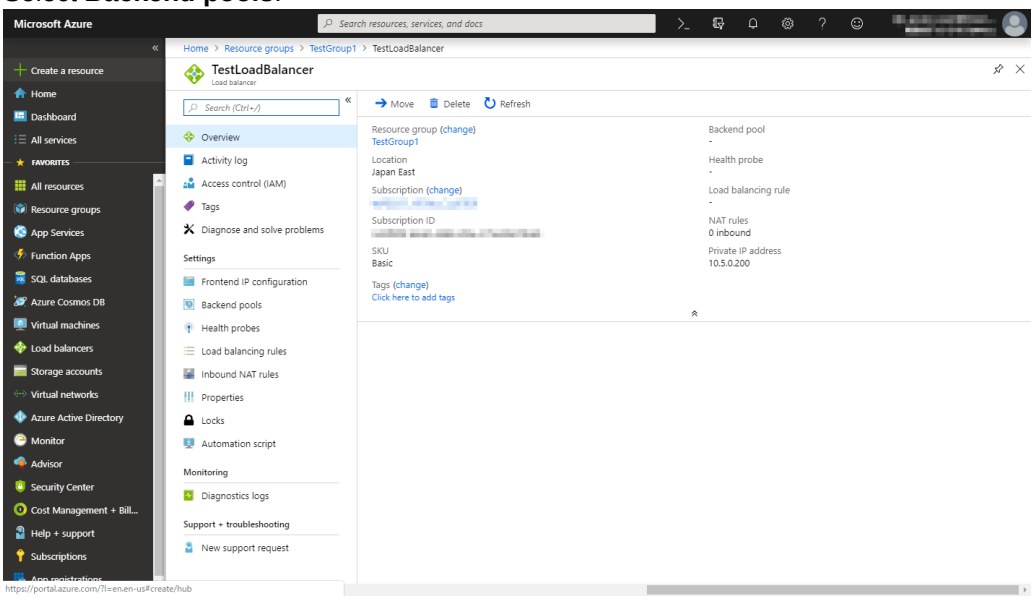
2. Select the resource group to which the created load balancer belongs from the resource group list.



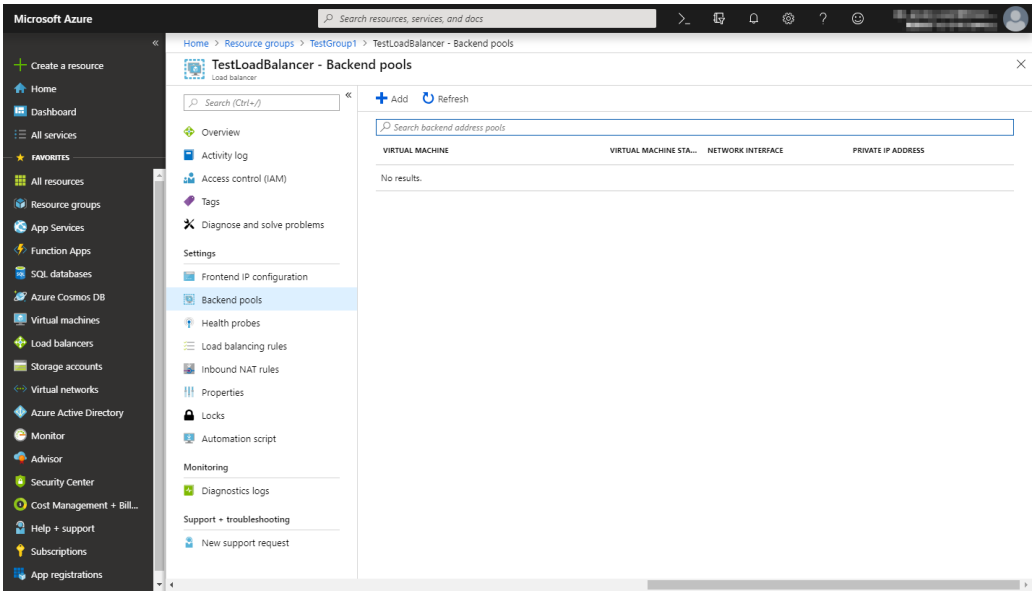
3. The summary of the selected resource group is displayed. Select the created load balancer from the item list.



4. Select **Backend pools**.



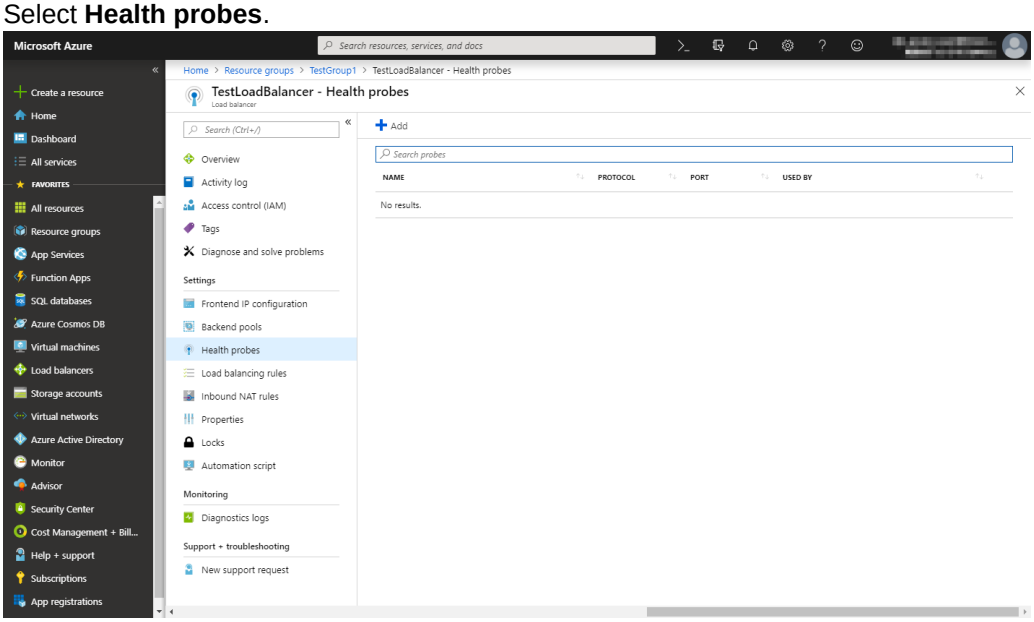
5. Click **Add**.



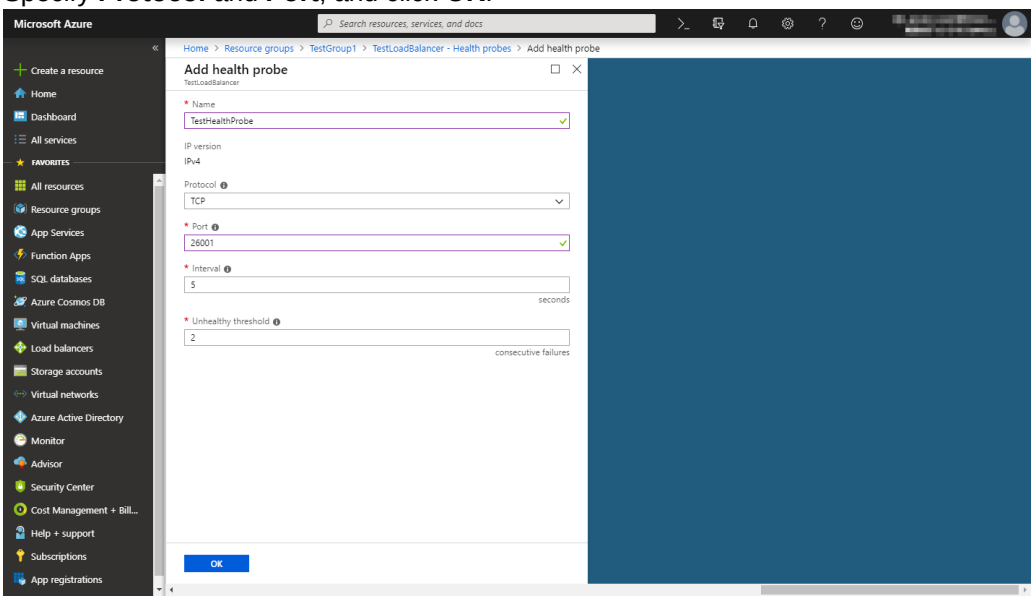
6. The **Add backend pool** blade is displayed. Specify **Name**.
7. For **Associated to**, select **Availability set**.
8. Specify **Availability set**.
9. Click **Add a target network IP configuration**.
10. Specify the target virtual machine for **Target virtual machine** and **Network IP configuration**.
11. Repeat steps 9 and 10 as many times as the number of target virtual machines.
12. Click **OK**.

8) Configuring a load balancer (configuring a health probe)

1. Select **Health probes**.

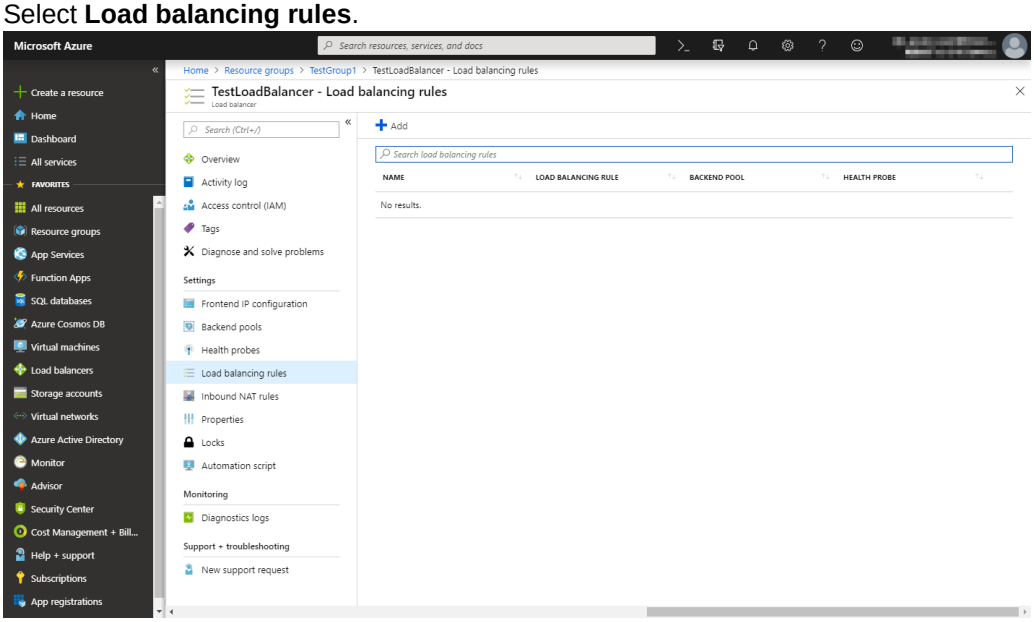


2. Click **Add**.
3. The **Add health probe** blade is displayed. Specify **Name**.
4. Specify **Protocol** and **Port**, and click **OK**.

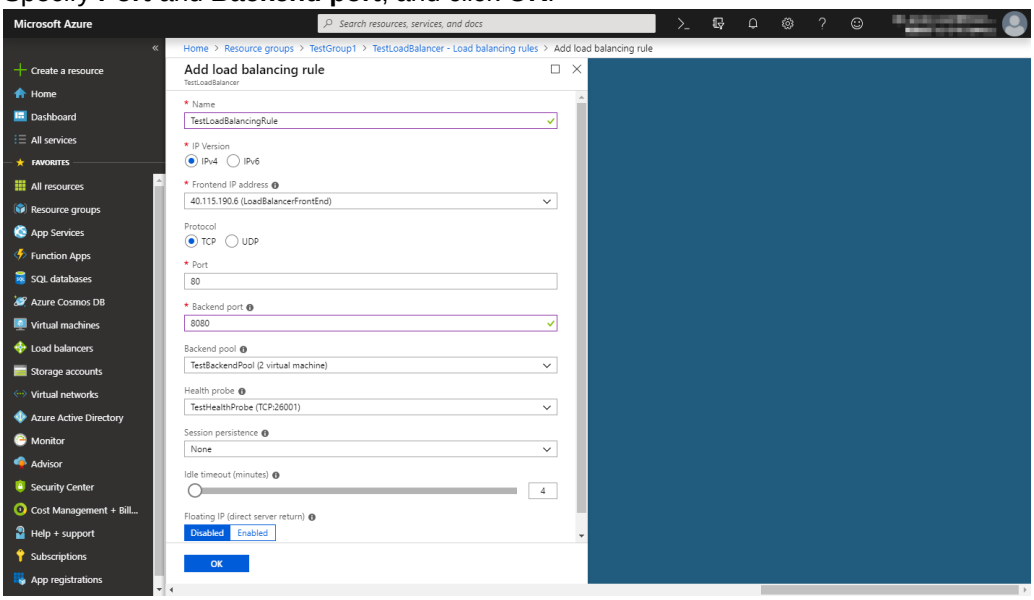


9) Configuring a load balancer (setting the load balancing rules)

1. Select **Load balancing rules**.



2. Click **Add**.
3. The **Add load balancing rule** blade is displayed. Specify **Name**.
4. Specify **Port** and **Backend port**, and click **OK**.



10) Adjusting the OS startup time, checking the network setting, checking the root file system, checking the firewall setting, synchronizing the server time, and checking the SELinux setting.

For each procedure, see “Settings after configuring hardware" in Chapter 1, “Determining a system configuration” in the *Installation and Configuration Guide*.

11) Installing EXPRESSCLUSTER

For the installation procedure, see the *Installation and Configuration Guide*.
After installation is complete, restart the OS.

12) Registering the EXPRESSCLUSER license

For the license registration procedure, see the *Installation and Configuration Guide*.

5.3 Configuring the EXPRESSCLUSTER settings

For the Cluster WebUI setup and connection procedures, see Chapter 5, “Creating the cluster configuration data" in the *Installation and Configuration Guide*.

This section describes the procedure to add the following resources and monitor resources:

- Mirror disk resource
- Azure probe port resource
- Azure probe port monitor resource
- Azure load balance monitor resource
- PING network partition resolution resource (for NP resolution)

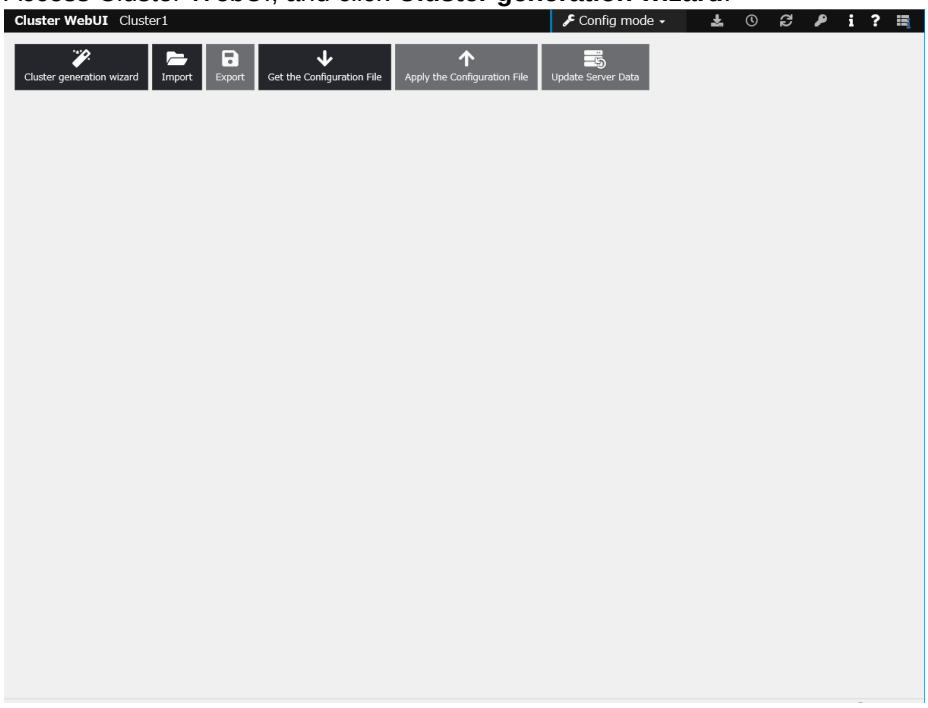
For the settings of other resources and monitor resources, see the *Installation and Configuration Guide* and the *Reference Guide*.

1) Creating a cluster

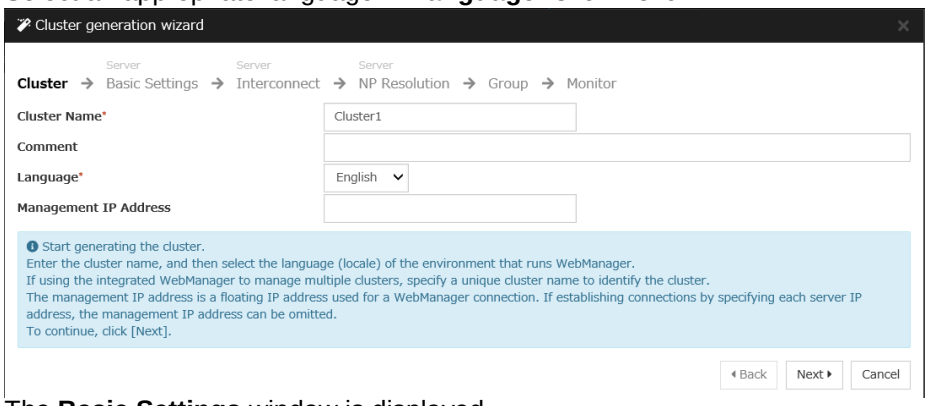
Start the cluster generation wizard to create a cluster.

◆ Creating a cluster

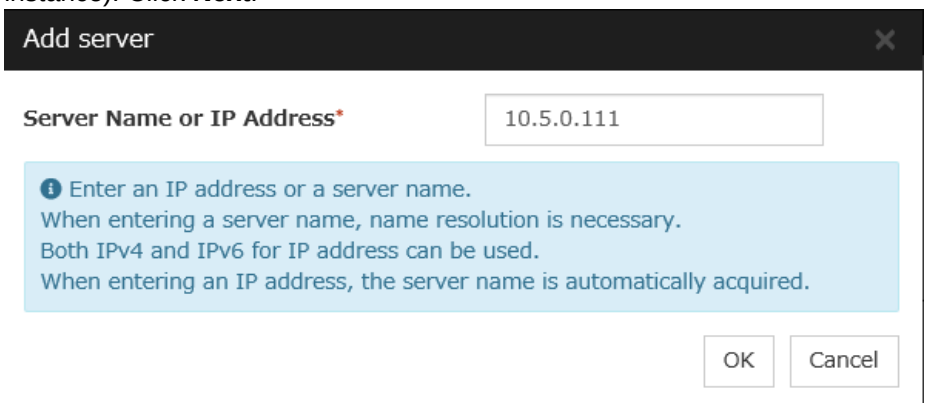
1. Access Cluster WebUI, and click C**luster generation wizard**.

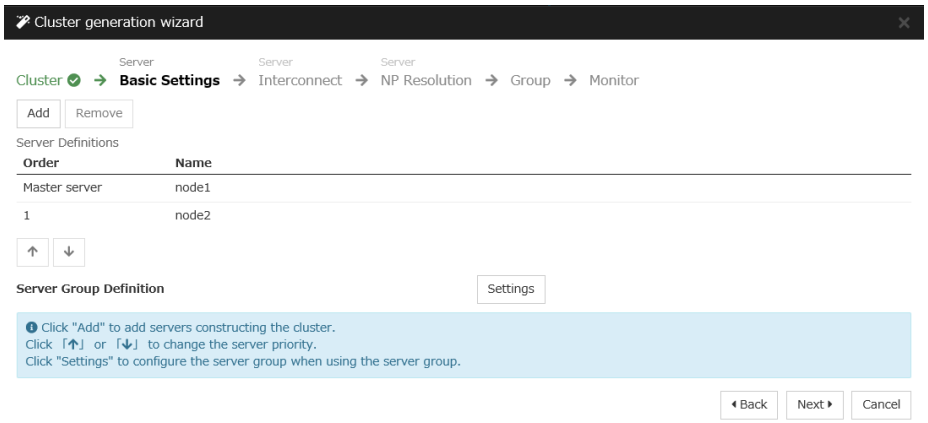


2. The **Cluster** window on the **Cluster Generation Wizard** is displayed.
   Enter a desired name in **Cluster Name**.
   Select an appropriate language in **Language**. Click **Next**.

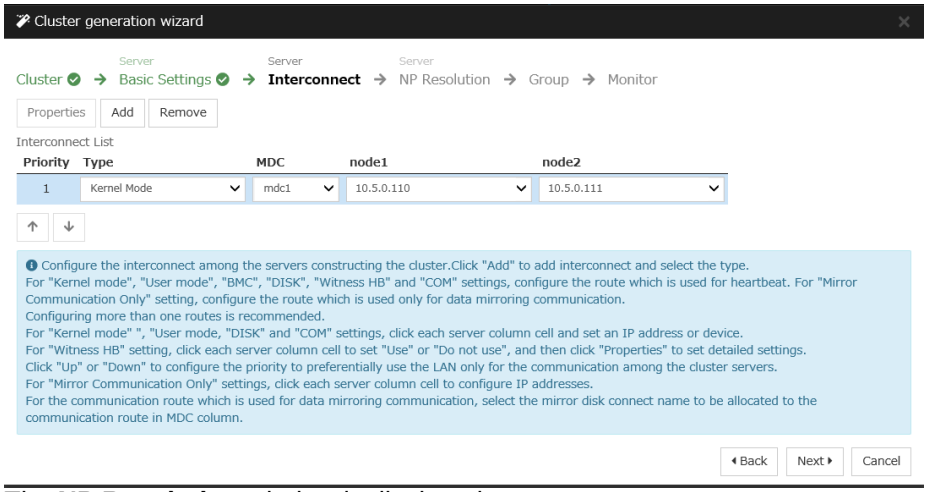


3. The **Basic Settings** window is displayed.
   The instance connected to Cluster WebUI is displayed as a registered master server.
   Click **Add** to add the remaining instances (by specifying the private IP address of each instance). Click **Next**.

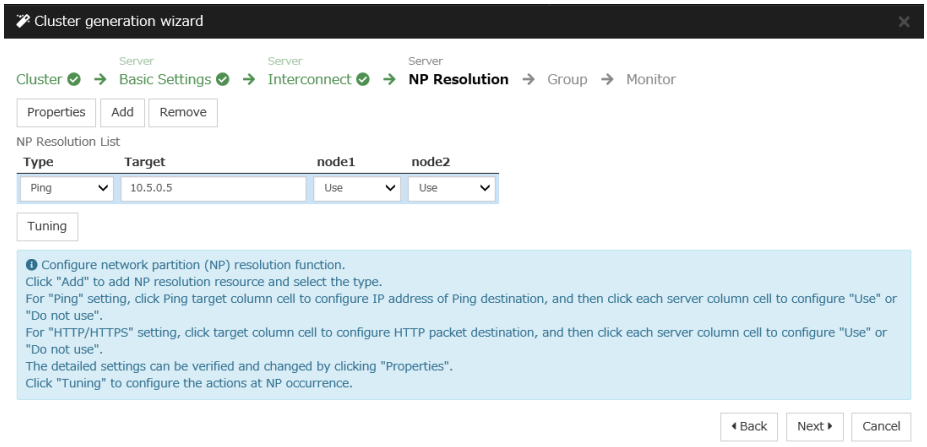




4. The **Interconnect** window is displayed.
   Specify the IP addresses (IP address of each instance) to be used for interconnect. In addition, select mdc1 for **MDC** as a communication path of a mirror disk resource to be created later. Click **Next**.



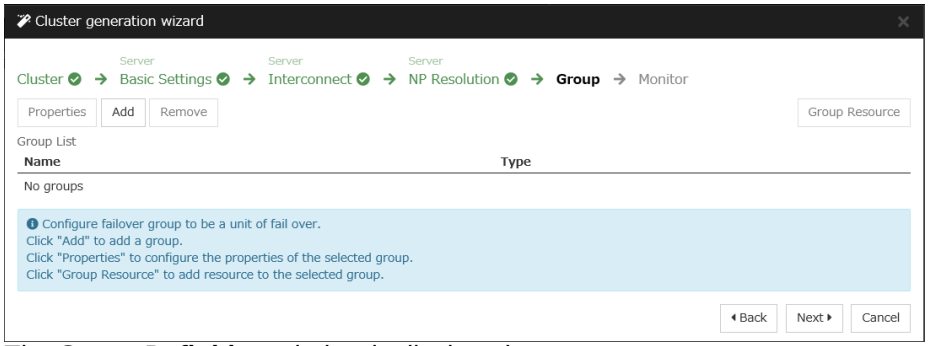
5. The **NP Resolution** window is displayed.
   To execute NP resolution by using a ping, click **Add** to add a line to the NP resolution list. Click a cell of the **Type** column and select **Ping**. Click the cell of the **Ping target** column and set the IP address of the device to which to send a ping. Be sure to specify the IP address of a server other than cluster servers within the Microsoft Azure network. Click a cell of each server column and select **Use** or **Not use**.
   Click **Next**.



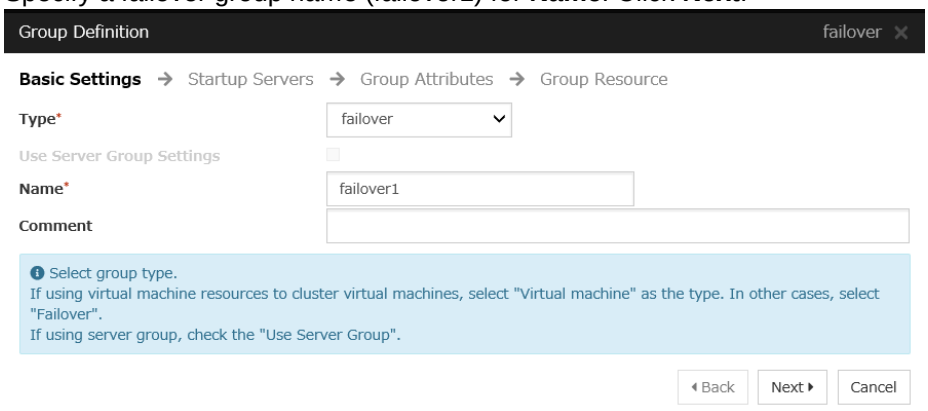
2) Adding a group resource

◆ Defining a group
Create a failover group.

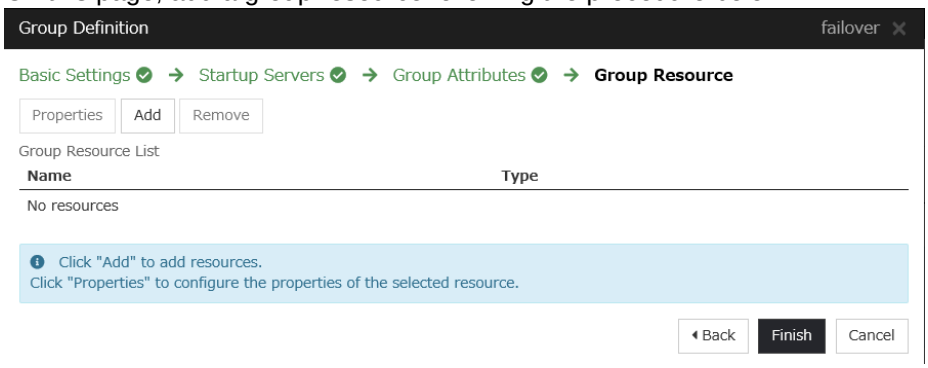
1. The **Group List** window s displayed.
Click **Add**.



2. The **Group Definition** window is displayed.
Specify a failover group name (failover1) for **Name**. Click **Next**.

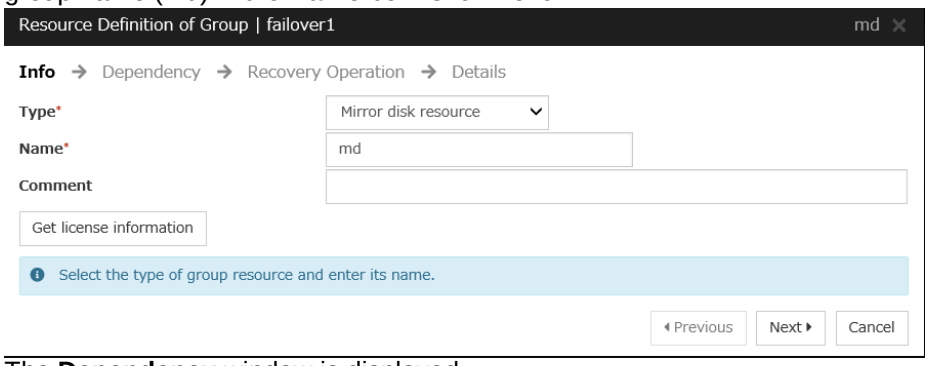


3. The **Startup Servers** window is displayed.
Click **Next** without specifying anything.
4. The **Group Attributes** window is displayed.
Click **Next** without specifying anything.
5. The **Group Resource** window is displayed.
On this page, add a group resource following the procedure below.

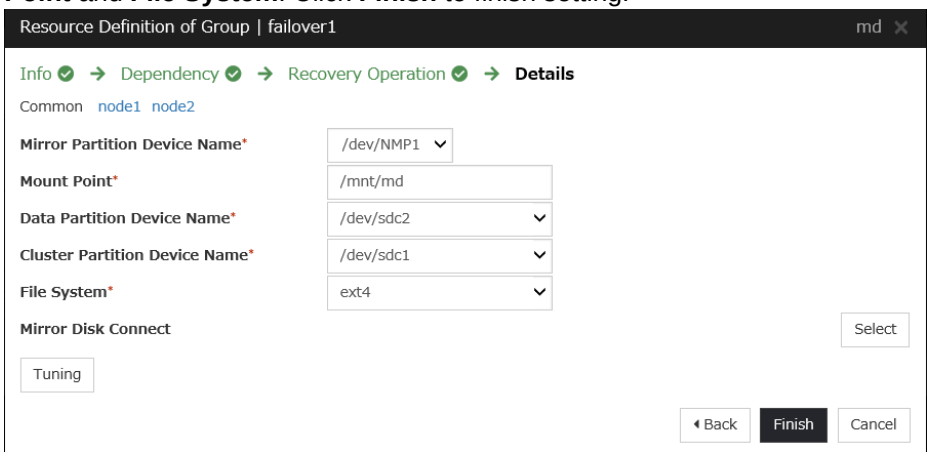


◆ Mirror disk resource
Create a mirror disk resource.
For details, see “Understanding mirror disk resources" in Chapter 4, “Group resource details” in the *Reference Guide*.

1. Click **Add** on the **Group Resource List** page.
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 name (md) in the **Name** box. Click **Next**.



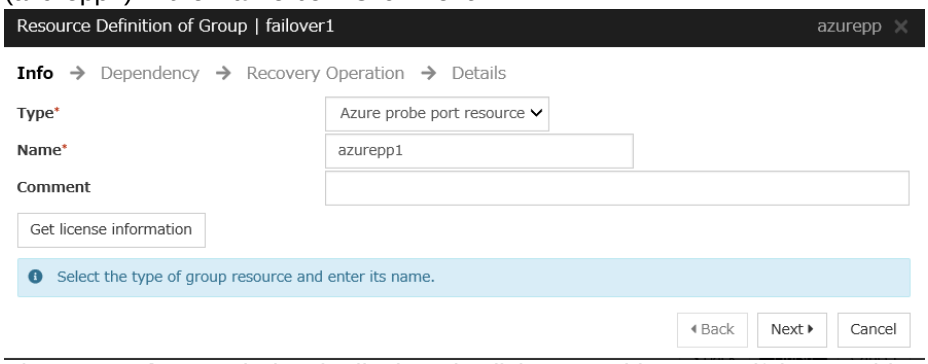
3. The **Dependency** window is displayed.
   Click **Next** without specifying anything.
4. The **Recovery Operation** window is displayed.
   Click **Next**.
5. The **Details** window is displayed.
   Enter the device name of the partition created in "5) **Configuring virtual machines**" in **Data Partition Device Name** and **Cluster Partition Device Name**. Specify **Mount Point** and **File System**. Click **Finish** to finish setting.



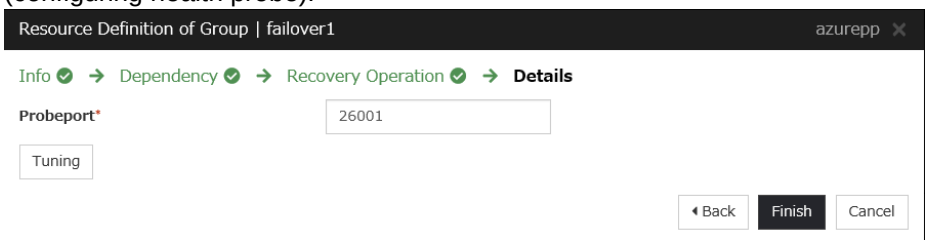
◆ Azure probe port resource
When EXPRESSCLUSTER is used on Microsoft Azure, EXPRESSCLUSTER provides a mechanism to wait for alive monitoring from a load balancer on a port specific to a node in which operations are running.

For details about the Azure probe port resources", see “Understanding Azure probe port resources." in the *Reference Guide*.

1. Click **Add** on the **Group Resource List** page.
2. The **Resource Definition of Group | failover1** window is displayed. Select the group resource type (Azure probe port resource) from the **Type** box and enter the group name (azurepp1) in the **Name** box. Click **Next**.



3. The **Dependency** window is displayed. Click **Next** without specifying anything.
4. The **Recovery Operation** window displayed. Click **Next**.
5. For **Probeport**, enter the value specified for **Port** when configuring a load balancer (configuring health probe).



6. Click **Finish**.

3) Adding a monitor resource

- Azure probe port monitor resource
  The port monitoring mechanism for alive monitoring is provided for the node in which the Microsoft Azure probe port resource is running.

  For details about the Azure probe port resources", see “Understanding Azure probe port resources" in the *Reference Guide*.

  Adding one Azure probe port monitor resource creates one Azure probe port monitor resource automatically.

- Azure load balance monitor resource
  The mechanism to monitor whether the port with the same port number as the probe port is open or not is provided for the node in which the Microsoft Azure probe port resource is not running.

  For details about the Azure load balance resource, see “Understanding Azure load balance monitor resources" in the *Reference Guide*.

  Adding one Azure probe port resource creates one Azure load balance monitor resource automatically.

4) Applying the settings and starting the cluster

1. Click **Apply the Configuration File** on the **File** in the config mode of Cluster WebUI.
   If the upload succeeds, the message saying “The application finished successfully.”
2. Select the **Operation Mode** on the drop down menu of the toolbar in Cluster WebUI to switch to the operation mode.
3. The procedure depends on the resource used. For details, refer to the following:*Installation and Configuration Guide* → How to create a cluster

5.4 Verifying the created environment

Verify whether the created environment works properly by generating a (dummy) monitoring error to fail over a failover group.
If the cluster is running normally, the verification procedure is as follows:

1. Start the failover group (failover1) on the active node (node1). In the Status tab on the Cluster WebUI, confirm that **Group Status** of failover1 of node1 is **Normal**.
2. Change **Operation Mode** to **Verification Mode** from the WebManager pull-down menu.
3. In the Status tab on the Cluster WebUI, click the **Enable dummy failure** icon of azureppw1 of Monitors.
4. When the time specified for **Interval** elapses, the failover group (failover1) enters an error status and fails over to node2. In the Status tab on the Cluster WebUI, confirm that **Group Status** of failover1 of node2 is **Normal**.
   Also, confirm that access to the frontend IP and port of the Azure load balancer is normal after the failover.

Verifying the failover operation in case of a dummy failure is now complete. Verify the operations in case of other failures if necessary.

Chapter 6 Error Messages

For the error messages related to resources and monitor resources, see the following:

- Chapter 9, “Error messages” in the *Reference Guide*.

Chapter 7 Notes and Restrictions

7.1 HA cluster using Azure DNS

7.1.1 Notes on Microsoft Azure

- There is a tendency for the performance difference (performance deterioration rate) to increase in a multi-tenant cloud environment compared to a physical environment or general virtualization environment (non-cloud environment). Therefore, pay careful attention to this point when designing a performance-oriented system.
- Even if a virtual machine is just shut down, its status is **Stopped** and billing continues. Execute **Stop** on the virtual machine setting window of the Microsoft Azure portal to change the virtual machine state to **Stopped (Deallocated)**.
- An availability set can be set only when creating a virtual machine. To move a virtual machine to and from the availability set, it is necessary to create an availability set again.
- To set up EXPRESSCLUSTER to work with Microsoft Azure, a Microsoft Azure organizational account is required. An account other than the organizational account cannot be used because an interactive login is required when executing the Azure CLI.

7.1.2 Notes on EXPRESSCLUSTER

Please refer the following for notes for EXPRESSCLUSTER on Azure:
EXRESSCLUSTER X Getting Started Guide
- “Communication port number" in Chapter 5, “Notes and Restrictions”
- “Azure DNS resources" in Chapter 5, “Notes and Restrictions”
- “Setting up Azure DNS resources" in Chapter 5, “Notes and Restrictions”

EXRESSCLUSTER X Reference Guide
- “Notes on Azure DNS resources”
- “Notes on Azure DNS monitor resources”

Virtual machines are paused for up to 30 seconds for Azure memory preserving maintenance.
Please refer the following for details about memory preserving maintenance.
https://docs.microsoft.com/en-us/azure/virtual-machines/linux/maintenance-and-updates
Therefore, it is recommended to set **Heartbeat Timeout** parameter on **Timeout** tab in **Cluster Properties** more than 30 sec.
In addition to **Heartbeat Timeout**, please also note the following.
- Please set **Heartbeat Timeout** parameter less than OS reboot time.
- When changing **Shutdown Monitor Timeout** parameter on **Monitor** tab in **Cluster Properties** from the default value (Use Heartbeat Timeout), please set the parameter less than **Heartbeat Timeout**.

Please refer the following about the above:
EXRESSCLUSTER X Getting Started Guide
- “Adjusting OS startup time” in Chapter 5, “Notes and Restrictions”

EXRESSCLUSTER X Reference Guide
- “Timeout tab”
- “Monitor tab”

7.2 HA cluster using a load balancer

7.2.1 Notes on Microsoft Azure

- There is a tendency for the performance difference (performance deterioration rate) to increase in a multi-tenant cloud environment compared to a physical environment or general virtualization environment (non-cloud environment). Therefore, pay careful attention to this point when designing a performance-oriented system.
- Even if a virtual machine is just shut down, its status is **Stopped** and billing continues. Execute **Stop** on the virtual machine setting window of the Microsoft Azure portal to change the virtual machine state to **Stopped (Deallocated)**.
- An availability set can be set only when creating a virtual machine. To move a virtual machine to and from the availability set, it is necessary to create an availability set again.

7.2.2 Notes on EXPRESSCLUSTER

Please refer the following for notes for EXPRESSCLUSTER on Azure:
EXRESSCLUSTER X Getting Started Guide
- “Communication port number" in Chapter 5, “Notes and Restrictions”
- “Azure probe port resources" in Chapter 5, “Notes and Restrictions”
- “Setting up Azure probe port resources" in Chapter 5, “Notes and Restrictions”
- “Setting up Azure load balance monitor resources" in Chapter 5, “Notes and Restrictions”

EXRESSCLUSTER X Reference Guide
- “Notes on Azure probe port resources”
- “Notes on Azure probe port monitor resources”
- “Note on Azure load balance monitor resources”

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https://docs.microsoft.com/en-us/azure/virtual-machines/linux/maintenance-and-updates
Therefore, it is recommended to set **Heartbeat Timeout** parameter on **Timeout** tab in **Cluster Properties** more than 30 sec.
In addition to **Heartbeat Timeout**, please also note the following.
- Please set **Heartbeat Timeout** parameter less than OS reboot time.
- When changing **Shutdown Monitor Timeout** parameter on **Monitor** tab in **Cluster Properties** from the default value (Use Heartbeat Timeout), please set the parameter less than **Heartbeat Timeout**.

Please refer the following about the above:
EXRESSCLUSTER X Getting Started Guide
- “Adjusting OS startup time” in Chapter 5, “Notes and Restrictions”

EXRESSCLUSTER X Reference Guide
- “Timeout tab”
- “Monitor tab”