Installing and Configuring a SQL Server 2014 Multi-Subnet Cluster on Windows Server 2012 R2

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Applies to:

- SQL Server 2012
- SQL Server 2014

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Introduction

A SQL Server 2014 multi-subnet failover clustered instance is a configuration where each node of the cluster is connected to a different network subnet or subnets. These network subnets can be in the same location or in a remote site commonly used for disaster recovery. This configuration provides the benefit of having both high availability and disaster recovery solution to meet business' recovery objectives for SQL Server 2014 databases.

This guide is intended for experienced Windows system administrators, IT professionals and SQL Server database administrators who would like to install and configure a 2-node Windows Server 2012 R2 Failover Cluster that will host a SQL Server 2014 multi-subnet failover clustered instance.

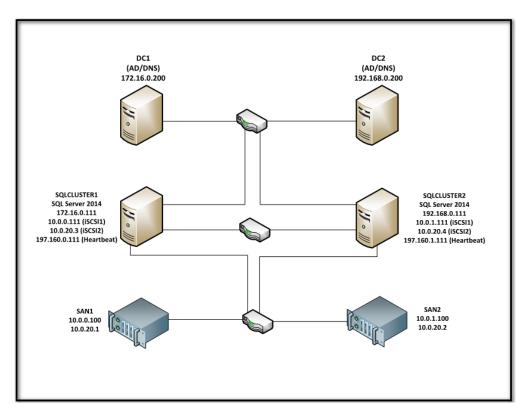
Assumptions

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

- Windows Server 2012 R2 is installed on each server that will be used for the cluster and that they are joined to the same Active Directory domain.
- 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. For demonstration purposes, an iSCSI storage is used in this document; in particular, <u>StarWind Virtual SAN</u>.
- You have decided which quorum model will be used by the failover cluster. This document will use a disk witness as the quorum model.

Network Architecture Design

Proper network architecture design is key to successfully implementing a multi-subnet SQL Server 2014 failover cluster instance. Enlist the help of your network engineers to make sure that your design complies with your corporate standards and done appropriately. Below is the network diagram that will be used to implement the multi-subnet SQL Server 2014 failover clustered instance.



There are two domain controllers - **DC1** and **DC2** - in the same Active Directory domain. The domain controllers are in different network subnets, each on a dedicated Active Directory site and configured for replication. Cluster nodes **SQLCLUSTER1** and **SQLCLUSTER2** have four network adapters - one for production traffic, one for heartbeat communication and two for the iSCSI storage. Technically, there is no shared storage in a multi-subnet cluster because each node will have its own storage subsystem. However, the storage subsystem used by one node is an exact replica of the storage subsystem being used by the other nodes. In the environment described above, storage system **SAN1** is being replicated over to **SAN2** via a TCP/IP connection. A breakdown of the servers, storage systems and IP addresses is shown in the table below.

Hostname	IP Address	Purpose
DC1	172.16.0.100	Domain Controller/DNS Server
DC2	192.168.0.100	Domain Controller/DNS Server
	172.16.0.111	Cluster Node 1 - public traffic
SQLCLUSTER1	197.160.0.111	Heartbeat communication
	10.0.0.111/10.0.20.3	iSCSI communication to SAN1/SAN2
	192.168.0.111	Cluster Node 2 - public traffic
SQLCLUSTER2	197.160.1.111	Heartbeat communication
	10.0.1.111/10.0.20.4	iSCSI communication to SAN1/SAN2
SAN1	10.0.0.100/10.0.20.1	iSCSI communication
SAN2	10.0.1.100/10.0.20.2	iSCSI communication

Active Directory Domain Name: TESTDOMAIN.COM

iSCSI storage primary IP addresses: SAN1 (10.0.0.100 and 10.0.20.1) and SAN2 (10.0.1.100 and 10.0.20.2)

Cluster Nodes: SQLCLUSTER1 & SQLCLUSTER2

Cluster Disks: Q:\, F:\, G:\ & H:\

Windows Server Failover Cluster Name and IP Address: WINMULTISUBCLUS (172.16.0.112 and 192.168.0.112)

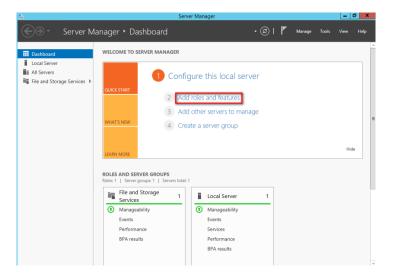
SQL Server Failover Cluster Name and IP Address: SQLCLUSTER (172.16.0.213 and 192.168.0.213)

SQL Server Service Account: TESTDOMAIN\sqlservice

Adding Required Windows Features

In this section, we will add the required Windows features to configure our multi-subnet failover cluster:

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



2. In the **Select Features** dialog box, select the **.NET Framework 3.5 Features** (*select only the .NET Framework 3.5 option*), **Failover Clustering** and the **Multipath I/O** checkboxes and click **Next**.

NOTE: The *.NET Framework 3.5* is a requirement for SQL Server 2014 and is no longer installed by the SQL Server setup process. Even if the *.NET Framework 4.5* is installed by Windows Server 2012 R2, the *.NET Framework 3.5* is not installed with it and has to be explicitly installed.

B	Add Roles and Features Wizard	_ _ ×
Select features		DESTINATION SERVER SQLCLUSTER1.TESTDOMAIN.COM
Before You Begin Installation Type	Select one or more features to install on the selected server.	Description
Server Selection Server Roles Features Confirmation Results		Multipath V(2, along with the Microsoft Device Specific Module (DSM) or a third-party DSM, provides support for using multiple data paths to a storage device on Windows.
	< <u>P</u> revious <u>N</u> ext	> Install Cancel

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

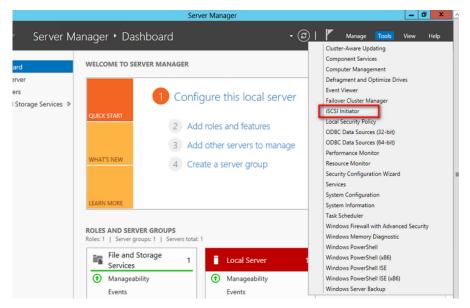
h	Add Roles and Features Wizard	□ ×
Confirm instal	lation selections sqlcluster1 testions	a serve en
A Do you need to spec	cify an alternate source path? One or more installation selections are missing source files on the destinati	×
Before You Begin	To install the following roles, role services, or features on selected server, click Install.	
Installation Type	Restart the destination server automatically if required	
Server Selection	Optional features (such as administration tools) might be displayed on this page because they	have
Server Roles	been selected automatically. If you do not want to install these optional features, click Previous their check boxes.	to clear
Features	their check boxes.	
Confirmation	.NET Framework 3.5 Features	^
Results	.NET Framework 3.5 (includes .NET 2.0 and 3.0)	
Theorem and	Failover Clustering	
	Multipath I/O	
	Remote Server Administration Tools	=
	Feature Administration Tools	
	Failover Clustering Tools Failover Cluster Management Tools	
	Failover Cluster Management 190is	
		\sim
	Export configuration settings	
	Specify an alternate source path	
	< <u>P</u> revious <u>N</u> ext > <u>Install</u>	Cancel

Discovering Target Portals

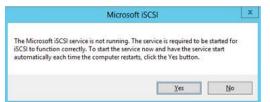
In this section, we will connect the iSCSI storage to the servers that will be added to the cluster.

NOTE: Windows Server 2012 R2 comes with iSCSI Initiator software that enables connection of a Windows host to an external iSCSI storage array using network adapters. You can launch the tool from the **Server Manager** dashboard, under **Tools** and select **iSCSI Initiator**.

These steps have to be performed on both of the servers that will act as nodes in your failover cluster. The steps below are performed on **SQLCLUSTER1**.



You will get a message saying that the Microsoft iSCSI service is not running. Simply click **Yes** to continue.



- 1. In the **iSCSI Initiator Properties** window, select the **Discovery** tab.
- 2. Click the **Discover Portal**... button. The **Discover Target Portal** dialog box appears.

	iSCSI I	nitiator Properties	
rgets Discover	Y Favorite Targets	Volumes and Devices	RADIUS Configuration
Target portals			
	look for <u>T</u> argets on		Rgfresh
Address	Port	Adapter	IP address
-	t portal, click Discove rget portal, select th ve.	er Portal. ne address above and	Discover <u>Portal</u> Remove
ISNS servers The system is r Name	egistered on the foll	owing (SNS servers:	Refresh
The system is r Name To add an ISNS	server, click Add Ser SNS server, select th		Refresh Add Server Remove
The system is r Name To add an ISNS To remove an i	server, click Add Ser SNS server, select th	rver.	Add Server

3. Type in the first IP address of the partner node you will use to connect to the highly available iSCSI devices. For this example, the IP address of **SAN1** is **10.0.0.100**

Discover Targe	et Portal X
Enter the IP address or DNS name and po want to add.	rt number of the portal you
To change the default settings of the disc the Advanced button.	overy of the target portal, click
IP address or DNS name:	Port: (Default is 3260.)
10.0.0.100	3260
Advanced	OK Cancel

Click **Advanced**.

4. Select Microsoft ISCSI Initiator as your Local adapter. Select the Initiator IP in the same subnet as the IP address on the SAN server from the previous step. For this example, the first IP address of SQLCLUSTER1 that communicates to SAN1 is 10.0.0.111.

	Advanced Settings	? X
General IPsec		
Connect using		
Local adapter:	Microsoft iSCSI Initiator	~
Initiator IP:	[10.0.0.111	`
Target portal IP:		~

Click **OK**. Then click **OK** again to close the **Discover Target Portal** dialog box.

- 5. Click the **Discover Portal** button once again. The **Discover Target Portal** dialog appears.
- 6. Type in the second IP address of the partner node you will use to connect to the HA iSCSI devices. For this example, the IP address of **SAN1** is **10.0.20.1**.

Discover Target Portal
Enter the IP address or DNS name and port number of the portal you want to add.
To change the default settings of the discovery of the target portal, dick the Advanced button.
IP address or DNS name: Port: (Default is 3260.) 10.0.20.1 3260
Advanced OK Cancel

Click Advanced.

 Select Microsoft ISCSI Initiator as your Local adapter. Select the Initiator IP in the same subnet as the IP address on the SAN server from the previous step. For this example, the second IP address of SQLCLUSTER1 that communicates to SAN1 is 10.0.20.3.

	Advanced Settings	?)
General IPsec		
Connect using		
Local adapter:	Microsoft iSCSI Initiator	~
Initiator IP:	10.0.20.3	~

Click **OK**. Then click **OK** again to close the **Discover Target Portal** dialog box.

- 8. Repeat the same steps (*steps #1 to #7*) to add **SAN2** to the list of discovered targets. Note the following:
 - 10.0.1.100 and 10.0.20.2 (first and second IP addresses of SAN2, respectively)
 - 10.0.0.111 (first IP address of SQLCLUSTER1 that communicates to the first IP address SAN2)
 - 10.0.20.3 (second IP address of SQLCLUSTER1 that communicates to the second IP address SAN2)

SQLCLUSTER1 should be connected on both SAN1 and SAN2 via the following target portals.

rgets Discovery	Favorite Targets	Volumes and Devices	RADIUS	Configuration
Target portals -				
				Refresh
The system will	look for <u>T</u> argets on fo	blowing portals:		Refresh
The system will Address	look for <u>T</u> argets on fo Port	Adapter		P address
			1	-
Address	Port	Adapter	tor	P address
Address 10.0.0.100	Port 3260	Adapter Microsoft iSCSI Initia	tor	- P address 10.0.0.111

- 9. Repeat the same steps (*steps #1 to #8*) for the second node **SQLCLUSTER2** until all the target portals have been added. Note the following:
 - 10.0.0.100 and 10.0.20.1 (first and second IP addresses of SAN1, respectively)
 - **10.0.1.111** (first IP address of **SQLCLUSTER2** that communicates to **SAN1**)
 - 10.0.20.4 (second IP address of SQLCLUSTER2 that communicates to SAN1)
 - 10.0.1.100 and 10.0.20.2 (first and second IP addresses of SAN2, respectively)
 - **10.0.1.111** (first IP address of **SQLCLUSTER2** that communicates to **SAN2**)
 - 10.0.20.4 (second IP address of SQLCLUSTER2 that communicates to SAN2)

SQLCLUSTER2 should be connected on both **SAN1** and **SAN2** via the following target portals.

	15051111	itiator Properties		
ets Discovery	Favorite Targets	Volumes and Devices	RADIUS	Configuration
arget portals				
	ook for <u>T</u> argets on fo			R <u>e</u> fresh
Address	Port	Adapter	I	– P address
Address			I	-
The system will & Address 10.0.0.100 10.0.20.1	Port	Adapter	I or i	– P address
Address 10.0.0.100	Port 3260	Adapter Microsoft iSCSI Initiat	or 1 or 1	– P address 10.0.0.111

Connecting Targets and Configuring Multipathing

In this section, we will connect the servers to the iSCSI targets and configure multipathing:

NOTE: These steps have to be performed on both of the servers that will act as nodes in your failover cluster. The steps below are performed on **SQLCLUSTER1**.

1. In the **iSCSI Initiator Properties** window, select the **Targets** tab. The iSCSI targets configured should be listed in the **Discovered Targets** section.

iSCSI Initiator Properties	×
Targets Discovery Pavorite Targets Volumes and Devices RADIUS Configuration Quick Connect To discover and log on to a target using a basic connection, type the IP address or DIS name of the target and then dick Quick Connect.	1
Jørget: Quick Connect Discovered largets gefresh	
Name Status on, 2008-08.com.starvindioofhware: 10.0.1.100-ha-data-f Inactive op. 2008-08.com.starvindioofhware: 20.0.1.100-ha-data-f Inactive op. 2008-08.com.starvindioofhware: 20.1.1-ha-data-f Inactive	
To connect using advanced options, select a target and then Cognect dick Connect. To completely disconnect a target, select the target and then dick Disconnect. For target processes, including configuration of sessions, select the target and dick Properties.	
For configuration of devices associated with a target, select Degices the target and then dick Devices.	
OK Cancel App	ly

- 2. Select the first target in the list and click **Connect**.
- 3. Enable both checkboxes. Click **Advanced...**

iSCSI Initiator Properties	x
Targets Discovery Fevorite Targets Volumes and Devices RADIUS Configuration Quek Connect To discover and log on to a larget using a basic connection, type the IP address or DPS name of the target and them click Quek Connect. To discover and log on to a larget using a basic connection, type the IP address or DPS name of the target and them click Quek Connect.	
Target: Quick Connect	
Refresh	
Name Status	
ign. 2008-08.com.starwindsoftware: 10.0.1.100-ha-backup-h Inactive	
ion. 2008-08.com. starwindsoftware: 10.0.1. 100-ha-data-f Inactive	
ign. 2008-08.com.starwindsoftware: 10.0.1.100-ha-log-g Inactive	
ign, 2008-08.com, starwindsoftware: 10.0.1, 100-ha-guorum-g Inactive	
ign, 2008-08.com, starwindsoftware:san1-ha-backup-h Inactive	
ign.2008-08.com.starwindsoftware:san1-ba-data-f Inactive	
ign.2008-08.com.starwindsoftware:san1-ha-log-g Inactive	
ign.2008-08.com.starwindsoftware:san1-ha-ouorum-g Inactive	
iqn.2008-08.com.starwindsontware:san1-na-quorum-q Inacuve	
< 11 >	
To connect using advanced options, select a target and then dick Connect.	1
Connect To Target	
Target name:	
iqn.2008-08.com.starwindsoftware: 10.0.1.100-ha-backup-h	
Add this connection to the list of Favorite Targets. This will make the system automatically attempt to restore the connection every time this computer restarts.	J
Advanced OK Cancel	
OK Cancel Appl	/

4. Select **Microsoft iSCSI Initiator** in the **Local adapter** drop down list.

In the **Initiator IP** drop down list, select the IP address of the server that connects to the corresponding initiator.

In the **Target portal IP** drop down list, select the IP address of the iSCSI Target where the Initiator IP address is mapped to.

NOTE: The selection for **Initiator IP** and **Target portal IP** addresses depend on the iSCSI target selected in Step #2. In this example, the target

iqn.2008-08.com.starwindsoftware:10.0.1.100-ha-backup-h

was selected. This corresponds to the iSCSI Qualified Name (IQN) of **SAN2**. The **Initiator IP** address for **SQLCLUSTER1** (10.0.0.111) is used to connect to **SAN2**.

Click **OK**.

	Advanced Settings	? X
General IPsec		
Connect using		
Local adapter:	Microsoft iSCSI Initiator	×
Initiator <u>I</u> P:	10.0.0.111	~
Target portal IP:	10.0.1.100 / 3260	¥

5. Select the partner target from the other iSCSI target node and click **Connect**. For the iSCSI target selected in Step #2, the partner target is

iqn.2008-08	.com.starwin	ndsoftware:san:	l-ha-backup-h
-------------	--------------	-----------------	---------------

	Connect To Ta	irget	×
Target name:			
ign.2008-08.com.starwin	dsoftware:san1-ha-ba	ackup-h	
Add this connection to This will make the syste connection every time	m automatically atten	pt to restore the	•
Enable multi-path			

- 6. Enable both checkboxes. Click **Advanced...**
- 7. Select **Microsoft iSCSI Initiator** in the **Local adapter** drop down list.

In the **Initiator IP** drop down list, select the IP address of the server that connects to the corresponding initiator.

In the **Target portal IP** drop down list, select the IP address of the iSCSI Target where the Initiator IP address is mapped to.

NOTE: The selection for **Initiator IP** and **Target portal IP** addresses depend on the iSCSI target selected in Step #5. In this example, the target

iqn.2008-08.com.starwindsoftware:san1-ha-backup-h

was selected. This corresponds to the iSCSI Qualified Name (IQN) of **SAN1**. The **Initiator IP** address for **SQLCLUSTER1** (10.0.0.111) is used to connect to **SAN1**.

Click **OK**.

	Advanced Settings	? X
General IPsec		
Connect using		
Local adapter:	Microsoft iSCSI Initiator	¥
Initiator IP:	10.0.0.111	¥
Target portal IP:	10.0.0.100 / 3260	~

8. Repeat the **Steps #1** to **#7** with the Initiator and Target portal IPs of the remaining iSCSI targets together with their corresponding partner targets. The server should now be connected to all provisioned highly available, fault tolerant iSCSI targets. The result should look similar to the one below.

	iSCSI Initiator Properties	2
Targets	Discovery Favorite Targets Volumes and Devices R	ADIUS Configuration
Quick C	onnect	
	over and log on to a target using a basic connection, type me of the target and then dick Quick Connect.	the IP address or
<u>T</u> arget	:	Quick Connect
Discove	red targets	
	-	Refresh
Name		Status
ign.20	108-08.com.starwindsoftware: 10.0. 1. 100-ha-backup-h	Connected
ign.20	108-08.com.starwindsoftware: 10.0. 1. 100-ha-data-f	Connected
ign.20	108-08.com.starwindsoftware: 10.0. 1. 100-ha-log-g	Connected
ign.20	108-08.com.starwindsoftware: 10.0. 1. 100-ha-quorum-q	Connected
ign.20	108-08.com.starwindsoftware:san1-ha-backup-h	Connected
ign.20	08-08.com.starwindsoftware:san1-ha-data-f	Connected
ign.20	108-08.com.starwindsoftware:san1-ha-log-g	Connected
iqn.20	108-08.com.starwindsoftware:san1-ha-quorum-q	Connected
<	ш	>
	nect using advanced options, select a target and then innect.	Connect
To con then d	pletely disconnect a target, select the target and ick Disconnect.	Disconnect
	get properties, including configuration of sessions, the target and click Properties.	Properties
	nfiguration of devices associated with a target, select get and then dick Devices.	De <u>v</u> ices
	OK	Cancel Apply

- 9. Repeat the **Steps #1** to **#8** on **SQLCLUSTER2**.
- 10. Once all targets are connected, launch the MPIO manager from the **Server Manager** dashboard, under **Tools** and select **MPIO**

ħ	Se	rver Manager	_ 0 ×
Server Ma	anager • Dashboard	- ©	Manage Tools View Help
📰 Dashboard	WELCOME TO SERVER MANAGER		Component Services Computer Management
Local Server Il Servers All Servers File and Storage Services ▷	QUICK START 2 AC	igure this local server Id roles and features Id other servers to manage eate a server group	Defagment and Optimize Drives Event Viewer Failower Cluster Manager ISCSI Initiator Local Security Policy MPIO ODBC Data Sources (32-bit) ODBC Data Sources (32-bit) ODBC Data Sources (32-bit) ODBC Data Sources (32-bit) Performance Monitor Resource Monitor Resource Monitor Security Configuration Wizard Services System Configuration
	Roles: 1 Server groups: 1 Servers tota Image: File and Storage Services 1 Image: Group Services 1 Image: Group Service Services 1	Local Server 1	System Information Task Scheduler Windows Firewall with Advanced Security Windows Nemory Diagnostic Windows PowerShell (x88) Windows PowerShell (x88)
	Events Performance	Events Services	Windows PowerShell ISE (x86) Windows Server Backup Activate Windows
	BPA results	Performance BPA results	Go to System in Control Panel to activate Windows.

- 11. In the **MPIO Properties** dialog box, select the **Discover Multi-Paths** tab and enable the **Add support for iSCSI devices** checkbox.
- 12. Click the **Add** button and click **OK**.

MPIO Properties
MPIO Devices Discover Multi-Paths DSM Install Configuration Snapshot
SPC-3 compliant
Device Hardware Id
Add support for ISCSI devices Add support for SAS devices
Add
Others
Device Hardware Id
Add
OK Cancel

Reboot the server to apply the changes. Repeat **Step #10** to **#12** on **SQLCLUSTER2**.

Initialize and Format the Disks

In this section, we will initialize and format the iSCSI disks. You can launch the tool from the **Server Manager** dashboard, under **Tools** and select **Computer Management.**

NOTE: Going thru the disk initialization process is a great way to validate whether or not the storage replication process works as per vendor specification. Disk configuration changes made on one of the cluster nodes should be replicated over to the other nodes within the cluster.

These steps have to be performed on both of the servers that will act as nodes in your failover cluster. The steps below are performed on **SQLCLUSTER1**.

- 1. Expand **Storage** and select **Disk Management**.
- 2. Right-click any of the disks that you want to configure and select **Online**. Once the disk is brought online, it is now marked as **Not Initialized**.

N Performance Bevice Manager	<	II		>
	Disk 0 Basic 20.00 GB Online	C) (C) 350 MB NTFS 19.66 GB NTFS Healthy (System, Active, Primary Partition) Healthy (Boot, Page File, Crash Dump, Primary Partition)		^
	Disk 1 Basic 10.00 GB Online	TEMPDB-LOCAL (T:) 10.00 GB NTFS Healthy (Primary Partition)		=
	Disk 2 Unknown 4.00 GB Offline Online Properties	4.00 GB Unallocated	2	
	Help Offline	Unallocated		

3. To initialize, right-click on the disk and select **Initialize Disk**. The Initialize Disk dialog box will appear.

Performance	<	Ш
 Device Manager Storage Windows Server Backup Disk Management Services and Applications 	Disk 0 Basic 20.00 GB Online	System Reserved 350 MB NTFS Healthy (System, Active, Primary Partition) Healthy (System, Active, Primary Partition)
	Disk 1 Basic 10.00 GB Online	TEMPDB-LOCAL (T.) 10.00 GB NTF5 Healthy (Primary Partition)
	GDi Offlin Unkn	erties

4. In the **Initialize Disk** dialog box, make sure that the correct disk is selected for initialization and then choose whether to initialize the disk using the MBR or GPT partition styles. For this configuration, we will use a **GPT** partition style. Click **OK**.

Initialize Disk	x
You must initialize a disk before Logical Disk Manager can access it. Select disks:	
☑ Disk 2	
Use the following partition style for the selected disks:	
O MBR (Master Boot Record)	
 GPT (GUID Partition Table) 	
Note: The GPT partition style is not recognized by all previous versions of Windows.	
OK Cancel	

6. To create a disk partition, right-click on the unallocated space and select **New Simple Volume**.

⊡Disk 2 Basic	<u> </u>	
3.97 GB Online	3.97 GB Unallocated	New Simple Volume
🐨 Disk 3		New Striped Volume
Unknown 8.00 GB Offline	0.00 CD	New Mirrored Volume
	8.00 GB Unallocated	New RAID-5 Volume
		Properties
🐨 Disk 4		Help

7. In the **Welcome to the New Simple Volume Wizard** dialog box, click **Next**.

 New Simple Volume Wizard
Welcome to the New Simple Volume Wizard
This wizard helps you create a simple volume on a disk. A simple volume can only be on a single disk.
To continue, click Next.
< Back Next > Cancel

8. In the **Specify Volume Size** dialog box, enter the volume size and click **Next**.

New Simp	le Volume Wizard
Specify Volume Size Choose a volume size that is between	the maximum and minimum sizes.
Maximum disk space in MB:	4062
Minimum disk space in MB:	8
Simple volume size in MB:	4052
	< Back Next > Cancel

9. In the **Assign Drive Letter or Path** dialog box, specify the drive letter you would like to use and click **Next**.

Assign the following drive letter: Mount in the following empty NTFS folder: Browse Do not assign a drive letter or drive path	New Simple Volume Wizard Assign Drive Letter or Path For easier access, you can assign a drive letter or drive path to your partition.			
	<u>M</u> ount in the following empty NTFS folde	:		

- 10. In the Format Partition dialog box,
 - Make sure that the file system selected is **NTFS**.
 - To follow Microsoft best practices on allocation unit size, select **64K**.
 - In the Volume label: text box, enter the appropriate name. For this example, F_DATA_Drive is used. Take note of this volume label because this will be used to verify the configuration on the other cluster node.

Click Next

New Simple Volume Wizard						
Format Partition To store data on this partition, you must format it first.						
Choose whether you want to format this volume, and if so, what settings you want to use.						
O Do not format this volume						
 Format this volume with the 	• Format this volume with the following settings:					
File system:	NTFS	~				
Allocation unit size:	64K	¥				
Volume label:	F_DATA_Drive					
 Perform a quick forma 	✓ Perform a quick format					
Enable file and folder compression						
	< Back	Next > Cancel				

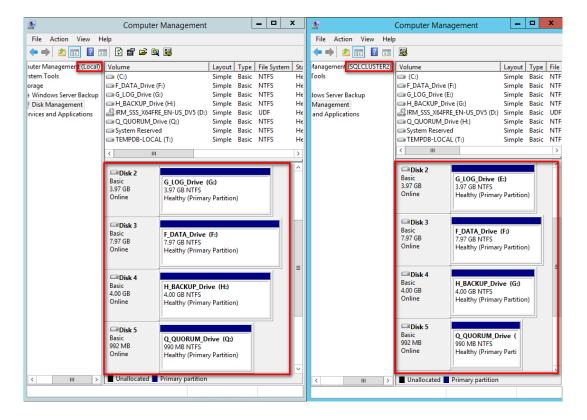
11. In the **Completing the New Simple Volume Wizard** dialog box, review the settings you have made and click **Finish**.

1	New Simple Volume Wizard
	Completing the New Simple Volume Wizard
	You have successfully completed the New Simple Volume Wizard. You selected the following settings: Volume type: Simple Volume Disk selected: Disk 2 Volume size: 4062 MB Dive letter or path: F: File system: NTFS Allocation unit size: 65536 Volume label: F_DATA_Drive Chairck format: Yes To close this wizard, click Finish.
	< Back Finish Cancel

- 12. Repeat **Steps #3** to **#11** on all of the iSCSI disks that you want to configure as part of your cluster.
- 13. Repeat **Step #2** on **SQLCLUSTER2**. No need to initialize the iSCSI disks.

Verify the Storage Replication Process

In this section, we will verify the storage replication process. In order to verify this process, simply bring all of the disks on the other cluster nodes online, as per **Step #2** in the previous section. If the storage replication works, the volume names will be propagated on all of the cluster nodes. In this example, the clustered disks have been named **Q_QUORUM_Drive**, **F_DATA_Drive**, **G_LOG_Drive** and **H_BACKUP_Drive** on **SQLCLUSTER1**. After bringing the disks online on **SQLCLUSTER2**, the same volume properties will appear. The drive letters will not be the same because Windows will assign them from the available drive letters on the server. The drive letters will be removed since they will be defined from within the Windows Server Failover Cluster. A screenshot of the **Disk Management** console for both **SQLCLUSTER1** and **SQLCLUSTER2** is shown below.



This is just a simple way to verify if the storage replication works as expected. Make sure that this verification step has been done and that all potential issues have been addressed prior to moving to the next step.

Running the Failover Cluster Validation Wizard

In this section we 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 **SQLCLUSTER1**.

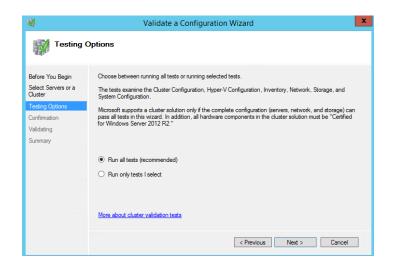
1. In the Failover Cluster Management console, under the Management section, click the Validate Configuration link. This will run the Validate a Configuration Wizard.

월		Failover Cluster Manager			_ 0 ×
<u>File Action View H</u> elp					
♦ ♦					
Hailover Cluster Manager				^	Actions
	 Overview 				Failover Cluster Mana 🔺
	A failover cluster is a set of independ clustered servers (called nodes) are	ent computers that work together to increase the connected by physical cables and by software if	availability of server roles. The		💐 Validate Configuration
	node begins to provide services. This	connected by physical cables and by software. If a process is known as failover.			Create Cluster
					Connect to Cluster
	 Clusters 				View 🕨
	Name	Role Status	Node Status		Q Refresh
					Properties
					<table-cell> Help</table-cell>
		No items found.			
	 Management 			=	
				-	
	are complete, you can manage the c	st validate your hardware configuration, and ther luster. Managing a cluster can include copying ro Server 2012, or Windows Server 2008 R2.	oles to it from a cluster running		
	Vindows Server 2012 R2, Windows	Server 2012, or Windows Server 2008 H2.			
	Create Cluster				
	Connect to Cluster				
	Connect to Clatter				
	 More Information 				
	Failover cluster topics on the Wel	2			
	Fallover cluster communities on th	ne Web			
	Microsoft support page on the We	<u>ab</u>			
	-			~	

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 cluster. Click **Next**.

樹	Va	lidate a Configuration Wizard	X
Select S	ervers or a Cluste	r	
Before You Begin Select Servers or a Cluster		vers, add the names of all the servers. ter, add the name of the cluster or one of its nodes.	
Testing Options Confirmation	Enter name:		Browse
Validating	Selected servers:	SQLCLUSTER1.TESTDOMAIN.COM SQLCLUSTER2.TESTDOMAIN.COM	Add
Summary			Remove
		< Previous Next >	Cancel

3. In the **Testing Options** dialog box, click **Next** to run all the necessary tests to validate whether or not the nodes are OK for clustering.



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

Category	- L
Inventory	_
Inventory	
Inventory	
Inventory	~
Inventory	
	Inventory Inventory Inventory

5. In the **Summary** dialog box, verify that all the report returns successful. Click **Finish** to create the Windows Server Failover Cluster.

N	Validate a Configuration Wizard
Summary	
Before You Begin Select Servers or a Cluster	Testing has completed successfully. The configuration appears to be suitable for clustering. However, you should review the report because it may contain warnings which you should address to attain the highest availability.
Testing Options	
Confirmation	Failover Cluster Validation Report
Validating	
Summary	Node: SQLCLUSTER1.TESTDOMAIN.COM Validated Node: SQLCLUSTER2.TESTDOMAIN.COM Validated
	Inventory
	✓ Create the cluster now using the validated nodes
	To view the report created by the wizard, click View Report. To close this wizard, click Rrish.
	Finish

NOTE: The **Cluster Validation Wizard** may report **Warning** messages pertaining to the network. This is because the iSCSI network is on a dedicated network segment that is not accessible from the public network traffic. You can ignore these warnings. In general, resolve all errors prior to proceeding with the next steps.

Creating the Windows Server 2012 R2 Multi-Subnet Cluster

In this section we will create a Windows Server 2012 R2 Multi-Subnet 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, the Create Cluster Wizard will automatically run after the Failover Cluster Validation Wizard runs the first time.

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 **SQLCLUSTER1**.

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

		Failover Cluster Manager			_ _ ×
File Action View Help					
				_	
📲 Failover Cluster Manager	Failover Cluster Manager			-	Actions
	Create failover clusters, va your failover clusters.	lidate hardware for potential failover clusters, and perf	orm configuration changes to		Failover Cluster Mana Validate Configuration Create Cluster
	 Overview 				Connect to Cluster
	A failover cluster is a set of indep clustered servers (called nodes) a node begins to provide services.	endent computers that work together to increase the a are connected by physical cables and by software. If o	availability of server roles. The ne of the nodes fails, another		View •
	Tidde begins to provide services.	This process is known as failover.			Refresh
	Clusters				Properties
	 Clusters 				🛛 Help
	Name	Role Status	Node Status		
		No items found.			
	 Management 				
	To begin to use failover clustering steps are complete, you can man running Windows Server 2012 R2 Waldate Configuration Create Cluster Connect to Cluster	s, first validate your hardware configuration, and then age the cluster Amaging a cluster can include copy 2. Windows Server 2012, or Windows Server 2008 R2	create a cluster. After these ng roles to it from a cluster		
	More Information			~	

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

4 9		Create Cluster Wizard	X
Select Se	ervers		
Before You Begin Select Servers Access Point for Administering the		e servers that you want to have in the cluster. You must add	
Cluster Confirmation	Enter server name: Selected servers:	SQLCLUSTER1.TESTDOMAIN.COM	Browse
Creating New Cluster Summary		SQLCLUSTER2.TESTDOMAIN.COM	Remove
		< <u>P</u> revious <u>N</u> ext	t > Cancel

3. In the **Access Point for Administering the Cluster** dialog box, enter the Windows Server Failover Cluster virtual hostname and IP addresses that you will use to administer the cluster. Notice that you now have multiple sections for the virtual IP address - one for each subnet. Only assign virtual IP addresses for the production network.

Virtual Server Name	Networks	IP Address
WINMULTISUBCLUS	172.16.0.0/24	172.16.0.112
	192.168.0.0/24	192.168.0.112

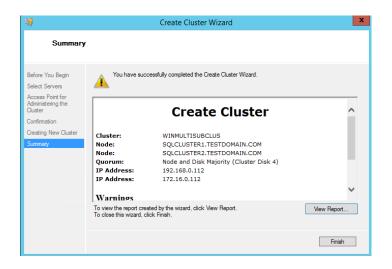
Click Next.

Before You Begin Select Servers Access Point for Administering the Cluster Confirmation	Cluster Name:		ers. One or more IP	v4 addresses could not be configur etwork is selected, and then type a	
Creating New Cluster	Γ	Networks		Address	^
Summary		192.16	58.0.0/24	192.168.0.112	
		197.16	50.0.0/24	Click here to type an address	=
		172.1	6.0.0/16	172.16.0.112	

4. In the **Confirmation** dialog box, click **Next**. This will configure Failover Clustering on both nodes of the cluster, add the configured cluster storage, add Active Directory and DNS entries for the cluster virtual server name.

a		Create Cluster Wizard	X
Confirma	tion		
Before You Begin Select Servers	You are ready to creat The wizard will create	e a cluster. your cluster with the following settings:	
Access Point for Administering the Cluster Corfinnation Creating New Cluster Summary	Cluster: Node: Node: IP Address: IP Address:	WINMULTISUBCLUS SQLCLUSTER1.TESTDOMAIN.COM SQLCLUSTER2.TESTDOMAIN.COM 192.168.0.112 172.16.0.112	Ŷ
	To continue, click Next	L.	
		< <u>P</u> revious <u>N</u> ext >	Cancel

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



NOTE: You may need to configure the cluster storage depending on how the local storage is configured on the server. In this example, the **Create Cluster Wizard** reported a warning because two disks are not configured as clustered storage. Each server is configured with one extra local storage that will be specifically used for the **tempdb** database. Be sure to reconfigure the cluster storage to reflect the configuration you want for your cluster. Also, name the cluster storage properly for proper identification during SQL Server 2014 failover clustered instance installation.

		Fa	ailover Cluster Man	ager					Ŀ	- 0	x
File Action View Help											
🗢 🄿 🙍 🖬 🚺 🖬											
📲 Failover Cluster Manager	Disks (4)							Act	ions		_
MINMULTISUBCLUS.TESTDOMA	Search				P Queri	ies 🔻 🔛	• •	Dis	sks		
Roles	Name 🔺	Status	Assigned To	Owner Node	Disk Number				Add Disk		
⊿ 📇 Storage	F_DATA_DRIVE		Available Storage	SQLCLUSTER1		8.00 GB	in onnatio	-	Move Availa	able Storage	• •
📇 Disks	G_LOG_DRIVE	<u> </u>	Available Storage	SQLCLUSTER1		4.00 GB		<u> </u>	View	one ononage	-
Pools	H_BACKUP_DRIVE	<u> </u>	Available Storage	SQLCLUSTER1		4.00 GB					_
Networks	A Q_QUORUM_DRIVE	<u> </u>	Disk Witness in Quorum			1.00 GB		a	Refresh		
a cluster Events		0			-			?	Help		
								F_C	DATA_DRIV	/E	•
								1	Bring Online	1	
									Take Offline		
								3	Add to Clust	ter Shared	
			11				>		Information	Details	
									Show Critica		
	👻 💐 F_DATA_DRIVE								More Action		•
								-	Remove		
	Volumes (1)								Properties		
	F_DATA_Drive (F:)							_			
	NTFS 7.88 GB free							?	Help		
	NTPS 7.00 GB free	017.37 GB									
< III >											

Tuning Cluster Heartbeat Settings

In this section, we will tune the cluster heartbeat settings for multi-subnet clusters. We will use **Windows PowerShell** to perform the following tasks.

NOTE: The communication between cluster nodes, more commonly known as the "**heartbeat**", needs to be properly configured for the cluster to work efficiently. Inefficient communication between cluster nodes may trigger a false failover, thus, it is necessary to properly tune the heartbeat settings.

There are two major settings that affect heartbeat. First, the frequency at which the nodes send signals to the other nodes in the cluster (subnet delays) and, second, the number of heartbeats that a node can miss before the cluster initiates a failover (subnet threshold). Rarely do we make modifications to these settings in a single-subnet cluster because the default delay and threshold values are tolerable enough for the cluster to handle without initiating a false failover. However, in a multi-subnet cluster, when the cluster nodes are too far away from each other, the communication may take longer and could possibly miss heartbeats. The table below outlines the default values for cluster subnet delays and thresholds.

Heartbeat Parameter	Default value
SameSubnetDelay	1000 (in milliseconds)
SameSubnetThreshold	5 heartbeats
CrossSubnetDelay	1000 (in milliseconds)
CrossSubnetThreshold	5 heartbeats

We need to increase the values for the **CrossSubnetDelay** and **CrossSubnetThreshold** parameters of the Windows Server Failover Cluster.

These steps can be performed on either of the nodes in your failover cluster. The steps below are performed on **SQLCLUSTER1**.

- 1. Open the **Windows PowerShell** console in Administrator mode
- 2. Type the following command. This will change the cross subnet delay value to **3** seconds and the cross subnet threshold value of **7**.

PS C:\> \$cluster = Get-Cluster;
PS C:\> \$cluster.CrossSubnetDelay = 3000;
PS C:\> \$cluster.CrossSubnetThreshold = 7;

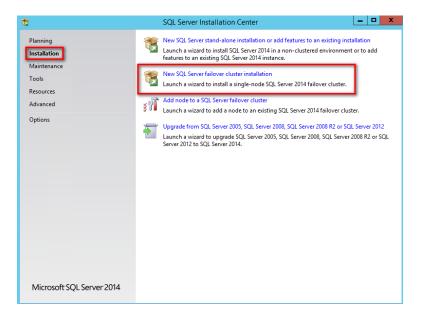
	Administrator: Windows PowerShell	_ D X
<pre>PS C:\> \$cluster = Get-Cluster;</pre>		<u>^</u>
PS C:\> \$cluster.CrossSubnetDelay =	3000;	
PS C:\> \$cluster.CrossSubnetThreshol	d = 7;	
PS C:\> Get-Cluster Format-List *		
Domain	: TESTDOMAIN.COM	
Name	: WINMULTISUBCLUS	
AddEvictDelay	: 60	
AdministrativeAccessPoint	: ActiveDirectoryAndDns	
BackupInProgress	: 0	
ClusSvcHangTimeout	: 60 : 5	
ClusSvcRegroupOpeningTimeout		
ClusSvcRegroupPruningTimeout		
ClusSvcRegroupStageTimeout	: 5	
ClusSvcRegroupTickInMilliseconds	: 300	
ClusterGroupWaitDelay	: 120	
MinimumNeverPreemptPriority	: 3000	
MinimumPreemptorPriority	: 1	
ClusterEnforcedAntiAffinity	: 0	
ClusterLogLevel	: 3	
ClusterLogSize	: 300	
CrossSubnetDelay	: 3000	
CrossSubnetThreshold	: 7	
DefaultNetworkRole	: 2	
Description		
FixQuorum	: 0	
WitnessDynamicWeight		
HangRecoveryAction		
IgnorePersistentStateOnStartup	: 0	
LogResourceControls	: 0	
PlumbAllCrossSubnetRoutes	: 0	
PreventQuorum	: 0	
QuorumArbitrationTimeMax	: 20	
RequestReplyTimeout	: 60	
RootMemoryReserved	: 4294967295	
RouteHistoryLength	: 10	
SameSubnetDelay	: 1000	
SameSubnetThreshold		
SecurityLevel	: 1	
SharedVolumeCompatibleFilters	: {}	
SharedVolumeIncompatibleFilters	: Ŏ	

This now changes the behavior of the cluster heartbeat to be more tolerable across multiple subnets.

Install SQL Server 2014 on a Multi-Subnet Failover Cluster

In this section, we will install SQL Server 2014 failover clustered default instance on a multi-subnet Windows Server Failover Cluster. We will run the installation process on the first node of our cluster, **SQLCLUSTER1**.

- 1. Run **setup.exe** from the SQL Server 2014 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 2014 Setup wizard



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

1	Install a SQL Server Failover Cluster	x
Product Key Specify the edition of SQL Se Product Key License Terms Global Rules Microsoft Update Product Update Install Setup Files Install Setup Files Install Failover Cluster Rules Setup Role Feature Selection Feature Configuration Rules Ready to Install Installation Progress Complete		×
	< Back Next > Cancel	-

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

1	Install a SQL Server Failover Cluster
License Terms To install SQL Server 2014, y	ou must accept the Microsoft Software License Terms.
Product Key License Terms Global Rules Microsoft Update	MICROSOFT SOFTWARE LICENSE TERMS MICROSOFT SQL SERVER 2014 ENTERPRISE SERVER/CAL EDITION
Product Updates Install Setup Files Install Failover Cluster Rules	These license terms are an agreement between Microsoft Corporation (or based on where you live, one of its affiliates) and you. Please read them. They apply to the software named above, which includes the media on which you received it, if any. The terms also apply to any Microsoft • updates,
Setup Role Feature Selection Feature Rules Feature Configuration Rules	supplements, Copy Prince
Ready to Install Installation Progress Complete	✓ I accept the license terms. ☐ Turn on Customer Experience Improvement Program ("CEIP") and Error Reporting to help improve the quality, reliability and performance of Microsoft SQL Server 2014.
	See the Microsoft SQL Server 2014 Privacy Statement for more information. * Microsoft SQL Server 2014 also includes a Visual Studio component that will have CEIP settings turned off by default. If Visual Studio is installed, this component will use the CEIP settings for Visual Studio.
	< Back Next > Cancel

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

Global Rules			
Global Kules			
Setup Global Rules identify corrected before Setup can o		nstall SQL Server Setup support files.	Failures must be
Product Key	Operation completed. Passed: 8.	Failed 0. Warning 0. Skipped 0.	
License Terms			
Global Rules			
Microsoft Update	Hide details <<		Re-r
Product Updates	View detailed report		
nstall Setup Files			
nstall Failover Cluster Rules	Rule		Status
Setup Role	Setup administrator		Passed
Feature Selection	Setup account privileges		Passed
Feature Rules	Restart computer		Passed
Feature Configuration Rules	🥝 Windows Management Instr	umentation (WMI) service	Passed
Ready to Install	Consistency validation for SC	L Server registry keys	Passed
nstallation Progress	Long path names to files on	SQL Server installation media	Passed
Complete	SQL Server Setup Product Inc	ompatibility	Passed
	NET 2.0 and .NET 3.5 Service	Pack 1 update for Windows 2008	Passed
			L

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

5	Install a SQL Server Failover Cluster
Microsoft Update	
Use Microsoft Update to chee	ck for important updates
Product Key License Terms Global Rules Microsoft Update Product Updates Install Setup Files Install Fallover Cluster Rules Setup Role Feature Selection Feature Configuration Rules Ready to Install Installation Progress Complete	Microsoft Update offers security and other important updates for Windows and other Microsoft software, including SQL Server 2014. 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
	< <u>B</u> ack <u>N</u> ext > Cancel

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**.

1	Install a SQL Server Failover Cluster	_ _ ×
Install Failover Cluster	Rules	
Setup rules identify potential can continue.	problems that might occur while running Setup. Failures must be correc	ted before Setup
Product Key	Operation completed. Passed: 19. Failed 0. Warning 4. Skipped 0.	
License Terms		
Global Rules		
Microsoft Update	Hide details <<	Re-run
Install Setup Files	View detailed report	
Install Failover Cluster Rules		
Setup Role	Rule	Status ^
Feature Selection	Microsoft .NET Application Security	Warning
Feature Rules	Network binding order	Passed
Feature Configuration Rules	🔥 Windows Firewall	Warning
Ready to Install	Ø DNS settings (SQLCLUSTER1)	Passed
Installation Progress	WOW64 setup	Passed
Complete	Block install when Microsoft SQL Server 2014 CTP1 is present.	Passed
	Windows Management Instrumentation (WMI) service (SQLCL	Passed
	Cluster Remote Access (SQLCLUSTER2)	Passed
	Sistributed Transaction Coordinator (MSDTC) installed (SQLCL	
	Remote registry service (SQLCLUSTER2)	Passed
	ONS settings (SQLCLUSTER2)	Passed V
		·
	< Back Next >	Cancel Help

8. In the **Setup Role** dialog box, select the **SQL Server Feature Installation** option and click **Next**.

1	Install a SQL Server Failover Cluster
Setup Role Click the SQL Server Feature In: feature role to install a specific	stallation option to individually select which feature components to install, or click a configuration.
Product Key License Terms Global Rules Microsoft Update Install Setup Files Install Failover Cluster Rules Setup Role Feature Selection Feature Rules Feature Configuration Rules Ready to Install Installation Progress Complete	 SQL Server Feature Installation Install SQL Server Database Engine Services, Analysis Services, Reporting Services, Integration Services, and other features. SQL Server PowerPivot for SharePoint Install PowerPivot for SharePoint on a new or existing SharePoint server to support PowerPivot data access in the farm. Optionally, add the SQL Server relational database engine to use as the new farm's database server. Add SQL Server Database Relational Engine Services to this installation.
	< Back Next > Cancel Help

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

1	Install a SQL Server Failover Cluster
Feature Selection	
Select the Enterprise features to	install.
Product Key License Terms Global Rules Microsoft Update Install Setup Files Install Failover Cluster Rules Setup Role Feature Selection Feature Rules Instance Configuration Cluster Resource Group Cluster Disk Selection Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete	Eeatures: Feature description: Instance Features: The configuration and operation of each instance feature of a SQL Server instances. SQL Server inst
	< <u>B</u> ack Next > Cancel Help

10. 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**.

1	Install a SQL Server Failover Cluster	_ 🗆 X
Feature Rules		
Feature rules identify problem:	that might block this setup operation based on the features selected.	
Product Key	Operation completed. Passed: 3. Failed 0. Warning 0. Skipped 0.	
License Terms		
Global Rules		
Microsoft Update	Hide details <<	Re-run
Install Setup Files	View detailed report	
Install Failover Cluster Rules		
Setup Role	Rule Status	
Feature Selection	Cluster supported for edition Passed	
Feature Rules	Prior Visual Studio 2010 instances requiring update. Passed	
Instance Configuration	Microsoft .NET Framework 3.5 Service Pack 1 is required Passed	
Cluster Resource Group		
Cluster Disk Selection		
Cluster Network Configuration		
Server Configuration		
Database Engine Configuration		
Feature Configuration Rules		
Ready to Install		
Installation Progress		
Complete		
	< Back Next > Cancel	Help

11.In the **Instance Configuration** dialog box, enter the following details:

- SQL Server Network Name: SQLCLUSTER
- Instance ID: MSSQLSERVER

1	Install a SQI	L Server Failov	er Cluster			x
Instance Configuration						
Specify the name and instance	ID for the instance of SQL Ser	ver. Instance ID be	ecomes part of	the installation pat	h.	
Product Key License Terms	Specify a network name for your failover cluster on the r		er failover clust	ter. This will be the	name used to identi	fy
Global Rules	SQL Server Net <u>w</u> ork Name:	SQLCLUSTER				
Microsoft Update Install Setup Files	• <u>D</u> efault instance					
Install Failover Cluster Rules Setup Role	O Named instance:	MSSQLSERVER				
Feature Selection Feature Rules	Instance ID:	MSSQLSERVER	-			
Instance Configuration			-			
Cluster Resource Group Cluster Disk Selection	SQL Server directory:	C:\Program Files	\Microsoft SQL	Server\MSSQL12.M	ASSQLSERVER	
Cluster Network Configuration	Detected SQL Server instance	es and <u>f</u> eatures or	n this computer	:		
Server Configuration Database Engine Configuration	Instance Cluster	Network Name	Features	Edition	Version	Inst
Feature Configuration Rules						
Ready to Install Installation Progress						
Complete	<		Ш			>
			< <u>B</u> ack	<u>N</u> ext >	Cancel H	elp

12.In the **Cluster Resource Group** dialog box, check the resources available on your Windows Server Failover Cluster. This tells you that a new Resource Group will be created on your cluster for the SQL Server instance. 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**.

1		Install a SQL Server Fa	ilover Cluster
Cluster Resource Grou	р		
Create a new cluster resource	group for your	r SQL Server failover cluster.	
Product Key License Terms Global Rules Microsoft Update Install Setup Files	failover clu or enter a r		
Install Failover Cluster Rules Setup Role Feature Selection Feature Rules Instance Configuration Cluster Resource Group	Qualified (E) (E)	Name Available Storage Cluster Group	Message The cluster group 'Available Storage' is reserved by Windows Fai The cluster group 'Cluster Group' is reserved by Windows Failov
Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress			
Complete			< Back Next > Cancel Help

12. In the **Cluster Disk Selection** dialog box, select the available disk groups that are on the cluster for SQL Server 2014 to use. Click **Next**.

1		Install a SQL S	erver Failover Cluster
Cluster Disk Selection			
Select shared cluster disk resour	ces for your S	QL Server failover o	luster.
Product Key License Terms Global Rules Microsoft Update Install Setup Files Install Failover Cluster Rules Setup Role	used as the	default drive for al nfiguration pages. _DRIVE DRIVE	included in the SQL Server resource cluster group. The first drive will be I databases, but this can be changed on the Database Engine or Analysis
Feature Selection Feature Rules	Available sh	ared disks:	
Instance Configuration Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Rules	Qualified	Disk F_DATA_DRIVE G_LOG_DRIVE H_BACKUP_DRI Q_QUORUM_D	Message The disk resource 'Q_QUORUM_DRIVE' cannot be used because it is a clust
Ready to Install Installation Progress Complete			Refresh
			< Back Next > Cancel Help

13. In the **Cluster Network Configuration** dialog box, enter the virtual IP address and subnet mask that the SQL Server 2014 cluster will use. Notice that the setup process has detected the existence of multiple network subnets. These are the names of the network adapters that have been defined in the Windows Server 2012 R2 Failover Cluster. Since the installation is performed on a cluster node that belongs to one of the network subnets, only that option will be available. The other option to assign a virtual IP address will be made available when the Add Node option is selected to install an additional node in the cluster.

We will be using the following information for the SQL Server failover cluster instance.

Virtual Server Name	Networks	IP Address
SQLCLUSTER	172.16.0.0/24	172.16.0.213
	192.168.0.0/24	192.168.0.213

Select the checkbox beside the IPv4 column as a static IP addresses will be used. Click **Next**.

Ĵ.		I	nstall a	SQL Server F	ailover Cluster		
Cluster Network Confi	gura	tion					
Select network resources for yo	our SQL	Server fai	lover clu	ster.			
Product Key	Spec	ify the ne	twork se	ttings for this fail	over cluster:		
License Terms		IP Type		Address	Subnet Mask	Subnet(s)	Network
Global Rules		IPv4		172.16.0.213	255.255.0.0	172.16.0.0/16	LAN-DC1
Microsoft Update		IPv4			255,255,255,0	192,168,0.0/24	LAN-DC2
Install Setup Files		16.64			233,233,233,0	152,100,0,0/24	LANDUZ
Install Failover Cluster Rules							
Setup Role							
Feature Selection							
Feature Rules							
Instance Configuration							
Cluster Resource Group							
Cluster Disk Selection							
Cluster Network Configuration							
Server Configuration							
Database Engine Configuration							
Feature Configuration Rules							
Ready to Install							
nstallation Progress							
Complete							Refresh
					< Back	Next > Cancel	Help

NOTE: The network adapter settings that will be displayed in this dialog box will depend on how the cluster network adapters are configured. Be sure to configure the iSCSI network adapters with the **Do not allow cluster network communication on this network** option.

- 14.In the **Server Configuration** dialog box, use the following 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 Windows Server Failover Cluster will take care of stopping and starting the service. Also, set the **Collation** property for the instance according to your application requirement.
 - **SQL Server Agent:** TESTDOMAIN\sqlservice
 - SQL Server Database Engine: TESTDOMAIN\sqlservice

Server Configuration					
Specify the service accounts and	d collation configuration.				
Product Key	Service Accounts Collation				
License Terms					
Global Rules	Microsoft recommends that you use	a separate account for each	SQL Server servi	ce.	
Microsoft Update	Service	Account Name	Password	Startup Type	
nstall Setup Files	SQL Server Agent	TESTDOMAIN\sqlservice	•••••	Manual	~
nstall Failover Cluster Rules	SQL Server Database Engine	RESRDOMAIN\sqlservice	•••••	Manual	Y
Setup Role	SQL Full-text Filter Daemon Launc	NT Service\MSSQLFDLa		Manual	
Feature Selection	SQL Server Browser	NT AUTHORITY\LOCAL		Automatic	~
Feature Rules					
nstance Configuration					
Cluster Resource Group					
Cluster Disk Selection					
Cluster Network Configuration					
-					
Server Configuration					
Server Configuration					
Server Configuration Database Engine Configuration Feature Configuration Rules					
Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install					
Cluster Network: Configuration Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete					

Click Next.

15.In the **Database Engine Configuration** dialog box, select the appropriate **Authentication Mode** in the **Server Authentication** tab. If you want to add the currently logged on user to be a part of the SQL Server administrators group, click the **Add Current User** button. Otherwise, you can add the appropriate domain accounts or security groups.

1	Install a SQL Server Failover Cluster	×
Database Engine Confi	guration	
Specify Database Engine authe	ntication security mode, administrators and data directories.	
Product Key	Server Configuration Data Directories FILESTREAM	
License Terms Global Rules	Specify the authentication mode and administrators for the Database Engine.	
Microsoft Update	Authentication Mode	-
Install Setup Files	Windows authentication mode	
Install Failover Cluster Rules	 Mixed Mode (SQL Server authentication and Windows authentication) 	
Setup Role		
Feature Selection	Specify the password for the SQL Server system administrator (sa) account.	-
Feature Rules	Enter password:	1
Instance Configuration	Confirm password:	i.
Cluster Resource Group	Contrim password:	_
Cluster Disk Selection	Specify SQL Server administrators	-
Cluster Network Configuration	TESTDOMAIN\administrator (Administrator) SQL Server administrators]
Server Configuration	have unrestricted access	
Database Engine Configuration	to the Database Engine.	
Feature Configuration Rules		
Ready to Install		
Installation Progress	Add Current User Add Remove	
Complete		
	< Back Next > Cancel Help	

In the Data Directories tab, enter the following

- Data root directory: F:\
- User database directory: F:\SQLSERVER\MSSQL\Data
- User database log directory: G:\SQLSERVER\MSSQL\Data

- Temp DB directory: T:\SQLSERVER\MSSQL\Data
- **Temp DB log directory:** T:\SQLSERVER\MSSQL\Data
- Backup directory: H:\SQLSERVER\MSSQL\Backup

1	Install a SQL Se	erver Failover Cluster	x
Database Engine Confi	guration		
Specify Database Engine auther	tication security mode, administr	ators and data directories.	
Product Key	Server Configuration Data Di	rectories FILESTREAM	
License Terms			
Global Rules	Data root directory:	F:\	
Microsoft Update	System database directory:	F:\MSSQL12.MSSQLSERVER\MSSQL\Data	
Install Setup Files	User database directory:	F:\SQLSERVER\MSSQL\Data	
Install Failover Cluster Rules	<u>o</u> ser adabase anceanyr		
Setup Role	User database log directory:	G:\SQLSERVER\MSSQL\Data	
Feature Selection	Temp DB directory:	T:\SQLSERVER\MSSQL\Data	
Feature Rules			=
Instance Configuration	Temp DB log directory:	T:\SQLSERVER\MSSQL\Data	
Cluster Resource Group	Backup directory:	H:\SQLSERVER\MSSQL\Backup	
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 Help	

NOTE: Introduced in SQL Server 2012 is the option to store the **tempdb** database on a local drive instead of a clustered drive. Should you decide to do so, you will get prompted to make sure that all of the nodes in the cluster contain the same directory structure and that the SQL Server service account has read/write permissions on those folders.

	Install a SQL Server Failover Cluster
?	You have specified a local directory Tr\SQLSERVER\MSSQL\Data as the tempdb data or log directory for a SQL Server duster. To avoid possible failures during a failover, you must make sure that the same directory exists on each cluster node and grant read/write permission to SQL server service.
8	Yes No

16.In the **Feature Configuration Rules** dialog box, click **Next**.

Setup is running rules to determine if the failover cluster installation operation will be blocked. For more information, click Help. Product Key License Terms Global Rules Microsoft Update Install Setup Files Install Setup Files Install Setup Fole Feature Selection Feature Rules Instance Configuration Cluster Resource Group Cluster Resource Group Cluster Network Configuration Setup Ionall Install Setup Files Instance Configuration Cluster Resource Group Cluster Resource Group Cluster Network Configuration Setup Ionall Install Setup Files Install Setup Files Instance Configuration Cluster Network Configuration Server Configuration Database Engine Configuration Ready to Install Installation Progress Complete Complete	1	Install a SQL Server Failover Cluster	Ŀ	- 🗆 X
Help. Product Key License Terms Operation completed. Passed: 2. Failed 0. Warning 0. Skipped 0. Global Rules Microsoft Update Microsoft Update Hide details < Install Setup Files View detailed report Install Failover Cluster Rules Status Setup Role Rule Feature Selection FAT32 File System Feature Rules Oluster Resource DLL Update Restart Check Instance Configuration Cluster Resource DLL Update Restart Check Cluster Network Configuration Server Configuration Server Configuration Server Configuration Database Engine Configuration Fasture Configuration Ready to Install Installation Progress Complete Complete	Feature Configuration	Rules		
License Terms Global Rules Microsoft Update Install Setup Files Setup Role Feature Selection Feature Rules Instance Configuration Cluster Resource Group Cluster Orisik Selection Cluster Resource Group Cluster Configuration Server Configuration Database Engine Configuration Feature Configuration Feature Configuration Ready to Install Installation Progress Complete		nine if the failover cluster installation operation will be blocked	For more information, click	
Clobal Rules Re-run Microsoft Update Hide details < Re-run Install Setup Files View detailed report Install Failover Cluster Rules Setup Role Rule Status Feature Selection Ø FAT32 File System Passed Feature Rules Ø Cluster Resource DLL Update Restart Check Passed Instance Configuration Cluster Resource DLL Update Restart Check Passed Cluster Network Configuration Server Configuration Server Configuration Database Engine Configuration Server Configuration Server Configuration Ready to Install Installation Progress Unstall Installation Progress Unstall Installation Progress Complete View Configuration Setup Complete Setup Complete Setup Complete	Product Key	Operation completed. Passed: 2. Failed 0. Warning 0. Skip	ped 0.	
Microsoft Update Hide details << Re-run Install Setup Files View detailed report Install Failover Cluster Rules Setup Role Feature Selection Feature Rules Instance Configuration Cluster Resource DLL Update Restart Check Passed Cluster Resource DLL Update Restart Check Passed Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration Feature F	License Terms			
Install Setup Files View detailed report Install Setup Files View detailed report Install Setup Files View detailed report Setup Role Feature Selection Feature Rules Instance Configuration Cluster Resource Group Cluster Resource Group Cluster Disk Selection Server Configuration Server Configuration Feature	Global Rules			
Install Failover Cluster Rules Setup Role Feature Selection Feature Rules Instance Configuration Cluster Resource DLL Update Restart Check Passed Cluster Resource Group Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Feature Configuration Facture Configuration Ready to Install Installation Progress Complete	Microsoft Update	Hide details <<		Re-run
Setup Role Rule Status Feature Selection Image: Configuration Passed Feature Rules Cluster Resource DLL Update Restart Check Passed Instance Configuration Cluster Resource Group Cluster Resource Group Cluster Network Configuration Sterver Configuration Passed Server Configuration Database Engine Configuration Feature Configuration Feature Configuration Feature Configuration Feature Configuration Ready to Install Installation Progress Complete	Install Setup Files	View detailed report		
Secury Note Data Feature Selection Image: FAT32 File System Passed Feature Rules Image: Cluster Resource DLL Update Restart Check Passed Instance Configuration Cluster Resource DLL Update Restart Check Passed Cluster Network Configuration Cluster Resource OLL Update Restart Check Passed Cluster Network Configuration Server Configuration Server Configuration Database Engine Configuration Feature Configuration Server Configuration Feature Configuration Feature Configuration Server Configuration Ready to Install Installation Progress Complete	Install Failover Cluster Rules			
Feature Rules Image: Cluster Resource DLL Update Restart Check Passed Instance Configuration Cluster Resource DLL Update Restart Check Passed Cluster Disk Selection Cluster Resource DLL Update Restart Check Passed Cluster Network Configuration Server Configuration Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete Server Complete	Setup Role	Rule	Status	
Instance Configuration Luster Network Configuration Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Ready to Install Installation Progress Complete	Feature Selection	FAT32 File System	Passed	
Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete	Feature Rules	Cluster Resource DLL Update Restart Check	Passed	
Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete	Instance Configuration			
Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete	Cluster Resource Group			
Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete	Cluster Disk Selection			
Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete	Cluster Network Configuration			
Feature Configuration Rules Ready to Install Installation Progress Complete	Server Configuration			
Ready to Install Installation Progress Complete	Database Engine Configuration			
Installation Progress Complete	Feature Configuration Rules			
Complete	Ready to Install			
	Installation Progress			
	Complete			
< Back Next > Cancel Help		< Back	Next > Cancel	Help

17.In the **Ready to Install** dialog box, verify that all configurations are correct. Click **Next**.

1	Install a SQL Server Failover Cluster	1
Ready to Install Verify the SQL Server 2014 feat	ures to be installed.	
Product Key License Terms Global Rules Microsoft Update Install Setup Files Install Failover Cluster Rules Setup Role Feature Selection Feature Rules Instance Configuration Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress	Ready to install the SQL Server 2014 failover cluster: Summary - Edition: Enterprise - Action: InstallFailoverCluster - Prerequisites - Already installed: - Microsoft .NET Framework 3.5 - Microsoft Visual Studio 2010 Redistributables - Microsoft Visual Studio 2010 Redistributables - Microsoft Visual Studio 2010 Shell - Database Engine Services - SQL Server Replication - Full-Text and Semantic Extractions for Search - Ditabase Engine Services - SQL Server Replication - Client Tools Connectivity - Microsoft Tools Connectivity - Configuration file path:	
Complete	C:\Program Files\Microsoft SQL Server\120\Setup Bootstrap\Log\20140818_230558\ConfigurationFile.ini < Back	

14. Once the installation finishes, in the **Complete** dialog box, click **Close**.

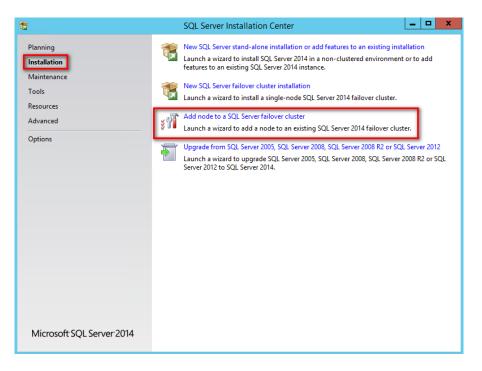
1	Install a SQL Server Failover Clu	uster 📃 🗖 🗙
Complete Your SQL Server 2014 failover o	luster installation is complete.	
Product Key License Terms Global Rules Microsoft Update	Information about the Setup operation or possible r Feature Management Tools - Complete Client Tools Connectivity	Status A Succeeded
Install Setup Files Install Failover Cluster Rules Setup Role Feature Selection Feature Rules	 Management Tools - Basic Database Engine Services Data Quality Services Full-Text and Semantic Extractions for Search 	Succeeded Succeeded Succeeded Succeeded V
Instance Configuration Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Rules	Details: Viewing Product Documentation for SQL Sc Only the components that you use to view and been installed. By default, the Help Viewer com SQL Server, you can use the Help Library Mani your local computer. For more information, see (< <u>http://go.microsoft.com/fwlink/?LinkID=29957</u>	manage the documentation for SQL Server have apponent uses the online library. After installing ager component to download documentation to Use Microsoft Books Online for SQL Server
Ready to Install Installation Progress Complete	Summary log file has been saved to the following lo <u>C\Program Files\Microsoft SQL Server\120\Setup B</u> \ <u>Summary SQLCLUSTER1 20140818 230558.txt</u>	

Adding a Node on a SQL Server 2014 Multi-Subnet Cluster

In this section, we will add a node to the SQL Server 2014 failover clustered default instance on a multi-subnet Windows Server Failover Cluster. We will run the installation process on the second node of the cluster, **SQLCLUSTER2**.

To add a node on a SQL Server 2014 multi-subnet failover clustered instance:

- 1. Run **setup.exe** from the installation media to launch SQL Server Installation Center.
- 2. 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 2014 Setup wizard.



- 3. In the **Product Key** dialog box, enter the product key that came with your installation media and click **Next**.
- 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**.
- 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**.
- 8. In the **Cluster Node Configuration** dialog box, validate that the information for the existing SQL Server 2014 failover clustered instance is correct. Click **Next**.

1		Add a Faile	over	Cluster Node			_ 🗆 X
Cluster Node Configur	ation						
Add a node to an existing SQL S	Server failover cluste	r.					
Product Key License Terms Global Rules Microsoft Update Install Setup Files Add Node Rules Cluster Node Configuration	<u>S</u> QL Server inst N <u>a</u> me of this n <u>D</u> isk Space Req	ode:	SQLO	QLSERVER CLUSTER2 e C: 2851 MB requir	red, 10915 MB available	e	
Cluster Network Configuration Service Accounts Feature Rules Ready to Add Node Add Node Progress Complete	Instance Name MSSQLSERVER	Cluster Network Name SQLCLUSTE	R	Features SQLEngine, SQ	Nodes SQLCLUSTER1]	
				< <u>B</u> ack	<u>N</u> ext >	Cancel	Help

9. In the Cluster Network Configuration dialog box, enter the virtual IP address and subnet mask that the SQL Server 2014 failover cluster instance will use in the network subnet that the second node is in - 192.168.0.213. Notice that the setup process also detected the existence of two network subnets. Since the virtual IP address for the 172.16.0.0/16 subnet has already been configured, that option has been disabled.

NOTE: A message box that gives you a brief explanation of how the OR logic dependency works will be displayed. Click the **Yes** button in the message box. Click **Next**.

5			Ado	d a Failover Clu	uster Node		_ 🗆 ×
Cluster Network Specify additional IP Server failover cluster	addresses	that are availab			t node and subnet	previously-configured SQL	
Product Key License Terms		Specify the n	etwork se	ttings for this faile	over cluster:		
Global Rules		✓ IP Type	DHCP	Address	Subnet Mask	Subnet(s)	Network
Microsoft Update		✓ IPv4		192.168.0.213	255.255.255.0	192.168.0.0/24	LAN-DC2
Install Setup Files		✓ IPv4		172.16.0.213	255.255.0.0	172.16.0.0/16	LAN-DC1
Add Node Rules							
Cluster Node Configurati							
Cluster Network Config				Add a Fai	lover Cluster No	de	
Service Accounts						ause of this, Setup sets the If	
Feature Rules	6					nulti-subnet failover clustering ards fail on the node that own	
Ready to Add Node						tions on a subnet when client SOL Server multi-subnet failo	
Add Node Progress		cluster configu					
Complete							
	E a					Yes	No
L							
							D.C.L
		🔔 SQL Serv	er Setup	detected that ther	e are multiple subn	ets. Because of this, Setup se	Refresh ts the IP address re
					< Back	Next > Cancel	Help

10. In the **Service Accounts** dialog box, verify that the information is the same as what was used to configure the first node. Click **Next**.

Î	Add a Failover Cl	uster Node			×
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 Type	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 SE		Automatic	~
Add Node Rules	SQL Server Agent	TESTDOMAIN\sqlservice	•••••	Manual	
Cluster Node Configuration					
Cluster Network Configuration					
cluster Network Configuration					
-					
Service Accounts Feature Rules					
Service Accounts					
Service Accounts Feature Rules Ready to Add Node					
Service Accounts Feature Rules Ready to Add Node Add Node Progress					
Service Accounts Feature Rules Ready to Add Node Add Node Progress					
Service Accounts Feature Rules Ready to Add Node Add Node Progress					
Service Accounts Feature Rules Ready to Add Node Add Node Progress					
Service Accounts Feature Rules					
Service Accounts Feature Rules Ready to Add Node Add Node Progress					
Service Accounts Feature Rules Ready to Add Node Add Node Progress					
Service Accounts Feature Rules Ready to Add Node Add Node Progress					

- 11. In the **Feature Rules** dialog box, click **Next**.
- 12. In the **Ready to Add Node** dialog box, verify that all configurations are correct and click **Install**.
- 13. Once the installation finishes, in the **Complete** dialog box, click **Close**. This concludes adding a node to a SQL Server 2014 Multi-Subnet Cluster.

1	Add a Failover Cluster Nod	le 📃 🗖 🗙
Complete Your SQL Server 2014 failover	cluster add node operation is complete.	
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	Information about the Setup operation or possible of Feature Management Tools - Complete Client Tools Connectivity Management Tools - Basic Database Engine Services Data Quality Services Full-Text and Semantic Extractions for Search Details: Viewing Product Documentation for SQL S Only the segment that you up to jour on the	Status A Succeeded E Succeeded Succeeded Succeeded Succeeded Succeeded V
Complete	been installed. By default, the Help Viewer con	nponent uses the online library. After installing lager component to download documentation to Use Microsoft Books Online for SQL Server (8>).

NOTE: When storing the **tempdb** database in a local drive instead of a clustered drive, be sure that:

- The same drive letter and folder structure exists in all of the nodes in the cluster
- The SQL Server service account has the appropriate permissions on the folder where **tempdb** will be created

Tuning the SQL Server 2014 Failover Clustered Instance DNS Settings

In this section, we will tune the SQL Server 2014 failover clustered instance DNS settings for multisubnet clusters. We will use Windows PowerShell to perform the following tasks.

NOTE: Client workstations and applications cache DNS entries for a period of time before checking with the DNS server to see if the name resolution has changed. This is called the Time-To-Live (TTL) value and, for cluster resources, the default value is 1200 seconds, or 20 minutes. This can significantly impact recovery time objective (RTO.) We can decrease the DNS TTL value of the virtual server name for the SQL Server 2014 failover clustered instance to 300 seconds or 5 minutes by changing the **HostRecordTTL** property value. Discuss this with your network engineers to make sure that they understand the impact of the change to the overall network infrastructure.

These steps can be performed on either of the nodes in the failover cluster. The steps below are performed on **SQLCLUSTER1**.

- 1. Open the **Windows PowerShell** console in Administrator mode
- 2. Type the following command. This will change the DNS TTL value of the virtual server name for the SQL Server 2014 failover clustered instance to **300** seconds (5 minutes).

```
PS C:\>#List different cluster resources
PS C:\>Get-ClusterResource | Select Name, ResourceType
PS C:\>#List parameters and their values of the SQL Server Network name
PS C:\>Get-ClusterResource "SQL Network Name (SQLCLUSTER)" | Get-ClusterParameter
PS C:\>#Set parameter value
PS C:\>Get-ClusterResource "SQL Network Name (SQLCLUSTER)" | Set-ClusterParameter
HostRecordTTL 300
```

	Administrat	or: Windows PowerShell	_ 0
PS C:\> Get-ClusterResource	Select Name, ResourceType		
Name		ResourceType	
 Cluster IP Address		IP Address	
Cluster IP Address 172.16.0.1	12	IP Address	
uster Name DATA DRIVE		Network Name	
		Physical Disk	
LOG DRIVE		Physical Disk	
BACKUP DRIVE		Physical Disk	
QUORUM DRIVE		Physical Disk	
QL IP Address 1 (SQLCLUSTER)		IP Address	
QL IP Address 2 (SQLCLUSTER)		IP Address	
QL Network Name (SQLCLUSTER)		Network Name	
QL Server		SQL Server	
QL Server Agent SQL Server Agent		SQL Server Agent	
PS C:\> Get-ClusterResource " Object	SQL Network Name (SQLCLUSTE Name	R)" Get-ClusterParameter Value	Туре
PS C:\> Get-ClusterResource " Dbject	Name	Value	Туре
VS C:\> Get-ClusterResource " bject QL Network Name (SQLCLUSTER)	Name Name	Value SQLCLUSTER	String
S C:\> Get-ClusterResource " bject QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER)	Name Name DnsName	Value	String String
S C:\> Get-ClusterResource " bject QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER)	Name Name DnsName Aliases	Value SQLCLUSTER SQLCLUSTER	String String String
S C:\> Get-ClusterResource " bject QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER) OL Network Name (SQLCLUSTER)	Name Name DnsName Aliases RemapPipeNames	Value SQLCLUSTER SQLCLUSTER 1	String String UInt32
PS C:\> Get-ClusterResource " bbject QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER) IOL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER)	Name Name DnsName Aliases RemapPipeNames HostRecordTTL	Value SQLCLUSTER SQLCLUSTER 1 1200	String String String UInt32 UInt32
S C:\> Get-ClusterResource " bject QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER)	Name Name DnsName Aliases RemapPipeNames HostRecordTTL RegisterAllProviderSIP	Value SQLCLUSTER SQLCLUSTER 1 1200 1	String String UInt32 UInt32 UInt32
S C:\> Get-ClusterResource " bject QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER)	Name Name DnsName Aliases RemapPipeNames HostRecordTTL RegisterAllProvidersIP PublishPTRRecords	Value SQLCLUSTER SQLCLUSTER 1 1200 1 0	String String UInt32 UInt32 UInt32 UInt32 UInt32
S C:\> Get-ClusterResource " bject QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER)	Name Name DnsName Aliases RemapPipeNames HostRecordTTL RegisterAllProvidersIP PublishPTRRecords ResourceData	Value SQLCLUSTER SQLCLUSTER 1 1200 1	String String UInt32 UInt32 UInt32
PS C:\> Get-ClusterResource " bject QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER)	Name Name DnsName Aliases RemapPipeNames HostRecordTTL RegisterAllProviderSIP PublishPTRRecords ResourceData StatusMetBIOS	Value SQLCLUSTER SQLCLUSTER 1 1200 1 0 {1, 0, 0, 0}	String String String UInt32 UInt32 UInt32 UInt32 ByteArray
PS C:\> Get-ClusterResource " bbject QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER)	Name Name DnsName Aliases RemapPipeNames HostRecordTTL RegisterAllProvidersIP PublishPTRRecords ResourceData StatusNetBIOS StatusNoNS	Value SQLCLUSTER SQLCLUSTER 1 1200 1 0 {1, 0, 0, 0}	String String UInt32 UInt32 UInt32 UInt32 ByteArnay UInt32
S C:\> Get-ClusterResource " bject QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER)	Name Name DnsName Aliases RemapPipeNames HostRecordTTL RegisterAllProviderSIP PublishPTRRecords ResourceData StatusNetBIOS StatusNetBIOS StatusKerberos CreatingDC	Value SQLCLUSTER SQLCLUSTER 1 1200 1 0 {1, 0, 0, 0} 0	String String String UInt32 UInt32 UInt32 UInt32 UInt32 UInt32 UInt32 UInt32 UInt32 String
S C:\> Get-ClusterResource " bject QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER)	Name Name DnsName Aliases RemapPipeNames HostRecordTTL RegisterAllProvidersIP PublishPTRRecords ResourceData StatusNetBIOS StatusNS StatusNS StatusKerberos CreatingDC LastDNSUpdateTime	Value SQLCLUSTER 1 1200 1 0 {1, 0, 0, 0} 0 0 \\AD-DC1.TESTDOMAIN.COM 8/19/2014 12:02:05 AM	String String String UInt32 UInt32 UInt32 UInt32 ByteArray UInt32 UInt32 UInt32 UInt32 String DateTime
S C:\> Get-ClusterResource " bject QL Network Name (SQLCLUSTER) QL Network Name (SQLCLUSTER)	Name Name DnsName Aliases RemapPipeNames HostRecordTTL RegisterAllProvidersIP PublishPTRRecords ResourceData StatusNetBIOS StatusKerberos CreatingDC LastDNSUpdateTime ObjectGUID	Value SQLCLUSTER SQLCLUSTER 1 1200 1 0 {1, 0, 0, 0} 0 0 \\AD-DC1.TESTDOMAIN.COM 8/19/2014 12:02:05 AM 5d7878007316b240b2d5707da6	String String String UInt32 UInt32 UInt32 UInt32 UInt32 UInt32 UInt32 UInt32 UInt32 String DateTime String
PS C:\> Get-ClusterResource "	Name Name DnsName Aliases RemapPipeNames HostRecordTIL RegisterAllProviderSIP PublishPTRRecords ResourceData StatusNetBIOS StatusKerberos CreatingDC LastDNSUpdateTime ObjectGUID DnsSuffix	Value SQLCLUSTER 1 1200 1 0 {1, 0, 0, 0} 0 0 \\AD-DC1.TESTDOMAIN.COM 8/19/2014 12:02:05 AM	String String String UInt32 UInt32 UInt32 UInt32 ByteArray UInt32 UInt32 UInt32 UInt32 String DateTime

3. Take the virtual server name for the SQL Server 2014 failover clustered instance offline and back online for the changes to take effect.

Testing Application Connectivity

In this section, we will test application connectivity for SQL Server 2014 multi-subnet failover clustered instance. We will use **SQL Server 2014 Management Studio** and **SQLCMD** to perform the following tasks.

NOTE: In order for client applications to be automatically redirected during a cluster failover, they need to either be using

- 1. the SQL Server 2012 Native Client or higher
- 2. the Data Provider for SQL Server in .NET Framework 4.02 or above
- 3. the Microsoft JDBC Driver 4.0 for SQL Server

A new connection string parameter named **MultiSubnetFailover** is made available to allow applications to simultaneously try all the IP addresses assigned for the SQL Server 2014 multisubnet failover clustered instance name and connects to the first one that responds. The parameter can be used with SQL Server Management Studio under the **Additional Connection Parameters** tab.

Connect to Server	X
Microsoft SQL Server 2014	
Login Connection Properties Additional Connection Parameters	
Enter additional connection string parameters (will be sent in clear text)):
MultiSubnetFallover=True	
(Note: Connection string parameters override graphical selections on other panels)	
Connect Cancel Help Option	ns <<

The **-M** parameter in **sqlcmd** can also be used as shown below.

C4.	SQLCMD		_ 🗆 X
C:∖>sqlcmd ⁄? Microsoft (R) SQL Server C Version 12.0.2000.8 NT Copyright (c) 2014 Microso			
[-N Encrypt Connection][[-d use database name] [[-h headers] [[-c cndend] [[-c cndend] [[-c endend] [[-m errorlevel] [[-u unicode output] [[-i inputfile] [[-f <codepage> ! i:<code [-y variable length type di [-y fixed length type di [-R use client regiona] [-M multisubnet failouer [-M error batch abort</code </codepage>	-H hostname] [- -C Trust Server Certific -C Trust Server Certific -s colseparator] [- -e echo input] [- -ulci] list servers[clean -Q "cndline query" and e -V severitylevel] [- -rt0il] msys to stderr] -o outputfile] [- page>[.o: <codepage>]] [- control characters] display width] splay width] splay width] setting]] -A dedicated admin conne startup script, environ stitution]</codepage>	-t query timeout] -v screen width] -I Enable Quoted Iden n output]] Exit] -W remove trailing s; -z new password] -Z new password and n ection]	ntifiers] paces] exit]
1> SEĹECT @@SEŔVERNAME 2> go			
SQLCLUSTER			
(1 rows affected)			

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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