

ARM Template – Deploy multiple SQL VM and set up Always On

Prepared by

Data SQL Ninja Engineering Team (datasqlninja@microsoft.com)

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1 Introduction

This ARM template creates multiple SQL virtual machines on Azure with new or existing virtual network. It also creates network security group, network interfaces and public IPs and availability set for the VMs. And finally, it creates an internal load balancer.

This template can be used independently however, you can use this template along with other available templates for creating Always On availability groups on SQL Server on Azure Virtual Machines.

2 General Guidelines

1. Parameters in this ARM template

You can find all parameter list in the below snapshot. You have the option to

- choose virtual machine's admin username and password.
- Select whether you are going to create a new virtual network, or you already have one where you want to deploy all the VMs.
- Provide virtual network name, VNet prefix (address space), subnet name, subnet prefix.
- virtual machines name's prefix
- number of virtual machines that you want to deploy.
- select a virtual machine size from the drop down.
- select image offer from the drop down, you can find the couple of options in the drop down.
- select image SKU for VMs (dev, standard, enterprise)
- provide availability set name.
- provide a DNS prefix for public IP for all the VMs.
- select location from the dropdown, it gives you the flexibility to deploy your resources in a different location than your resource group.
- provide appropriate IP for load balancer, it must be in the range of subnet IP range, that you provided above.
- provide a suitable name for network security group, you can leave it default as well. However, if you try to run this template twice, you might encounter an issue that duplicate network security group cannot be created.

[Home](#) >

Custom deployment

Deploy from a custom template

Subscription *	Visual Studio Ultimate with MSDN
Resource group *	rg-multisql Create new
Location *	(US) East US

SETTINGS

Virtual Machine Admin User Name ⓘ	DataSQLNinja
Virtual Machine Admin Password *
VNE Tnew Or Existing	new
VNET Name ⓘ	SQLVNET
VNET Prefix ⓘ	10.0.0.0/16
SQL Subnet Name ⓘ	sqlsubnet
SQL Subnet Prefix ⓘ	10.0.1.0/24
Virtual Machine Name Prefix ⓘ	MyVM0
Virtual Machine Count ⓘ	3
Virtual Machine Size ⓘ	Standard_B1ms
Image Offer ⓘ	sql2019-ws2019
Image Sku ⓘ	enterprise
Availability Set Name ⓘ	MyAvailabilitySet
Dns Prefix For Public IP ⓘ	[uniqueString(resourceGroup().id)]
Location ⓘ	EAST US
Private IP Address For LB ⓘ	10.0.1.6
Network Security Group Name	default-NSG

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2. Resources

This ARM template reduces lot of manual effort by deploying various resources on Azure without any hassle. When you try to deploy this template, it will ask you to select an existing resource group or create a new one. Based on your selection, this template will start deploying all the resources under that specific resource group.

<input type="checkbox"/>	default-NSG	Network security group
<input type="checkbox"/>	diagsto6av6t4bf6uvi	Storage account
<input type="checkbox"/>	lib	Load balancer
<input type="checkbox"/>	MyVM01	Disk
<input type="checkbox"/>	MyVM01	Virtual machine
<input type="checkbox"/>	MyVM01-NIC1	Network interface
<input type="checkbox"/>	MyVM01-PIP1	Public IP address
<input type="checkbox"/>	MyVM02	Disk
<input type="checkbox"/>	MyVM02	Virtual machine
<input type="checkbox"/>	MyVM02-NIC1	Network interface
<input type="checkbox"/>	MyVM02-PIP1	Public IP address
<input type="checkbox"/>	MyVM03	Disk
<input type="checkbox"/>	MyVM03	Virtual machine
<input type="checkbox"/>	MyVM03-NIC1	Network interface
<input type="checkbox"/>	MyVM03-PIP1	Public IP address
<input type="checkbox"/>	SQLAvailabilitySet	Availability set
<input type="checkbox"/>	SQLVNET	Virtual network

3 SQL Server Always On setup

This template can be used with other existing templates for SQL Server Always On setup. You need to follow below mentioned steps.

3.1 Create a new AD Domain with 2 Domain Controllers

- Click on the below link to navigate to the ARM template to create a new AD domain with 2 domain controllers.

<https://azure.microsoft.com/en-us/resources/templates/active-directory-new-domain-ha-2-dc/>

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Templates / Create an new AD Domain with 2 Domain Controllers

Create an new AD Domain with 2 Domain Controllers

by Simon Davies
Last updated: 3/25/2020

[Deploy to Azure >](#) [Browse on GitHub](#)

This template creates 2 new VMs to be AD DCs (primary and backup) for a new Forest and Domain


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Parameters

PARAMETER NAME	DESCRIPTION
adminUsername	The name of the Administrator of the new VM and Domain
adminPassword	The password for the Administrator account of the new VM and Domain
domainName	The FQDN of the AD Domain created

- Click on **Deploy to Azure** and fill in all the required details.
 - Admin Username: **DomainAdmin**
 - Admin Password: **Microsoft01***
 - DomainName: **corp.contoso.com**
 - DNS prefix: **sqlninja**
 - You can leave rest of the fields as it is

- Click on **Purchase** and the deployment will begin. This will take approximately 30 minutes to complete the deployment.

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Create an new AD Domain with 2 Domain Controllers


Azure quickstart template

TEMPLATE

 active-directory-new-domain-ha-2-dc
13 resources

 Edit template

 Edit paramet...

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BASICS

Subscription *
Visual Studio Ultimate with MSDN

Resource group *
(New) multisqlvm
[Create new](#)

Location *
(US) East US

SETTINGS

Admin Username * ⓘ
DomainAdmin

Admin Password * ⓘ
.....

Domain Name * ⓘ
corp.contoso.com

Dns Prefix * ⓘ
sqlninja

Pdc RDP Port ⓘ
3389

Bdc RDP Port ⓘ
13389

_artifacts Location ⓘ
[deployment().properties.templateLink.uri]

_artifacts Location Sas Token ⓘ

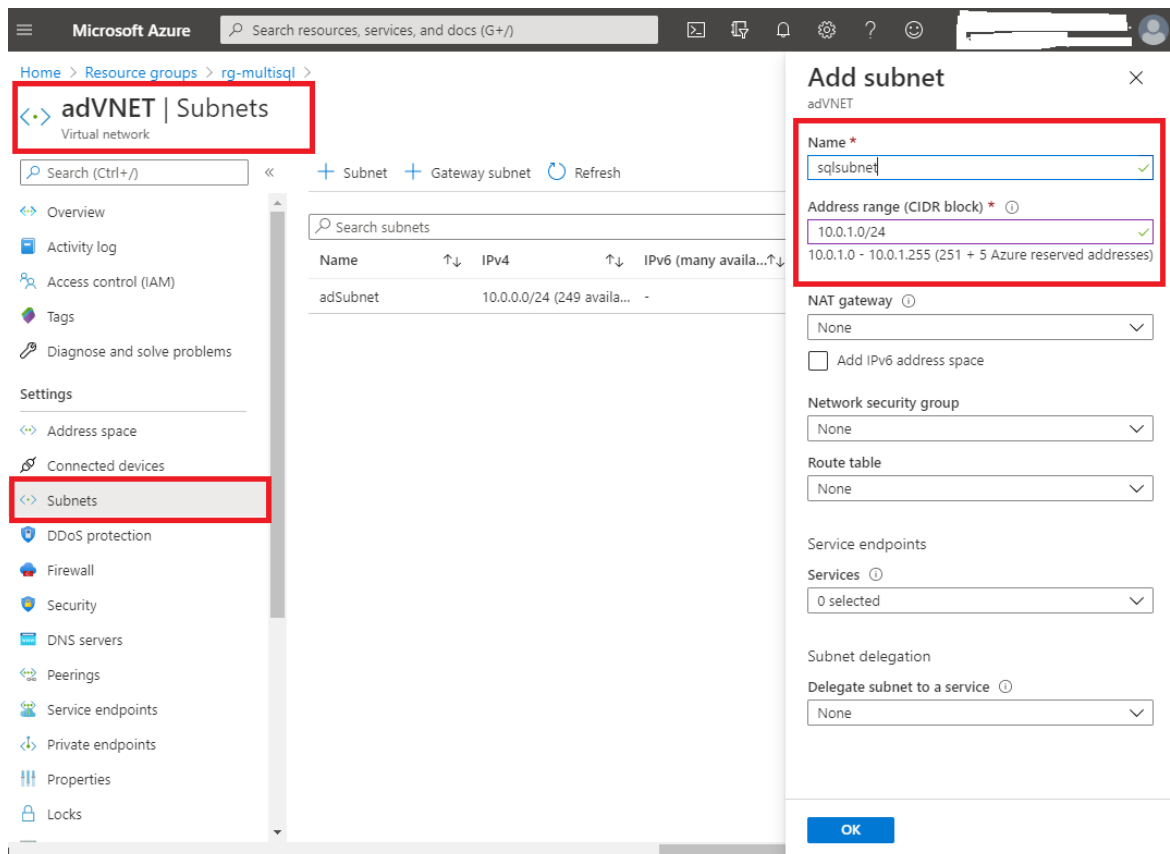
Location ⓘ
[resourceGroup().location]

Ad VM Size ⓘ
Standard_DS2_v2

TERMS AND CONDITIONS

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- Go to Azure portal and click on the virtual network **adVNET** and add a subnet, or you can use this template to add a subnet.



- Configure the domain account.
 - Sign into the **adPDC** machine.
 - In Server Manager, select Tools, and then select Active Directory Administrative Center.
 - Select **corp (local)** from the left pane.
 - On the right Tasks pane, select New, and then select User.
 - Fill in the details

Create User: sqladmin

TASKS ▾ SECTIONS ▾

Account

Organization

Member Of

Password Settings

Profile

Policy

Silo

Account

First name: sqladmin

Middle initials:

Last name:

Full name: * sqladmin

User UPN logon: sqladmin @ corp.contoso.com ▾

User SamAccountName I... corp * sqladmin

Password: *****

Confirm password: *****

Create in: DC=corp,DC=contoso,DC=com [Change...](#)

☐ Protect from accidental deletion

[Log on hours...](#) [Log on to...](#)

Account expires: ☒ Never ☐ End of

Password options:

☐ User must change password at next log on

☒ Other password options

☐ Microsoft Passport or smart card is required for interactive log...

☒ Password never expires

☐ User cannot change password

Encryption options:

Other options:

Organization

Display name: sqladmin

Office:

E-mail:

Web page:

Job title:

Department:

Company:

Manager: [Edit...](#) [Clear](#)

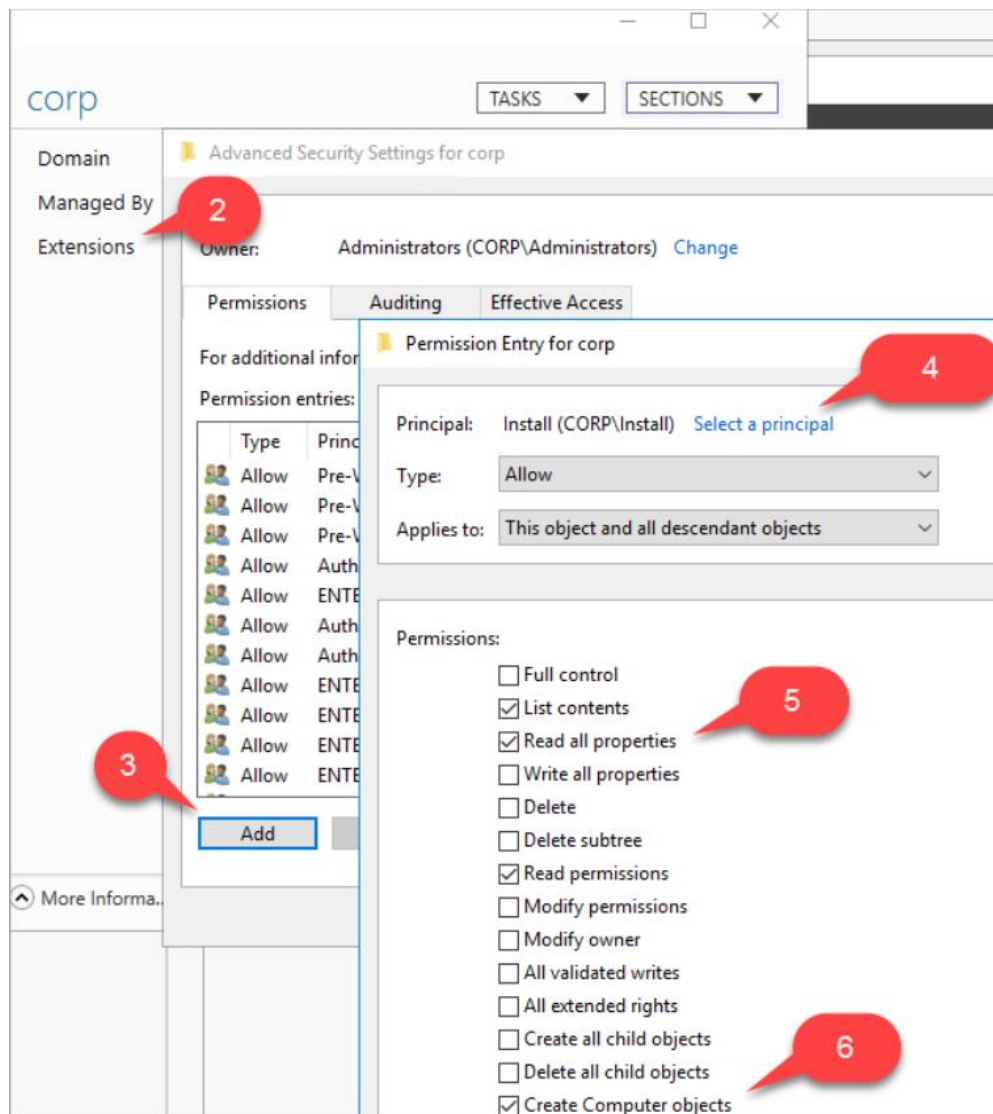
[Other web pages...](#)

Direct reports:

[More Information](#)

OK Cancel

- Grant the required permissions to the sqladmin account
 - In the Active Directory Administrative Center, select corp (local) in the left pane. Then in the right-hand Tasks pane, select Properties.
 - Select Extensions, and then select the Advanced button on the Security tab.
 - In the Advanced Security Settings for corp dialog, select Add.
 - Click Select a principal, search for CORP\sqladmin, and then select OK.
 - Select the Read all properties check box.
 - Select the Create Computer objects check box.
 - Select OK, and then select OK again. Close the corp properties window.



3.2 Deploy multiple SQL Virtual Machines on existing virtual network

- Click on the **Deploy** link and fill in the details.
 - Virtual machine Admin Username: **SQLVMADMIN**
 - Virtual Machine Admin Password: **Microsoft01***
 - VNET new or existing: **existing**
 - VNET Name, VNET Prefix, SQL Subnet Name, SQL Subnet Prefix: Fill in the details of your existing virtual network and corresponding subnet. In this example, virtual network is **adVNET**, address prefix is **10.0.0.0/16**, SQL Subnet name: **SQLSubnet**, SQL Subnet prefix: **10.0.1.0/24**

- Virtual Machine Name prefix: Provide appropriate prefix for your VM names, in this example we are using **SQLVM0**, so the VM names will be SQLVM01, SQLVM02 and so on.
- Virtual Machine count: Number of SQL VMs that you want to deploy, in this example we are going to deploy **2** SQL virtual machines.
- Virtual machine size, Image offer: You can select the values from drop down as per your requirement otherwise, you can leave the default values as it is.
- Image SKU: You have the option to choose from the drop down but leave it at default value. Later steps require the VM's SKU to be enterprise.
- Availability Set Name: **SQLAvailabilitySet**
- DNS prefix for public IP: **sqlvm**
- Location: **EAST US**
- Public IP Address for LB: You need to provide appropriate IP address for load balancer, this IP must fall in the range of SQLSubnet. In this example, we are using **10.0.1.6**
- Network Security Group: **default- NSG**

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Custom deployment

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BASICS

Subscription *

Visual Studio Ultimate with MSDN

▼

Resource group *

▼

[Create new](#)

Location *

(US) East US

▼

SETTINGS

Virtual Machine Admin User Name

sqlvmadmin

Virtual Machine Admin Password *

.....

✓

VNET new Or Existing

existing

▼

VNET Name ⓘ

adVNET

VNET Prefix ⓘ

10.0.0.0/16

SQL Subnet Name ⓘ

sqlsubnet

SQL Subnet Prefix ⓘ

10.0.1.0/24

Virtual Machine Name Prefix ⓘ

SQLVM0

Virtual Machine Count ⓘ

2

✓

Virtual Machine Size ⓘ

Standard_B1ms

▼

Image Offer ⓘ

sql2019-ws2019

▼

Image Sku ⓘ

enterprise

▼

Availability Set Name ⓘ

MyAvailabilitySet

Dns Prefix For Public IP ⓘ

sqlvm

✓

Location ⓘ

EAST US

▼

Private IP Address For LB ⓘ

10.0.1.6

Network Security Group Name

default-NSG

Purchase

- Login to the SQL virtual machine **SQLVM01** using credentials that you provided while deploying the template. Username: **SQLVM01\SQLVMADMIN** and Password: **Microsoft01***
- Now you can create your new database on the primary SQL Server. However, you can follow [this](#) link if you want to migrate a SQL Server database to SQL Server on this Azure virtual machine.

3.3 Join existing SQL VMs to AD Domain

This template allows you to join an already existing Windows virtual machine into an existing Active Directory Domain. For this template to work you need an existing virtual machine, an AD Domain and a Domain Controller that has communication with this virtual machine and DNS settings that will allow this virtual machine to resolve the Domain DNS name.

- Click on the link below to navigate to the template documentation and then click on **Deploy to Azure** link and fill in the required details.

<https://azure.microsoft.com/en-us/resources/templates/201-vm-domain-join-existing/>

<https://azure.microsoft.com/en-us/resources/templates/201-vm-domain-join-existing/>



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Templates / Joins an existing Windows VM to AD Domain

Joins an existing Windows VM to AD Domain

by Paulo Marques
Last updated: 4/24/2017

[Deploy to Azure >](#) [Browse on GitHub](#)

This template allows you to join an already existing Windows virtual machine into an existing Active Directory Domain, an AD Domain and a Domain Controller that has communication with this virtual machine and DNS settings.

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- Fill in the required information to deploy this template on Azure.
 - VM List: Provide list of SQL Virtual machines, use comma (,) as separator for multiple VMs. In this example we have two SQL VMs **SQLVM01, SQLVM02**
 - Domain Join Username: **CORP\SQLAdmin**
 - Domain Join User Password: **Microsoft01***
 - Domain FQDN: **corp.contoso.com**

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Joins an existing Windows VM to AD Domain

Azure quickstart template

TEMPLATE

201-vm-domain-join-existing

1 resource

Edit template

Edit paramet...

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BASICS

Subscription *

Visual Studio Ultimate with MSDN

Resource group *

multisqlvm

Create new

Location

(US) East US

SETTINGS

Vm List * ⓘ

SQLVM01,SQLVM02

Location ⓘ

[resourceGroup().location]

Domain Join User Name * ⓘ

SQLAdmin@corp.contoso.com

Domain Join User Password * ⓘ

Domain FQDN * ⓘ

corp.contoso.com

Ou Path ⓘ

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Template information

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☒ I agree to the terms and conditions stated above

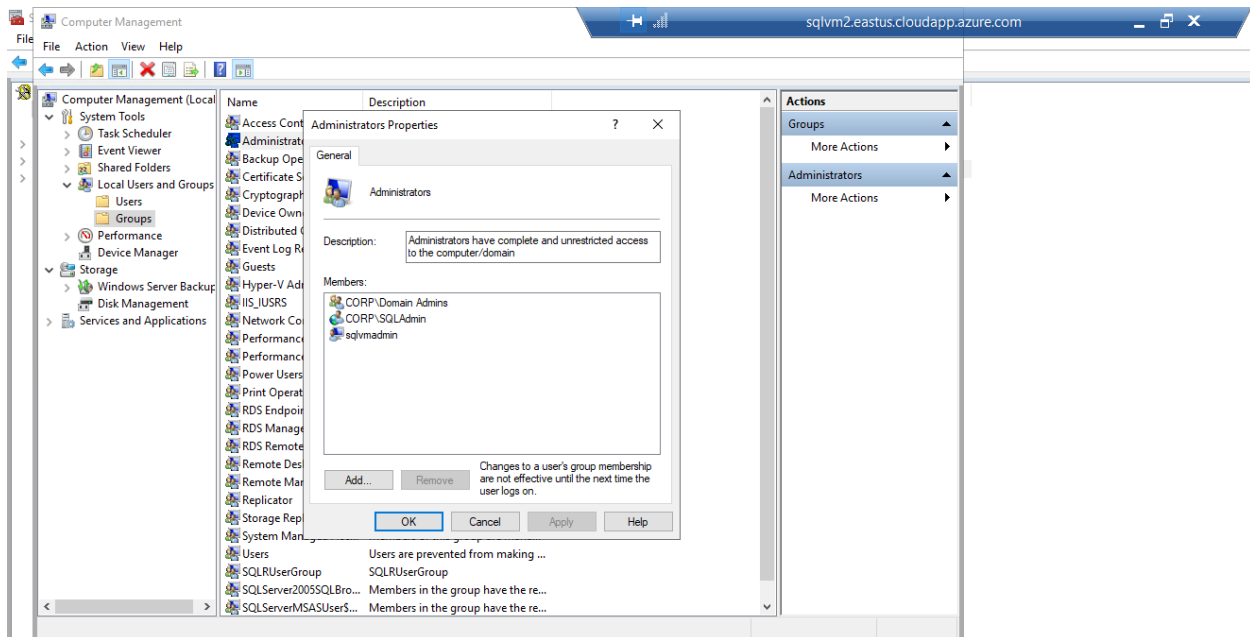
Purchase

3.4 Additional Settings on SQL VMs

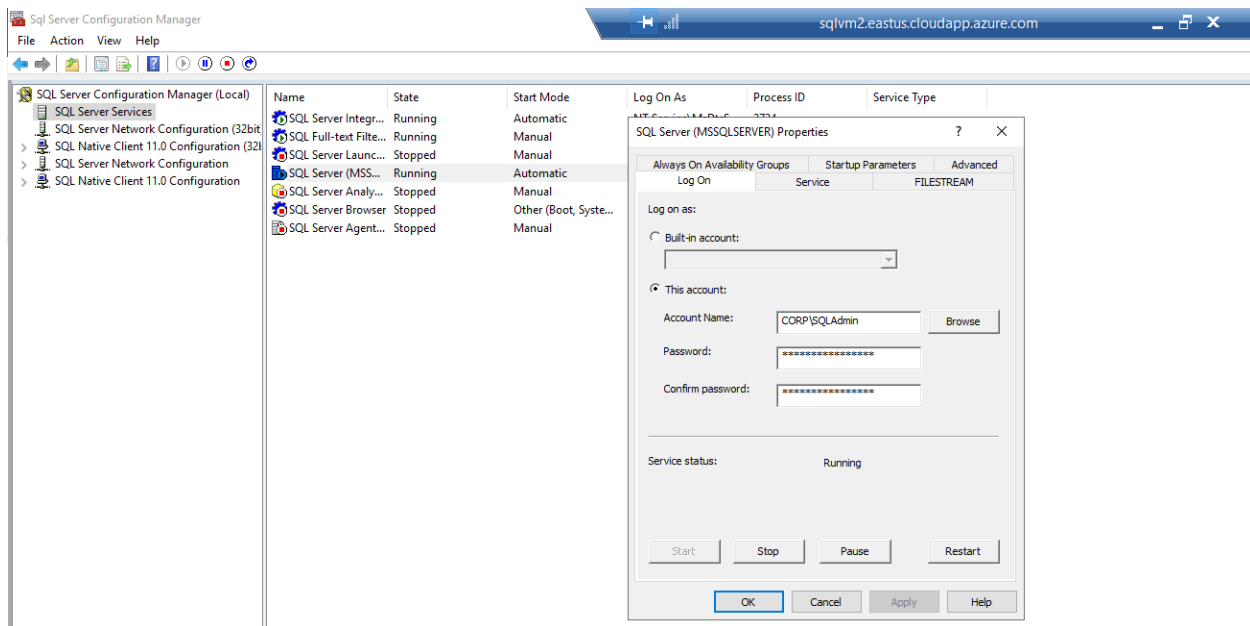
- Add the domain user account **CORP\SQLAdmin** as an administrator on each cluster VM.
 - Wait until the VM is restarted, then launch the RDP file again from the primary domain controller to sign in to any one SQL Server virtual machines by using the **CORP\SQLAdmin** account.
 - In Server Manager, select Tools, and then select Computer Management.

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- In the Computer Management window, expand Local Users and Groups, and then select Groups.
- Double-click the Administrators group.
- In the Administrators Properties dialog, select the Add button.
- Enter the user **CORP\SQLAdmin** and then select OK.
- Select OK to close the Administrator Properties dialog.
- Repeat the previous steps on other SQL virtual machines.



- Add **CORP\SQLAdmin** user login for SQL Server on both the VMs.
 - Go to the management studio on VM.
 - Connect to SQL Server instance
 - Expand security and right click on Login.
 - Search for **CORP\SQLAdmin** under entire directory
 - Provide sysadmin permission.
- On each SQL Server VM, set the SQL Server service account. Use the accounts that you created when you configured the domain accounts.
 - Open SQL Server Configuration Manager.
 - Right-click the SQL Server service, and then select Properties.
 - Set the account and password.
 - Repeat these steps on the other SQL Server VM.
 - For SQL Server availability groups, each SQL Server VM needs to run as a domain account.



- Grant the required permissions to [NT AUTHORITY\SYSTEM] on each SQL Server instance:
 - ALTER ANY AVAILABILITY GROUP
 - CONNECT SQL
 - VIEW SERVER STATE

Script:

```
GRANT ALTER ANY AVAILABILITY GROUP TO [NT AUTHORITY\SYSTEM]
```

```
GO
```

```
GRANT CONNECT SQL TO [NT AUTHORITY\SYSTEM]
```

```
GO
```

```
GRANT VIEW SERVER STATE TO [NT AUTHORITY\SYSTEM]
```

```
GO
```

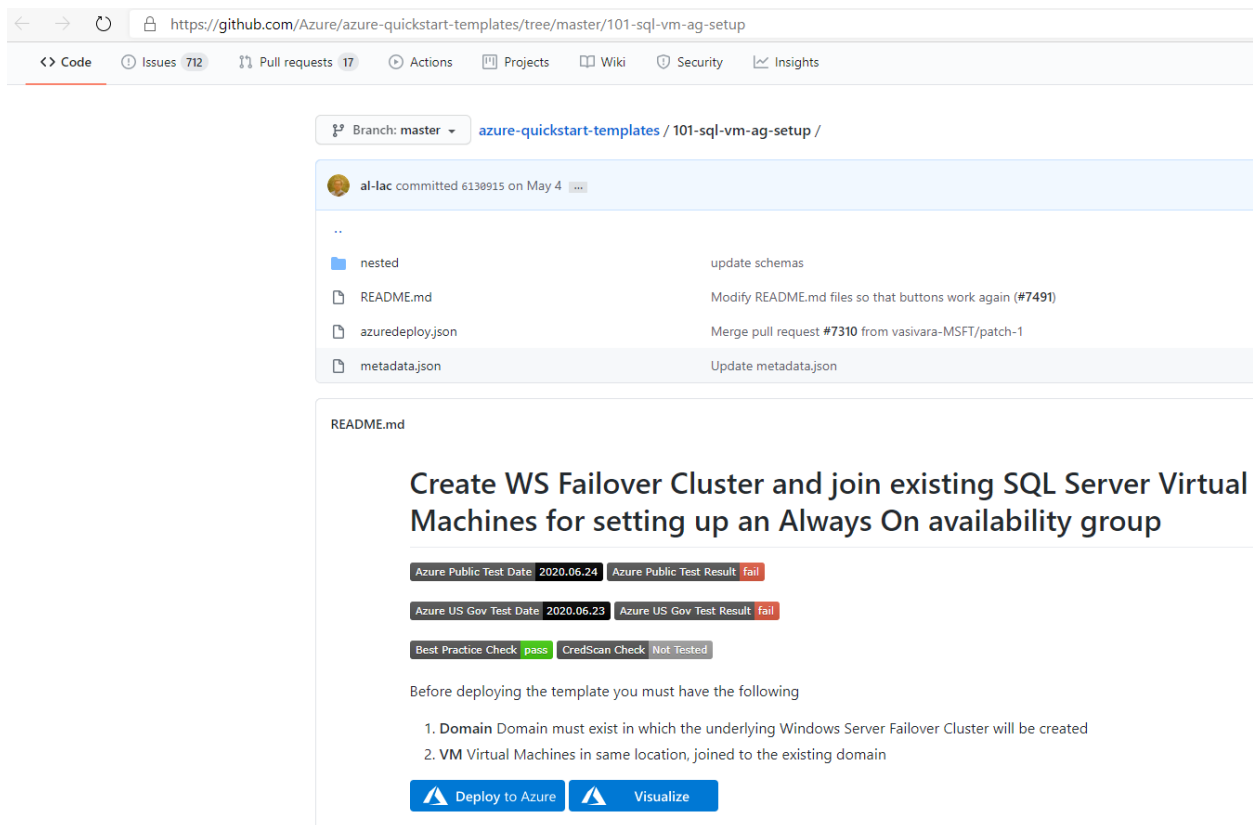
3.5 Create Windows Server Failover Cluster

This deployment will create a WS failover cluster with cloud witness on the provided VMs (in same region) and enable SQL Always ON them. This will enable creating SQL Availability Groups over the created Always ON setup. Following resources will be created

Storage Account to be used as Cloud Witness for failover cluster.

- Resource of type "SqlVirtualMachine" in Microsoft.SqlVirtualMachine resource provider. This corresponds to the existing Virtual Machine.
- Resource of type "SqlVirtualMachineGroup" in Microsoft.SqlVirtualMachine resource provider. This captures details of WS failover cluster setup

<https://github.com/Azure/azure-quickstart-templates/tree/master/101-sql-vm-ag-setup>



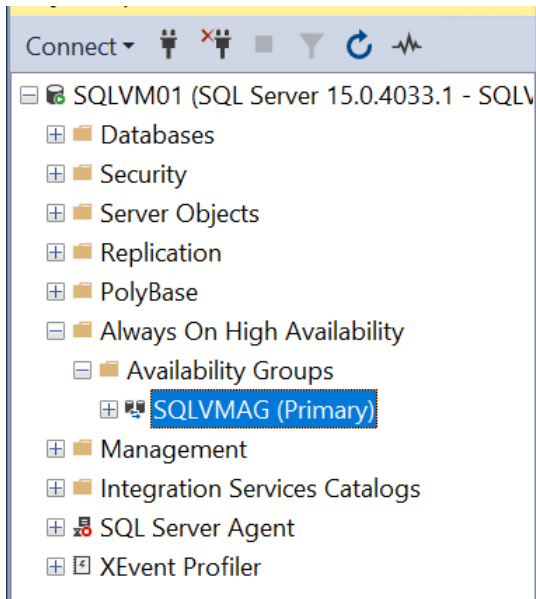
3.6 Create Availability Group manually

- In Object Explorer, connect to the server instance that hosts the primary replica.
- Expand the Always On High Availability node and the Availability Groups node.
- To launch the New Availability Group Wizard, select the New Availability Group Wizard command.
- The first time you run this wizard, an Introduction page appears. To bypass this page in the future, you can click Do not show this page again. After reading this page, click Next.
- On the Specify Availability Group Options page, enter the name of the new availability group in the Availability group name field. This name must be a valid SQL Server

identifier that is unique on the cluster and in your domain. The maximum length for an availability group name is 128 characters.

- Next, specify the cluster type. The possible cluster types depend on the SQL Server version and operating system. Choose **WSFC** from the drop-down list.
- On the Select Databases page, the grid lists user databases on the connected server instance that are eligible to become the availability databases. Select one or more of the listed databases to participate in the new availability group. These databases will initially be the initial primary databases.
- For each listed database, the Size column displays the database size, if known. The Status column indicates whether a given database meets the prerequisites or availability databases. If the prerequisites are not met, a brief status description indicates the reason that the database is ineligible; for example, if it does not use the full recovery model. For more information, click the status description.
- If you change a database to make it eligible, click Refresh to update the databases grid.
- If the database contains a database master key, enter the password for the database master key in the Password column.
- On the Specify Replicas page, specify and configure one or more replicas for the new availability group.
- On the Select Initial Data Synchronization page, choose Join only if you have manually prepared secondary databases on the server instances that will host the secondary replicas otherwise choose Automatic seeding
- The Validation page verifies whether the values you specified in this Wizard meet the requirements of the New Availability Group Wizard. To make a change, click Previous to return to an earlier wizard page to change one or more values. The click Next to return to the Validation page and click Re-run Validation.
- On the Summary page, review your choices for the new availability group. To make a change, click Previous to return to the relevant page. After making the change, click Next to return to the Summary page.

For reference: <https://docs.microsoft.com/en-us/sql/database-engine/availability-groups/windows/use-the-availability-group-wizard-sql-server-management-studio>



3.7 configure ILB and create listener for an existing Always On availability group on SQL Server VMs in Azure

This deployment will create an AG listener for a SQL Availability Group. This will also setup Load balancer rules corresponding to the Listener. The following resources will be created.

- SQL Availability Group Listener for the provided AG.
- Load balancer rules that will enable Listener to work in Azure.
- Resource of type "AvailabilityGroupListener" in Microsoft.SqlVirtualMachine resource provider.

<https://github.com/Azure/azure-quickstart-templates/tree/master/101-sql-vm-aglistener-setup>

Parameters:

- Existing failover cluster name: **sqlfc**
- Existing SQL Availability Group: **SQLVMAG**
- Existing VM list: **SQLVM01, SQLVM02**

Note: You can add a maximum of up to 6 VMs to this field

- Listener: **aglistener**

Note: Maximum character limit for listener is 15

- Listener IP: **10.0.1.7**

Note: When you create one AG listener within an SQL VM Group, you can use an LB IP address. But when you create multiple LB within the SQL VM group, they must choose the available IP address within the LB subnet.

- Existing VNet: **adVNET**
- Existing subnet: **sqlsubnet**
- Existing load balancer: **ilb**

[Home](#) >

Create SQL AvailabilityGroup listener on existing Always ON setup.

Azure quickstart template

TEMPLATE



101-sql-vm-aglistener-setup
1 resource


Edit template
Edit paramet...
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BASICS

Subscription *	Visual Studio Ultimate with MSDN	▼
Resource group *	multisqlvm	▼
	Create new	
Location	(US) East US	▼

SETTINGS

Existing Failover Cluster Name * ⓘ	sqlfc	✓
Existing Sql Availability Group * ⓘ	SQLVMAG	✓
Existing Vm List * ⓘ	SQLVM01,SQLVM02	✓
Listener ⓘ	aglistener	
Listener Port ⓘ	1433	
Listener Ip ⓘ	10.0.1.7	
Existing Vnet Resourcegroup ⓘ	[resourcegroup().name]	
Existing Vnet * ⓘ	adVNET	✓
Existing Subnet * ⓘ	sqlsubnet	✓
Existing Internal Load Balancer * ⓘ	ilb	✓
Probe Port ⓘ	59999	
Location ⓘ	[resourceGroup().location]	

TERMS AND CONDITIONS

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4 Appendices

Configure an availability group for SQL Server on Azure VM (Azure portal - Preview)

It has always been an overhead to create availability group and listener for SQL Server on Azure VM however, now you can configure it on Azure portal directly. You just need to have certain prerequisites before you start creating an availability group for SQL Server on Azure VM.

1. You need to have a domain controller in your resource group, if you don't have it already you can create it using the steps mentioned [here](#).
2. Create SQL Server on Azure VM from the portal, however, make sure that you create/use **Standard** public IP address and **Enterprise** edition for SQL Server.

Home > New > Create a virtual machine

Basics Disks **Networking** Management Advanced SQL Server settings Tags Review + create

Define network connectivity for your virtual machine by configuring network interface card (NIC) settings. You can control ports, inbound and outbound connectivity with security group rules, or place behind an existing load balancing solution. [Learn more](#)

Network interface

When creating a virtual machine, a network interface will be created for you.

Virtual network * [Create new](#)

Subnet * [Create new](#)

Public IP [Create new](#)

NIC network security group ☐ None ☒ Basic ☐ Advanced

[Review + create](#) < Previous Next: Management >

Create public IP address x

Name *

SKU ☐ Basic ☒ Standard

Assignment ☒ Static

Availability zone Zone-redundant

OK

3. Join your VM to the existing domain using the steps mentioned [here](#).
4. Two available (not used by any entity) IP addresses. One is for the internal load balancer. The other is for the availability group listener within the same subnet as the availability group. If you're using an existing load balancer, you only need one available IP address for the availability group listener.
5. Recovery mode for SQL Server must be set to **Full** recovery mode.
6. Add database to the existing SQL Server and take a full backup of the database.

Now that you have all the prerequisites in place, let's try to create availability group and listener from the portal.

1. Go to High Availability tab of SQL Virtual Machine (not the underlying virtual machine) and click on **+New Windows Server Failover Cluster** and provide all the required details

Configure Windows Server Failover Cluster

Configure Windows Server Failover Cluster

Feedback

Witness Storage Account *

(New) storageaccounts
[Create new](#)

Windows Server Failover Cluster credentials [Learn more](#)

SQL service account: *

sqladmin@corp.contoso.com

Password *

Cluster bootstrap credentials

Same as SQL service account Custom

Cluster operator credentials

Same as SQL service account Custom

Following SQL Server VMs will be restarted to enable HA : SQLVM02

You can only attach enterprise SQL Server VMs that are registered in full manageability mode, in the same resource group, location, domain, and in the same virtual network as the SQL Server VM: SQLVM01 [Learn more](#)

resourceGroup == All

Location == eastus

vnet == adVNET

Domain == corp.contoso.com

Edition == Enterprise

SQL Server VM	Resource group	SQL restart required	SQL version	SQL image
<input type="checkbox"/> SQLVM01	multisqlvm	Yes (i)	Enterprise	SQL2017-WS
<input checked="" type="checkbox"/> SQLVM02	multisqlvm	Yes (i)	Enterprise	SQL2017-WS

Apply

Cancel

- Click on Apply after providing all the required details and click on **+New Always On Availability Group**
- Enter a name for the availability group.
- Select **Configure listener** to open the **Configure availability group listener** page.

Create availability group

SQLVM1



AVAILABILITY GROUP DETAILS

The Always On availability groups feature is a high-availability solution that provides an enterprise-level alternative to database mirroring. Always On availability groups maximizes the availability of a set of user databases for an enterprise. An availability group supports a failover environment for a discrete set of user databases, known as availability databases, that fail over together. An availability group supports a set of read-write primary databases and one to eight sets of corresponding secondary databases. Optionally, secondary databases can be made available for read-only access and/or some backup operations [Learn more](#)

Availability group name *

SQLAG ✓

AVAILABILITY GROUP LISTENER

Routing of traffic to primary and secondary replicas requires configuration of an availability group listener and load balancer. You can optionally configure this now, or do this later. [Learn more](#)

Listener configuration

[Configure listener](#)

5. Fill out the values, and either use an existing load balancer, or select **Create new** to create a new load balancer. Select **Apply** to save your settings and create your listener and load balancer.
6. Choose **+ Select replica** to open the **Configure availability group replicas** page.
7. Select the virtual machines you want to add to the availability group and choose the availability group settings that best suit your business needs. Select **Apply** to save your settings.
8. Verify your availability group settings and then select **Apply** to create your availability group.

5 Feedback and suggestions

If you have feedback or suggestions for improving this data migration asset, please contact the Data SQL Ninja Engineering Team (datasqlninja@microsoft.com). Thanks for your support!

Note: For additional information about migrating various source databases to Azure, see the [Azure Database Migration Guide](#).