Continuously Available File Shares (CAFS)

Continuously Available File Shares (CAFS) is an important new technology in <u>W ndows Server 2012</u>. At its basic level, Server 2012's CAFS feature takes Wndows file sharing capabilities and scales them using a Server 2012 cluster. CAFS takes advantage of new Server Message Block (SMB) 3.0 capabilities to increase the availability of Windows Server file shares used for document storage and application support. Some of the new SMB 3.0 features that enable CAFS include SMB Scale-Out, SMB Direct, and SMB Multichannel.

The CAFS feature addresses problems that occurred in earlier implementations of highly available file servers on Windows Server failover clusters. Previous i mplementations provided high availability for file shares but were hampered by brief periods of downtime and a momentary loss of connectivity in the event of a failover. Such brief outages were usually acceptable for M crosoft Office-type applications that perform frequent file opens and closes, because these apps could reconnect and save changes after the failover completed. Ho we ver, these same out ages we ren't acceptable for applications like Hyper-Vor SQL Server, which hold files open for extended periods of time, and out ages would result in data loss. Before the advent of Server 2012, Microsoft didn't support these types of server installations on file shares. Providing application support was one of Microsoft's primary design points for CAFS. While you can use CAFS for simple client file sharing, CAFS is really targeted at supporting server applications. CAFS gives you the ability to take advantage of Wndows Server's low-cost storage

capabilities for mission-critical applications. CAFS provides continuous access to file shares with al most zero do writime.

Choose an I mpl e ment ation

There are essentially two ways to implement CAFS:

- General Purpose File Server Very much like the highly available file server support in Windows Server 2008 R2, the CAFS general use file server implementation allows a file share to be supported on a failover cluster. CAFS improves the availability and performance of this implementation with the new higher performance SMB 3.0 client access.
- Scale-Out File Server The scale-out file server implementation is the new CAFS option for supporting applications like Hyper-V and SQL Server with no downtime. This implementation is limited to four servers.

You can see an overview of the CAFS architecture in Figure 1.



Figure 1: Overview of Continuously Available File Shares Architecture

One of the key technologies that enable CAFS is Server 2012 s support for SMB Transparent Failover. SMB Transparent Failover lets file server services fail over to a backup node in the cluster so that applications with open files on the file server won't see an interruption in connectivity. CAFS addresses both planned maintenance and unplanned failures with zero application downtime.

Meet the Requirements

Because CAFS uses the SMB 3.0 features in Server 2012, the Server 2012 operating system is a definite requirement. CAFS is supported on both the Server 2012 Standard and Server 2012 Datacenter editions. CAFS is not supported on the Essentials or Foundation editions.

In addition, CAFS requires a Server 2012 failover cluster. This means you must have a minimum of a two-node Server 2012 cluster. Server 2012 failover clusters support a maximum of 64 nodes. You can find step-by-step instructions on setting a Server 2012 failover cluster in my article "Wndows Server 2012: Building a Two-Node Failover Cluster." You also can watch a short video in which I describe the process of building a two-node Server 2012 Failover Cluster.

In addition to the cluster itself, the file server role must be installed on all cluster nodes. The clustered file server must be configured with one or more file shares that use the new continuously available setting. I provide more details about creating and configuring continuously available file shares later in this article.

For a two-node fail over cluster, the cluster storage requires a minimum of two separate volumes (LUNs). One volume stores the shared files. This volume should be configured as a cluster shared volume (CSV). The other volume will function as the cluster witness disk. Most implementations use more volumes.

It's also recommended that you design your net work so there are multiple pathways between nodes. This prevents the net work from becoming a single point of failure. Using net work adapter teaming and multiple switches and/or redundant routers can add resiliency to your net work configuration.

Finally, the SMB client computers must be running Windows 8 client or Server 2012 to take advantage of the new SMB Transparent Failover capability. When an SMB 3.0 client connects to a CAFS, the SMB client notifies the witness service on the cluster. The cluster picks a node to be the witness for this SMB connection. The witness node is responsible for switching the client to the new host in the case of an interruption of service, without requiring the client to wait for TCP timeouts.

Create a General Purpose CAFS

To configure a CAFS, open the Failover Cluster Manager on any of the nodes in the cluster. Then click the Roles node in the navigation pane. This displays existing roles in the Roles pane, as shown in the center of Figure 2.



Figure 2: Failover Cluster Manager

The cluster can support multiple roles and provide high availability capabilities to all of them Figure 2 shows an existing, highly available virtual machine (VM). To create a new general purpose CAFS, click the *Configure Role* link highlighted in the Actions pane. This starts the High Availability Wizard shown in Figure 3.



Figure 3: Adding the File Server Role

Scroll through the list of roles until you see the file server role. The file server role supports both the general purpose and scaleout application types of CAFS. Select File Server and then click Next to select the type of CAFS, which is displayed on the next screen, as Figure 4 shows.

80	High Availability Wizard	x
File Ser	ver Type	
Before You Begin Select Role File Server Type Client Access Point Select Storage Confirmation Configure High Availability Summary	 Select an option for a clustered file server: File Server for general use Use this option to provide a central location on your network for users to share files or for server applications that open and close files frequently. This option supports both the Server Message Block (SMB) and Network File System (NFS) protocols. It also supports Data Deduplication, File Server Resource Manager, DFS Replication, and other File Services role services. Scale-Out File Server for application data Use this option to provide storage for server applications or virtual machines that leave files open for extended periods of time. Scale-Out File Server client connections are distributed across nodes in the cluster for better throughput. This option supports the SMB protocol. It does not support the NFS protocol, Data Deduplication, DFS Replication, or File Server Resource Manager. 	
	< Previous Next > Cancel	

Figure 4: Selecting the File Server Type to Greate a General Purpose File Server

The File Server Type dialog box lets you choose between creating a *File Server for general use* or a *Scale-Out File Server for application dat a*. The general use option can be used for both W ndows SMB-based file shares and NFS-based file shares. The general purpose CAFS also supports data deduplication, DFS replication, and data encryption. Click Next to continue creating the general purpose CAFS. This displays the Client Access Point dialog box that Figure 5 shows.

à		Hig	h Availability Wiza	rd						×
Client Ac	ccess Point									
Before You Begin Select Role	Type the name t	hat clients wi	I use when accessing this	clustered ro	le:					
File Server Type	Name.	C/10C								
Client Access Point	The NetBIOS	S name is limit	ed to 15 characters. One	e or more IP	v4 ad	dresses	could	not be	e configure	ed
Select Storage	address.	y. TOF Eduli	ietwork to be used, make	sure utertie	CWOIP	CIS SEIE	Licu, a		en type a	
Confirmation			Maturadas	0.44						
Configure High Availability			192.168.100.0/24	192		168	. 10	10.	177	1
Summary				51 <u>7</u>						÷7
				< Previou	JS	Ne	od >		Cancel	
									0011001	

Figure 5: Client Access Point for General Purpose File Server

To create a new general purpose CAFS, you must provide a server name that dients will use when they access the CAFS. This name will be registered in your DNS, and clients will use it like a server name. In addition, the general purpose CAFS also needs an IP address. In Figure 5 I named the service CAFS- Gen (for general purpose CAFS) and gave it a static IP address of 192, 168, 100, 177. Gicking Next lets you select the cluster storage for the CAFS.

The Select Storage dialog box that Figure 6 shows lets you select the storage for the general purpose CAFS. The storage

must be available to the cluster. In other words, it must be listed under the cluster's storage node and designated as available storage. You cannot use preassigned CSVs for your general purpose CAFS.

8	Hi	gh Availability \	Wizard	x
Select S	torage			
Before You Begin Select Role File Server Type Client Access Point Select Storage Confimation Configure High Availability Summary	Select only the storage volu You can assign additional s Name H H Cluster Disk 2 H H Cluster Disk 5 Cluster Disk 6	umes that you want to torage to this clustere Status Online Online Online Online	assign to this clustered role. d role after you complete this wizard.	
			< Previous Next > 0	Cancel

Figure & The Select Storage Dalog Box

There are three disks that I could have used for this example, and I selected Cluster Disk 5 because I had previously allocated this storage to the CAFS (Figure 6). However, you can select any of the available cluster disks. Clicking Next displays the Confirmation screen. At this point you can either confirm your selections or go back through the Hgh Availability Wzard dialog boxes and make changes. If everything is OK, clicking Next on the Confirmation screen displays the Configure Hgh Availability dialog box, which shows the progress of the CAFS configuration process. When it's complete, a Summary screen is displayed. Clicking Finish on the Summary screen closes the Hgh Availability Wzard and returns you to the Failover Cluster Manager.

After creating the CAFS role, the next step is to create a continuously available file share that uses that role. Figure 7 shows that the CAFS- Gen role is actively running and that it uses the file server role. To add a new continuously available file share, select the *Add File Share* link in the Actions pane that you see on the right side of Figure 7. This displays a Task Progress dialog box that shows the progress of retrieving server information. Upon completion, the New Share Wizard displays.

1		Failover Clus	ster Manager		L
ile Action View Help					
🕨 🔿 📶 🖾 👘					
Eailover Cluster Manager	Roles (2)				Actions
WS2012-CL01.contoso.com	Search		P.	Queries 🕶 🔛 🐨 👽	Roles
A Nodes	News	Orter	Time	Ourses Nada	🤴 Configure R
WS2012-N1	E CAES-Gen	Russing	File Server	WS2012-N1	Virtual Mach
WS2012-N2	ORPORTVM1	() Off	Virtual Machine	WS2012-N1	Create Empt
Storage Disks	a our our test	O OII			View
Pools					G Refresh
4 🏢 Networks					Liele
Cluster Network 1					I Heip
Cluster Network 2					CAFS-Gen
CI classic creats					🛟 Start Role
					G Stop Role
				C	Add File Sha
	L.C.				Move
	<u> </u>	m		2.	😼 Change Star
	v CAFS-Gen		Pre	ferred Owners: Any node	Information
	10 and a dail				Show Critica
	Status:	Running		^	Add Storage
	Priority:	Medium			Add Storage
	Owner Node: Client Access Name:	WS2012-N1			Add Resource
	IP Addresses:	192 168 100 177		~	More Action
	<	un anna a failte anna an a		>	X Remove
	Summary Resources	Shares			Properties

Figure 7: Adding a File Share

The New Share Wzard begins by asking what type of CAFS you want to create. You can choose to create either SMB or NFS types of CAFS. The *SMB Share-Quick* option creates a general purpose CAFS. The *SMB Share-Applications* option creates a highly available application share for applications like Hyper-V or SQL Server. I cover how to create a scale-out CAFS for applications later in this article. To create a general purpose

CAFS, select the *SMB Share-Quick* option at the top of the list, as Figure 8 shows, and then click Next. The New Share Wzard displays the Share Location dialog box that Figure 9 shows.

Her sha	Wizard 📃 🗖
ect the profile for this share lect Profile mare Location mare Name ther Settings amissions anfirmation sults	Description: This basic profile represents the fastest way to creat SMB file share, typically used to share files with Windows-based computers. • Suitable for general file sharing • Advanced options can be configured later by using the Properties dialog

Figure & Selecting a Profile for a General Purpose File Server

	Ne	w Share Wizard			_
Select the serv	er and path for th	nis share			
Select Profile	Server:				
Share Location	Server Name	Status	Cluster Role	Owner Node	
Share Name	CAFS-Gen	Online	File Server	300	
Other Settings					
Permissions					
Confirmation					
Resulte					
1055a (2)(413)(2)	Share location:				
	Select by volume:				
	Volume	Free Space	Capacity File	System	
	G:	19.9 GB	20.0 GB NTF	s	
	The location of the	file chare will be a new fol	der in the \Shares	directory on the	coloctor
	volume.	ine share will be a new lor		surrectory on the	selected
	 Type a custom path 	:			
					Brov
		< Previous	Next >	Create	Ca

Figure 9: Share Location for General Purpose File Server

The name of the CAFS role is displayed in the Server Name box. Figure 9 shows the name of the CAFS-Gen role that I created earlier with a status of Online. You can select the location of the share using the options in the bottom half of the screen. In this example the G drive was selected by default (see Figure 9). If you want to use a different drive, you can manually enter the alternative path in the *Type a custom path* text box at the bottom of the screen. In this example I stuck with the default G drive and clicked Next to display the Share Name dialog box shown in Figure 10.

		New Share Wizard	-
pecif <mark>y</mark> share r	name		
Select Profile	Share name:	CAFS-Gen	
Share Location		1	
Share Name	Share description:	1	
Other Settings			
Permissions			
Confirmation	Local path to share		
Results	G:\Shares\CAFS-Ge	en l	
	If the folder doe	s not exist, the folder is created.	
	Remote path to sha	ire:	
	\\CAFS-Gen\CAFS-	Gen	
		< Previous Next >	Create

Figure 10: Share Name for General Purpose File Server

The Share Name dialog box lets you provide a name for the file share. For simplicity, I used the same name for the general purpose CAFS that I used for the service: CAFS-Gen, but that isn't necessary. You can name the share any valid SMB name. In the center of the screen you also can see the local and remote paths to the CAFS. The local path for this example is $G \setminus Shares \setminus CAFS$ -Gen. The share will be accessed by net worked systems using the path $\setminus CAFS$ -gen $\setminus CAFS$ -Gen. Gicking Next displays the *Configure share settings* dialog box shown in Figure 11.

-	New Share Wizard 📃 🗖
Select Profile Share Location Share Name Other Settings Permissions Confirmation Results	 New Share Wizard Enable access-based enumeration Access-based enumeration displays only the files and folders that a user has permissions to access. If a user does not have Read (or equivalent) permissions for a folder, Windows hides folder from the user's view. Enable continuous availability Continuous availability features track file operations on a highly available file share so that clients can fail over to another node of the cluster without interruption. Learn more about Services for Continuously Available File Shares Allow caching of share
	 Network Files role service is installed, you can enable BranchCache on the share. Enable BranchCache on the file share BranchCache enables computers in a branch office to cache files downloaded from this share, and then allows the files to be securely available to other computers in the branch Learn more about configuring SMB cache settings Encrypt data access When enabled, remote file access to this share will be encrypted. This secures the data agai unauthorized access while the data is transferred to and from the share. If this box is checked and grayed out, an administrator has turned on encryption for the entire server.
	< Previous Next > Create Canc

Figure 11: Configuring Share Settings for the General Purpose File Server

The Configure share settings dialog box lets you control how the share will be treated by the server. The Enable continuous availability check box is required to make the file share continuously available. This setting is checked by default. The Enable access-based enumeration setting controls whether users without per missions can vie wfiles and folders. This setting isn't checked by default. The Allow caching of share setting enables the contents of the share to be available to offline users via BranchCache. Finally, the Encrypt data access setting secures re mote file access by encrypting the data transferred to and from the share. This setting is unchecked by default. Clicking Next displays the Permissions dialog box shown in Figure 12.



Figure 12: Specifying Permissions for the General Purpose File Server

By default, the CAFS is created with Full Control given to the Everyone group. You'll probably want to change this for most i mplementations. I accepted the default permissions in this example. Clicking Next displays the Confirmation dialog box where you can view a summary of the choices you made in the previous New Share Wzard dialog boxes. You can click Previous to go back and change any of the settings. Clicking Greate on the Confirmation dialog box creates the CAFS and sets the permissions for the share. After the CAFS share has been created you can access it like any other file share. Figure 13 demonstrates howto access the share by entering the \\cafsgen\ CAFS- Gen server and share name into Windows Explorer. At this point you can populate the share with documents or other types of files that would benefit from the availability of a CAFS.



Figure 13: Accessing the CAFS by Its Net work Path

Create a Scale-Out CAFS

The primary purpose behind CAFS is to provide high availability to applications that store data on file shares. In the past, Microsoft didn't provide this kind of support for applications such as SQL Server that store their database on file shares. That changed with the release of Server 2012 and its support for the CAFS feature. Scale-out CAFS is implemented differently than general purpose CAFS. However, you use the same Hgh Availability Wzardto create the scale-out option. To create a new CAFS for scale-out application support, select the Configure Role link in the Actions pane of the Failover Cluster Manager as demonstrated in Figure 2. Then on the Select Role dialog box, select the File Server role as shown in Figure 3. These first two steps are the same as for creating a general purpose CAFS. However, on the File Server Type dialog box, select the Scale-Out File Server for application data option as shown in Figure 14.

80	High Availability Wizard	x
File Sen	ver Type	
Before You Begin	Select an option for a clustered file server:	
Select Role	File Server for general use	
File Server Type	Use this option to provide a central location on your network for users to share files or for server	
Client Access Point	(SMB) and Network File System (NFS) protocols. It also supports Data Deduplication, File Server	
Confirmation	Resource Manager, DFS Replication, and other File Services role services.	
Configure High Availability	Scale-Out File Server for application data	
Summary	Use this option to provide storage for server applications or virtual machines that leave files open for extended periods of time. Scale-Out File Server client connections are distributed across nodes in the cluster for better throughput. This option supports the SMB protocol. It does not support the NFS protocol, Data Deduplication, DFS Replication, or File Server Resource Manager.	
	< Previous Next > Cancel	

Figure 14: Selecting the File Server Type to Greate a Scale-Out File Server

The scale-out file server option is designed for applications that leave their files open for extended periods of time. Clicking Next displays the Client Access Point dialog box shown in Figure 15. The Client Access Point dialog box lets you name the CAFS role. I christened the Scale-Out CAFS with the name CAFS- Apps (see Figure 15). This is the server name that client applications use when they access the share. Clicking Next displays the Confirmation screen, which lets you confirm your selections or go back through the Hgh Availability Wzard dialog boxes and make changes. If everything is OK, click Next on the Confirmation screen to display the Configure Hgh Availability dialog box, which shows the progress of the CAFS configuration process. When it's complete, a Summary screen is displayed. Clicking Finish on the Summary screen closes the H gh Availability Wzard and returns you to the Fail over Cluster Manager.

8	High Availability Wizard	x
Client A	ccess Point	
Before You Begin Select Role File Server Type Client Access Point Configure High Availability Summary	Type the name that clients will use when accessing this clustered role: Name: CAFS-Apps The NetBIOS name is limited to 15 characters. All networks were configured automatically.	
	< Previous Next > Cance	el

Figure 15: Client Access Point for Scale-Out File Server

The next step is to add a file share to the CAFS scale-out application server. To create a newfile share for the CAFS role, select the *Add File Share* link from the Actions pane, as I did for

the general purpose file share in Figure 7. Clicking the *Add File Share* link for the scale-out CAFS starts the New Share Wzard shown in Figure 16.

	New Share	Wizard 📃 🗖
Select the profi	File share profile: SMB Share - Quick SMB Share - Advanced SMB Share - Applications NFS Share - Quick NFS Share - Advanced	Description: This profile creates an SMB file share with settings appropriate for Hyper-V, certain databases, and oth server applications.
		< Previous Next > Create Canc

Figure 16: Selecting Profile for Scale-Out File Server

To create a scale-out CAFS on the Select Profile dialog box, highlight the SMB Share-Applications option from the File

share profile list and then click Next to display the Share Location dialog box shown in Figure 17. The *Server* box near the top of the dialog box lists two CAFS file servers that were previously created. To add the CAFS to the scale-out application file server, select the CAFS- APPS file server that shows Scale-Out File Server in the Cluster Role column. Then select the CSV on which you want the CAFS share created.

elect Profile	Server:				
hare Location	Server Name	Status	Cluster l	Role	Owner Node
hare Name	CAFS-APPS	Online	Scale-O	ut File	
Ther Settings	CAFS-GEN	Online	File Serv	ver	
ermissions					
Confirmation					
ionalina port					
1275 U.N.S.	Share location:				
	Select by volume:				
	Volume	Free Space	Capacity	File System	1
	C:\ClusterStorage\Volume	1 227 GB	375 GB	CSVFS	- 1
	C:\ClusterStorage\Volume2	2 752 MB	7.86 GB	CSVFS	
	The location of the file share volume.	will be a new fold	der in the \S	hares direct	tory on the

Figure 17: Share Location for Scale-Out File Server

This example has two existing CSVs. I selected $C \setminus C$ uster Storage Volume 1 as the location for the new scale-out CAFS. You also can enter a custom path to another CSV. After selecting the CSV, click Next to display the Share Name screen shown in Figure 18.

Select Profile	Share name:	HyperV-CAFS	
Share Location	Share hame.		
Share Name	Share description:		
Other Settings			
Permissions			
Confirmation	Local path to share:		
Results	C:\ClusterStorage\Volume1\Shares\HyperV-CAFS		
	If the folder doe Remote path to sha	s not exist, the folder is created. re:	
	\\CAFS-APPS\Hype	rV-CAFS	

Figure 18: Share Name for Scale-Out File Server

The Share Name dialog box enables you to provide a name for the file share. I used the name Hyper V-CAFS for the scale-out application CAFS (see Figure 18). In the center of the screen you also can see the local and remote paths to the CAFS. The local pat h for this exa mpl e is $C \setminus C$ ust er St or age Vol u me 1 Shares Hyper V-CAFS. The share will be accessed by net worked systems using the path \cafs apps\ Hyper V-CAFS. Clicking Next displays the Configure share settings dialog box shown in Figure 19.

New Share Wizard

Configure share settings Enable access-based enumeration Select Profile Access-based enumeration displays only the files and folders that a user has permissions to Share Location access. If a user does not have Read (or equivalent) permissions for a folder, Windows hides folder from the user's view. Share Name Other Settings Enable continuous availability Continuous availability features track file operations on a highly available file share so that Permissions clients can fail over to another node of the cluster without interruption. Learn more about Services for Continuously Available File Shares Allow caching of share Caching makes the contents of the share available to offline users. If the BranchCache for Network Files role service is installed, you can enable BranchCache on the share. Enable BranchCache on the file share BranchCache enables computers in a branch office to cache files downloaded from this share, and then allows the files to be securely available to other computers in the branch Learn more about configuring SMB cache settings Encrypt data access When enabled, remote file access to this share will be encrypted. This secures the data agai unauthorized access while the data is transferred to and from the share. If this box is checked and grayed out, an administrator has turned on encryption for the entire server.

< Previous

Next >

Figure 19: Configuring Share Settings for the Scale-Out File Ser ver

When you create a scale-out CAFS, the *Enable continuous* availability setting is checked by default. In addition, the Enable access-based enumeration and Allow caching of share settings are disabled. You cannot select them The only other optional setting that you can choose is the *Encrypt data access* setting I kept the default settings (see Figure 19). Clicking Next displays

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Create

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the Specify permissions to control access dialog box shown in Figure 20.

HAR .		12			
pecify permis	sions to co	ontrol access			
Select Profile Share Location Share Name Other Settings Permissions Confirmation	If this share will be used for Hyper-V, you may need to enable constrained delegation to enable remote management of the Hyper-V host. For more information refer to the constrained validation help topic. Permissions to access the files on a share are set using a combination of folder permission permissions, and, optionally, a central access policy. Share permissions: Everyone Full Control				
Results	Folder permissions:				
	Type	Principal	Access	Applies To	
	Allow	BUILTIN/Users	Special Bood & events	This folder and	
	Allow		Full Control	Subfolders and	
	Allow	NT AUTHORITY/SYSTEM	Full Control	This folder sub	
	Allow	BUILTINAdministrators	Full Control	This folder, sub	
	Allow	NT VIRTUAL MACHINE\Virtual Machines	Special	Subfolders only	
	Allow	NT VIRTUAL MACHINE\Virtual Machines	Special	This folder only	
	<				
	Custom	nize permissions			
	Custon	ize permissions			

Figure 20: Specifying Permissions for the Scale-Out File Server

Like the general purpose CAFS, the scale-out CAFS is created with Full Control given to the Everyone group, which you'll probably want to change. I accepted the default per missions and clicked Next, which displays the Confirmation dialog box where you can see a summary of the choices that you made in the previous New Share Wzard dialog boxes. You can click Previous to go back and change any of the settings. Clicking Greate on the Confirmation dialog box creates the scale-out CAFS and sets its permissions. After the share is created, it can be accessed locally from C\ClusterStorage\Volume1\Shares\HyperVCAFS or remotely from\\cafs-apps\HyperVCAFS. The new CAFS is visible in the CSV mount point (Figure 21). At this point you can populate the share with Hyper-VVMs, SQL Server data, and log files or other types of application data.



Figure 21: Accessing the CAFS Share Locally