Windows Clustering 101

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Dave Bermingham

- Microsoft Cluster MVP (2010-current)
- Founder of www.clusteringformeremortals.com
- SIOS Technology Senior Technical Evangelist (2004-current)
  - Focused on helping customers deploy HA and DR solutions on Windows Servers

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Agenda

- What is Clustering?
- SQL High Availability Options
  - AlwaysOn Availability Groups
  - AlwaysOn Failover Cluster Instance
  - #SANLess Failover Cluster Instance
- Clustering Basics
- Configuration Details
- High Performance #SANLess Failover Clusters
- Clustering in the Cloud
What is clustering?
Clustering...A Brief History

1995  LifeKeeper 1.0 available on NCR NT based servers

1997  Microsoft Cluster Server (MSCS) introduced in Windows NT Server 4.0 Enterprise

2008  MSCS rebranded with the release of Windows Server 2008 to Windows Server Failover Cluster (WSFC)

        SIOS launches DataKeeper Cluster Edition to support #SANLess Clusters with WSFC

2012  “AlwaysOn” label introduced to describe SQL High Availability (HA) options in SQL Server 2012
Terms to Know

- Downtime
  - Planned
  - Unplanned
- Recovery Time Objective (RTO)
- Recovery Point Objective (RPO)
- Disaster Recovery (Multisite Cluster)
- High Availability (How many 9’s)
- Failover
- Replication
## Availability Equation

- **Availability** = \(\frac{\text{total time} - \text{down time}}{\text{total time}}\)

<table>
<thead>
<tr>
<th>Availability %</th>
<th>Downtime per year</th>
<th>Downtime per month</th>
<th>Downtime per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>90% (&quot;one nine&quot;)</td>
<td>36.5 days</td>
<td>72 hours</td>
<td>16.8 hours</td>
</tr>
<tr>
<td>95%</td>
<td>18.25 days</td>
<td>36 hours</td>
<td>8.4 hours</td>
</tr>
<tr>
<td>97%</td>
<td>10.96 days</td>
<td>21.6 hours</td>
<td>5.04 hours</td>
</tr>
<tr>
<td>98%</td>
<td>7.30 days</td>
<td>14.4 hours</td>
<td>3.36 hours</td>
</tr>
<tr>
<td>99% (&quot;two nines&quot;)</td>
<td>3.65 days</td>
<td>7.20 hours</td>
<td>1.68 hours</td>
</tr>
<tr>
<td>99.5%</td>
<td>1.83 days</td>
<td>3.60 hours</td>
<td>50.4 minutes</td>
</tr>
<tr>
<td>99.8%</td>
<td>17.52 hours</td>
<td>86.23 minutes</td>
<td>20.16 minutes</td>
</tr>
<tr>
<td>99.9% (&quot;three nines&quot;)</td>
<td>8.76 hours</td>
<td>43.8 minutes</td>
<td>10.1 minutes</td>
</tr>
<tr>
<td>99.95%</td>
<td>4.38 hours</td>
<td>21.56 minutes</td>
<td>5.04 minutes</td>
</tr>
<tr>
<td>99.99% (&quot;four nines&quot;)</td>
<td>52.56 minutes</td>
<td>4.32 minutes</td>
<td>1.01 minutes</td>
</tr>
<tr>
<td>99.995%</td>
<td>26.28 minutes</td>
<td>2.16 minutes</td>
<td>30.24 seconds</td>
</tr>
<tr>
<td>99.999% (&quot;five nines&quot;)</td>
<td>5.26 minutes</td>
<td>25.9 seconds</td>
<td>6.05 seconds</td>
</tr>
<tr>
<td>99.9999% (&quot;six nines&quot;)</td>
<td>31.5 seconds</td>
<td>2.59 seconds</td>
<td>0.605 seconds</td>
</tr>
<tr>
<td>99.999999% (&quot;seven nines&quot;)</td>
<td>3.15 seconds</td>
<td>0.259 seconds</td>
<td>0.0605 seconds</td>
</tr>
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</table>
High availability and disaster protection

- **Protect** mission-critical applications – SQL Server, SAP, Oracle
- **Failover** for high availability
  - Moves operation of application to a standby server
- **Replication** for #SANLess clustering and disaster recovery
Poll Question #1
SQL Server High Availability Options

**SQL Server 2012/2014 “AlwaysOn”**
- AlwaysOn Availability Groups
- AlwaysOn Failover Cluster Instance

**VS**

**#SANLess Clusters**
- AlwaysOn Failover Cluster Instance *WITHOUT a SAN*
- SIOS DataKeeper Cluster Edition Replication Software
SQL Server 2014 AlwaysOn Availability Groups

- Introduced in SQL Server 2012
- Evolution of Database Mirroring
- **New Features Include**
  - Grouping Databases into Failover Groups
  - Integration with Windows Server Failover Clustering (WSFC)
    - Uses WSFC quorum models
    - Uses Cluster Client Access Point
  - Readable Secondary
  - SQL 2014 Enhancements…
    - Secondary Replicas increased from 4 to 8
  - **Requires SQL Server 2012/2014 Enterprise Edition**
SQL Server 2014 AlwaysOn Failover Cluster Instance

- Renamed in SQL Server 2012
  - Previously called SQL Server Failover Cluster
- **New Features Include:**
  - Support for cross subnet failover
  - Integration with Windows Server Failover Clustering (WSFC)
    - Uses WSFC quorum models
    - Uses cluster Client Access Point
    - Actually is a true “clustered instance”
  - Requires SQL Server 2012/2014 Standard or Enterprise Edition
  - Requires Shared Storage
Poll Question #2
#SANLess Cluster

- Combines the benefits of AlwaysOn Failover Cluster Instance with AlwaysOn Availability Groups
-Eliminates need for a SAN
- Supports Cloud Deployments
- Runs on SQL 2008/2012/2014 **Standard** or Enterprise Edition
- Supports High Performance Failover Clusters
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Clustering Basics
The Building Block…

- Regardless of which solution you use, Windows Server Failover Clustering is the building block of all the SQL Server HA solutions
Building a 2-node Failover Cluster Instance

Documented in detail in my blog article

- Add the Failover Clustering Feature
- Configure your storage (optional)
- Run Cluster Validation
- Create the cluster
- Adjust quorum type if necessary
Configuring the Quorum

- Highly recommend reading this Microsoft Press Blog: *From the MVPs: Understanding the Windows Server Failover Cluster Quorum in Windows Server 2012 R2*

- Quorum Types
  - Node Majority
  - Node & Disk Majority
  - Node & File Share Majority
  - Disk Only (legacy, not recommended)

- Rule of Thumb
  - Always have an odd number of votes
  - Multisite cluster quorum…it’s complicated
    - File Share Witness in 3rd site required for automatic failover
    - Read TechNet Blog on [File Share Witness](#)
Node and Disk Witness

Node1

Node2
Node and File Share Witness

Node1

Node2

File Share Witness

Node3

Node4
Multisite Cluster

File Share Witness

Node 1

Failover

WAN/LAN

Replication

Node 2
Multisite Cluster

Node1

Failover

Replication

Node2

File Share Witness
Multisite Cluster

Node1

Failover

WAN/LAN

Replication

Node2

File Share Witness
In 3rd location
Quorums in Windows 2012 R2

- Dynamic Quorum (introduced in Windows 2012)
- Dynamic Witness
- Tie Breaker for 50% node split
  - (Get-ClusterNode –Name "Node1").Id
  - (Get-Cluster).LowerQuorumPriorityNodeID = 1

**Take Away** – In Windows 2012 R2 it is ALWAYS recommended to configure a witness, regardless of the number of nodes in the cluster.
Configuration Detail
Configuring AlwaysOn Availability Groups

Creation and Configuration of Availability Groups (SQL Server)

- Install Windows Cluster
- Install a Standalone SQL Server 2012/2014 Enterprise
- Use the **domain account** for the SQL service account
- Open Port **1433** and **5022** or disable the Windows Firewall
  - Create a sample database
  - Set recovery model to Full
  - Back up this sample database
- Enable the AlwaysOn feature on both instances using SQL Server Configuration Manager
- Create an Availability Group using the Availability Group Wizard
Configuring AlwaysOn Failover Cluster

Create a New SQL Server Failover Cluster (Setup)
Install Windows Cluster

• Configure the SAN to share LUNS with each cluster node
• Install Windows Cluster
• Use SQL Server 2012/2014 Standard or Enterprise
• Install the first node using New SQL Server Failover Cluster Installation
• Install additional nodes using Add node to a SQL Server Failover Cluster
Configuring AlwaysOn Failover Cluster

- **New SQL Server stand-alone installation or add features to an existing installation**
  - Launch a wizard to install SQL Server 2012 in a non-clustered environment or to add features to an existing SQL Server 2012 instance.

- **New SQL Server failover cluster**
  - Launch a wizard to install a single-node SQL Server 2012 failover cluster.

- **Add node to a SQL Server failover cluster**
  - Launch a wizard to add a node to an existing SQL Server 2012 failover cluster.

- **Upgrade from SQL Server 2005, SQL Server 2008 or SQL Server 2008 R2**
Configuring a #SANLess CLuster

http://clusteringformeremortals.com/2013/01/05/clustering-sql-server-2012-on-windows-server-2012-step-by-step/

- Create the cluster
- Install SIOS DataKeeper
- Create the DataKeeper Volume Resources
- Install the first node using *New SQL Server Failover Cluster Installation*
- Install additional nodes using *Add node to a SQL Server Failover Cluster*
#SANLess Clusters for High Performance Environments
Clusters Your Way.

#SANLess Clustering with DataKeeper Cluster Edition

- **Flexible** – protects physical, virtual, cloud, hybrid cloud
- **Easy** – Supports Windows Server Failover Clustering Environments
- **Efficient** – Real time, block-level replication synchronizes local storage

Synchronous or Asynchronous Low Latency Block Replication Between Server Nodes
#SANLess Cluster Replication Performance

Inserts per Second

- 1.2M
- 1M
- 800K
- 600K
- 400K
- 200K

HA nearly as Fast as no-HA!

250% Faster than AlwaysOn!

- No Mirror
- SANLess Cluster Replication
- AlwaysOn SQL Replication
Poll Question #3
#SANLess MultiSite Clusters in Azure

Azure-West

Fault Domain

FAILOVER

Block Replication across Fault Domains

Fault Domain

REPLICATION

Azure Cloud Service

Fault Domain

DC1

File Share Witness

SQL1

SQL2
#SANLess MultiSite Clusters in Amazon

Amazon AWS

- Availability Zone
  - SQL1
- Availability Zone
  - SQL2
- Availability Zone
  - DC1
- Availability Zone
  - Witness

Amazon VPC

Block Replication across Fault Domains

FAILOVER

REPLICATION
Poll Question #4
Why Use #SANLess Clustering?
Spend a lot less on licensing

- Included in SQL Server Enterprise & Standard Edition
- Provides HA and more robust features
- Huge savings on licensing

AlwaysOn Availability Groups
- Requires SQL Server 2012/2014 Enterprise Edition
Protect distributed transactions.

**AlwaysOn Failover Clustering**
- Cannot protect distributed transaction coordinator (DTC)
- Not aware of post failover instance ID of server

**SIOS DataKeeper with Always On Availability Groups**
- Works with Windows Server Failover Clustering to Protect Entire SQL Instance
- Preserves server instance ID after failover

**SIOS DataKeeper Cluster Edition**
Protect System Databases

AlwaysOn Availability Groups

- Only replicates user defined databases
  - *NOT* MSDB & Master DBS
- Agent jobs & SQL Server account info NOT automatically synchronized – no failover as part of the Availability Groups

SIOS DataKeeper & AlwaysOn Failover Cluster

- Protects the entire SQL Server instance
- All system databases, failover ensuring complete recovery, including SQL Agent jobs and account information.
- Protects the entire SQL Server instance
- Automatically includes databases as they are added (or dropped), in the protection scheme

Clusters Your Way.™
Failover with more than two nodes.

**AlwaysOn Availability Groups**
- No more than two nodes in a failover configuration
- Limited to a single site.

**SIOS DataKeeper with AlwaysOn Failover Clustering**
- Flexibility to configure a multinode failover
- Mix SAN-based and #SANLess
- Deploy a multisite cluster for HA & DR
- No need for multiple SANs.
- Configure all replicated storage or combine shared & replicated storage.
Replicate any data type.

**AlwaysOn Availability Groups**

- Only replicates SQL Server databases, leaving other data types unprotected.

**SIOS DataKeeper Cluster Edition with Windows Server Failover Cluster**

- Delivers complete protection of both SQL data and the data your application relies on outside of the SQL database.
Improve replication efficiency.

- When AlwaysOn Availability Groups is configured in a synchronous-commit mode (required for high availability) it slows application write performance.

Microsoft describes synchronous-commit mode as “…emphasizes high availability over performance, at the cost of increased transaction latency.”

**SIOS DataKeeper**

- Uses efficient block level replication that minimizes the performance impact of synchronous replication
- Also supports asynchronous replication
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Resources

- Clustering for Mere Mortals
  - www.clusteringformere mortals.com

- Always On Failover Cluster Overview

- Understanding Quorum in a Failover Cluster

- Understanding File Share Witness Placement

- Configuring Availability Groups

- What’s New in Failover Clustering in Windows Server 2012 R2
THANK YOU!

For More Information

Contact SIOS!

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