

SQL Server AlwaysOn Availability Groups (AG) on Tintri

Best Practices Guide

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Intended Audience

This Best Practices Guide for running SQL Server AlwaysOn Availability Groups on Tintri VMstore[™] systems is intended to assist SQL DBAs, IT Administrators and Architects who are responsible for deploying and managing clustered Microsoft SQL Database servers within their virtual infrastructures powered by Tintri VMstore storage appliances. This guide focuses specifically on Clustering Microsoft SQL Server databases and is intended to be used as a supplement to the <u>Microsoft SQL Server on Tintri</u> <u>- Best Practices Guide</u>. Recommendations from the SQL Single Instance best practice guide should be followed prior to following SQL Server clustering recommendations found in this guide.

If you are not already versed in SQL clustering, we recommend you follow the content within this guide to create one or more SQL AlwaysOn Availability Groups in a test environment to gain familiarity with the technologies prior to jumping straight into a production deployment.

Executive Summary

Virtualization technology has matured significantly over the years and mission critical servers can safely be <u>deployed as VMs</u>. Deploying SQL Servers as Virtual Machines (VMs) provides higher availability and more flexibility than their bare metal physical server counterparts. While a standalone VM may be highly available with many 9's of uptime, the availability of the application that runs within the VM may not have the same high level of availability for reasons such as reboots required for OS & application patching, recovering from disasters and DR testing, to name a few. To obtain an even higher level of application availability, some administrators turn to clustering as a solution. This guide is intended to assist those who want to further minimize disruptions caused by application outage and provide higher levels of resiliency.

With SQL Server 2012, Microsoft introduced "AlwaysOn" Technologies including Server Failover Instances and Availability Groups, a new way to cluster databases that departs from the previous methods that relied on Microsoft Clustering Services (MSCS). MSCS has historically been difficult to configure within a virtual environment and often brought limitations due to its requirements on having Raw Disk Mappings (RDM). With the new SQL Server AlwaysOn Availability Groups (AG), MSCS is no longer required.

This guide will walk you through the process of setting up SQL Server Availability Group in a virtualized environment and configuring your databases to achieve higher availability than what could be achieved in the virtual infrastructure layer alone. For your convenience, many links to additional information have been provided in each section.

Not included in this guide: the storage configuration. This is NOT an oversight! There is no manual tweaking/tuning required on a Tintri VMstore to accommodate a SQL Workload. Whether SQL is configured as AG or stand-alone, the Tintri VMstore automatically adapts.

This guide was created using Microsoft SQL Server 2014 on Windows Server 2012 R2 VMs running on VMware vSphere 5.1 and 5.5 hosts, but the information within is also applicable to MS SQL Server 2012 on Windows 2008 R2 and/or Windows 2012 running on versions of vSphere that are compatible with Tintri VMstores.

Assumptions

This document assumes you are working with a fully configured, highly-available virtual infrastructure. The VMs used for SQL Server are configured as described in our <u>Microsoft SQL Server on Tintri Best</u> <u>Practices Guide</u> and you have reviewed the recommendations provided within that guide.

Microsoft SQL Server AlwaysOn Availability Groups Overview

The <u>AlwaysOn Availability Groups</u> (AG) feature is a high-availability and disaster-recovery solution that provides an enterprise-level alternative to database mirroring. Introduced in SQL Server 2012, Availability Groups maximize the availability of a set of user databases for an enterprise. An *availability group* supports a failover environment for a discrete set of user databases, known as *availability databases* that failover together.



Figure 1 - Graphical overview of SQL Server AG. Image source: http://msdn.microsoft.com/en-us/library/ff877884.aspx

An availability group supports a set of read-write primary databases and up to eight sets of corresponding secondary databases in SQL Server 2014 (only up to four secondary DBs in SQL 2012). Optionally, secondary databases can be made available for read-only access and/or some backup operations. Microsoft's article <u>Windows Server Failover Clustering (WSFC) with SQL Server</u> describes two methods of applying AlwaysOn Technologies to SQL Server:

- Database-level High Availability with AlwaysOn Availability Groups (AG)
 - Availability Groups are SUPPORTED ON TINTRI
 - Does NOT require shared disk.
 - Some reporting tasks can be offloaded to the replica instances.
 - Backup operations can be offloaded to the secondary replica instances. This will minimize load on the primary database.
 - Think of this method as "Data Availability".
- Failover Cluster Instances (FCI) combined with AlwaysOn Availability Groups (AG)
 - Failover Cluster Instances (FCI) are NOT YET supported on Tintri.
 - Requires shared disk that supports the SMB 3.0 Remote Shared Virtual Disk protocol.
 - SQL Server application runs on one node of a 2 node cluster. The other node is passive awaiting failover from the primary node, should it fail.

This guide has been written to address Database-level AlwaysOn Availability Groups (AG).

DO: Use Database-level High Availability with AlwaysOn Availability Groups (AG)

DON'T: Use Failover Cluster Instances (FCI) with the Tintri VMstore providing the shared storage.

DO: Leverage AG read-only secondaries as a way to decrease overall vCPU footprint per VM

Consolidated List of Practices

The table below includes the recommended practices in this document. Click the text on any of the recommendations to jump to the section that corresponds to each recommendation for additional information.

DO: Use Database-level High Availability with AlwaysOn Availability Groups (AG)

DON'T: Use Failover Cluster Instances (FCI) with the Tintri VMstore providing the shared storage.

DO: Leverage AG read-only secondaries as a way to decrease overall vCPU footprint per VM

DO: Create an AD security group to simplify management of permissions required for the service accounts of the SQL Server Service on each node prior to setting up SQL Server AG databases.

DO: Reboot SQL Server VMs and/or restart the SQL Server service prior to proceeding in the Configuration section if group memberships to the AD security group were recently changed.

DO: Use a file share as a Quorum and ensure that all nodes have sufficient permissions to read and write to the share.

DO: Consider deploying the file server as a VM. Ensure that the file share is highly available and that the file server VM hosting the file share is highly available.

DO: Size VMs participating in a SQL Availability Group identically

DO: For future changes to a VM's configured size, remember to also resize the other VMs with nodes participating in the same SQL Server AG.

DO: Keep SQL Server AG VMs on separate Tintri VMstores for Highest Availability.

DO: Review the warnings and recommendations within the results of the Cluster Validation Test. Determine whether they are valid concerns, or false positives (i.e. Disk missing – not applicable since we are not using a shared disk configuration)

DO: When prompted with the Confirmation screen during the Cluster Creation Wizard, be sure to UNCHECK the "Add all eligible Storage to the cluster" checkbox. Failing to do this may render existing volumes inaccessible.

DO: Configure the quorum options for "Select the quorum witness" and provide the path to the file share to be used as the quorum witness.

DO: Create a rule to prevent SQL Server VMs that are members of the same Availability Group (AG) from running on the same host.

Prerequisites

Licensing - OS and Application Editions

SQL Licensing - SQL Server Enterprise Edition is required to leverage AG with SQL Server. The article <u>Features Supported by the Editions of SQL Server 2014</u> provides details on various licensing options of SQL Server.

Windows Licensing - SQL Server AG requires two main Roles/Features that are not common across all licensed editions of Windows Server. These are Windows Failover Clustering (WSFC) feature and the Application Server role. Both of these features combined are only available with licenses for the following versions:

- Windows Server 2008 R2: Datacenter and Enterprise Editions only.
- Windows Server 2012 / 2012 R2: Datacenter and Standard Editions only.

In a virtual infrastructure with high VM to host consolidation ratios, Datacenter licensing is more costeffective and applied per-CPU socket of each host.

Refer to <u>Windows Server 2012 R2 Products and Editions Comparison</u> for more information.

Windows Failover Clustering (WSFC)



Figure 2 - Add the Failover Clustering feature to each VM

SQL Server AG leverages technology made available with the Windows Failover Clustering (WSFC) feature, found only in versions of Windows Server listed above. Before we are able to configure WSFC, we must first add the feature to each of the VMs we would like to include in our SQL Database Cluster(s). To do so, use the Add Roles and Features Wizard to add the "Failover Clustering" feature to each of your VMs, as shown here:

Active Directory (AD) Permissions & Security

Configuring a failover cluster within an AD environment (the method described in this guide) requires the SQL Server VMs to be members of the same Windows Domain. Domain Admin-level access permissions are required to get it setup and configured. If you do not have Domain Admin access rights, refer to this article to <u>Pre-stage Cluster Computer Objects in Active Directory Domain Services</u>, which also contains useful information on the exact permissions required.

Introduced in Windows 2012 R2 is the ability to <u>Deploy an Active Directory-Detached Cluster</u>, which removes the AD requirement. The method in this article is untested by Tintri and out of scope of this guide.

SQL Server Accounts, Permissions and Groups

Throughout this guide, references are made to ensuring that the SQL Server nodes have sufficient permissions to various AD objects, SQL objects, and other resources. Most often, this refers to the Service Account used on the SQL Server Service, as shown here:

SQL Serve	(MSSQLSERVER) Properties (Local Comput	x			
General	g On Recovery Dependencies				
Log on as					
C Local	ystem account w service to interact with desktop				
This a	count: NT Service \MSSQLSERVER Browse				
Passw	vrd:				
Confim	password:				
	Properties of the "SQL Server (INSTANCE_NAME)" service				
	OK Cancel Apply				

Figure 3 - Use the Log On tab on the properties of the SQL Server service to view or change the service account

Configuration and testing carried out for the creation of this guide used the default service account for SQL. To other systems on the network, this account appears as the computer domain account of the SQL Server Virtual Machine: *DOMAIN\MACHINENAME\$*. Because two or more nodes are used, all ACLs for resources being permissioned need to include all the nodes.

To simplify management of permissions for the computer accounts, an AD security group named "DOMAIN\SQL-AAG-Computers" is created. Membership of this group contained both SQL Server computer accounts used in the cluster, as well as Computer Object for the cluster (to be created later):

DO: Create an AD security group to simplify management of permissions required for the service accounts of the SQL Server Service on each node prior to setting up SQL Server AG databases.

In the future, if a new node is added to the cluster, simply add the new computer account or service account to this group. In your organization's environment, one or more unique AD Service Accounts (User objects) may be used for the "Logon As" properties of the SQL Server service instead of the default machine account.

Throughout this guide, use this newly created security group for applying permissions to the various resources (file share, SQL permissions, computer objects, etc... which are covered later).

AAG-Comput	ers Properties ?
Object General	Security Attribute Editor Members Member Of Managed By
Name	Active Directory Domain Services Folder
NU SQL-AAG SQL-AAG-0 SQL-AAG-0	ttucs.tm.tintri.com/Computers 1 ttucs.tm.tintri.com/Computers 2 +ucs.tm.tintri.com/Computers
(SQL Server Computer Objects + VCO (Virtual Computer Object) of the cluster
Add	Remove

Figure 4 - AD Group created to simplify managing permissions

NOTE: Computer accounts won't register as members of a new security group until AFTER a reboot, which is required to build a new token containing this group for the computer account. In the case of AD service accounts, services need to be restarted for the accounts to register as members of the new security group.

DO: Reboot SQL Server VMs and/or restart the SQL Server service prior to proceeding in the Configuration section if group memberships to the AD security group were recently changed.

For each computer account of nodes that will join the cluster (DOMAIN\SQL-AAG-01\$ and DOMAIN\SQL-AAG-02\$), the security group (DOMAIN\SQL-AAG-Computers) was added to the security tab and given full-control:

-AAG-01 Propertie	5			? >
General Dperating	System Mem	ber Of Del	egation Pass	sword Replication
Location Manag	ed By 📔 Objec	t Security	Dial-in	Attribute Editor
Group or user names:				
 Everyone SELF Authenticated Us SYSTEM 	ers			
& SQL-AAG-Compu	ters (TTUCS\SQL	-AAG-Compute	rs)	
🚨 Domain Admins (TUCS\Domain A	dmins)		
Cert Publishers []	TUCS\Cert Publis	hersj		•
			Add	Remove
Permissions for SQL-A	AG-Computers		Allow	Deny
Full control				
Read			\checkmark	
Write			\checkmark	
Create all child obje	ots		\checkmark	
Delete all child obje	ots		$\mathbf{\nabla}$	
Allowed to authentic	ate			
Change password				
For special permission:	s or advanced set	iings, click Adv	anced.	Advanced
			_	
Learn about access ci	ontrol and permissi	ons		
	ОК	Cancel	Apply	Help
				_

Figure 5 - Security group added to Computer Account (or Service Accounts)

Create a File Share for Quorum

To prevent a cluster of two nodes (or any *even* number of nodes) from suffering split-brain, a condition where both nodes believe they are the master, a quorum is used. The quorum can be thought of as a 3rd party tie-breaker. Traditionally, this has been a shared disk accessible to both nodes, but with recent improvements in WSFC, a file share can be used instead.

lour folder is sharest.	
'ou can <u>te-mail</u> someone links to these shated items, or <u>ca</u>	py and parts the links into another program.
Individual Demo	e
SQL-AAG_QuonenWitness UUCSADUDU-AAGQueenmmiliteress	
Ana we of the network chain on the connector	

Create a File Share to use as a Quorum for the failover cluster. The file share must be networkaccessible to all nodes of your cluster, and permissions must be configured to allow all nodes to read and write from the file share. **Use the security group you created**

DO: Use a file share as a Quorum and ensure that all nodes have sufficient permissions to read and write to the share.

Figure 6 - A file share has been created on a 3rd Party server to be used as a quorum

Use an existing file server on which to create the file share or consider creating a new dedicated VM for the share. Availability of the quorum (file share) can adversely affect the health of your failover cluster, so be sure that your file share is also highly available.

DO: Consider deploying the file server as a VM. Ensure that the file share is highly available and that the file server VM hosting the file share is highly available.

Virtual Machine Sizing

Before proceeding further within this guide, refer to our <u>Microsoft SQL Server on Tintri Best Practices</u> <u>Guide</u> and apply the recommendations to your SQL VM(s).

When sizing SQL VMs that will participate as nodes in the same Availability Group, we recommend you configure and size them all identically, including:

- # of vCPUs
- Memory
- # of vNICs (2 or more recommended, with one of the vNICs being dedicated to WFSC traffic)
- # of vDisks, with matching capacities, SCSI controller properties, and SCSI IDs
- any other property of the VM specifically tuned for SQL

There may be exceptions to this recommendation where you may want to size VMs from the same Availability Group differently, specifically in cases where one or more of the secondary instances will be used as a read-only copy of the database(s). Use cases for this include read-only copies for reporting, exporting, and backup services. We recommend that you have at least two VMs sized the same that are capable of handling the full production load in the event of a VM failure, but additional read-only instances (up to eight are allowed with SQL 2014) may be sized smaller, depending on their use case.

DO: Size VMs participating in a SQL Availability Group identically

By offloading some of the load associated with reporting and backup processes, it is possible to size your primary SQL Servers smaller (fewer vCPUs) than if a single VM had to handle the load of all user and application access, reporting and backups. Smaller VMs schedule better in a virtual infrastructure and are less likely to create resource contention, specifically where vCPU counts within a VM are high.

Here are some additional tips to consider with respect to VM sizing:

- If you extend the capacity of a vDisk on one VM, be sure to extend the same corresponding drive on all other VMs with the same AlwaysOn Databases
- When increasing RAM on a VM, remember to not only adjust the other VM(s), but also to extend the size of the vDisk allocated to the Page file on the primary VM, as well as the secondary instances. The vDisk assigned to hold the page file should be at least the same size as the amount of RAM allocated to the VM.
- Use multiple smaller VMs with fewer vCPUs per VM and leverage read-only secondary SQL Server AG copies to handle specific reporting demands. Reducing the overall CPU demand from the production SQL servers may allow you to decrease their vCPU count to improving performance and scalability holistically with the virtual environment.

DO: For future changes to a VM's configured size, remember to also resize the other VMs with nodes participating in the same SQL Server AG.

Different Sites and VMstores (Optional)

Failover Clustering may be used to enable High Availability within the same site to maintain uptime during application and OS patching. Or it may be used as a Disaster Recovery (DR) solution to provide failover to another site. And it may also be used serve both use cases, with two instances in the primary site and a third instance in the DR site. There are many possibilities to consider while architecting your solution, but keep in mind that the primary goal of SQL Server AG configurations is to provide maximum uptime and mitigate the risk of failure of common components. Spreading instances across Tintri VMstores is an effective way to mitigate the risk of a VMstore becoming unavailable (power loss, physical damage, human error, etc.).

DO: Keep SQL Server AG VMs on separate Tintri VMstores for Highest Availability.

Additional Prerequisites and Information

For a more details, refer to Microsoft's article on <u>Prerequisites, Restrictions, and Recommendations for</u> <u>AlwaysOn Availability Groups.</u> When reviewing the link, keep in mind that it was written for both Database Availability and Failover Cluster Instances (FCI) and information on the latter (FCI) is not applicable as it is not support on Tintri VMstores, nor is it covered within this guide.

Configuration

In this section, we'll provide information on configuring SQL Server AG. It is assumed that you've met the prerequisites from the previous section and are starting with a Stand-alone instance of SQL, ready to extend it to an additional node for higher availability. Similar steps can be followed during setup of new SQL instances.

Configuring Windows Failover Clustering (WSFC)

Validate Configuration

With the WSFC feature added to each of the VMs we want to cluster, we are ready to perform a validation prior to creating a cluster. Open the Failover Cluster Manager, which can be accessed from the Tools menu of the main Server Manager dashboard in Windows 2012:



Figure 7 - Accessing the Failover Cluster Manager

Detailed Step-by-Step instructions for the validation process are found in <u>Appendix A</u>, however we'll cover some the highlights from the process in this section. From within the Failover Cluster Manager, start the configuration validation process:

4		Failover Cluster Manager			_ - ×
File Action View Help					
唱 Failover Cluster Manager	Failover Cluster Manager			^	Actions
	Create failover clusters, your failover clusters.	validate hardware for potential failover clusters, and p	erform configuration changes to		Failover Cluster Mana Validate Configuration
	 Overview 				Create Cluster
	A failover cluster is a set of inde	ependent computers that work together to increase th	e availability of server roles. The		View
	clustered servers (called nodes node begins to provide services	 are connected by physical cables and by software. I s. This process is known as failover. 	If one of the nodes fails, another		Q Refresh
					Properties
	 Clusters 				👔 Help
	Name	Role Status	Node Status		
	 Management 				
	To begin to use failover clusteri steps are complete, you can mi running Windows Server 2012	ing, first validate your hardware configuration, and the anage the cluster. Managing a cluster can include cop R2, Windows Server 2012, or Windows Server 2008 f	en create a cluster. After these oving roles to it from a cluster R2.		
	Validate Configuration	<u>_</u>			
	Connect to Cluster				
	More Information			~	
🗧 📥 🛛 🚦					▲ 🔀 🔁 🍓 11:53 AM 9/4/2014

Figure 8 - Click on Validate Configuration

Add Servers to your cluster and run all tests.

¥	Va	alidate a Configuration Wizard		x
Select S	ervers or a Cluste	er		
Before You Begin Select Servers or a Cluster	To validate a set of se To test an existing clu	rvers, add the names of all the servers. ster, add the name of the cluster or one of its not	des.	
Testing Options Confirmation Validating	Enter name: Selected servers:	SQL-AAG-01.ttucs.tm.tintri.com SQL-AAG-02.ttucs.tm.tintri.com	Le C	Browse

Figure 9 - Select Servers you want to add to a cluster using the Browse button, then click Next

After validation tests have run, a summary of test results will be show. Click on "View Report..." for a detailed summary of test results and recommendations:

9	Validate a Configurati	on wizard		
Summar	у			
lefore You Begin ielect Servers or a Juster	Testing has completed successfully. The configuration apper However, you should review the report because it may conta to attain the highest availability.	ars to be suitable for clustering. in warnings which you should ad	Idress	
esting Options	- INCHIVIA			
Confirmation	Name	Result	Description	
Validating Summary	List Network Binding Order	1	Success	
	Validate Cluster Network Configuration	1	Success	
	Validate IP Configuration	1	Success	
	Validate Network Communication	R 12	Warning	
	Validate Windows Firewall Configuration		Success	~
	Create the cluster now using the validated nodes	ome warnings are		
	To view the report created by the wizard, click View Report. To close this wizard, click Finish.	xpected Click /iew Report" for dditional details.	View Rep	port
				Finish

Figure 10 - Summary of Validation results

Some warnings are expected, such as the warning regarding networking redundancy as well as warning regarding storage.

DO: Review the warnings and recommendations within the results of the Cluster Validation Test. Determine whether they are valid concerns, or false positives (i.e. Disk missing – not applicable since we are not using a shared disk configuration)

The warning about the number of NICs is likely not be accurate in the case of a virtual machine because the redundancy is built into the host design, but the guest OS (Windows) wouldn't be able to detect that.

However, even though this may be the case, a 2nd NIC is recommended to isolate WSFC traffic.

idate]	Network Communicati	O D	when the physical network re virtual infrastructure host(s). It least 2 NICs should be team	dundancy is taken cal f this VM were a physi ed together for redund	re of by the ical server, a lancy.	t
Analyzing	connectivity results			Status - Zerethins - Status I send a s	ersene In	-
Following 02.ttucs.tr	r communication within the cluster. Pleas are the connectivity checks made using m.tintri.com	e verify that this single path UDP on port 3343 from netw	is highly available, or considered addi ork interfaces on node SQL-AAG-01.ttucs.	tional networks to the cluster.	es on node SQL-AA	G-
-						
Result	Source Interface Name	Source IP Address	Destination Interface Name	Destination . Iddress	Same Cluster Network	Packet Lo:
Result Success	Source Interface Name SQL-AAG-01.ttucs.tm.tintri.com - Ethernet	Source IP Address	Destination Interface Name SQL-AAG-02.ttucs.tm.tintri.com - Ethernet	Destination . Adress	Same Cluster Network True	Packet Lo: 0
Result Success Node SQL failure for	Source Interface Name SQL-AAG-01.ttucs.tm.tintri.com - Ethernet AAG-01.ttucs.tm.tintri.com is reachable communication within the duster. Pleas	Source IP Address from Node SQL-AAG-02.ttud se verify that this single path	Destination Interface Name SQL-AAG-02.ttucs.tm.tintri.com - Ethernet s.tm.tintri.com by only one pair of network is highly available, or consider adding addi	Destination * dress interfaces. It is possible that th tional networks to the cluster.	Same Cluster Network True is network path is a	Packet Los O a single point o
Result Success Node SQL failure for Following 01:tbucs.tr	Source Interface Name SQL-AAG-01.ttucs.tm.tintri.com - Ethernet -AAG-01.ttucs.tm.tintri.com is reachable communication within the cluster. Pleas are the connectivity checks made using m.tintri.com	Source IP Address from Node SQAAG-02.ttuc se verify that this single path UDP on port 3343 from source	Destination Interface Name SQL-AAG-02.ttucs.tm.tintri.com - Ethernet cs.tm.tintri.com by only one pair of network is highly available, or consider adding addi rork interfaces on node SQL-AAG-02.ttucs.t	Destination a dress interfaces. It is possible that th tional networks to the cluster. m.tintri.com to network interface	Same Cluster Network True is network path is a es on node SQL-AA	Packet Los 0 a single point o G-
Result Success Node SQL failure for Following 0.1 thucs.tr Result	Source Interface Name SQL-AAG-01.ttucs.tm.tintri.com - Ethernet AAG-01.ttucs.tm.tintri.com is reachable communication within the duster. Pleas are the connectivity checks made using m.tintri.com Source Interface Name	Source IP Address	Destination Interface Name SQL-AAG-02.ttucs.tm.tintri.com - Ethernet s.tm.tintri.com by only one pair of network is highly available, or consider adding addi tork interfaces on node SQL-AAG-02.ttucs.t Destination Interface Name	Destination . ddress interfaces. It is possible that th tional networks to the duster. m.tintri.com to network interface Destination IP Address	Same Cluster Network True is network path is a as on node SQL-AA Same Cluster Network	Packet Los O Bingle point o G- Packet Los

Figure 11 - Warning re: Networking Redundancy

There will be many storage warnings as well. Review each, but in most cases, these warnings shouldn't be applicable because we will not be configuring clustering that requires a shared disk.

< 🕞 🧟 mhtml:file://C:\User 💦 \AppData\Local\Temp	p' 🔎 🔹 🖒 🥥 Failover Cluster Validation 🗙	n 🖈 🕸
All servers have the same software updates.		
		^
Back to Summany Back to Top		
Validate Storage Spaces Persistent Reservation		
· moute storage spaces i er sistent reser varion		
Description: Validate that storage supports the SCSI-3 Persistent Reservation	n commands needed by Storage Spaces to support clustering.	
Starb 9/4/2014 11:54:41 AM		
No disks were found on which to perform duster validation tests.		
Stop: 9/4/2014 11:54:41 AM		
	Expected errors when cluster won't be configured	
Back to Summary	to use disks.	
	Shared vDick configurations are not supported on	
Validate Windows Firewall Configuration	Tintri VMstores	
valuate windows fillewall coungulation		
Real	. f-11	

Figure 12 - Warnings re: disks are a false positive, and not applicable because we won't be using shared disks

Create a Windows Failover Cluster

Once the server configuration has been validated and warnings have been reviewed (and rectified or dismissed as false positives), we're ready to proceed with creating a cluster. Leave the "Create the cluster now using the validated nodes" option selected at the end of the validation wizard, then click Finish to launch the Create Cluster Wizard. <u>Detailed Step-by-Step instructions</u> are available in <u>Appendix</u> <u>A</u>, continuing on from the prior validation steps.



Figure 13 - Click Finish to launch the Create Cluster Wizard

Provide a name for the Failover Cluster:

Access F	Create Cluster Wizard
Before You Begin Access Point for Administering the Cluster	Type the name you want to use when administering the cluster. Cluster Name: SQL-AAG
Confirmation Creating New Cluster Summary	The NetBIOS name is limited to 15 characters. One or more DHCP IPv4 addresses were configured automatically.
	< Previous Next > Cancel

Figure 14 - Provide a name for your cluster. This will be the name of the virtual IP of the active cluster node

The name supplied here will create a Computer Object in the AD, in the default Computers OU, as shown here:

🔁 Active Directory Users and Com	puters			_ 🗆 🗙
File Action View Help				
♦ ♦ 2 🖬 ¼ 🗉 🗙 🛛) 🖻 🗟 🚺 🔂 🕯	💐 🛅 🍸 🗾 🍇		
Active Directory Users and Comput	Name 🔺	Туре	Description	
🕀 🧮 Saved Queries	👰 SQL-AAG	Computer	Failover cluster virtual network name account	
🖃 🚔 ttucs.tm.tintri.com	👰 SQL-AAG-01	Computer		
🕀 🚞 Builtin	👰 SQL-AAG-02	Computer		
	& SQL-AAG-Computers	Security Group		
	👰 SQL-AAG-DR-01	Computer		
	👰 SQL-SA-01	Computer		
🛨 🧾 Domain Controllers	👰 SQL-SINGLEDISK	Computer		
EnerginSecurityPrincipals	👰 TINTRIHRA	Computer		
	ΙΝΤΡΙVΔΔΙΧΟ-10	Computer		

Figure 15 - A new Computer Object is created in the AD with the name provided in the Wizard

When users and applications access the Highly Available SQL AlwaysOn databases, this is the object that is entered as the SQL Server name, not the names of each underlying SQL Server instance (except in cases where a readable secondary wants to be explicitly accessed). In this case, users connect to **SQL-AAG**, which will send the request to the underlying server acting as master.

After providing a cluster name, a confirmation screen is shown. It is important to **uncheck** the "Add storage" checkbox, which defaults to checked, prior to clicking next to proceed, as shown here:

樽		Create Cluster Wizard
Confirma	tion	
Before You Begin Access Point for Administering the	You are ready to create The wizard will create y	e a cluster. your cluster with the following settings:
Cluster	Cluster:	SQL-AAG
Confirmation	Node:	SQL-AAG-01.ttucs.tm.tintri.com
Creating New Cluster	ID Address:	
Summary	IF Address.	WARNING! FAILING TO
		CLEAR THIS CHECK-BOX
		WILL ADD ELIGIBLE
		STORAGE TO CLUSTER
		AND MAY RENDER
STOP	Add all eligible stora	ige to the cluster.
	To continue, click Next	EXISTING VOLUMES
		INACCESSIBLE
		Benfine Netter Court

Figure 16 - On the confirmation, UNCHECK the "Add all eligible storage to the cluster" checkbox

DO: When prompted with the Confirmation screen during the Cluster Creation Wizard, be sure to UNCHECK the "Add all eligible Storage to the cluster" checkbox. Failing to do this may render existing volumes inaccessible.

After the cluster has been created, click **View Report** in the final summary screen and review the details.

Configure Cluster Quorum Settings

Once the cluster has been successfully created, we need to configure a File Share Witness to be the cluster quorum. <u>Detailed</u> <u>Step-by-Step</u> instructions for this process can be found in <u>Appendix B</u>.

Instead of configuring a shared disk as our quorum, which is most commonly configured in a virtual environment using a Raw Disk Mapping (RDM) that can limit some VM functionality, we're going to configure a file share instead. In the prerequisites section, we created a file share and configured the permissions on it. To begin, launch the "Configure Cluster Quorum Settings" wizard from within Failover Cluster Manager, show here:

轞			Failover Cluster Manager	
File Action View H	lelp			
🗢 🄶 🙋 📰 🛛 🗖	Ĩ			
Hailover Cluster Manag	ger	Cluster SQL-AAG.ttuc	s.tm.tintri.com	
 ✓ SQL-AAG.ttucs.tex Roles Nodes ✓ Storage ✓ Disks ✓ Pools ✓ Networks ✓ Cluster Even 	Config Valida View V Add N Close Reset	gure Role te Cluster /alidation Report lode Connection Recent Events	Cluster SQL-AAG clustered roles and 2 nodes. tintri.com Networks: Cluster N QL-AAG-01 Subnets: 1 IPv4 and Error: 28	etwork 1 0 IPv6
	More	Actions +	Configure Cluster Quorum Settings	1
	View	•	Copy Cluster Roles	des), or
	Refresh		Shut Down Cluster	R2.
	Prope	rties	Destroy Cluster	- s on me
	Help		Move Core Cluster Resources	
-		Copy Cluster Roles	Cluster-Aware Updating	
		Cluster-Aware Updat	ing	
		 Navigate 		
		Roles	Nodes T	orage
		Networks	Cluster Events	
		Cluster Core	Resources	
		Name	Status	
		Server Name	•	
< 111	>	🕀 🔩 Name: SQL-A	AG 🛞 C	nline

Figure 17 - Launch the Cluster Quorum Configuration Wizard

Choose the second option "**Select the Quorum Witness**" (shown below). Press **Next** to continue, and then provide the path to the file share, <u>\\FULLY.QUALIFIED.HOSTNAME\Sharename</u>, when prompted.

櫩	Configure Cluster Quorum Wizard
Select C	Quorum Configuration Option
Before You Begin	Select a quorum configuration for your cluster.
Select Quorum Configuration Option	O Use default quorum configuration
Select Quorum Witness	The cluster determines quorum management options, including the quorum witness.
Confirmation	Select the quorum witness
Configure Cluster	You can add or change the quorum witness. The cluster determines the other quorum management options.
Summary	Advanced quorum configuration You determine the quorum management options, including the quorum witness. Failover Cluster Quorum and Witness Configuration Options
	< Previous Next > Cancel

Figure 18 - Cluster Quorum Configuration Wizard - Select Quorum Witness

DO: Configure the quorum options for "Select the quorum witness" and provide the path to the file share to be used as the quorum witness.

Tip: When using an asymmetric storage configuration for Availability Groups, you should generally use the **Node Majority** quorum mode when you have an odd number of voting nodes, or the **Node and File Share Majority** quorum mode when you have an even number of voting nodes. For the majority of this guide, we've been referencing 2 nodes and testing was performed with **Node and File Share Majority quorum mode**. <u>WSFC Quorum Modes and Voting Configuration</u>

SQL Permissions

In order to configure SQL Server clustering, each node will require some level of access to other nodes. The <u>security group</u> (DOMAIN\SQL-AAG-Computers) simplifies this task for us. On each SQL Server instance, use the SQL Server Management Studio to create an ID for domain-based security group that contains SQL Server service accounts.



Figure 19 - Create a SQL Login for the Security Group contain Service Accounts

The new login for the security group only needs minimal CONNECT privileges (Public role).

Once the new login is created, assign CONNECT permissions to the HA_DR Endpoint on EACH SQL Instance, using the following command:

```
use [master]
GO
GRANT CONNECT ON ENDPOINT::[Hadr_endpoint] TO [DOMAIN\SQL-AAG-COMPUTERS]
GO
```

By proactively assigning this permission to the endpoint object on each server, you may be saving yourself hours of troubleshooting by avoiding the problems described in this article: <u>Failed to Join the Instance to the Availability Group while configuring AlwaysOn</u> and avoid getting this error in the AG Creation Wizard (next section):

6	Add Replica to Availability Group - Tintri-SQL-AAG	. 🗆 🗙
Results		
Introduction Specify Replicas Select Data Synchronization Validation	Summary:	🕑 Help
-	Name	Result
Summary	Configuring endpoints.	Success
Results	Starting the 'AlwaysOn_health' XEvent session on 'SQL-AAG-02'.	Success
	Adding secondary replicas to availability group 'Tintri-SQL-AAG'.	Success
	Joining secondary replicas to availability group 'Tintri-SQL-AAG'.	Success
	Creating a full backup for 'tpcc_AAG'.	Success
	Restoring 'tpcc_AAG' on 'SQL-AAG-02'.	Success
	Backing up log for 'tpcc_AAG'.	Success
	Restoring 'tpcc_AAG' log on 'SQL-AAG-02'.	Success
	Solution of the state of the st	Error
Joining database on	Microsoft SQL Server Management Studio	
(Microsoft.SqlServer	.Management. <mark>HadrTasks</mark>)	
Additional inform → Attempting to jo (Microsoft.SqlSe	a tion: in availability group resulted in an error. rver.Management.HadrTasks)	
i→ Failed to joi replica 'SQL	n the database 'tpcc_AAG' to the availability group 'Tintri-SQL-AAG' on the availability -AAG-02'. (Microsoft.SqlServer.Smo)	
L An exce (Micros L The (Mic	eption occurred while executing a Transact-SQL statement or batch. oft.SqlServer.ConnectionInfo) e connection to the primary replica is not active. The command cannot be processed. crosoft SQL Server, Error: 35250)	Close
0- B 🖀	ОК	

Figure 20 - An error due to not having the required permissions in place

More information on this setting can be found here: <u>Setup Login Accounts for Database Mirroring or</u> <u>AlwaysOn Availability Groups</u>

Enable SQL Server Availability Groups

At this stage, the underlying Failover Clustering is configured on your VMs and you are ready to enable SQL Availability Groups within SQL Server. Here are the steps:

- 1. Open SQL Server Configuration Manager and navigate to SQL Server Services.
- 2. Right-click on the "SQL Server (INSTANANCE_NAME)" service and choose Properties.

		Sql S	erver Confi	guration Manager			_ 0 ×
File Action View Help Image: Constraint of the state of the stat							
SQL Server Configuration Manager (Local) SQL Server Services SQL Server Network Configuration (32bit	Name	State Integr Runnin d Filte Runnin	g	Start Mode Automatic Manual	Log On As NT Service\MsDtsS NT Service\MSSQL	Process ID 1088 1972	Service Type
▶ ● SQL Native Client 11.0 Configuration (328 ▶ ■ SQL Server Network Configuration ▶ ■ SQL Native Client 11.0 Configuration ▶ ■ SQL Native Client 11.0 Configuration	SQL Server /	MSSRunnin Start Stop Pause Resume Restart	. 2	Automatic Other (Boot, Syste Automatic	NT Service\MSSQL NT AUTHORITY\LO NT Service\SQLSER	1152 0 1928	SQL Server
		Propert s Help	3				

Figure 21 - Open properties of the SQL Server service

3. Click on the AlwaysOn High Availability tab and check the box: "Enable AlwaysOn Availability Groups". Press OK when complete.

		Sql Server	Configuration	Manager		
File Action View Help						
SQL Server Configuration Manager (Local)	Name	State	Start N	1ode	Log On As	
SQL Server Services	3 SQL	Server Integr Running	Autom	atic	NT Service	MsDts
 ↓ Justice Server Network Configuration (32bit) ▶ Justice Server Network Configuration (32bit) 	toso Toso	SQL Server (M	ASSQLSERVER	R) Properti	es ? 🗙	SQL SQL
▶	to se	Log On	Service	FILE	STREAM] ML
▶	₿\$ SC	AlwaysOn High Availability	Startup Par	ameters	Advanced	LSE
		Windows failover duster name				
		SQL-AAG				
		Al Ar this instance of SQL S availability and disaster rec	erver to use availa	Apply	or high	

Figure 22 - Properties of the SQL Server service - Enable AlwaysOn Availability Groups

4. After enabling AlwaysOn, Restart the SQL Server service.



Figure 23 - Restarting the SQL Server service from within Configuration Manager

5. Repeat for each SQL Server to be clustered.

Create SQL Server Availability Group

Once SQL Server services have been successfully restarted with AlwaysOn High Availability enabled, it's time to create a SQL Server Availability Group. The steps will walk you through this:

- 1. Open SQL Server Management Studio and a new AlwaysOn High Availability node should be available.
- 2. Right-click on the new node and choose "New Availability Group Wizard...":



Figure 24 - Launch the New Availability Group Wizard

3. The Wizard launches and presents an overview of the process. Click Next



Figure 25 - New Availability Group Wizard – Overview

4. Specify a name for the Availability Group and click Next

4	New Availability Group	_ _ X
Specify Availa	bility Group Name	
Introduction		🔞 Help
Specify Name	Specify an availability group name.	
Select Databases	Availability group name:	
Specify Replicas	Tintri-SQL-AAG	
Select Data Synchronization		
Validation		
Summary		
Results		

Figure 26 - Specify a name

5. Select the database(s) to be added to the new AG and click Next. NOTE: Additional databases can be added later

1	New Availability Group				
Select Databas	ses				
Introduction Specify Name	Select user databases	for the <mark>availability</mark>	group.	🔞 Help	
Select Databases	User databases on this	instance of SQL Serv	er:		
Specify Replicas	Name	Size	Status		
Select Data Synchronization Validation	Pcc_AAG	99.9 GB	Meets prerequisites		

Figure 27 - Select Databases to add to the Availability Group

6. Specify Replicas. Click **Add Replica** and select one or more additional SQL Server instances to join the AG:

Specify Replice	New A as	vailability Gr	oup		_ D X	
ntroduction Specify Name Select Databases	Specify an instance of Replicas Endpoints	SQL Server to Backup Prefere	host a seconda	y replica.	🍘 Help	
pecify Replicas	Availability Replicas:	94				
elect Data Synchronization	Server Instance	Initial Role	Automatic Failover (Up to 2)	Synchronous Commit (Up to 3)	Readable Seco	
Summary	SQL-AAG-01	Primary	•		No	
Doculto	SQL-AAG-02	Secondary			Yes	
	Add Replica	Add Azure Re	eplica Rer	nove Replica		
	Replica mode: Synch This replica will use syn- and manual failover. Readable secondar In the secondary role, th connections running with	nronous commit w chronous-commit y: Yes nis availability repl h older clients.	vith automatic failov availability mode a ica will allow all co	rer nd support both automa nnections for read acce	atic failover	
	Ŕ					
			< P	revious Next >	Cancel	

Figure 28 - Additional Replica options

- 7. Configure Automatic Failover, commit, and Readable Secondary options. More information can be found in Microsoft's <u>Overview of AlwaysOn Availability Groups</u>. If you are unsure which options to choose, configure it as shown above. All options can be adjusted later.
- 8. Before clicking Next, review the additional tabs for Endpoints

Specify Replic	Net	w Availability	Group		
Introduction Specify Name Select Databases	Specify an instance	e of SQL Server	to host a seconda	ry replica.	🎯 Hel
Specify Replicas	Endpoint values:	васкир Ртег	erences Listener	-	
Select Data Synchronization		Port	Endpoint	Encrypt	SQL Server
Validation	m:5022	5022	Hadr_endpoint		NT Service\MSSQLSERVER
Results	m:5022	5022	Hadr_endpoint		NT Service\MSSQLSERVER
	<			Ш	>
	Status				Refresh

Figure 29 - Endpoint options for Replicas

9. Backup Preferences

Specify Replicas Introduction Specify Name Select Databases Specify Replicas Select Data Synchronization Validation Summary Results O Prefer Secondary Automated backups for this availability group should occur on a secondary replica. If there is no secondary replica available, backups will be performed on the primary replica. O Prefer Secondary Automated backups for this availability group must occur on a secondary replica. If there is no secondary replica availability group must occur on a secondary replica. O Primary All automated backups for this availability group must occur on a secondary replica. O Primary All automated backups for this availability group must occur on the current primary replica. O Any Replica Backup Priority Clowest=1, Highest=100) Server Instance Server Instance <th>10</th> <th colspan="6">New Availability Group</th>	10	New Availability Group					
Introduction Image: Specify name Specify Name Specify an instance of SQL Server to host a secondary replica. Select Databases Replicas Specify Replicas Where should backups occur? Select Data Synchronization Image: Specify of the should backups occur? Validation Image: Specify of the should backups for this availability group should occur on a secondary replica. If there is no secondary replica available, backups will be performed on the primary replica. Summary Secondary only All automated backups for this availability group must occur on a secondary replica. Primary All automated backups for this availability group must occur on the current primary replica. Any Replica Backup Priority Backup priorities: Server Instance Server Instance Backup Priority Server Instance	Specify Replic	as					
Select Databases Replicas Endpoints Backup Preferences Listener Specify Replicas Where should backups occur? Select Data Synchronization • Prefer Secondary Validation Automated backups for this availability group should occur on a secondary replica. If there is no secondary replica available, backups will be performed on the primary replica. Summary Secondary only All automated backups for this availability group must occur on a secondary replica. Primary All automated backups for this availability group must occur on the current primary replica. Any Replica Backup Priority replica backup priorities: Server Instance Backup Priority (Lowest=1, Highest=100) Exclude Replica Server Instance Server Ins	Introduction Specify Name	Specify an instance of SQL S	erver to host a secondary replica.	🞯 Help			
Specify Replicas Where should backups occur? Select Data Synchronization • Prefer Secondary Automated backups for this availability group should occur on a secondary replica. If there is no secondary replica available, backups will be performed on the primary replica Summary Secondary only All automated backups for this availability group must occur on a secondary replica. Primary All automated backups for this availability group must occur on a secondary replica. Primary All automated backups for this availability group must occur on the current primary replica. Any Replica Backup can occur on any replica in the availability group. Replica backup priorities: Server Instance Backup Priority (Lowest=1, Highest=100) Exclude Replica	Select Databases	Replicas Endpoints Backu	p Preferences Listener				
	Specify Replicas Select Data Synchronization Validation Summary Results	 Where should backups occur Prefer Secondary Automated backups for the there is no secondary replice Secondary only	r? is availability group should occur on a ca available, backups will be performed r this availability group must occur on a r this availability group must occur on a replica in the availability group. Backup Priority (Lowest=1, Highest=100)	secondary replica. If d on the primary replica. a secondary replica. the current primary Exclude Replica			
ISOL-AAG-02 50		SOL-AAG-01	5				

Figure 30 - Backup Preferences for Availability Group

10. Listener – Leave blank, or add a Listener (optional). More information regarding <u>Availability</u> <u>Group Listeners</u> is covered later in this guide.

<u>n</u>	New Availability Group		
Specify Replic	as		
Introduction Specify Name	Specify an instance of SQL Server to host a secondary replica.		
Select Databases	Replicas Endpoints Backup Preferences Listener		
Specify Replicas	Specify your preference for an availability group listener that will provide a client connection		
Select Data Synchronization	Do not create an availability group listener now		
Validation	You can create the listener later using the Add Availability Group Listener dialog.		
Summary	O Create an availability group listener		
Results	Specify your listener preferences for this availability group. Listener DNS Name: Port:		
	Network Mode: Static IP		
	Subnet IP Address		

Figure 31 - Listener options for Availability Group

11. Once Replica options are selected, click **Next** to move on to Data Synchronization options:



- 12. Choose **Full** and provide a network share that a .bak backup file will be created in. In this example, a new folder was created on the primary SQL server's **vDisk assigned to SQL backups**, was shared, and permissions were assigned to the **DOMAIN\SQL-AAG-Computers** security group created earlier. *NOTE: REQUIRES SUFFICIENT FREE SPACE FOR A FULL BACKUP!*
- 13. Confirm that Validation Checks are OK

fû -	New Availability Group	. D X
Validation		
Introduction		🕜 Help
Specify Name	Results of availability group validation.	
Select Databases	Name	Result
Specify Replicas	Checking whether the endpoint is encrypted using a compatible algorithm	Success
Select Data Synchronization	Checking shared network location	Success
Select Data Synchronization	Checking for free disk space on the server instance that hosts secondary replica SQL-AAG-02	Success
Validation	Checking if the selected databases already exist on the server instance that hosts secondary replica SQL	Success
Summary	Checking for compatibility of the database file locations on the server instance that hosts secondary re	Success
Results	Checking for the existence of the database files on the server instance that hosts secondary replica SQL	Success
	Checking the listener configuration	Success
	Checking the availability mode compatibility between the primary and secondary replicas	Success

Figure 32 - Validation Checks – review any line times that do not have a Successful result

14. After validation is complete, review the summary, and click **Finish**.

3	New Availability Group		_ D X
Summary			
ntroduction			🔞 Help
pecify Name	Verify the choices made in this wizard.		
elect Databases	Click Finish to perform the following extreme		
inecify Replicar	Click Finish to perform the following actions:		
pecity replicas	Availability Group: Tintri-SQL-AAG		^
elect Data Synchronization	Primary replica: SQL-AAG-01		
alidation	- Availability Group Listener: SQL-AAG		
	Automated backup preference: Secondary		
immary	these AAG (00.0 GP)		
esults	Initial data synchronization: Full		
	Backup location: \\SOL-AAG-01\InitialSvpc		
	En Benlicas		
	Server instance name: SOL-AAG-01		
	- Role: Primary		=
	Replica mode: Synchronous commit with automatic failover		
	Readable secondary: No		
	Endpoint: Hadr_endpoint		
	URL: TCP://SQL-AAG-01.ttucs.tm.tintri.com:5022	Ν	
	Encrypted: Yes	М	
	Service account: NT Service\MSSQLSERVER		
	Automated backup priority: 50		
	E Server instance name: SQL-AAG-02		
	Role: Secondary		
	Replica mode: Synchronous commit with automatic failover		
	Endnoint: Hadr endnoint		
	IIII - TCP://SOI - 44G-02 ttucs tm tintri com:5022		~
			E
			Script 🔻
		< Previous Finish	Cancel

Figure 33 – Summary of options to be used to create the Availability Group

15. Once the process starts, click on **More Details** to see an itemized list of each step, as well as the progress of each:

6	New Availability Group	_ D X
Progress		
Introduction Specify Name Select Databases Specify Replicas	Creating a full backup for 'tpcc_AAG'.	🔞 Help
Select Data Synchronization	Name	Status
Validation	Configuring endpoints.	Success
Summary	Starting the 'AlwaysOn_health' XEvent session on 'SQL-AAG-01'.	Success
	Starting the 'AlwaysOn_health' XEvent session on 'SQL-AAG-02'.	Success
Kesults	Creating availability group 'Intri-SQL-AAG'.	Success
	Waiting for availability group 'Lintri-SQL-AAG' to come online.	Success
	Joining secondary replicas to availability group Tintri-SQL-AAG	Success
	Constinue of the second	Juccess (20%)
	Restering the AAG on SQL AAG 02'	Not started
	Backing up log for 'there AAG'	Not started
	Restoring 'these AAG' log on 'SOL-AAG-07'	Not started
	laining these AAG' to availability group 'Tintri-SQL-AAG' on 'SQL-AAG-02'	Not started
	Fewer details	
	< Previo	us Next > Cancel

Figure 34 - Availability Group Wizard - Progress of final tasks

If the wizard fails to join the availability group, for any reason, review the Error using the link provided in the Result column. Often the errors are well described, but in other cases the root cause may be more obscure and harder to identify. Review the Windows System, Security, Application and SQL event logs for clues and double-check that permissions were assigned as previously outlined.

Adding Databases to the SQL Server Availability Group

Adding additional databases to an existing SQL Server Availability Group is fairly straight-forward and can be performed while the database is online, without interruption. There may be some overhead associated with some of the operations, primarily seen with backing up the database, transferring it to the other server, and restoring it.

Refer to <u>Appendix C</u> for detailed <u>Step-by-Step instructions</u>.

HammerDB was used to generate load using the schema creation process within a newly-created single instance database. The new database was actively being written to under heavier load than typically found in day to day operations of most environments. In this case, the new database was being populated at a rate of over 2 Million transactions per minute (tpm). Although the tpm rate dropped by ~15% during process of making the DB highly available, none of the HammerDB client nodes lost their connections to the database and they continued populated the database with unique, random data without interruption.



Figure 35 - HammerDB was used to apply load while testing the AG creation process and various AG failover/resiliency tests

To add a database to an existing AG, open SQL Management Studio, **right-click on Availability Databases**, and select **Add Database...**, as shown here:

Refer to <u>Appendix C</u> for detailed Step-by-Step guidance.



With databases added to the AG, use the Availability Dashboard to verify that all server nodes are healthy, and that the AG itself has a healthy status, as shown here:

Figure 36 – Right-click the Availability Databases node and Select "Add Database..." to invoke launch the wizard

bject Explorer 🔹 👎	X Tintri-SQL-AAG:SQL-AA	G-01 🗙 Dashboard: SQL-AAG	j-01	•
ionnect * 🛂 🛃 = 7 😰 🔜	inr 🕢 Tintri-SQL-	AAG: hosted by SQL-AA	G-01 (Replica role: Prim	Last updated: 9/15/2014 12:34:43 PM Auto refresh: on
 □ Databases ● Databases ● Database Snapshots ● tpcc_AAG (Synchronized) ● tpcc_aag_2 (Synchronized) ● tpcc_aag_3 (Synchronized) ● tpcc_aag_4 (Synchronized) 	Availability group state Primary instance: Failover mode: Cluster state: Availability replica:	: 🕜 Healthy SQL-AAG-01 Automatic SQL-AAG (Normal Quori	um)	Start Failover Wizard View AlwaysOn Health Events View Cluster Quorum Information Add/Remove Columns
	Name Ø SQL-AAG-01 Ø SQL-AAG-02	Role Failover Mode Primary Automatic Secon Autom	Synchronization State Issues Synchronized Synchronized	
AlwaysOn High Availability Availability Groups	Group by -			Add/Remove Columns
 Tintri-SQL-AAG (Primary) Availability Replicas 	Name SQL-AAG-01	Replica	Synchronization State	Failover Readi Issues
► Availability Databases ↓ fpcc_AAG ↓ fpcc_aag_2 ↓ fpcc_aag_3	<pre> tpcc_AAG tpcc_aag_2 tpcc_aag_3 </pre>	SQL-AAG-01 SQL-AAG-01 SQL-AAG-01	Synchronized Synchronized Synchronized	No Data Loss No Data Loss No Data Loss
Ust tpcc_aag_4 Ust tpch Isteners	tpcc_aag_4	SQL-AAG-01 SQL-AAG-01	Synchronized	No Data Loss
 Baragement Integration Services Catalogs B SQL Server Agent 	tpcc_AAG tpcc_aag_2 tpcc_aag_3 tpcc_aag_4	SQL-AAG-02 SQL-AAG-02 SQL-AAG-02 SQL-AAG-02	Synchronized Synchronized Synchronized Synchronized	No Data Loss No Data Loss No Data Loss No Data Loss
	Ø tpch	SQL-AAG-02	Synchronized	No Data Loss

Figure 37 - Green is good! Use the dashboard to check the health status of your AlwaysOn Servers and Databases. Right-click AlwaysOn Availability and choose "Show Dashboard"

Create an Availability Group Listener (Optional)

An availability group listener is a virtual network name (VNN) to which clients can connect in order to access a database in a primary or secondary replica of an AlwaysOn availability group. An Availability Group Listener is assigned a unique DNS name and one or more IP addresses.

While availability group listeners enable support for failover redirection and read-only routing, **client connections are not required to use them**. A client connection can also directly reference the instance of SQL Server instead of connecting to the availability group listener. In this guide, we used the Virtual IP and unique DNS name assigned to the windows failover cluster for client database connections instead of an availability group listener.

There are no unique requirements for Availability Group Listeners with respect to running your SQL Server Availability Group databases on Tintri VMstores, so we've left this step as optional, but felt it worth mentioning for completeness. For more information, refer to the following two links:

- Availability Group Listeners, Client Connectivity, and Application Failover
- Create or Configure an Availability Group Listener

VMware vCenter Settings

DRS Cluster Settings

Create a rule to prevent SQL Server VMs within the same Availability Group from running on the same host. Running two or more servers responsible for keeping a single logical database highly available creates a single point of failure if the host fails affecting both the SQL Server VMs. Implement DRS rules for your highly-available VMs to provide better resiliency to complete host failures.

Cluster Features vSphere HA Virtual Machine Options VM Monitoring	Use this pa while they a cluster.	ge to create rules for virtual machines within are deployed to this cluster and will not be re	n this cluster. Rules will apply to etained if the virtual machines ar	virtual machines only e moved out of the
Datastore Heartbeating	Name		Туре	Defined by
vSphere DRS DRS Groups Manager Rules Virtual Machine Options Power Manageme Host Options VMware EVC		Keep SQLAIwaysOn Servers Separate SQL-AAG-01 SQL-AAG-02	Separate Virtual Machines	User
Help	Add	III Remove	Edi	Details

Figure 38 - DRS Rule that prevent Clustered SQL Database VMs from sharing the same host

DO: Create a rule to prevent SQL Server VMs that are members of the same Availability Group (AG) from running on the same host.

Conclusion

SQL Server AlwaysOn Availability Groups allow us to obtain a higher level of application availability than is otherwise possible in a stand-alone instance of a SQL Server. This guide has provided information around SQL Server Availability Groups and how to configure in a supported configuration on Tintri VMstore storage appliances.

Microsoft Clustering Services (MSCS) has historically been difficult to configure within a virtual environment, but was required in order to cluster SQL Server. Thanks to Microsoft technology advancements and the advent of Windows Failover Clustering (WSFC) and SQL AlwaysOn technology, MSCS is no longer required to deploy and manage highly available SQL Server databases.

Thank you for choosing Tintri. We hope the options and guidance presented in this guide enable you to leverage this new technology. For additional information about Tintri VMstores and other technical whitepapers and resources, visit <u>www.tintri.com</u>.

References

Tintri Links

<u>Microsoft SQL Server Best Practices Guide on Tintri</u>

Microsoft Links

- SQL Server Failover Cluster Installation
- Windows Server 2012 R2 Failover Clustering Overview
- Overview of AlwaysOn Availability Groups
- Windows Server Failover Clustering (WSFC) with SQL Server
- Failover Cluster Permissions (Windows 2012 R2)
- Deploy an Active Directory-Detached Cluster
- WSFC Quorum Modes and Voting Configuration
- Prerequisites, Restrictions, and Recommendations for AlwaysOn Availability Groups
- Setup Login Accounts for Database Mirroring or AlwaysOn Availability Groups
- Availability Group Listeners, Client Connectivity, and Application Failover
- Create or Configure an Availability Group Listener
- SQL 2014 AlwaysOn Enhancements (compared to SQL 2012)
- Features Supported by the Editions of SQL Server 2014
- <u>Cluster-Aware Updating Overview</u>

Other Links

• HammerDB – Testing Tool

Appendix A – Step-by-Step: Windows Failover Cluster Creation

Follow the steps below to validate and create a Windows Failover Cluster:

1. Open the Failover Cluster Manager, which can be accessed from the Tools menu of the main Server Manager dashboard in Windows 2012:

a	Server Manager	_ _ X
Server Ma	anager • Dashboard 🛛 • 🕲 l 🏲 🖞	Manage Tools View Help
Dashboard	WELCOME TO SERVER MANAGER	Active Directory Domains Active Directory Module for Active Directory Sites and
All Servers	1 Configure this local server	Active Directory Users and ADSI Edit Cluster-Aware Updating
Flie and Storage Services P	2 Add roles and features 3 Add other servers to manage	Component Services Computer Management Defragment and Optimize
	WHAT'S NEW 4 Create a server group	Event Viewer Failover Cluster Manager
	5 Connect this server to cloud serv	/iCes Local Security Policy Microsoft Azure Services
	ROLES AND SERVER GROUPS Roles: 2 Server groups: 1 Servers total: 4	ODBC Data Sources (52-b) ODBC Data Sources (64-b) Performance Monitor Resource Monitor
	App Server 4	4 Services System Configuration
	Manageability Manageability Events Events	System Conngulation System Information Task Scheduler

Figure 39 - Accessing the Failover Cluster Manager

2. Click on Validate Configuration:

3	Failover Cluster Manager		_ _ X
File Action View Help			
Nanager Gluster Manager	Failover Cluster Manager	^	Actions
	Create failover clusters, validate hardware for potential failover clusters, and perform configuration your failover clusters.	on changes to	Failover Cluster Mana Validate Configuration
	Overview		Create Cluster
	A failover cluster is a set of independent computers that work together to increase the availability of ser clustered servers (called nodes) are connected by physical cables and by software. If one of the nodes	ver roles. The fails, another	View
	node begins to provide services. This process is known as failover.		G Refresh
	- Chistory		Properties
	~ Clusters		Pelp
	No items found.	=	
	▲ Management		
	To begin to use failover clustering, first validate your hardware configuration, and then create a cluster, steps are complete, you can manage the cluster. Managing a cluster can include copying roles to it from running Windows Server 2012 R2, Windows Server 2012, or Windows Server 2008 R2.	After these n a cluster	
	More Information		-
			▲ 🔀 🔁 🍓 11:53 AM 9/4/2014

Figure 40 - Click on Validate Configuration

3. Click Next to proceed beyond the Intro:



Figure 41 - Validate a Configuration Wizard - Click Next to proceed

4. Select servers to add to the cluster:

N	Va	lidate a Configuration Wizard		X
Select S	ervers or a Clust	er		
Before You Begin Select Servers or a Cluster	To validate a set of se To test an existing clu	rvers, add the names of all the servers. ster, add the name of the cluster or one of its nodes.		
Testing Options Confirmation Validating Summary	Enter name: Selected servers:	SQL-AAG-01 ttucs.tm.tintri.com SQL-AAG-02 ttucs.tm.tintri.com	4	Browse Add Remove
		< Previous	Next >	Cancel

Figure 42 - Select Servers you want to add to a cluster using the Browse... button, the click Next

5. Choose "Run all tests" and click Next:



Figure 43 - Run all tests and click Next

6. Wait for Validation tests to run:

Before You Begin	The following v amount of time	alidation tests are running. Depending on the test select	ion, this may take a significant	
Cluster	Progress	Test	Result	~
Testing Options	100%	List BIOS Information	The test passed.	
Calling Options	100%	List Environment Variables	The test passed.	Ξ
Confirmation	100%	List Memory Information	The test passed.	
Validating	100%	List Operating System Information	The test passed.	
Summary	100%	List Plug and Play Devices	The test passed.	
sample j	100%	List Running Processes	The test passed.	
	100%	List Services Information	The test passed.	
	50%	List Software Updates	Gathering data about	
		List Sustan Driver	Ponding	~
	<	ш	>	

Figure 44 - Validation....

7. Review the Summary:



Figure 45 - Summary of Validation results

- 8. After reviewing the results for errors and warnings. Refer to the previous section on <u>creating a</u> <u>Windows Failover Cluster</u> for detail on some known false-positive errors and warnings.
- 9. Check the checkbox for "Create the cluster now..." and click Finish to launch the Create Cluster Wizard, as shown here:

N	Validate a Configuration Wizard	X
Summar	у	
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	- INCHINER	
Confirmation	Name Result Description	· · · · ·
Validating Summary	List Network Binding Order Success	
Party and a second of the	Validate Cluster Network Configuration	
	Validate IP Configuration After reviewing results, leave the "Create cluster" option checked and click finish to initiate the "Create Cluster Wizard"	
	Validate Windows Firewall Configuration	~
1	Create the cluster now using the validated nodes	
	To view the report created by the wizard, click View Report. To close this wizard, click Finish.	View Report
	2	Finish

Figure 46 - Click Finish to launch the Create Cluster Wizard

10. Click **Next** to proceed past the intro:

Create Cluster Wizard
ou Begin
 This wizard creates a cluster, which is a set of servers that work together to increase the availability of clustered roles. If one of the servers fails, another server begins hosting the clustered roles (a process known as failover). Before you run this wizard, we strongly recommend that you run the Validate a Configuration Wizard to ensure that your hardware and hardware settings are compatible with failover clustering. Microsoft supports a cluster solution only if the complete configuration (servers, network, and storage) can pass all tests in the Validate a Configuration Wizard. In addition, all hardware components in the cluster solution must be "Certified for Windows Server 2012 R2." You must be a local administrator on each of the servers that you want to include in the cluster. To continue, click Next. More about Microsoft support of cluster solutions that have passed validation tests.
Do not show this page again

Figure 47 - Intro screen for the Create Cluster Wizard

11. Provide a name for the cluster. The name supplied here will create a Computer Object in the AD, as described in the <u>previous configuration section</u>:

B	Create Cluster Wizard
Access F	Point for Administering the Cluster
Before You Begin	Type the name you want to use when administering the cluster.
Access Point for Administering the Cluster	Cluster Name: SQL-AAG
Confirmation Creating New Cluster Summary	The NetBIOS name is limited to 15 characters. One or more DHCP IPv4 addresses were configured automatically.
	< Previous Next > Cancel

Figure 48 - Provide a name for your cluster. This will be the name of the virtual IP of the active cluster node

12. On the confirmation, **UNCHECK** the "Add all eligible storage to the cluster" checkbox and click **Next** to start the cluster creation:

4	Create Cluster Wizard				
Confirma	tion				
Before You Begin Access Point for Administering the	You are ready to create The wizard will create y	e a cluster. your cluster with the following settings:			
Cluster	Cluster:	SQL-AAG			
Confirmation	Node:	SQL-AAG-01.ttucs.tm.tintri.com			
Creating New Cluster	Node:	SQL-AAG-02.tt			
Summary	Add all eligible stora	age to the cluster.			
	To continue, click Next	<pre>INACCESSIBLE Cancel</pre>			

Figure 49 - On the confirmation, UNCHECK the "Add all eligible storage to the cluster" checkbox

13. Wait while the new cluster is created:

	Create Cluster Wizard
Creating	New Cluster
Before You Begin Access Point for Administering the Cluster	Please wait while the cluster is configured.
Confirmation Creating New Cluster Summary	
	Forming cluster "SQL-AAG".
	X
	Cancel

Figure 50 - A new cluster is being created

14. On the Summary screen, click **View Report** for a detailed report on the creation tasks and review for warnings and/or errors.



Figure 51 - Cluster Summary - Click "View Report" for details

You have now successfully created a Windows Failover Cluster!

Appendix B – Step-by-Step: Configuring Cluster Quorum Settings

To configure a File Share to be used as the cluster quorum, follow the steps below.

 From within Failover Cluster Manager, right-click on the newly-created Cluster and select More Actions – Configure Cluster Quorum Settings:



Figure 52 - Configure Cluster Quorum Settings can be found under the "More Actions" menu

2. Click **Next** to proceed past the intro:

躍	Configure Cluster Quorum Wizard
Before Y	'ou Begin
Before You Begin Select Quorum Configuration Option Configure Queter Quorum Settings Summany	This wizard guides you through configuring the quorum for your failover cluster. The relevant cluster elements are the nodes and, in some quorum configurations, a disk witness or file share witness. The quorum configuration affects the availability of your cluster. A sufficient number of cluster elements must be online, or the cluster loses quorum and must stop running. Note that the full function of a cluster depends not only on the quorum, but also on the capacity of each node to support the clustered roles. Important: Run this wizard only if you have determined that you need to change the quorum configuration for your cluster. When you create a cluster, the cluster software automatically chooses a quorum configuration that will provide the highest availability for your cluster. To continue, click: Next. Failover Cluster Quorum and Witness Configuration Options Do not show this page again
	Next > Cancel

Figure 53 - Cluster Quorum Configuration Wizard - Intro

3. Choose the second option (Select Quorum Witness) and click Next:

耀	Configure Cluster Quorum Wizard	×
Select Q	uorum Configuration Option	
Before You Begin Select Quorum Configuration Option Select Quorum	Select a quorum configuration for your cluster. O Use default quorum configuration The cluster determines quorum management options, including the quorum witness.	
Witness Configure Cluster Quorum Settings Summary	 Select the quorum witness You can add or change the quorum witness. The cluster determines the other quorum management options. Advanced quorum configuration You determine the quorum management options, including the quorum witness. 	
	Failover Cluster Quorum and Witness Configuration Options < Previous]

Figure 54 - Cluster Quorum Configuration Wizard - Select the Quorum witness Option

4. Provide a file share path for the quorum. This is the share that was created on a file server in the <u>Prerequisites section</u>. Use a FQDN for the host, if applicable, and click **Next** to proceed:

×
ust not be
Browse
Cancel

Figure 55 - Cluster Quorum Configuration Wizard - Enter the File Share path, using the FQDN of the share, if required

5. Review the confirmation page and click **Next** to continue:

巃	Configu	re Cluster Quorum Wizard	×
Confirma	tion		
Before You Begin Select Quorum Configuration Option	You are ready to configure the	e quorum settings of the cluster.	
Select Quorum	Witness Type:	File Share Witness	~
vvitness	Witness Resource:	\\ucsad\SQL-AAG_QuorumWitness	
Configure File Share Witness	Voting:	Enabled	
Confirmation	All nodes are configure	d to have quorum votes	
Configure Cluster Quorum Settings	Your cluster quorum co above.	nfiguration will be changed to the configuration shown	
Summary			v
	To continue, click Next.	< Previous Next Cance	el

Figure 56 - Cluster Quorum Configuration Wizard - Confirmation

6. After the Quorum has been configured, click **View Report** on the summary page to review the details and ensure the operation was successful and without errors.



Figure 57 - Cluster Quorum Configuration Wizard - Summary

Congratulations, the Quorum is now configured!

Appendix C – Step-by-Step: Adding Databases to an existing Availability Group

Here are the steps to add a database to an existing AG. Note: this is only one of several methods available.

 Backup the Database - Before adding the database to an availability group, one of the prerequisites is that the database needs to have had a full backup. If this is not done, you will be warned in a later step and prevented from proceeding with the add operations. In this example, a full backup was made to a folder on the vDisk allocated for SQL Backups, and shared as <u>\\Server\InitialSync</u>, accessible to the other nodes. In our tests, selecting the "copyonly" option was not sufficient to meet prerequisites and a FULL backup was required. NOTE: Make sure there is enough free space in the backup vDisk to hold the full backup (.bak) of the database(s) being added to the AG

0		Back Up Database - tpch	_ 🗆 🗙
Select a page	🖾 Script 🔻 🚺 Help		
Media Options	Source Database: Recovery model: Backup type: Copy-only backup Backup component:	tpch FULL Full	▼ ▼
	Database Files and filegroups: Destination Back up to:	Disk	
Connection	I:\InitialSync\tpch.bak	Backup Location = \\SQL-AAG-01\\InitialSync , the	Add Remove
Server: SQL-AAG-01 Connection: TTUCS\adminrgirard		same share used during AAG creation and Add Database to AG operations	Contents
Progress Ready			
		OK	Cancel

Figure 58 - Prior to adding a database to an availability group, create a full backup

2. Once the backup has completed, navigate to **AlwaysOn High Availability – Availability Groups** and **right-click** on **Availability Databases** from within SQL Management Studio. Choose **Add Database...**

	Tintri-SC	QL-AAG:SQL-AAG-01	- Microsoft	SQL Server M	anagement Studio		_	. a ×
ile Edit View Debug Tools W	uery 👔 🐴 📸 🏹	よ日送	· 月 · 月,		-		- 100 2	
Dbject Explorer	+ ₽ ×	Tintri-SQL-AAG:SQL-AA	AG-01 × Das	hboard: SQL-AAG	-01			
Connect 🕶 🛃 🔳 🍸 🛃						. L	ast updated: 9/15/201	4 12:33:13 PM
🖃 🐻 SQL-AAG-01 (SQL Server 12.0.2	2000 - TTUCS\adminr	Tintri-SQL	-AAG: hoste	ed by SQL-AA	G-01 (Replica role: P	rim	uto refresh: on II	
🖃 🧰 Databases							Start Failover Wizard	4
🗄 🧰 System Databases		Availability group state	e: 🕑 Healthy	1			View Always On Hea	th Events
Database Snapshots	.n	Primary instance:	SQL-A4	AG-01			View Cluster Quoru	m Informatic
tpcc_AAG (Synchronize	a)	Failover mode:	Autom	atic			view cluster Quoru	minioniado
tpcc_aag_2 (Synchroniz	ed)	Cluster state:	SQL-A4	AG (Normal Quoru	ım)			
The second secon	ed)	Availability replica:					Add/Remo	ve Columns
	,	Name	Role	Failover Mode	Synchronization State	Issues		
🕀 🚞 Security			Dia	Automatic	Contracted			I.
🗉 🚞 Server Objects		SOL-AAG-UI	Primary	Automatic	synchronized			
🖭 🧰 Replication		SQL-AAG-02	Secon	Automatic	Synchronized			
📄 🚞 AlwaysOn High Availability		Group by -					Add Demand C	
🖃 🛅 Availability Groups		Group by +					Add/Kemove Co	
🖃 🗊 Tintri-SQL-AAG (Pri	mary)	Name	Replica		Synchronizati	on State	Failover Readi	Issues
🕀 🧾 Availability Repli	icas	SQL-AAG-01						
	Add Database	tpcc_AAG	SQL-AA	G-01	Synchronized		No Data Loss	
the the	hè	D tpcc_aag_2	SQL-AA	G-01	Synchronized		No Data Loss	
	Start PowerShell	tpcc_aag_3	SQL-AA	G-01	Synchronized		No Data Loss	
tpcc aac	Reports	• D tpcc_aag_4	SQL-AA	G-01	Synchronized		No Data Loss	
🕀 🧰 Availability	Pafrash	SQL-AAG-02						
🗄 🛅 Management	Neiresii	Dec_AAG	SQL-AA	G-02	Synchronized		No Data Loss	
🗄 🛅 Integration Services Catalog	gs	Ø tpcc_aag_2	SQL-AA	G-02	Synchronized		No Data Loss	
🗉 📸 SQL Server Agent		Ø tpcc aag 3	SQL-AA	G-02	Synchronized		No Data Loss	
		0.	COL 44	0.00	<u> </u>		N. D. C. I	

Figure 59 - The AlwaysOn Dashboard

3. The Add Database to Availability Group Wizard appears. Click Next to proceed.



Figure 60 – Add Database to Availability Group wizard - Introduction

4. Select the database(s) you want to add. If prerequisites have not been met, click the link provided for instructions on how to proceed. In our tests, the prerequisite was always related to taking a FULL backup first. Click **Next** to proceed.

A A	dd Database to Avail	ability Group - 1	Fintri-SQL-AAG
Select Database	25		
Introduction			Help
Select Databases	Select user databases i	for the availability o	proup.
Select Data Synchronization	User databases on this i	nstance of SQL Serve	er:
Connect to Replicas	Name	Size	Status
Validation	✓ tpcc_AAG	99.9 GB	Already part of this availability group
S	✓ tpcc_aag_2	10.2 GB	Already part of this availability group
Summary	✓ tpcc_aag_3	64.1 GB	Already part of this availability group
Results	cc_aag_4	37.7 GB	Already part of this availability group
	tpch	474.1 MB	Meets prerequisites
	13		
			-
			Refresh
			< Previous Next > Cancel

Figure 61 - Add Database to Availability Group wizard – Select Database(s)

 Select a method populate data in the other nodes. We chose the Full option and used the backup share we created earlier, located on the local SQL instance: <u>\\SQL-AAG-01\InitialSync</u>. Click Next to continue.

10	Add Database to Availability Group - Tintri-SQL-AAG
Select Initia	al Data Synchronization
Introduction	 Help
Select Databases	Select your data synchronization preference.
Select Data Synchronization	Full
Connect to Replicas Validation Summary	Starts data synchronization by performing full database and log backups for each selected database. These databases are restored to each secondary and joined to the availability group. Specify a shared network location accessible by all replicas:
Results	\\SQL-AAG-01\InitialSync Browse
	 Join only Starts data synchronization where you have already restored database and log backups to each secondary server. The selected databases are joined to the availability group on each secondary. This action will be skipped for Azure replicas. Skip initial data synchronization Choose this option if you want to perform your own database and log backups of each primary database.

Figure 62 - Add Database to Availability Group wizard - Initial Data Synchronization options

6. Connect to Replicas (other nodes) within the Availability Group, and click Next once connected.

Connect to Exi	sting Secondary Repl	icas	
Introduction Select Databases Select Data Synchronization Connect to Replicas	Connect to all the exist Before the wizard can co you must connect to all	ing secondary replicas. nfigure existing endpoints to grant then the existing secondary replicas.	Help
Validation	Server Instance	Connected As	
-	SQL-AAG-02	TTUCS\admin	Connect
		2	Connect All
		< Previous	Next > Cancel

Figure 63 - Add Database to Availability Group wizard - Connect to Replicas

7. **Validation** is performed. Click **Next** assuming all tests are successful. In the event of a warning or error, review the details, correct the problem, and then continue.

n Validation	Add Database to Availability Group - Tintri-SQL-AAG	O X
Introduction Select Databases	Results of availability group validation.	Help
Select Data Synchronization	Name	Result
Connect to Replicas	Checking whether the endpoint is encrypted using a compatible algorithm	Success
Validation	Checking shared network location	Success
	Checking for free disk space on the server instance that hosts secondary re	Success
Summary	Checking if the selected databases already exist on the server instance that	Success
Results	Checking for compatibility of the database file locations on the server insta	Success
	Checking for the existence of the database files on the server instance that	Success
		Sugar

Figure 64 - Add Database to Availability Group wizard – Validation

8. Summary – Click Finish on the summary screen, assuming everything looks correct.



Figure 65 - Add Database to Availability Group wizard - Summary

9. As tasks are automatically performed to add the DB to the AG, click **More Detail** to track progress:

10	Add Database to Availability Group - Tintri-SQL-AAG
Progress	
Introduction Select Databases Select Data Synchronization	Restoring 'tpch' on 'SQL-AAG-02'.
Select Data Synchronization Connect to Replicas Validation Summary Results	Name Status Adding secondary databases to availability group 'Tintri-SQL-AA Success Creating a full backup for 'tpch'. Success Restoring 'tpch' on 'SQL-AAG-02'. In Progress (30%) Backing up log for 'tpch'. Not started Restoring 'tpch' log on 'SQL-AAG-02'. Not started Joining 'tpch' log on 'SQL-AAG-02'. Not started Joining 'tpch' to availability group 'Tintri-SQL-AAG' on 'SQL-AA Not started
	Fewer details <previous next=""> Cancel</previous>

Figure 66 - Add Database to Availability Group wizard

10. In the screenshot above, the backup taken in the step before adding the DB to the availability group is restored to the other node(s). In our example, the <u>HammerDB</u> schema creation process is still aggressively populating the databases. All database changes from the time of the initial backup are captured and replayed into the replica server(s) and then the AlwaysOn clustering technology keeps the database(s) in sync going forward.



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