Installing and Configuring a SQL Server 2016 Failover Clustered Instance on Windows Server 2016

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Applies to:

- SQL Server 2016
- Windows Server 2016

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Introduction

This guide is intended for experienced Windows Server system administrators, IT professionals and SQL Server database administrators who need to install and configure a 2-node Windows Server 2016 Failover Cluster (WSFC) that will host a SQL Server 2016 failover clustered instance (FCI).

Assumptions

When using this guide, a few assumptions have been made:

- Windows Server 2016 is installed on each server that will be used for the failover cluster and that they are joined to the same Active Directory domain.
- Installation and configuration of the shared storage used for the cluster is outside the scope of this document. Enlist the assistance of your storage vendors and engineers to accomplish this task.
- You have decided which quorum model will be used by the WSFC. This document will use a disk witness as the quorum model.

Cluster Configuration Details

Prior to building your WSFC, it is important to have all the details in place to make sure that installation and configuration will go smoothly. The following details will be used to build and configure a SQL Server 2016 FCI.

- Active Directory Domain Name: TESTDOMAIN.COM
- Cluster Nodes: WSFC2016-NODE1 & WSFC2016-NODE2
- **Cluster Disks:** W:\, H:\, I:\ & J:\
- Windows Server Failover Cluster Name and IP Address: WIN2K16CLUSTER (172.16.0.33)
- SQL Server Failover Cluster Virtual Server Name and IP Address: SQL2016FCI (172.16.0.35)
- **SQL Server Service Account:** TESTDOMAIN\sqlservice

Preparing Shared Storage

It is assumed that the underlying shared storage has already been physically attached to all of the WSFC nodes and that the hardware meets the requirements defined in the Microsoft TechNet article Failover Clustering Hardware Requirements and Storage Options.

Managing shared storage requires an understanding of your specific storage product which is outside the scope of this document. Consult your storage vendor for more information.

This particular environment has four (4) shared storage volumes configured - SQL_DATA_H, SQL_DATA_I and SQL_DATA_J allocated for the SQL Server databases and DISK_W for the witness disk.

File Action	<u>V</u> iew <u>H</u> elp						_	
(+ +) 🖬	🛛 📻 🖉 🕫	2						
Volume		Layout	Type	File	Status	Capaci	Free Space	% Free
- (C;)		Simple	Basic	NTFS	Healthy (Boot, Page File, Crash Dump, Primary Partition)	49.51 GB	39.62 GB	80 %
DISK_W (W:)		Simple	Basic	NTFS	Healthy (Primary Partition)	1021 MB	997 MB	98 %
- SQL_DATA_H	H (H:)	Simple	Basic	NTFS	Healthy (Primary Partition)	50.00 GB	49.90 GB	100 %
- SQL_DATA_I	(1:)	Simple	Basic	NTFS	Healthy (Primary Partition)	50.00 GB	49.90 GB	100 %
SQL_DATA_J	(J:)	Simple	Basic	NTFS	Healthy (Primary Partition)	50.00 GB	49.90 GB	100 %
SSS_X64FRE_F	EN-US_DV9 (D:)	Simple	Basic	UDF	Healthy (Primary Partition)	5.27 GB	0 MB	0 %
- System Reser	ved	Simple	Basic	NTFS	Healthy (System, Active, Primary Partition)	500 MB	167 MB	33 %
Disk 1 Basic 50.00 GB Online	SQL_DATA 50.00 GB N Healthy (Pr	_ H (H:) TFS imary Parl	tition)					
- Disk 1 Basic 50.00 GB Online	SQL_DATA 50.00 GB N Healthy (Pr	_H (H:) TFS imary Parl	tition)					
Disk 1 Basic 50.00 GB Online Disk 2 Basic 50.00 GB Online	SQL_DATA 50.00 GB N Healthy (Pr SQL_DATA 50.00 GB N Healthy (Pr	_H (H:) TFS imary Part _I (I:) TFS imary Part	tition) tition)					
Disk 1 Basic 50.00 GB Online Disk 2 Basic 50.00 GB Online Disk 3	SQL_DATA 50.00 GB N Healthy (Pr SQL_DATA 50.00 GB N Healthy (Pr	_H (H:) TFS imary Part _I (I:) TFS imary Part	tition) tition)					
Disk 1 Basic S0.00 GB Online Disk 2 Basic S0.00 GB Online Disk 3 Basic S0.00 GB Online	SQL_DATA 50.00 GB N Healthy (Pr SQL_DATA 50.00 GB N Healthy (Pr SQL_DATA 50.00 GB N Healthy (Pr	_H (H:) TFS imary Part _I (I:) TFS imary Part _J (J:) TFS imary Part	tition) tition)					

The goal here is to provision shared storage both for capacity and performance. Perform the necessary storage stress tests to make sure that you are getting the appropriate amount of IOPs as promised by your storage vendor.

Adding the Failover Clustering Feature

In this section, the Failover Clustering feature is added to create and configure the WSFC:

NOTE: Perform these steps on all of the servers that you intend to join in your WSFC.

1. Open the **Server Manager Dashboard** and click the **Add roles and features** link. This will run the **Add Roles and Features Wizard**

🔂 Server Manager		- 0 ×
🕞 🕘 🔹 🛯 🖓 🖓 🖓	bard	🕶 遼 🚩 Manage Tools View Help
🗰 Dashboard	WELCOME TO SERV	ER MANAGER
Local Server All Servers File and Storage Services		1 Configure this local server
	QUICK START	2 Add roles and features
	WHAT'S NEW	3 Add other servers to manage
		5 Connect this server to cloud services
	LEARN MORE	Hide
	ROLES AND SERVER Roles: 1 Server grou	R GROUPS ss:1 Servers total: 1
	File and Sto Services	trage 1 Local Server 1
	Manageabilit Events	y Manageability 2 Events

2. In the **Select Features** dialog box, select the **Failover Clustering** checkbox and click **Next**.

Add Roles and Features Wizard			- 0
Select features			DESTINATION SERVER WSFC2016-NODE1.TESTDOMAIN.COM
Before You Begin	Select one or more features to install on the selected ser	ver.	Description
Server Selection Server Roles	▶NET Framework 3.5 Features ■ .NET Framework 4.6 Features (2 of 7 installed) ■ .Background Intelligent Transfer Service (BITS)	^	Failover Clustering allows multiple servers to work together to provide high availability of server roles.
Confirmation Results	BitLocker Drive Encryption BitLocker Network Unlock BranchCache Client for NFS Containers Data Center Bindging Data Center Bindging		Failover Clustering is often used for File Services, virtual machines, database applications, and mail applications.
	Direct Play Finhanced Storage Tailover Clustering Group Policy Management Host Guardian Hyper-V Support VO Quality of Service		
	IIS Hostable Web Core Internet Printing Client IP Address Management (IPAM) Server SNS Server service LRP Port Monitor Management Obata IIS Extension Media Foundation	~	
	and an and an		

When prompted with the Add features that are required for Failover Clustering dialog box, click Add Features. Click Next.



NOTE: In previous versions of SQL Server, you were required to install the .NET Framework 3.5 with SP 1. This is no longer the case with SQL Server 2016.

3. In the **Confirm Installation Selections** dialog box, click **Install** to confirm the selection and proceed to do the installation.

Confirm installa	ition selections	WSFC2	DESTIN 016-NODE1.TES	ATION SE	CON
Before You Begin Installation Type	To install the following roles, role services, or features	s on selected server, click l	nstall.		
Server Selection Server Roles	Optional features (such as administration tools) migh selected automatically. If you do not want to install th check boxes.	t be displayed on this pag hese optional features, clic	e because the k Previous to	y have b clear thei	eer ir
Confirmation	Failover Clustering Remote Server Administration Tools				
	Feature Administration Tools Failover Clustering Tools Failover Cluster Management Tools Failover Cluster Module for Windows	PowerShell			
	Export configuration settings Specify an alternate source path				

Running the Failover Cluster Validation Wizard

In this section, you will run the Failover Cluster Validation Wizard from the **Failover Cluster Management** console. You can launch the tool from the **Server Manager** dashboard, under **Tools** and select **Failover Cluster Manager**.

NOTE: These steps can be performed on any of the servers that will act as nodes in your failover cluster. The steps below are performed on **WSFC2016-NODE1**.

1. In the Failover Cluster Management console, under the Management section, click the Validate Configuration link. This will run the Validate a Configuration Wizard.

Failover Cluster Manager	with Control of the International Action in the International Action	^ Ac	tions	-
	perform configuration changes to your failover clusters.	Fa	ilover Cluster Ma	
		-	Validate Confi	
	Overview	-	Create Cluster.	•••
	A failover cluster is a set of independent computers that work together to increase the availability of server roles. The clustered servers (called nodes) are connected		Connect to Cl.	
	by physical cables and by software. If one of the nodes fails, another node begins to provide services. This process is known as failover.		View	
		0	Refresh	
	© Clusters		Properties	
		?	Help	
	Management To begin to use failover clustering, first validate your hardware configuration, and then create a cluster. After these steps are complete, you can manage the cluster. Managing a cluster can include copying roles to it from a cluster running Windows Server 2016 or supported the vious versions of Windows Server. Waldate Configuration. Create Cluster. Create Cluster.			
	More Information			

2. In the **Select Servers or a Cluster** dialog box, enter the hostnames of the nodes that you want to add as members of your WSFC. Click **Next**.

Before You Begin Select Servers or a Cluster	To validate a set of se To test an existing clus	rvers, add the names of all the servers. ster, add the name of the cluster or one of its nodes.	
Testing Options Confirmation Validating Summary	Enter name: Selected servers:	WSFC2016-NODE1.TESTDOMAIN.COM WSFC2016-NODE2.TESTDOMAIN.COM	Browse Add Remove

 In the Testing Options dialog box, accept the default option Run <u>all</u> tests (recommended) and click Next. This will run all the necessary tests to validate whether or not the nodes are OK for the WSFC.

Validate a Confi	guration Wizard Options	×
Before You Begin Select Servers or a Cluster Confirmation Validating Summary	Choose between running all tests or running selected tests. The tests examine the Cluster Configuration, Hyper-V Configuration, Inventory, Network, Storage, and System Configuration. Microsoft supports a cluster solution only if the complete configuration (servers, network, and storage) can pass all tests in this wirard. In addition, all hardware components in the cluster solution must be "Certified for Windows Server 2016." Run all tests (recommended) Run only tests I gelect <u>More about cluster validation tests</u>	
	< <u>P</u> revious <u>N</u> ext > Cancel	Í,

4. In the **Confirmation** dialog box, click **Next**. This will run all the necessary validation tests.

Validate a Config	guration Wizard		
Before You Begin Select Servers or a Cluster	You are ready to start validation. Please confirm that the following settings are correct:		
Testing Options	Servers to Test		^
Confirmation	WSFC2016-NODE1.TESTDOMAIN.COM		
Validating	WSFC2016-NODE2.TESTDOMAIN.COM		
Summary	Tests Selected by the User	Category	
	List Fibre Channel Host Bus Adapters	Inventory	
	List iSCSI Host Bus Adapters	Inventory	
	List SAS Host Bus Adapters	Inventory	
	List BIOS Information	Inventory	~
	To continue, click Next.		
		< Previous Next >	Cancel

5. In the **Summary** dialog box, verify that all the report returns successful.

fore You Begin lect Servers or a	Testing has completed for the tests you selected. To you must run all tests. A cluster solution is supported validation tests, and all tests succeed (with or withou	confirm that your cluster solution by Microsoft only if you run all clu t warnings).	is supported ister
ister otion Options	Besuitt		
sung Options	List BIOS Information	Success	
nnmation	List Disks	Success	
lidating	List Disks To Be Validated	Success	
mmary	List Environment Variables	Success	
	List Fibre Channel Host Bus Adapters	Success	
	List Host Guardian Service client configuration	Success	
	List iSCSI Host Bus Adapters	Success	
		-	•

A note on the results: In the past, the **Cluster Validation Wizard** may report **Warning** messages pertaining to network and disk configuration issues, missing security updates, incompatible drivers, etc. The general recommendation has always been to resolve all errors and issues that the Cluster Validation Wizard reports prior to proceeding with the next steps. And it still is.

With Windows Server 2016, checks for Storage Spaces Direct have been included in the Cluster Validation Wizard. Despite choosing the **Run <u>a</u>ll tests (recommended)** option, the Cluster Validation Wizard will exclude those checks.

Validate a Config	guration Wizard	×
Before You Begin Select Servers or a Cluster Testing Options Test Selection Confirmation Validating Summary	Select the tests that you want to run. A few tests are dependent on other tests. If you choose a dependent test, the test that it depends on will also run. Description Description These tests gather and display information about the nodes.	
	< Previous Next > Cancel]

This is why you will get a Warning message in the cluster validation report despite having all selected default checks return successful results.

	Failover Cluster Validation Repo	rt
lode:	WSFC2016-NODE1.TESTDOMAIN.COM	Validated
lode:	WSFC2016-NODE2.TESTDOMAIN.COM	Validated
Started Completed		
The Validate a Cor http://go.microsof	figuration Wizard must be run after any change is made to the configuration of the cluste t_com/twlink/b/?Linkid=280145.	r or hardware. For more informatio
The Validate a Cor http://go.microsof Results by Name	htguration Wizard must be run after any change is made to the configuration of the cluste t.com/twlink/p/?Linkld=280145. Category Result Summary	r or hardware. For more informatio
The Validate a Cor http://go.microsof Results by Name Inventory	htguration Wizard must be run after any change is made to the configuration of the duste t.com/twlink/p/?Linkld=280145.	r or hardware. For more informatio Description Success
The Validate a Cor http://go.microsof Results by Name Inventory Network	figuration Wizard must be run after any change is made to the configuration of the duste t.com/twlink/b/?Linkid=280145. Category Result Summary	Perscription Description Success
The Validate a Cor http://qo.microsof Results by Name Inventory Network Storage	Inguration Wizard must be run after any change is made to the configuration of the duste t.com/twlink/p/?LinkId=280145.	r or hardware. For more informatio Description Success Success Success

6. To create the WSFC using the servers you've just validated, select the **Create the cluster now using the validated nodes...** checkbox and click **Finish**.

Another way of running the Failover Cluster Validation is by using the <u>Test-Cluster</u> PowerShell cmdlet.

Test-Cluster -Node WSFC2016-NODE1, WSFC2016-NODE2

Creating the Windows Server 2016 Failover Cluster

In this section, you will create a Windows Server 2016 Failover Cluster from the **Failover Cluster Management** console. You can launch the tool from the **Server Manager** dashboard, under Tools and select **Failover Cluster Manager**. Alternatively, you can run the **Create Cluster Wizard** after running the **Failover Cluster Validation Wizard**. Be sure to check the **Create the cluster now using the validated nodes...** checkbox.



NOTE: These steps can be performed on any of the servers that will act as nodes in your WSFC. The steps below are performed on **WSFC2016-NODE1**.

1. Under the **Management** section, click the **Create a Cluster** link. This will run the **Create Cluster Wizard**.



2. In the **Select Servers** dialog box, enter the hostnames of the nodes that you want to add as members of your WSFC. Click **Next**.

Before You Begin	Add the names of all th	e servers that you want to have in the cluster. You must ad	d at least one server.
Gelect Servers Access Point for Administering the Cluster	Enter server name:	l	Browse
Confirmation Creating New Cluster Summary	Selected servers:	WSFC2016-NODE1.TESTDOMAIN.COM WSFC2016-NODE2.TESTDOMAIN.COM	<u>A</u> dd

3. In the Access Point for Administering the Cluster dialog box, enter the virtual hostname and IP address that you will use to administer the WSFC. Click Next. Note that because the servers are located within the same network subnet, only one virtual IP address is needed. This is a typical configuration for local high availability.

Before You Begin	Type the name yo	u want to use wh	en administering the cluste	r.		
Select Servers	Cluster Name:	WIN2K16-CL	USTER			_
Confirmation Creating New Cluster	address.	Netw	adra	Addres		
Summary			172.16.0.0/16	Abdres	172.16.0.33	

4. In the **Confirmation** dialog box, click **Next**. This will configure Failover Clustering on both of the servers that will act as nodes in your WSFC, add the configured shared storage, add Active Directory and DNS entries for the WSFC virtual server name.

Before You Begin Select Servers	You are ready to create a cluster. The wizard will create your cluster with the following settings:	
Access Point for Administering the	Cluster	^
Cluster	WIN2K16-CLUSTER	
Confirmation	Node	
Creating New Cluster	WSFC2016-NODE1.TESTDOMAIN.COM	
Summary	WSFC2016-NODE2.TESTDOMAIN.COM	
	Cluster registration	
	DNS and Active Directory Domain Services	~
	Add all eligible storage to the cluster.	~

A word of caution before proceeding: Before clicking **Next**, be sure to coordinate with your Active Directory domain administrators on the appropriate permissions that you need to create the computer name object in Active Directory. It will save you a lot of time and headache troubleshooting why you cannot create a WSFC. Local Administrator permission on the servers that you will use as nodes in your WSFC is not enough. Your Active Directory domain account needs the following permissions in the **Computers** Organizational Unit. By default, this is where the computer name object that represents the virtual hostname for your WSFC will be created.

- Create Computer objects
- Read All Properties

For additional information, refer to the <u>Failover Cluster Step-by-Step Guide: Configuring</u> <u>Accounts in Active Directory</u> documentation.

In a more restrictive environment where your Active Directory domain administrators are not allowed to grant you those permissions, you can request them to pre-stage the computer name object in Active Directory. Provide the <u>Prestage Cluster Computer Objects in Active</u> <u>Directory Domain Services</u> documentation to your Active Directory domain administrators.

This also applies to WSFC running Windows Server 2008 and higher.

5. In the **Summary** dialog box, verify that the report returns successful results. Click **Finish**.

🖓 Create Cluster Wi	zard	>
Summary		
Before You Begin Select Servers	You have successfully completed the Create Cluster Wizard.	
Access Point for Administering the	Node	^
Cluster	WSFC2016-NODE1.TESTDOMAIN.COM	
Confirmation	WSFC2016-NODE2.TESTDOMAIN.COM	
Creating New Cluster	Cluster	
Summary	WIN2K16-CLUSTER	
	Quorum	
	Node and Disk Majority (Cluster Disk 1)	
	IP Address	
	172.16.0.33	
	To view the report created by the without click View Report	V.
	To close this wizard, click Finish.	view Report
		Finish

6. Verify that the quorum configuration is using Node and Disk Majority - **Witness: Cluster Disk n** - using the appropriate drive that you configured as the witness disk.

🔿 🖄 📰 🕻			
Failover Cluster I	Cluster WIN2K16-CLUSTER.TESTDOMAIN.COM		Actions
Roles Nodes Storage Disks Pools Enclo Networks	Summary of Cluster WIN2K16-CLUSTER WIN2K16-CLUSTER has 0 clustered roles and 2 r Name: WIN2K16-CLUSTER.TESTDOMAIN.COM Networks Networks Current Host Server: WSc2016NODE1 Recent Cluster Events: None in the last hour Witness: Cunter Plak 1 Image: Configure Image: Navigate	R nodes. : Ouster Network 1, Cluster Network 2 (Pv4 and 0 IPv6	2 Winz Ke-LUW. Winz Ke-LUW. Winz Ke-LUW. View Valia. Close Co Reset Rec More Acti View Reset Rec Refresh
	 Cluster Core Resources 		Properties
	Name B 1 Name: WIN2K16-CLUSTER Storage B Cluster Disk 1 DISK M (an)	Status Inf Online Online 	io ^
	NTFS 969 MB free of 1,021 MB	,	

Another way of creating the WSFC is by using the <u>New-Cluster</u> PowerShell cmdlet.

New-Cluster -Name WIN2K16-CLUSTER -Node WSFC2016-NODE1, WSFC2016-NODE2 -StaticAddress 172.16.0.33

Renaming Shared Storage Resources

As a best practice, you should rename your shared storage resources prior to installing SQL Server 2016. This makes it easy to identify what the disks are used for - data, log, backups, etc. - during the installation and later on when troubleshooting availability issues. And while you may have renamed the disks using the **Disk Management** console, you still have to rename them from the point-of-view of the WSFC. The default names of the shared storage will be **Cluster Disk n** where **n** is the number assigned to the disks.



To rename the shared storage resources:

1. Within the **Failover Cluster Manager** console, under the **Storage** navigation option, select **Disks**. This will display all of the shared storage resources added to the WSFC.

Failover Cluster Manager	Disks (4)				Actions
WIN2K16-CLUSTER.TEST	Search		🔎 Queries 🔻		Disks
Nodes	Name	Status	Assigned To	Owner Nor	😫 Add Disk
✓ Call Storage	Cluster Disk 1	() Online	Disk Witness in Quorum	WSFC201	🍰 Move Av
Disks	📇 Cluster Disk 2	(Online	Available Storage	WSFC201	View
Enclosures	E Cluster Disk 3	() Online	Available Storage	WSFC201	G Refresh
Networks	El Cluster Disk 4	(🕑 Online	Available Storage	WSFC201	Help
	¢			>	
	*				

2. Right-click one of the shared disks and select **Properties**. This will open up the **Properties** page for that specific disk.

Failover Cluster Manager	Disks (4)				Actions
WIN2K16-CLUSTER.TESTI	Search		🔎 Queries 🔻		Disks
Nodes	Name	Status	Assigned To	Owner Not	🔮 Add Disk
 ✓ Estorage ✓ Disks ✓ Pools ✓ Enclosures ✓ Networks ✓ Cluster Events 	금, Ouster Disk 1 종, Ouster Disk 2 골광 Ouster Disk 3 골광 Ouster Disk 4	Online Online Online Online Online Online	Price Mineces in Owners Image: A start of the start	weec201 201 201 201 • • •	Move Av View Refresh Help Cluster Disk 1 Bring Onl Take Offli Show Critt
	Volumes (1)				Replication More Acti Properties
	DISK_W (W)	ee of 1,021 MB			👔 Help

3. In the **Properties** page, on the **General** tab, type the appropriate name for the shared disk in the **Name** textbox. Click **OK**.

Name: Type: Status:	DISK_W Physical Disk Online	
isk number:	4	
Volume	Capacity	Free Space

Do this on all of the shared storage resources available on your WSFC.

					. —		_
Failover Cluster Manager	Disks (4)			~	Acti	ions	
Roles	Search		PG	Queries 🔻 🔛 🔻 😪	Dis	ks	*
Nodes	Name	Status	Assigned To	Owner Node	\$	Add Disk	
🗸 📇 Storage	킖 DISK_W	Online	Disk Witness in Quorum	WSFC2016-NODE1	3	Move Availabl	
Disks	E SQL_DATA_H	() Online	Available Storage	WSFC2016-NODE1		View	
Pools Enclosures	A SQL_DATA_I	() Online	Available Storage	WSFC2016-NODE1	0	Refresh	
Networks	E SQL_DATA_J	(1) Online	Available Storage	WSFC2016-NODE1	?	Help	
[별] Cluster Events					SOL	DATA J	
						Bring Online Take Offline Add to Cluster	
	<			5		Information D	
		A.J		2		Show Critical E	
	Volumes (1)					More Actions Remove	•
					6777	D	
	SQL_DATA	_J (J)				Properties	

Renaming Cluster Network Resources

Similarly, you should rename your cluster network resources prior to installing SQL Server 2016. And while you may have renamed the network adapters using the **Network Connections** management console, you still have to rename them from the point-of-view of the WSFC. The default names of the cluster network resources will be **Cluster Network n** where **n** is the number assigned to the cluster network adapter.

Failover Cluster Manager	Networks (2)				Actions
WIN2K16-CLUSTER.TES	Search		P Queri	es 🔻 🔒 🔻 👽	Networks
Nodes	Name	Status	Cluster Use	Information	型 Live Migration
> <u>ä</u> Storage	I Cluster Network 1	🛞 Up	Cluster and Client		View
Networks	Cluster Network 2	🛞 Up	Cluster Only		G Refresh
Cluster Events					Help
			Network Connections		-
			🗧 🔿 🗠 🛧 😰 « N	et > Network	✓ ひ Searc
			Organize 🔻		BH • 🔲 🕜
			Name	Status	
			II LAN	TEETBOIN	AINCOM
	< 2		Private	Unidentifie	AllN.COM
		102	W Plivate	Onidentitie	ed network
	Cluster Netw	ork 2			
	Name				
		1 - Private	<		1
	€ WSFC2016-NODE	2 - Private	2 items	9 m	8

To rename the cluster network resources:

1. Within the **Failover Cluster Manager** console, select the **Networks** navigation option. This will display all of the cluster network resources added to the WSFC.

	Networks (2)				Actions
WIN2K16-CLUSTER.TES	Search		P Querie	s 🕶 🔛 🐨 😔	Networks
Nodes	Name	Status	Cluster Use	Information	Live Migration
🛩 📇 Storage	Guster Network 1	💽 Up	Cluster and Client		View
E Disks	Cluster Network 2	💽 Up	Cluster Only		Refresh
Enclosures					Help
Networks					
Cluster Events					
				2	
	<u></u>				
				3	
	•				
	*				
	*				
	•			9 2	
	•				

2. Right-click one of the cluster network adapters and select **Properties**. This will open up the **Properties** page for that specific cluster network resource.

Failover Cluster Manager	Networks (2)				Actions
WIN2K16-CLUSTER.TES	Search		PQuer	ies 🔻 🔐 🔻 🗸	Networks
 Nodes Nodes Disks Pools ■ Pools ■ Redisoures Networks ● Cluster Events 	Name Cluster Network 1 Cluster Network 2	Status (*) Up (*) Up	Oluster Use Oluster and Client Cluster Only	Information Information Show Critica Properties	Live Migration Details Events Cluster Network 1 Information D Show Critical E
	<	ork 1		>	Properties
	Name WSFC2016-NODE WSFC2016-NODE	1 - LAN 2 - LAN		Status Up Up Up	

3. In the **Properties** page, type the appropriate name for the cluster network resource in the **Name** textbox. Click **OK**.

Cluster Netw	ork 1 Properties	>
General		
i a	uster Network 1	
Name:	1	
۲	Allow cluster network communication on this network	
	Allow clients to connect through this network	
С) Do not allow cluster network communication on this netw	ork
Status:	Up	
Subnets:	172.16.0.0/16	
	OK Cancel Ap	ply

Do this on all of the cluster network resources available on your WSFC.

Failover Cluster Manager	Networks (2)				Act	ions
Roles	Search		Quer	ies 🔻 📊 🔻 👻	Net	works
Nodes	Name	Status	Cluster Use	Information	鳢	Live Migration
> 📇 Storage	县 LAN	🕞 Up	Cluster and Client			View
Networks	🖳 Private	🛞 Up	Cluster Only		Q	Refresh
In Cluster Events					?	Help
					LAN	1
					6	Information D
					1	Show Critical E
						Properties
					2	Help
	<			>		
	v 📕 LAN					
	Name		18	Status		
		NODE1 - LAN		🕥 Up		
		NODE2 - LAN		🕑 Up		

NOTE: The WSFC will detect whether or not client applications can connect thru the specific cluster network resource. This is determined based on whether or not a network adapter has a default gateway and can be identified via network discovery. This is why it is important to get your network administrators involved in properly assigning the IP address, the subnet mask and the default gateway values of all the network adapters used on the servers prior to creating the WSFC.

Also, by default, all available network adapters will be used for inter-node communication, or what is commonly known as private communication/heartbeat.

Installing a SQL Server 2016 Failover Clustered Instance (FCI)

In this section, you will install a default instance of SQL Server 2016 FCI. You will run the installation process on the first node of your WSFC, **WSFC2016-NODE1**.

- 1. Run **setup.exe** from the SQL Server 2016 installation media to launch **SQL Server Installation Center**. Click on the **Installation** link on the left-hand side
- 2. Click the **New SQL Server failover cluster installation** link. This will run the SQL Server 2016 Setup wizard



3. In the **Product Key** dialog box, enter the product key that came with your installation media and click **Next**.

🖞 Install a SQL Server Failover Clu	ster	-	٥	>
Install a SQL Server Failover Clu Product Key Specify the edition of SQL Sc Product Key License Terms Global Rules Microsoft Update Product Updates Install Failover Cluster Rules Feature Sules Feature Rules Feature Rules	nver 2016 to install. Validate this instance of SQL Server 2016 by entering the 25-character key from the of authenticity or product packaging. You can also specify a free edition of SQL Server Books Online, and is activated with a 180-day expiration. Developer edition: express Development only. To upgrade from one installed edition to another, ru Upgrade Wizard. • Specify a free edition: • Evaluation • Evaluation	Microso ver: Deve imented does not -product	D Aft certific loper, in SQL have an ion data	cate

4. In the **License Terms** dialog box, click the **I accept the license terms** check box and click **Next**.



5. In the **Global Rules** dialog box, validate that the checks return successful results and click **Next**.

Setup Global Rules identify corrected before Setup can o	problems ti continue.	hat might occur when you install SQL Server Setup support files.	Failures must be		
Product Key	Oper	ation completed. Passed: 8. Failed 0. Warning 0. Skipped 0.			
License Terms					
Global Rules				1	
Microsoft Update	Hid	le detail <u>s</u> <<		<u>R</u> e-	ru
Product Updates	View	detailed report			
Install Setup Files					
Install Failover Cluster Rules		Rule	Status		
Feature Selection	9	Setup administrator	Passed		
Feature Rules		Setup account privileges	Passed		
Feature Configuration Rules		Restart computer	Passed		
Ready to Install		Windows Management Instrumentation (WMI) service	Passed		
Installation Progress	0	Consistency validation for SQL Server registry keys	Passed		
Complete	0	Long path names to files on SQL Server installation media	Passed		
	0	SQL Server Setup Product Incompatibility	Passed		
		.NET 2.0 and .NET 3.5 Service Pack 1 update for Windows 2008	Passed		_
		· · · · · · · · · · · · · · · · · · ·			_

6. In the Microsoft Update dialog box, you have the option to include SQL Server product updates like service packs and cumulative updates in the installation process. By default, it searches for product updates thru the Microsoft Updates service online, assuming that the server has access to the Internet. In cases where your servers do not have access to the internet, you can manually download the updates and store them on a network shared folder. You can, then, point the installation media to search the network shared folder instead. For this option, you will need to run setup.exe from the command-line, passing the /UpdateSource parameter. A more detailed approach to using this feature is outlined in this Microsoft documentation. Click Next.

		U	×
k for important updates			
Microsoft Update offers security and other important updates for Winds software, including SQL Server 2016. Updates are delivered using Auton visit the Microsoft Update website. Use Microsoft Update to check for updates (recommended) <u>Microsoft Update FAQ</u> <u>Microsoft Update Privacy Statement</u>	ews and other M	icrosoft you can	
	k for important updates Microsoft Update offers security and other important updates for Winde software, including SQL Server 2016. Updates are delivered using Auton visit the Microsoft Update website. Use Microsoft Update to check for updates (recommended) Microsoft Update FAQ Microsoft Update Privacy Statement	k for important updates Microsoft Update offers security and other important updates for Windows and other M software, including SQL Server 2016. Updates are delivered using Automatic Updates, or visit the Microsoft Update vebsite. Use Microsoft Update to check for updates (recommended) Microsoft Update FAQ Microsoft Update Privacy Statement	k for important updates Microsoft Update offers security and other important updates for Windows and other Microsoft software, including SQL Server 2016. Updates are delivered using Automatic Updates, or you can visit the Microsoft Update website. Use Microsoft Update to check for updates (recommended) Microsoft Update FAQ Microsoft Update Privacy Statement

NOTE: Another way to include SQL Server service packs and cumulative updates in the installation process is to create a slipstreamed installation media.

7. In the **Install Failover Cluster Rules** dialog box, validate that the checks return successful results. If the checks returned a few warnings, make sure you fix them before proceeding with the installation. Click **Next**.

Be aware that you will get a warning result for **Microsoft Cluster Service (MSCS) cluster verification warnings** as a side effect of the storage spaces direct (S2D) checks.

Install a SQL Server Failover Clu	ter			U	^
Install Failover Cluste	er Rule	25			
Setup rules identify potentia can continue.	problem	ns that might occur while running Setup. Failures must be correcte	ed before Setup		
Product Key	Ope	eration completed. Passed: 18. Failed 0. Warning 3. Skipped 0.			
License Terms					
Global Rules					
Vicrosoft Update	Hi	de detail <u>s</u> <<		<u>R</u> e-	run
install Setup Files	View	v detailed report			
Install Failover Cluster Rules					
eature Selection		Rule	Status		_
Feature Rules		Fusion Active Template Library (ATL)	Passed		
Feature Configuration Rules		Cluster Node	Passed		
Ready to Install		Windows Management Instrumentation (WMI) service (WSFC2	Passed		
nstallation Progress	0	Cluster Remote Access (WSFC2016-NODE1)	Passed		
Complete	0	Cluster nodes name length verification	Passed		
	0	Cluster service verification	Passed		
		Distributed Transaction Coordinator (MSDTC) installed (WSFC2	Passed		
		Distributed Transaction Coordinator (MSDTC) service	Passed		
		Microsoft Cluster Service (MSCS) cluster verification errors	Passed		
			Warning		
		Microsoft Cluster Service (MSCS) cluster verification warnings			_
		Microsoft Cluster Service (MSCS) cluster verification warnings Remote registry service (WSFC2016-NODE1)	Passed		

8. In the Feature Selection dialog box, select the following components – Database Engine Services and Client Tools Connectivity. Click Next.

Note that SQL Server Management Studio is no longer included in the SQL Server 2016 installation media and have to be downloaded separately.

Feature Selection Select the Enterprise features to install. Product Key License Terms Global Rules Microsoft Update Install Setup Files Select All Unselect All	Install a SQL Server Failover Clus	ter			-	Ø	×
Select the Enterprise features to install.	Feature Selection						
Product Key Eastures: Feature description: License Terms Instance Features: Includes components for communication Global Rules SQL Server Replication Includes components for communication Microsoft Update SQL Server Replication Prerequisites for selected features: Install Failover Cluster Rules Data Quality Services Prerequisites for selected features: Pature Selection PolyBase Query Service for External Data Aiready installed: Cluster Reles Reporting Services - Native Microsoft NFT Framework 4.6 Cluster Reles Kelection Reporting Services - SharePoint Disk Space Requirements Cluster Network Configuration Data Quality Client Disk Space Requirements Cluster Network Configuration Server Configuration Select All Seture Configuration Instance goot directory: C:\Program Files/Microsoft SQL Serve/ Seture Configuration Ready to Install Instance goot directory: C:\Program File/Microsoft SQL Serve/	Select the Enterprise features	to install.					
License Terms Global Rules Microsoft Update Install Setup Files Microsoft Sules Feature Selection Feature Rules Instance Configuration Cluster Disk Selection Cluster Disk Selection Cluster Network Configuration Server Configuration	Product Key	Eeatures:		Feature description:			
Install Statup Files Install Failover Cluster Rules Feature Selection Feature Sclection Cluster Releving Cluster Resource Group Cluster Rules Instance Configuration Cluster Resource Group Cluster Resource	License Terms Global Rules Microsoft Update	Instance Features Database Engine Services SQL Server Replication	n	Includes componer between clients and	nts for commun d servers.	ication	Ô
Database Engine Configuration Select All Unselect All Feature Configuration Rules Instance goot directory: C\Program Files\Microsoft SQL Server\ Installation Progress Shared feature directory: C\Program Files\Microsoft SQL Server\	Install Setup Files Install Failover Cluster Rules Feature Selection Feature Rules Instance Configuration Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration	Inui - Lext and semaint Otata Quality Services PolyBase Query Service Analysis Services Reporting Services - Nati Shared Features Reporting Services - Shar Reporting Services - Add- Data Quality Client Otient Tools Connectivity <	ce for External Data ve ePoint n for SharePoint Pro	Prerequisites for sele Already installed: - Windows Powe - Microsoft .NFT C Disk Space Requirem Drive C: 1677 MB re	ected features: rShell 3.0 or hig! Framework 4.6 nents equired, 41693 M	ner B availab	> >
Complete Shared feature directory (286): C:\Program Files (x86)\Microsoft SQL Server\	Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete	Select <u>A</u> II <u>U</u> nselect AII Instance <u>r</u> oot directory: Shared feature directory: Shared feature directory (<u>2</u> 86):	C:\Program Files\Mi C:\Program Files\Mi C:\Program Files (x8)	crosoft SQL Server\ crosoft SQL Server\ 6)\Microsoft SQL Serve	er\		

9. In the **Feature Rules** dialog box, verify that all the rules have passed. If the rules returned a few warnings, make sure you fix them before proceeding with the installation. Click **Next**.

Install a SQL Server Failover Clust	ter			_	٥	>
Feature Rules						
Feature rules identify problem	ns that n	night block this setup operation based on the features	selected.			
Product Key	Ope	ration completed. Passed: 3. Failed 0. Warning 0. Sk	ipped 0.			
License Terms						
Jiobai Kules Missasaft Undata	Hi	de details <<			Re	-010
Install Satur Eilas		de detaing ex			Te	Turr
install Failover Cluster Rules	viev	v detailed report				
Feature Selection		Rule	Status			_
eature Rules		Cluster supported for edition	Passed			_
nstance Configuration		Product Update Language Compatibility	Passed			_
Cluster Resource Group		KB2919355 Installation	Passed			_
Cluster Disk Selection	-					_
Cluster Network Configuration						
Gerver Configuration						
atabase Engine Configuration						
eature Configuration Rules						
eady to Install						
nstallation Progress						
Complete						
				11		
			< <u>B</u> ack <u>N</u> ex	rt >	Cance	el

10. In the **Instance Configuration** dialog box, enter the SQL Server Network Name. This is the name that the client applications will use to connect to this server. A couple of things need highlighting in this section. By default, the instance name is used as the **Instance ID**. This is used to identify installation directories and registry keys for this specific instance of SQL Server - very helpful when you want to run multiple instances in a WSFC. It applies to both the default instance and named instances. For a default instance, the instance name and instance ID would be **MSSQLSERVER**. To use a non-default instance ID, you should specify a value in the **Instance ID** box. Click **Next**.

Install a SQL Server Failover Clust	ter				- 1	y X
Instance Configuratio	n					
Specify the name and instanc	e ID for the instance of SQL Ser	ver. Instance ID be	ecomes part of t	he installation path	1.	
roduct Key icense Terms	Specify a network name for your failover cluster on the	the new SQL Serv network.	er failover cluste	er. This w <mark>ill</mark> be the r	name used to id	antify
Blobal Rules	SQL Server Network Name:	SQL2016FCI				
/licrosoft Update nstall Setup Files nstall Failover Cluster Rules	Default instance					
eature Selection	O Named instance:	MSSQLSERVER				
eature Rules						
nstance Configuration	Instance ID:	MSSQLSERVER				
luster Resource Group luster Disk Selection luster Network Configuration	SQL Server directory:	C:\Program Files	Microsoft SQL	Server\MSSQL13.M	ISSQLSERVER	
erver Configuration	Detected SQL Server instand	ces and <mark>f</mark> eatures or	n this computer:			
atabase Engine Configuration	Instance Cluster	Network Name	Features	Edition	Version	Ins
eature Configuration Rules eady to Install istallation Progress complete						
	<					>
			-			-

11. In the **Cluster Resource Group** dialog box, check the resources available on your WSFC. This tells you that a new Resource Group will be created on your WSFC for the SQL Server FCI. To specify the SQL Server cluster resource group name, you can either use the drop-down box to specify an existing group to use or type the name of a new group to create it. Accept all the defaults and click **Next**.

Chusten Deseurse Cres					
Cluster Resource Grou	ıþ				
Create a new cluster resource	group for your	SQL Server failover cluster.			
Product Key License Terms Global Rules Microsoft Update Install Setup Files	Specify a n Server failo name or en <u>S</u> QL Serv	ame for the SQL Server cluster ver cluster resources will be pla ter a new cluster resource grou ver cluster resource group name	resource group. The cluster resource gr ced. You can choose to use an existing p name to be created. ; SQL Server (MSSQLSERVER)	oup is where cluster resou	SQL irce group
Install Failover Cluster Rules	Qualified	Name	Message		
Feature selection	۲	Available Storage	The cluster group 'Available Storage' is	reserved by V	Vindows F
reature Rules	۲	Cluster Group	The cluster group 'Cluster Group' is rese	arved by Wind	dows Failo
Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete					
					<u>R</u> efresh
			< <u>B</u> ack <u>N</u> e	xt >	Cancel

12. In the **Cluster Disk Selection** dialog box, select the available disk groups that are on the WSFC for the SQL Server FCI to use. Click **Next**.

Install a SQL Server Failover Clust	er				<u> </u>	٥	×
Cluster Disk Selection							
Select shared cluster disk reso	urces for your S	QL Server failove	r cluster.				
roduct Key cense Terms lobal Rules	Specify the used as the Services cor	shared disks to b default drive for ifiguration pages.	e included in the SQL Server all databases, but this can b	resource cluster e changed on th	group. The first di e Database Engine	ive will be or Analys	e is
licrosoft Update stall Setup Files ıstall Failover Cluster Rules eature Selection	SQL_DA SQL_DA SQL_DA	TA_H TA_I TA_J					
ature Rules	Available sh	ared disks:					
Istance Configuration	Qualified	Disk	Message				
uster Disk Selection	۲	DISK_W	The disk resource 'DISK_W	/' cannot be use	d because it is a clu	ster quoru	um
uster Network Configuration	0	SQL_DATA_H					
rver Configuration	0	SQL_DATA_I					
atabase Engine Configuration	0	SQL_DATA_J					
ature Configuration Rules							
A DECEMBER OF THE OWNER							
ady to install							
stallation Progress							
istallation Progress omplete						Refres	sh
aady to install stallation Progress omplete						Refres	sh

13. In the **Cluster Network Configuration** dialog box, enter the IP address and subnet mask that your SQL Server FCI will use. Be sure to deselect the checkbox under the DHCP column as you will be using static IP addresses. Click **Next**.

Cluster Network Confi	igura	tion						
Select network resources for ye	our SQL	Server failo	ver cluster.					
Product Key	Spe	cify the netw	ork <u>s</u> etting	s for this failover	cluster:			
License Terms		IP Type	DHCP	Address	Subnet Mask	Subnet(s)	 Netwo	rk
Microsoft Undate		IPv4		172.16.0.35	255.255.0.0	172.16.0.0/16	LAN	
nstall Setup Files								
nstall Failover Cluster Rules								
eature Selection								
Feature Rules								
Feature Rules nstance Configuration								
Feature Rules nstance Configuration Cluster Resource Group								
Feature Rules nstance Configuration Cluster Resource Group Cluster Disk Selection								
eature Rules nstance Configuration Cluster Resource Group Cluster Disk Selection Cluster Network Configuration								
eature Rules nstance Configuration Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Gerver Configuration								
Feature Rules instance Configuration Cluster Resource Group Cluster Dick Selection Cluster Net Selection Cluster Network Configuration Server Configuration Database Engine Configuration Entrus Configuration								
Feature Rules Instance Configuration Cluster Resource Group Cluster Disk Selection Cluster Net Vork Selection Server Configuration Database Engine Configuration Feature Configuration Rules Pearly to Install								
Feature Rules instance Configuration Cluster Resource Group Cluster Disk Selection Cluster NetWork Configuration Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install								
Feature Rules instance Configuration Cluster Rosource Group Cluster Disk Selection Cluster Network Configuration Server Configuration Otabases Engine Configuration Feature Configuration Rules Ready to Install installation Progress Complete								
Feature Rules Instance Configuration Cluster Resource Group Cluster Net Selection Cluster Net Work Configuration Server Configuration Jatabase Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete							<u>R</u> ef	fresk

14. In the **Server Configuration** dialog box, provide the credentials for the SQL Server service accounts in the **Service Accounts** tab. Make sure that both the SQL Server Agent and SQL Server Database Engine services have a **Startup Type** of Manual. The WSFC will take care of stopping and starting these services.

Select the checkbox **Grant Perform Volume Maintenance Task privilege to SQL Server Database Engine Service** - this is new in SQL Server 2016. This enables Instant File Initialization for SQL Server. Because this is a local permission assigned to an account, you need to explicitly do this on all of the nodes in the SQL Server FCI.

Click Next.

Server Configuration Specify the service accounts and	d collation configuration.				0
Specify the service accounts and	d collation configuration.				
	-				
oduct Key	Service Accounts Collation				
ohal Rules	Microsoft recommends that you use	a separate account for each	SQL Server serv	ice.	
icrosoft Update	Service	Account Name	Password	Startup Typ	e
stall Setup Files	SQL Server Agent	TESTDOMAIN\sqlservice		Manual	~
stall Failover Cluster Rules	SQL Server Database Engine	TESTDOMAIN\sqlservice	•••••	Manual	~
ature Selection	SQL Full-text Filter Daemon Launc	NT Service\MSSQLFDLa		Manual	
ature Rules	SQL Server Browser	NT AUTHORITY\LOCAL		Automatic	~
uster Resource Group uster Disk Selection stver Network Configuration stver Configuration trabase Engine Configuration ature Configuration Rules uady to Install stallation Progress	Grant Perform Volume Maintenan This privilege enables instant file i to information disclosure by allow Click here for details	ce Task privilege to SQL Ser nitialization by avoiding zen ing deleted content to be ac	ver Database En bing of data pag cessed.	igine Service	ad

15. In the Database Engine Configuration dialog box, under the Server Configuration tab,

- Select **Windows authentication mode** in the **Authentication Mode** section. If required, you can change it later after the installation is complete.
- Add the currently logged on user to be a part of the SQL Server administrators group by clicking the **Add Current User** button in the **Specify SQL Server Administrators** section. You can also add Active Directory domain accounts or security groups as necessary.

Install a SQL Server Failover Cluste	f	-	٥	>
Database Engine Confi Specify Database Engine authe	guration ntication security mode, administrators, data directories and TempD8 settings.			
Product Key License Terms Slobal Rules Microsoft Update Install Satup Files Install Failover Cluster Rules Feature Selection Feature Rules Instance Configuration Cluster Resource Group Cluster Disk Selection Cluster Network Configuration	Server Configuration Data Directories TempDB FILESTREAM Specify the authentication mode and administrators for the Database Engine. Authentication Mode Mindows authentication mode Mixed Mode (SQL Server authentication and Windows authentication) Specify the password for the SQL Server system administrator (sa) account. Enter password: Confirm password: Specify SQL Server administrators			
Server Configuration Database Engine Configuration Festure Configuration Rules Ready to Install Installation Progress Complete	TESTDOMAIN(esarmiento (Edwin M. Sarmiento) Si au u Iterational U Add Current User Add	QL Server dministrator nrestricted a re Database	s have access to Engine.	
y	< <u>B</u> ack <u>N</u>	ext >	Cance	el

In the **Data Directories** tab, specify the location of the data files, the log files and the backup files.

	index of secondy mode, dominist	rators, data directories and TempDB settings.	
Product Key License Terms	Server Configuration Data Di	rectories TempDB FILESTREAM	
Global Rules	Data root directory:	H:\	
Microsoft Update	System database directory:	H:\MSSQL13.MSSQLSERVER\MSSQL\Data	
nstall Setup Files nstall Failover Cluster Rules	User database directory:	I:\MSSQL13.MSSQLSERVER\MSSQL\Data	
Feature Selection	User database log directory:	I:\MSSQL13.MSSQLSERVER\MSSQL\Data	
Feature Rules Instance Configuration	Backup directory:	J:\MSSQL13.MSSQLSERVER\MSSQL\Backup	
Cluster Resource Group			
Cluster Disk Selection			
Cluster Network Configuration			
Server Configuration			
Server Configuration Database Engine Configuration			
Server Configuration Database Engine Configuration Feature Configuration Rules			
Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install			
server Contiguration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress			

Also, new in SQL Server 2016 is the specific tab for **TempDB** configuration. You can set the number of tempdb data files, initial size and autogrowth settings of both data and log files as well as their corresponding locations.

Specify Database Engine authe	ntication security mode,	administrators, data directories and TempDB settings.	
Product Key License Terms Slobal Rules Microsoft Update Install Setup Files Install Fallover Cluster Rules Feature Selection Feature Rules Instance Configuration Cluster Resource Group Cluster Disk Selection Cluster Network Configuration	Server Configuration TempD8 data files: Number of files: Initial size (MB): Autogrowth (MB): Data directories:	Data Directories TempDB FILESTREAM tempdb.mdf, tempdb_mssql.≢.ndf 4 128 Total initial size (MB): 512 64 Total autogrowth (MB): 256	Add Remove
Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete	TempDB log file: Initial size (MB): Autogrowth (MB): Log directory:	templog.ldf 64 - 64 - Ht\MSSQL13.MSSQLSERVER\MSSQL\Data	

Note that, starting with SQL Server 2012, you have the option to store your tempdb database files on a local disk in a WSFC. You can still choose to host the tempdb database on shared storage like the one provided in this example. Should you decide to store tempdb on a local disk, you will get prompted to make sure that all of the nodes in the WSFC contain the same directory structure and that the SQL Server service account has read/write permissions on those folders.

?	You have specified a local directory C:\tempdb as the ter cluster. To avoid possible failures during a failover, you exists on each cluster node and grant read/write permiss	npdb data or log directory for a SQL Server must make sure that the same directory ion to SQL server service.

16. In the **Feature Configuration Rules** dialog box, verify that all checks are successful. Click **Next**.

🖀 Install a SQL Server Failover Clust	er	- 0 >
Feature Configuration	Rules	
Setup is running rules to dete click Help.	rmine if the failover cluster installation operation will be block	ed. For more information,
Product Key License Terms	Operation completed. Passed: 2. Failed 0. Warning 0. Sk	cipped 0.
Global Rules Microsoft Update Install Setup Files Install Failover Cluster Ruler	Hide details << <u>View detailed report</u>	<u>R</u> e-run
Feature Selection	Rule	Status
Feature Rules	FAT32 File System	Passed
Instance Configuration	Cluster Resource DLL Update Restart Check	Passed
Instance Configuration Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete		
	[< <u>B</u> ack <u>N</u> ext > Cancel

17. In the **Ready to Install** dialog box, verify that all configuration settings are correct. Click **Install** to proceed with the installation.



18. In the **Complete** dialog box, click **Close**. This concludes the installation of a SQL Server 2016 FCI.

	ter		-	D)
Complete Your SQL Server 2016 failove	r cluster installation is complete.				
Product Key License Terms	Information about the Setup operation or possible	next steps:			
Slobal Rules	Feature	Status			-1
Vicrosoft Update	Client Tools Connectivity	Succeeded			
nstall Setup Files	Data Ouality Services	Succeeded			
nstall Failover Cluster Rules	Eull-Text and Semantic Extractions for Search	Succeeded			
eature Selection	SOL Server Replication	Succeeded			
Casture Delection		Succeeded			
eature rules					
nstance Configuration					
Cluster Resource Group	Details:				
Cluster Resource Group Cluster Disk Selection	Details:				
Cluster Resource Group Cluster Disk Selection Cluster Network Configuration	Details:				
Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration	Details:				
Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration	Details:				
Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Rules	Details:				
Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration reature Configuration Rules Ready to Install	Details:				
Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration eature Configuration Rules Ready to Install	Details:	scation:			
Cluster Resource Group Cluster Network Configuration Server Configuration Database Engine Configuration Database Engine Configuration Ready to Install Installation Progress Complete	Details: Summary log file has been saved to the following lo C\Program Files\Microsoft SQL Server\130\Setup1 Summary_WSFC2016-NODE1_20170405_081724	scation: 3ootstrap\Log\20170405_081724 .txt			

At the completion of a successful installation and configuration of the node, you now have a fully functional SQL Server 2016 FCI. To validate, open the **Failover Cluster Manager** console and click on **SQL Server (MSSQLSERVER)** under **Roles**. Make sure that all dependencies are online.

Failover Cluster Manager	B-1 (1)					Action		_
WIN2K16-CLUSTER.TE	Roles (1)		Q		•	Roles	•	
Roles	News	Charles	Tree	Overan Ne de	Deter	in Co	onfigure	
> A Storage	SOL Server (MSSOLSERVER)	A Running	Other	WSEC2016-NODE1	Mer	Vir	tual Mac	
Networks	Le sac surver (mosacscritter)	() norming	Ound	Word2010 Hober	mot	C.	anto Emp	-
Cluster Events							eate criip	
	<				>	VIE	ew	1
			D.			Q Re	fresh	
	SQL Server (MSSQ	LSERVER)	FI	referred Owners. Any I	IOUE	👔 He	lp	
	Name			Status	^	SQL Se	rver (MSS	•
	Server Name					🗘 Sta	art Role	
	🗈 🍓 Name: SQL2016FCI			(Online		C Sto	op Role	
	Other Resources					Ad	ld File Sh	
	Other Resources			(Online		😥 Ad	ld File Sh ove	•
	Other Resources			OnlineOnline		💼 Ad	ld File Sh ove	•
	Other Resources			OnlineOnline		Ad	ld File Sh ove nange Sta))
	Other Resources	.SERVER)		 Online Online Online Online 		Ad Ma Ch Ma Ch	Id File Sh ove hange Sta))
	Other Resources	SERVER)		OnlineOnlineOnlineOnline		Ad Ma Ch Ma Ch Ma Sh	ld File Sh ove hange Sta formatio ow Critic	•
	Other Resources	.SERVER)		 Online Online Online Online Online 		Add Image: Sharp Image: Sharp	ld File Sh ove hange Sta formatio ow Critic ld Storage	•
	Other Resources SQL Server SQL Server Agent Roles SQL Server CEIP (MSSQL Socage SQL_DATA_H SQL DATA_I SQL DATA_I	SERVER)		Online Online Online Online Online Online Online Online Online		Adler	ld File Sh ove nange Sta iormatio ow Critic Id Storage Id Resour))

Also new in SQL Server 2016 FCI is the additional cluster resource named **SQL Server CEIP** (MSSQLSERVER) or the Local Audit for SQL Server Usage Feedback Collection feature. This additional cluster resource/role inside the SQL Server cluster resource group does not directly impact the SQL Server FCI. By default, failure of this resource does not cause a failover of the entire SQL Server cluster resource group. However, you still need to monitor whether this resource is online or not.

SQL Server 2016 Failover Cluster Instance Installation - Install Secondary (Failover) Cluster Node

In this section, you will add a node to the SQL Server 2016 FCI on a WSFC. You will run the installation process on the second node of the cluster, **WSFC2016-NODE2**.

To add a node to an existing SQL Server 2016 FCI:

- 1. Run **setup.exe** from the installation media to launch SQL Server Installation Center.
- Click on the Installation link on the left-hand side. Click the Add node to a SQL Server failover cluster link. This will run the SQL Server 2016 Setup wizard.



3. In the **Product Key** dialog box, enter the product key that came with your installation media and click **Next**.

Specify the edition of SQL Se	erver 2016 to install.			
Product Key License Terms Global Rules Microsoft Updates Install Setup Files Add Node Rules Cluster Node Configuration Feature Rules Ready to Add Node Add Node Progress Complete	Validate this instance of SQL Server 2016 by entering the 25-character key of authenticity or product packaging. You can also specify a free edition of Evaluation, or Express. Evaluation has the largest set of SQL Server Fautre Server Books Online, and is activated with a 180-day expiration. Developer expiration, has the same set of features found in Evaluation, but is license application development only. To upgrade from one installed edition to an Upgrade Wizard. © Specify a free edition: Evaluation © Inter the product key:	from the Microso SQL Server: Devo as documented edition does not for non-product other, run the Edi	oft certific eloper, in SQL have an ino datation datation	ate

4. In the License Terms dialog box, click the I accept the license terms check box and click Next.

Add a Failover Cluster Node		- 0	J,	×
License Terms				
To install SQL Server 2016,	you must accept the Microsoft Software License Terms.			
Product Key License Terms Global Rules Microsoft Update Product Updates Install Setup Files Add Node Rules Cluster Node Configuration Feature Rules Ready to Add Node Add Node Progress Complete	MICROSOFT SOFTWARE LICENSE TERMS MICROSOFT SQL SERVER 2016 ENTERPRISE These license terms are an agreement between Microsoft Corporation (or base you live, one of its affiliates) and you. Please read them. They apply to the softw above, which includes the media on which you received it, if any. The terms also Microsoft • updates, • supplements, • Internet-based services, and	d on wh are nam apply to	ere ed o any	
	III SUDDOR SPRICES	Cop	ı V	<i>B</i> Prin
	SQL Server 2016 transmits information about your installation experience, as well as oth performance data, to Microsoft to help improve the product. To learn more about SQL S processing and privacy controls, please see the <u>Privacy Statement</u> .	er usage erver 20	and 16 da	ta

5. In the **Global Rules** dialog box, validate that the checks return successful results and click **Next**.

Ope	ration completed. Passed: 8. Failed 0. Warning 0. Skipped 0.		
-			1
View	de details << / detailed report		Re-ru
	Rule	Status	
	Setup administrator	Passed	
0	Setup account privileges	Passed	
	Restart computer	Passed	
0	Windows Management Instrumentation (WMI) service	Passed	
0	Consistency validation for SQL Server registry keys	Passed	
0	Long path names to files on SQL Server installation media	Passed	
0	SQL Server Setup Product Incompatibility	Passed	
	.NET 2.0 and .NET 3.5 Service Pack 1 update for Windows 2008	Passed	
		Hide details <	Hide details <

6. In the **Microsoft Update** dialog box, click **Next**.



7. In the **Add Node Rules** dialog box, validate that the checks return successful results. If the checks returned a few warnings, make sure you fix them before proceeding with the installation. Click **Next**.

Setup rules identify potential problems that might occur while running Setup. Failures must be corrected before Setup can continue. Product Key License Terms Global Rules Microsoft Update Install Setup Files Add Node Rules Cluster Node Configuration Feature Rules Ready to Add Node Add Node Progress Complete Windows Management Instrumentation (WMI) service (WSFC2 Passed Cluster Node: Configuration Passed Complete Outser Node Complete Distributed Transaction Coordinator (MSDIC) service Distributed Transaction Coordinator (MSDIC) service Microsoft Cluster Service (MSFC2) cluster verification errors Passed Microsoft Cluster Service (MSFC2) cluster verification errors Passed Microsoft Cluster Service (MSFC2) cluster verification errors Mic	Add a Failover Cluster Node			-	D	×
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		Remote registry service (WSFC2016-NODE2))	Passed		-
				1		
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8. In the **Cluster Node Configuration** dialog box, validate that the information for the existing SQL Server 2016 FCI is correct. Click **Next**.

🖀 Add a Failover Cluster Node				-	-	٥	×
Cluster Node Configu Add a node to an existing SQL	ration . Server failover clust	er.					
Product Key License Terms Global Rules Microsoft Update Install Setup Files Add Node Rules Cluster Node Configuration	<u>S</u> QL Server ins N <u>a</u> me of this <u>D</u> isk Space Re	stance name: node: equirements:	MSSQLSERVER WSFC2016-NODE2 Drive C: 1677 MB required, 41	1730 MB available			~
Cluster Network Configuration Service Accounts Feature Rules Ready to Add Node Add Node Progress Complete	Instance Name MSSQLSERVER	Cluster Network Name SQL2016FCI	Features SQLEngine, SQLEngine	Nodes Replic WSFC2016-NODE]		
				< <u>B</u> ack <u>N</u> ext >		Canc	el

9. In the **Cluster Network Configuration** dialog box, validate that the IP address information is the same as the one you provided in the previous section.

roduct Key	Spec	ify the ne	twork set	ttings for this fail	lover cluster:		
icense Terms Iobal Rules		IP Ty	DHCP	Address	Subnet Mask	Subnet(s)	Networ
1icrosoft Update		IPv4		172.16.0.35	255.255.0.0	172.16.0.0/16	LAN
stall Setup Files							
dd Node Rules							
Juster Node Configuration							
luster Notwork Configuration							
uster Network Configuration							
ervice Accounts							
eature Rules							
eady to Add Node							
dd Node Progress							
omplete							

10. In the **Service Accounts** dialog box, verify that the information is the same as what was used to configure the first node. Provide the appropriate credentials for the corresponding SQL Server service accounts.

Service Accounts							
Specify the service accounts a	nd collation configuration.						
Product Key	Microsoft recommends that you use a separate account for each SQL Server service.						
License Terms	Service	Account Name	Password	Startup Typ	e		
Global Rules	SQL Full-text Filter Daemon Launcher	NT Service\MSSQLFDLaun		Manual			
Microsoft Update	SQL Server Database Engine	TESTDOMAIN\sqlservice		Manual			
Install Setup Files	SQL Server Browser	NT AUTHORITY\LOCAL S		Automatic			
Add Node Rules	SQL Server Agent	TESTDOMAIN\sqlservice		Manual			
Service Accounts	This privilege enables instant file ini information disclosure by allowing o	tialization by avoiding zeroing deleted content to be accessed	of data pages. 1	This may lead to			
ervice Accounts eature Rules Leady to Add Node vdd Node Progress Complete	This privilege enables interactions information disclosure by allowing of <u>Click here for details</u>	r ask privilege to Suc Javier i tialization by avoiding zeroing feleted content to be accessed	of data pages. 1	This may lead to			

NOTE: Pay close attention to the order of the SQL Server services especially when you use different service accounts. In the previous section, you see the SQL Server Agent service come before the SQL Server Database Engine service. Here, it's the reverse - the SQL Server Database Engine service comes before the SQL Server Agent service. Be sure not to mix those two up.

Select the checkbox **Grant Perform Volume Maintenance Task privilege to SQL Server Database Engine Service** to enable Instant File Initialization for SQL Server. Because this is a local permission assigned to an account, you need to explicitly do this on all of the nodes in the SQL Server FCI.

Click Next.

11. In the Feature Rules dialog box, verify that all checks are successful. Click Next.



12. In the **Ready to Add Node** dialog box, verify that all configuration settings are correct. Click **Install** to proceed with the installation.

Ready to Add Node	itures to be installed as part of the add node operation.	
Product Key License Terms Global Rules Microsoft Update Install Setup Files Add Node Rules Cluster Node Configuration Cluster Network Configuration Service Accounts Feature Rules Ready to Add Node Add Node Progress Complete	Ready to add this node to the SQL Server 2016 failover cluster: Summary Edition: Enterprise Action: AddNode Prerequisites Hicrosoft NET Framework 4.6 Growth Source Schell 3.0 or higher Microsoft VET Framework 4.6 Growth Source Schell 3.0 or higher Microsoft Vauid Studio 2010 Redistributables General Configuration Features Database Engine Services SQL Server Replication Full-Text and Semantic Extractions for Search Database Engine Services Client Tools Connectivity Instance Name MSSOLSERVER Instance Name MSSOLSERVER Instance Name MSSOLSERVER Configuration file path: C:\Program Files\Microsoft SQL SERVER	

13. In the **Complete** dialog box, click **Close**. This concludes adding a node to an existing SQL Server 2016 FCI.

Your SQL Server 2016 failover	cluster add node operation is complete.			
Product Key	Information about the Setup operation or possible	next steps:		
Sicense terms	Feature	Status		
Siobal Rules	Client Tools Connectivity	Succeeded		
Vicrosoft Update	Oatabase Engine Services	Succeeded		
nstall Setup Files	Oata Quality Services	Succeeded		
Add Node Rules	Full-Text and Semantic Extractions for Search	Succeeded		
Cluster Node Configuration	SQL Server Replication	Succeeded		
Cluster Network Configuration	SOL Browser	Succeeded		
Service Accounts				
astura Pular	Details			
Feature Rules	Details:			
eature Rules Ready to Add Node	Details:		 	
Feature Rules Ready to Add Node Add Node Progress	Details:		 	
Feature Rules Ready to Add Node Add Node Progress C omplete	Details:		 	
Feature Rules Ready to Add Node Add Node Progress C omplete	Details:		 	
Feature Rules Ready to Add Node Add Node Progress Somplete	Details:			
eature Rules Ready to Add Node Add Node Progress Complete	Details:		 	
eature Rules Ready to Add Node Add Node Progress Complete	Details:			
eature Rules Ready to Add Node Add Node Progress Complete	Details: Summary log file has been saved to the following log	pcation:		
eature Rules Ready to Add Node Add Node Progress Complete	Details:	scation: Soststrap)Log\20170411_205053		

To add more nodes to the SQL Server 2016 FCI, simply repeat steps #1 to #13.

At the completion of a successful installation and configuration of the node, you need to validate whether the SQL Server 2016 FCI will failover - either automatically or manually - to all of the available nodes.

About The Author



Edwin M Sarmiento is a Microsoft SQL Server MVP and Microsoft Certified Master from Ottawa, Canada specializing in high availability, disaster recovery and system infrastructures running on the Microsoft server technology stack - ranging from Active Directory to SharePoint and anything in between. He is very passionate about technology but has interests in music, professional and organizational development, leadership and management matters when not working with databases. He lives up to his primary mission statement – "To help people grow and develop their full potential as God has planned for them."

He wants the whole world to know that the FILIPINO is a worldclass citizen and brings JESUS CHRIST to the world.

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