

# Microsoft SQL Server Virtualization Through SMB 3.0 on Cisco UCS and a Tegile IntelliFlash Array

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## Table of Contents

<b>Executive Summary</b> .....	<b>3</b>
<b>Introducing the Cisco Unified Computing System</b> .....	<b>3</b>
Comprehensive Management .....	3
Radical Simplification .....	3
High Performance .....	4
<b>Microsoft Hyper-V Virtualization Solution</b> .....	<b>4</b>
Scalability, Performance & Density .....	4
Security & Multi-tenancy .....	4
Flexible Infrastructure .....	4
High Availability & Resiliency .....	4
Microsoft System Center Virtual Machine Manager .....	5
<b>Microsoft SQL Server</b> .....	<b>5</b>
Mission-critical performance .....	5
Faster insights on any data .....	5
Platform for hybrid cloud .....	5
<b>SMB 3.0 Brings Enterprise-Class File Storage to Microsoft Deployments</b> .....	<b>5</b>
<b>Tegile IntelliFlash Storage Array Overview</b> .....	<b>6</b>
Intelligent Flash Management .....	7
Cloud Analytics .....	7
<b>Tegile Differentiators for Microsoft Hyper-V</b> .....	<b>7</b>
Increase Virtual Server Consolidation .....	7
Reduce Storage Footprint .....	7
Continuous VM Availability .....	7
Certified and Integrated .....	8
<b>Tegile Differentiators for Microsoft SQL Server</b> .....	<b>8</b>
Dramatically Improve Database Response Times .....	8
Reduce Your Storage Footprint .....	8
Maximized Storage Efficiency .....	8
Consolidate Workloads with Multi-Protocol Support .....	8
Ensure the Availability and Protection of Your Business-Critical Data .....	8
<b>Tegile Differentiators for SMB 3.0</b> .....	<b>9</b>
<b>Reference Architecture 1 – SQL Server Single Instance</b> .....	<b>9</b>
Multiple SQL Server Single Instances .....	10
<b>Reference Architecture 2 – SQL Server AlwaysOn Failover Cluster</b> .....	<b>10</b>
<b>Reference Architecture 3 – SQL Server AlwaysOn Availability Group</b> .....	<b>12</b>
<b>Reference Architecture 4 – SQL Server Mixed Workloads</b> .....	<b>13</b>
<b>UCS and UCS Mini Considerations</b> .....	<b>15</b>
<b>Best Practices</b> .....	<b>16</b>
<b>Conclusion</b> .....	<b>16</b>

## Executive Summary

Server virtualization has evolved over the past few years from a nascent technology into a mature IT feature. In the process, businesses of all shapes and sizes have begun taking advantage of its power to meet shifting business needs. By virtualizing their workloads, organizations can reduce and control costs while improving the scalability, flexibility, and reach of IT systems. It has becoming a norm for IT organizations to virtualize SQL Server applications.

Microsoft introduced SMB 3.0 network file sharing protocol with Windows Server 2012. With SMB 3.0, for the first time you have the performance and enterprise-class storage capabilities you need to run applications like Hyper-V and SQL Server databases directly using a file protocol.

Businesses depend on Microsoft SQL Server databases for online transaction (OLTP), data warehousing, and analytics workloads. It's important that SQL Server delivers consistently high levels of performance and availability. But this can be difficult without the right storage infrastructure. As a result, revenue and productivity can suffer.

Tegile offers a comprehensive portfolio of all-flash and hybrid storage solutions that increases transaction throughput by 10x, delivers sub-millisecond latency, and dramatically reduces your storage footprint. Tegile arrays also offer comprehensive enterprise-class data protection and business continuity features at no extra license cost. Furthermore, Tegile is among the forerunners that has native SMB 3.0 network file protocol support and certified for Windows Server 2012/Hyper-V and Microsoft SQL Server.

Implementing a virtualized SQL Server application requires careful planning and validation. With introduction of SMB 3.0 file protocol, you now have more factors to consider when planning your SQL server installation or upgrade.

This document offers a few typical reference architectures of deploying Microsoft Windows Server Hyper-V based SQL Server virtualization using SMB 3.0 protocol on Cisco Unified Compute Server (UCS) and Tegile IntelliFlash™ storage, which can help to save you time when planning your next SQL Server deployment. Typical use cases include: Single Instance SQL Server, SQL Server AlwaysOn Failover Cluster, SQL Server AlwaysOn Availability Group, and SQL Server Mixed Workloads.

The reference architectures in this document are applicable to Microsoft SQL Server 2012, 2014 and 2016 on Windows Server 2012 R2 and onwards.

## Introducing the Cisco Unified Computing System

The Cisco Unified Computing System addresses many of the challenges faced by database administrators and their IT departments, making it an ideal platform for SQL Server and virtualization implementations.

### Comprehensive Management

The system uses an embedded, end-to-end management system that uses a high-availability active-standby configuration. Cisco UCS Manager uses role and policy-based management, which allows IT departments to give the power to application owners to define server, network, and storage access policy. After a server and its identity, firmware, configuration, and connectivity are defined, the server (or a number of servers like it) can be deployed in minutes, rather than the hours or days that it typically takes to move a server from the loading dock to production use. This capability relieves database administrators from tedious, manual assembly of individual components and makes scaling an SQL Server configuration a straightforward process.

### Radical Simplification

The Cisco Unified Computing System represents a radical simplification compared to the way that servers and networks are deployed today. It reduces network access-layer fragmentation by eliminating switching inside the blade server chassis. It integrates compute resources on a unified I/O fabric that supports standard IP protocols, as well as Fibre Channel through FCoE encapsulation. The system eliminates the limitations of fixed I/O configurations with an I/O architecture that can be changed through software on a per-server basis to provide needed connectivity using a

just-in-time deployment model. The result of this radical simplification means you need fewer switches, cables, adapters, and management points, thereby helping to reduce cost, complexity, power needs, and cooling overhead.

## High Performance

The system's blade servers are based on the Intel® Xeon® E5 and E7 processor families. These processors adapt performance to application demands, increasing the clock rate on specific processor cores as workload and thermal conditions permit. The system is integrated within a 10 or 40 Gigabit Ethernet-based unified fabric that delivers the throughput and low-latency characteristics needed to support the demands of the cluster's public network, storage traffic, and high-volume cluster messaging traffic.

## Microsoft Hyper-V Virtualization Solution

Microsoft has taken a leading position in the advancement of virtualization technology with Hyper-V. First introduced as part of Windows Server 2008, and then expanded and enhanced in Windows Server 2008 R2 and again in Windows Server 2012, Hyper-V provides organizations with a tool for optimizing server hardware investments by consolidating multiple server roles as separate virtual machines running on a single physical host machine.

## Scalability, Performance & Density

With Hyper-V customers can run the biggest, most powerful virtual machines to handle the demands of their biggest workloads. As hardware scale grows, customers wishing to take advantage of the largest physical systems to drive the highest levels of density and reduce overall costs, can do so successfully with Hyper-V—in all editions. In addition, further integration between Hyper-V and hardware drives the highest levels of performance for enterprise applications.

## Security & Multi-tenancy

BitLocker enables a level of physical security for the virtualized hosts. In addition, the in-box, granular networking security capabilities of Hyper-V are simply built in, unlike VMware. This enables customers to securely and easily isolate and control access to their key workloads inside the virtualized environment at significantly lower cost.

## Flexible Infrastructure

In a modern datacenter, customers are looking to be agile so they can respond to changing business demands quickly, and efficiently. Hyper-V innovations like Live Migration are provided in the box, which is incredibly important for those who need to move workloads flexibly around the infrastructure. Customers also want to be able to choose where best to deploy their workloads based on the needs of that workload specifically; and to do that, Network Virtualization plays a significant part. What's more, customers running heterogeneous infrastructures with a mixture of both Linux and Windows-based workloads appreciate Microsoft's continued engineering and development to improve Linux performance on Hyper-V.

## High Availability & Resiliency

As customers' confidence in virtualization grows and they virtualize more of their mission-critical workloads, the importance of keeping those workloads continuously available grows. Windows Server 2012 R2 has capabilities built in to the platform that not only help keep those workloads highly available, but also give users the ability to quickly restore those workloads in another geographical location in the event of a disaster. The specific improvements at both the fabric- and the workload-level help ensure that users can keep their most mission-critical applications and data as continuously available as possible.

Automatic VM Activation is a fantastic addition for Service Providers and organizations with disconnected environments. As a second generation of VM technology, Hyper-V has new capabilities for performance, flexibility, and security.

For more information on Windows Server 2012 R2 Hyper-V, visit <http://www.microsoft.com/en-us/servercloud/solutions/virtualization.aspx>

## Microsoft System Center Virtual Machine Manager

Microsoft System Center Virtual Machine Manager 2012 (SCVMM 2012) is Microsoft's virtualization management product. It is part of the System Center 2012 systems management suite.

With SCVMM, an administrator can configure and manage virtualized environments, including hosts, networking and storage resources. Tasks such as consolidation and conversion of physical machines and rapid provisioning of virtual machines (VMs) can be completed using a central console.

Private clouds are a major focus of SCVMM 2012: administrators can create and delegate VM resources to users, who can then use self-service tools to deploy their own VMs. It has the ability to create Hyper-V clusters and enhanced power management features.

SCVMM 2012 also supports Citrix XenServer, in addition to Microsoft Hyper-V and VMware vSphere.

## Microsoft SQL Server

When it comes to managing your data, Microsoft SQL Server has been viewed as an industry leader in ODBMS (Operational Database Management Systems).

### Mission-critical performance

SQL Server accelerates mission-critical applications with a new in-memory online transaction-processing (OLTP) engine that can deliver up to 30x transaction performance gains. For data warehousing, the new updatable in-memory columnstore can query 100x faster than legacy solutions. SQL Server also delivers peace of mind with unparalleled security and the fewest vulnerabilities of any enterprise database six years in a row.

### Faster insights on any data

Get to insight faster with a complete BI platform that speed up how you access, analyze, clean, and shape both internal and external data. With SQL Server 2014 and Microsoft Power BI, it's easy to connect every user in an organization to the right data they need to make better decision, faster.

### Platform for hybrid cloud

SQL Server 2014 was designed to work in a hybrid environment that spans on-premises and the cloud. New tools in SQL Server and Microsoft Azure make it even easier to build patching, backup, and disaster recovery solutions with Azure. These tools provide an easy on-ramp to the cloud for on-premises SQL Server databases, enabling customers to use their existing skills to take advantage of Microsoft datacenters worldwide.

## SMB 3.0 Brings Enterprise-Class File Storage to Microsoft Deployments

With SMB 3.0 Microsoft extended the functionality of its file-sharing protocol to improve performance, reliability, availability, manageability and security. Now you can deploy Microsoft SQL Server and Hyper-V using shared storage presented over SMB 3.0.

Compared to CIFS/SMB 1.x and 2.x, SMB 3.0 has support for the following features:

- Performance Optimization.
- SMB Transparent Failover.

- SMB Scale Out.
- SMB Multichannel.
- SMB Direct.
- SMB Encryption.
- VSS for SMB file shares.
- SMB Directory Leasing.
- SMB PowerShell.
- Performance Counters for server applications.

Tegile IntelliFlash arrays natively support SMB 3.0. The IntelliFlash built-in SMB 3.0 server has been validated compatible with the built-in SMB 3.0 client on Windows Server 2012.

For more details about SMB 3.0 support in Microsoft Windows Server, please visit: [https://technet.microsoft.com/en-us/library/hh831795\(v=ws.11\).aspx](https://technet.microsoft.com/en-us/library/hh831795(v=ws.11).aspx)

## Tegile IntelliFlash Storage Array Overview

Tegile Systems is pioneering a new generation of flash-driven enterprise storage arrays that balance performance, capacity, features and price for virtualization, file services and database applications. With Tegile's line of all-flash and hybrid storage arrays, the company is redefining the traditional approach to storage by providing a family of arrays that accelerate mission-critical enterprise applications and allow customers to significantly consolidate mixed workloads in virtualized environments.

Tegile's patented IntelliFlash™ technology accelerates performance and enables inline deduplication and compression of data so each array has a usable capacity far greater than its raw capacity. Tegile's award-winning solutions enable customers to better address the requirements of server virtualization, virtual desktop integration and database integration than any other offerings. Featuring both NAS and SAN connectivity, Tegile arrays are easy-to-use, fully redundant and highly scalable. They come complete with built-in snapshot, remote-replication, near-instant recovery, onsite or offsite failover, and VM-aware features.

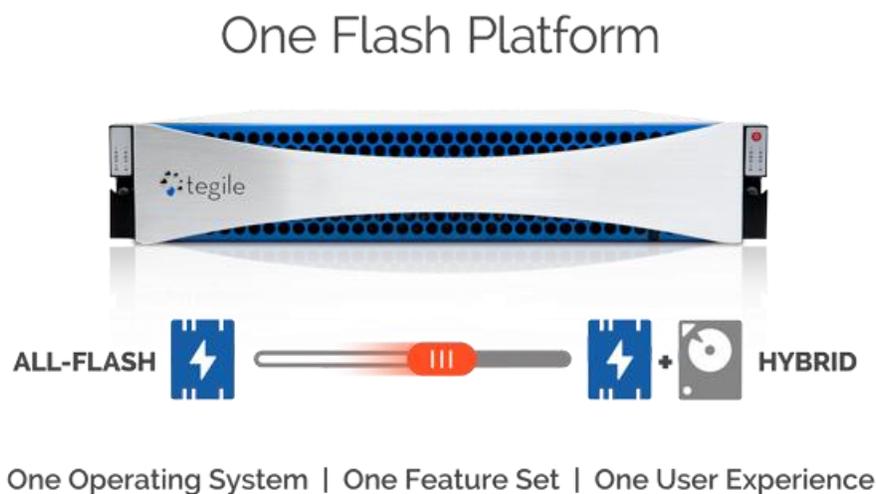


Figure 1 – Tegile IntelliFlash: One Flash Platform.

The following are the Tegile IntelliFlash highlights:

**All-Flash & Hybrid** – Tegile gives you a single storage system that supports both all-flash and hybrid configurations. Scale up economically by adding flash and disk as your needs change over time.

**Unified Storage** – Store virtual machines, application data, and unstructured data on a single storage system. Tegile flash arrays natively support SAN and NAS storage protocols, including iSCSI, Fibre Channel, NFS, and SMB 3.0.

**Superior Data Reduction** – Reduce your storage footprint, drive down costs, and get a performance boost with inline compression and deduplication.

**Built-in Data Protection** – Eliminate the risk of downtime and data loss. Tegile arrays include snapshot and replication capabilities. You can also natively replicate data between all-flash and hybrid systems for affordable disaster recovery.

## *Intelligent Flash Management*

Tegile flash storage arrays are powered by IntelliFlash, a software architecture that leverages different grades of storage media to deliver optimal performance (speed and latency) with the best possible economics. IntelliFlash also includes advanced data services, multi-protocol support, and robust management capabilities, enabling you to significantly shrink your storage footprint, maximize uptime, consolidate workloads, and simplify storage administration.

## *Cloud Analytics*

Tegile IntelliCare is a cloud-based support platform designed to simplify storage administration and maximize the uptime and efficiency of your Tegile IntelliFlash storage arrays. With IntelliCare, you can quickly and easily monitor the health, performance and usage of all your Tegile arrays, predict future requirements, and detect problems before they develop into component and system failures.

## *Tegile Differentiators for Microsoft Hyper-V*

### *Increase Virtual Server Consolidation*

Tegile IntelliFlash arrays deliver low latency and high IOPS for virtual server environments running performance-hungry applications like VDI, SQL Server, SharePoint, Oracle, and other business-critical applications. Tegile arrays deliver 5X the performance of traditional storage arrays for one-third the cost, allowing you to virtualize more enterprise applications and achieve better VM consolidation. All Tegile arrays support multiple protocols – Fibre Channel, iSCSI, NFS and CIFS/SMB 3.0 simultaneously from the same array. You can choose to provision storage for VMs using block storage or file protocols like NFS and SMB 3.0, depending on your specific needs. What's more, you can also provision file shares for the VMs using NFS or SMB 3.0—all on a single array. Instead of deploying multiple arrays from different vendors, you can consolidate multiple workloads on one Tegile array.

### *Reduce Storage Footprint*

Reduce your storage capacity needs for virtual servers by 90% using Tegile's data reduction technologies. Tegile's patented IntelliFlash technology enables inline data deduplication and compression of data across both flash and hard disk drives. Moreover, deduplication and compression act as performance multipliers by maximizing the use of flash storage. Tegile's unique data reduction capabilities dramatically cut down your storage acquisition and operational costs.

### *Continuous VM Availability*

All Tegile arrays come bundled with space-efficient snapshots and clones. Integration with Microsoft VSS enables VM-consistent snapshots for virtual machine images and application-consistent snapshots for application data, which ensures continuous VM availability.

All Tegile arrays also come bundled with snapshot based remote replication software for bandwidth efficient and VM consistent and application consistent data replication across datacenters. With Tegile, the VM infrastructure and application data for your enterprise applications are always available.

## *Certified and Integrated*

Tegile IntelliFlash arrays are certified with all the major hypervisors, including VMware vSphere, Microsoft Hyper-V and Citrix XenServer. Joint development and integration with hypervisors through various APIs enables you to deploy your virtual server infrastructure with confidence and peace of mind.

Tegile arrays also integrate with Microsoft System Center Virtual Machine Manager (SCVMM), enabling you to provision and manage Tegile storage and VMs from the unified central console of SCVMM.

## *Tegile Differentiators for Microsoft SQL Server*

### *Dramatically Improve Database Response Times*

Tegile IntelliFlash arrays are able to reduce SQL Server database transaction wait times to sub-milliseconds.

### *Reduce Your Storage Footprint*

Compress your databases by 2x - 5x. Maintain multiple copies of your databases without taking up additional storage space with Tegile's inline compression and deduplication.

### *Maximized Storage Efficiency*

Tegile thin provisioning increases storage utilization rates by not over-allocating capacity.

### *Consolidate Workloads with Multi-Protocol Support*

IT organizations often deploy multiple storage arrays to fit the protocol needs and workload characteristics of specific databases. Tegile arrays natively support both block and file protocols, enabling you to host SQL Server databases and your other workloads on a single arrays. Supported file protocols include NFS, CIFS and SMB 3.0. Block protocols include iSCSI and Fibre Channel. All protocols can be used simultaneously over a variety of storage ports.

### *Ensure the Availability and Protection of Your Business-Critical Data*

Prevent data loss due to corruption and ensure your data is available 24x7. When deploying SQL Server databases on Tegile arrays, you will benefit from the resilience, end-to-end data integrity, and high-availability features provided by the IntelliFlash architecture.

With Tegile arrays, there is no single point of failure. The controllers are configured in an active/active mode and can be configured for simultaneous data access. Capacity expansion, system upgrades, media swaps are performed with zero downtime and minimal performance impact.

To protect against silent data corruption, Tegile arrays perform a checksum process to match data blocks as writes and reads happen and automatically fix corrupt blocks.

Tegile arrays offer built-in data protection capabilities with a Microsoft VSS (Volume Shadow-copy Services) Provider that ensures point-in-time, application-consistent snapshots for your SQL Server databases and Hyper-V virtual machines for backup and disaster recovery.

## Tegile Differentiators for SMB 3.0

Tegile IntelliFlash supports SMB 3.0 natively.

IntelliFlash array not only offers the rich feature sets of SMB 3.0 protocol as a SMB 3.0 Server; it also provides consistently high performance with the other interconnect protocols of iSCSI, Fibre Channel and NFS.

In addition to the core SMB 3.0 feature sets mentioned in previous sections, Tegile IntelliFlash also supports integration with Windows Active Directory, so you can deploy the IntelliFlash array seamlessly in the Windows Active Directory environment and leverage the centralized authentication and access control through Windows Active Directory.

For consolidation with legacy application and server platforms, IntelliFlash is also backward-compatible with SMB/CIFS clients, so you can have one storage platform for true consolidation of legacy applications and new applications across various interconnect protocols.

## Reference Architecture 1 – SQL Server Single Instance

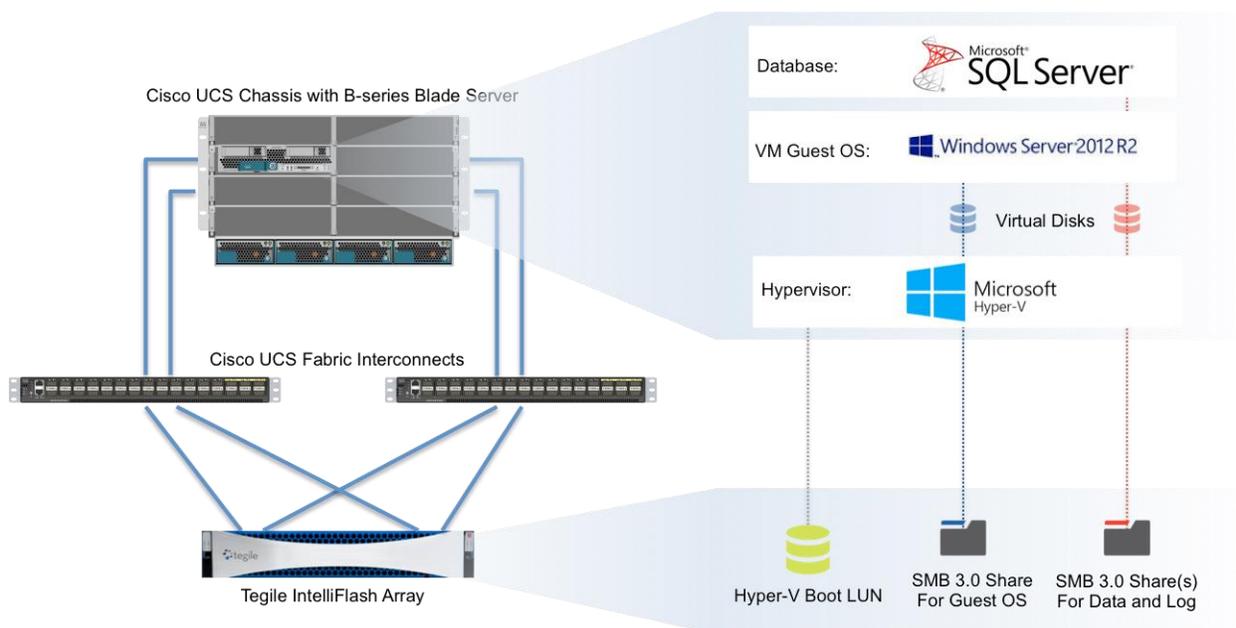


Figure 3 – Reference Architecture for SQL Server Single Instance

Comparing to the other deployment models, the Single Instance model is the simplest one. As illustrated in the figure above, this architecture contains:

Hardware:

- Server
  - 1x Cisco UCS 5518 chassis
  - 1x Cisco UCS B series blade, as the server
- Storage
  - 1x Tegile IntelliFlash storage array
  - Storage provisioning on the IntelliFlash storage array:
    - 1x iSCSI LUN for SAN boot of the UCS blade server
    - 2x SMB 3.0 file shares: one for the guest OS image of the virtual machine; the other for the SQL Server data and log.
- Network and Interconnect

- 2x Cisco UCS Fabric Interconnects (FI)
- The UCS chassis and the IntelliFlash arrays are connected directly through UCS FI in No-Single-Point-of-Failure fashion
- Interconnect protocols: 10GbE iSCSI and SMB 3.0
- Total 9 RU rack space

#### Software:

- 1x hypervisor host
  - Microsoft Windows Server 2012 R2 with Hyper-V is installed on the UCS blade
  - SAN boot is used. The UCS blade boots from an iSCSI LUN on the Tegile IntelliFlash array
- 1x virtual machine
  - Microsoft Windows Server 2012 R2 is installed on the VM
  - SQL Server is installed on the VM
  - The guest operating system and the SQL Server software are installed on a virtual disk presented to the VM by the Hyper-V host.
  - The virtual disk resides on a SMB 3.0 file share on the Tegile array
- Databases
  - The data and log files of the SQL Server database(s) are stored on a virtual disk presented to the VM by the Hyper-V host.
  - The virtual disk resides on a SMB 3.0 file share on the Tegile array.

### Multiple SQL Server Single Instances

For following this architecture, you may have multiple SQL Server applications running on multiple Windows Server VMs on the same Hyper-V host or on multiple hosts. Tegile IntelliFlash is capable of hosting multiple SQL Server databases, multiple VMs and multiple Hyper-V hosts on the same array.

From storage provisioning perspective,

- A separate boot LUN should be configured exclusively for each physical host;
- One SMB 3.0 file share can be used to store multiple VMs, regardless on which host, as long as the hosts are in the same Hyper-V cluster

### Reference Architecture 2 – SQL Server AlwaysOn Failover Cluster

AlwaysOn Failover Cluster Instances leverages Windows Server Failover Clustering (WSFC) functionality to provide local high availability through redundancy at the server-instance level—a *failover cluster instance* (FCI). An FCI is a single instance of SQL Server that is installed across Windows Server Failover Clustering (WSFC) nodes and, possibly, across multiple subnets. On the network, an FCI appears to be an instance of SQL Server running on a single computer, but the FCI provides failover from one WSFC node to another if the current node becomes unavailable.

Microsoft SQL Server Virtualization  
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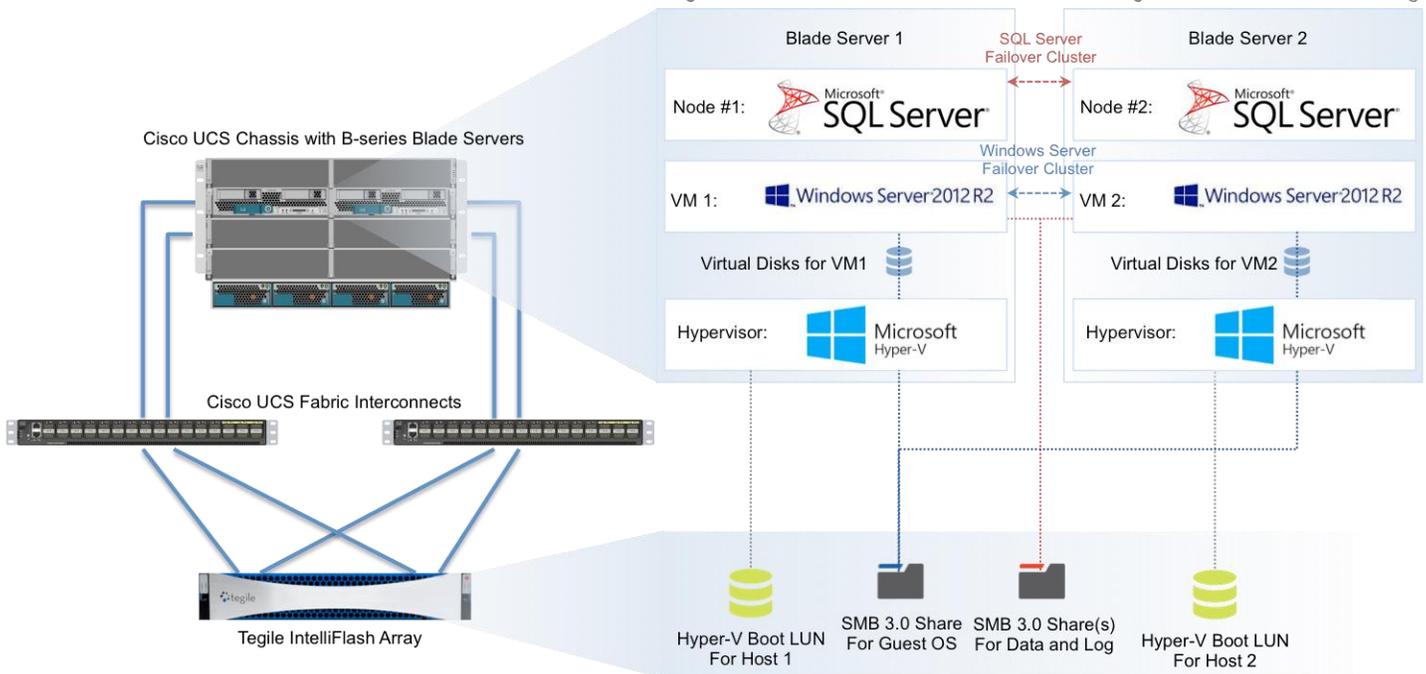


Figure 4 – Reference Architecture for SQL Server AlwaysOn Failover Cluster

As illustrated in the figure above, this architecture contains:

Hardware:

- Server
  - 1x Cisco UCS 5518 chassis
  - 2x Cisco UCS B series blade, as the server
- Storage
  - 1x Tegile IntelliFlash storage array
  - Storage provisioning on the storage array:
    - 2x iSCSI LUNs for SAN boot of the two UCS blade servers
    - 2x SMB 3.0 file shares: one for the guest OS image of the VMs; the other for the SQL Server data and log, which directly accessed by the two SQL Server application through SMB3 protocol.
- Network and Interconnect
  - 2x Cisco UCS Fabric Interconnects (FI)
  - The UCS chassis and the IntelliFlash arrays are connected directly through UCS FI in a no-single-point-of-failure fashion
  - Interconnect protocols: 10GbE iSCSI and SMB 3.0
- Total rack space: 9 RU

Software:

- 2x hypervisor host
  - Microsoft Windows Server 2012 R2 with Hyper-V is installed on the UCS blade
  - SAN boot is used. The UCS blade boots from an iSCSI LUN on the Tegile IntelliFlash array
  - Each UCS blade has its own SAN boot LUN exclusively provisioned on the Tegile array.
- 2x VMs
  - Microsoft Windows Server 2012 R2 is installed on each VM; and the two Windows servers are configured as a failover cluster
  - SQL Server is installed on each of VMs; the two SQL Server installations are installed as Failover Cluster

- The guest OS and the SQL server software are installed on a virtual disk presented to the VM by the Hyper-V host.
- The virtual disk resides on a SMB 3.0 file share on the Tegile array
- Both VMs can be stored on the same SMB 3.0 file shares on the Tegile array
- Databases
  - The data and log files of the SQL Server database(s) are stored directly on the SMB 3.0 file share provisioned on the Tegile array
  - Both the SQL server nodes access the same SMB 3.0 share for database data and log files.

## Reference Architecture 3 – SQL Server AlwaysOn Availability Group

The AlwaysOn Availability Groups feature is a high-availability and disaster-recovery solution that provides an enterprise-level alternative to database mirroring. Introduced in SQL Server 2012, AlwaysOn 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*, which fail over together. An availability group supports a set of read-write primary databases and one to eight sets of corresponding secondary databases. Optionally, secondary databases can be made available for read-only access and/or some backup operations.

The following architecture diagram gives an example of the commonly used SQL Server AlwaysOn Availability Group with one set of corresponding secondary database.

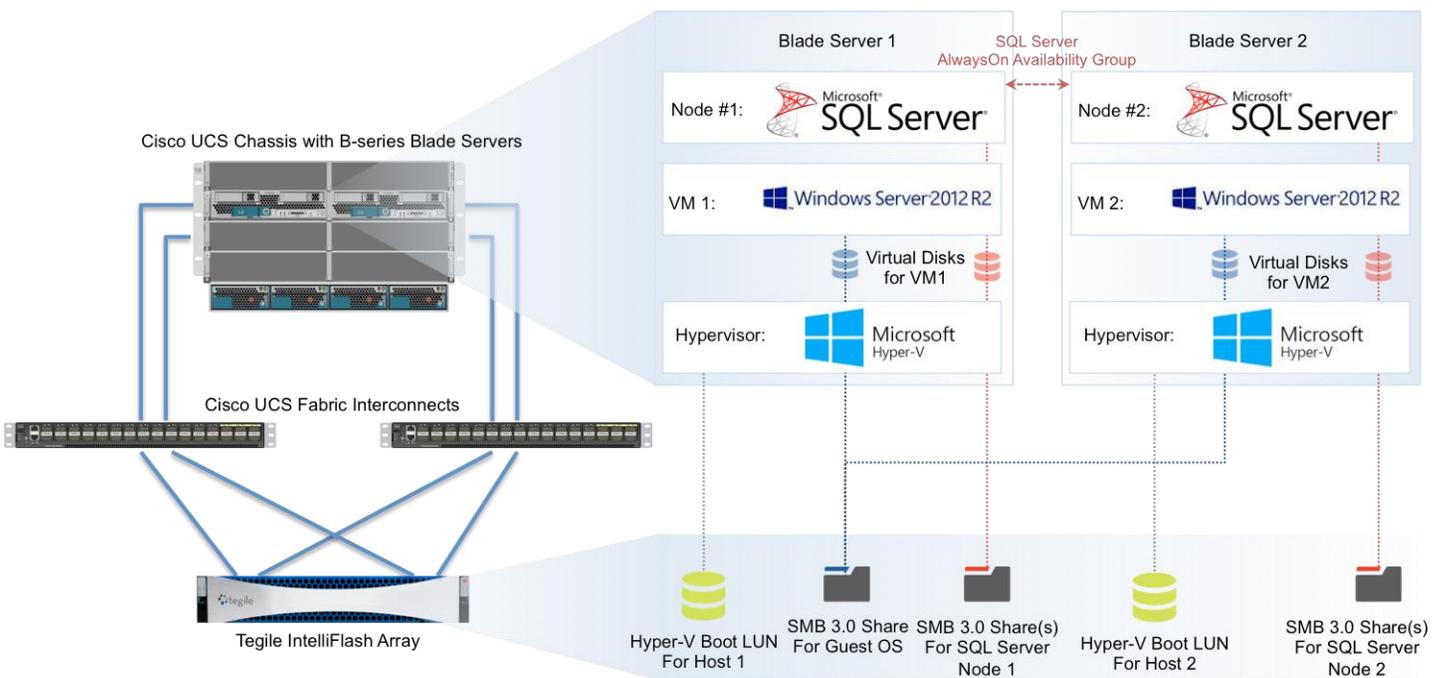


Figure 5 – Reference Architecture for SQL Server AlwaysOn Availability Group

As illustrated in the figure above, this architecture contains:

Hardware:

- Server
  - 1x Cisco UCS 5518 chassis

- 2x Cisco UCS B series blade, as the server
- Storage
  - 1x Tegile IntelliFlash storage array
  - Storage provisioning on the storage array:
    - 2x iSCSI LUNs for SAN boot of the two UCS blade servers
    - 3x SMB 3.0 file shares: one for the guest OS image of the virtual machines; the other two file shares are to store the data and log of the two SQL Server nodes: one file share per node.
- Network and Interconnect
  - 2x Cisco UCS Fabric Interconnects (FI)
  - The UCS chassis and the IntelliFlash arrays are connected directly through UCS FI in a no-single-point-of-failure fashion
  - Interconnect protocols: 10GbE iSCSI and SMB 3.0
- Total rack space: 9 RU

Software:

- 2x hypervisor host
  - Microsoft Windows Server 2012 R2 with Hyper-V is installed on the UCS blade
  - SAN boot is used. The UCS blade boots from an iSCSI LUN on the Tegile IntelliFlash array
  - Each UCS blade has its own SAN boot LUN exclusively provisioned on the Tegile array.
- 2x virtual machine
  - Microsoft Windows Server 2012 R2 is installed on the VM
  - SQL Server is installed on each of VMs; both the two SQL servers form AlwaysOn Availability Group.
  - The guest operating system and the SQL server software are installed on a virtual disk presented to the VM by the Hyper-V host.
  - The virtual disk resides on a SMB 3.0 file share on the Tegile array
  - Both VMs can be stored on the same SMB 3.0 file shares on the Tegile array
- Databases
  - On each SQL Server virtual machine, the data and log files of the SQL Server database(s) are stored on a virtual disk presented to the VM by the Hyper-V host.
  - The virtual disks resides their corresponding SMB 3.0 file shares on the Tegile array.
  - Each SQL Server VM stores one full copy of the database on its virtual disk.

## Reference Architecture 4 – SQL Server Mixed Workloads

In today's IT environments, you no longer deal with one single type of application, but mostly mixed workload such as e-commerce transactions, ERP, business intelligence analytics, emails, collaborations, virtual desktops, etc. Cisco and Tegile offer a unified computing, network, and storage platform for any workload in today's dynamic IT environments.

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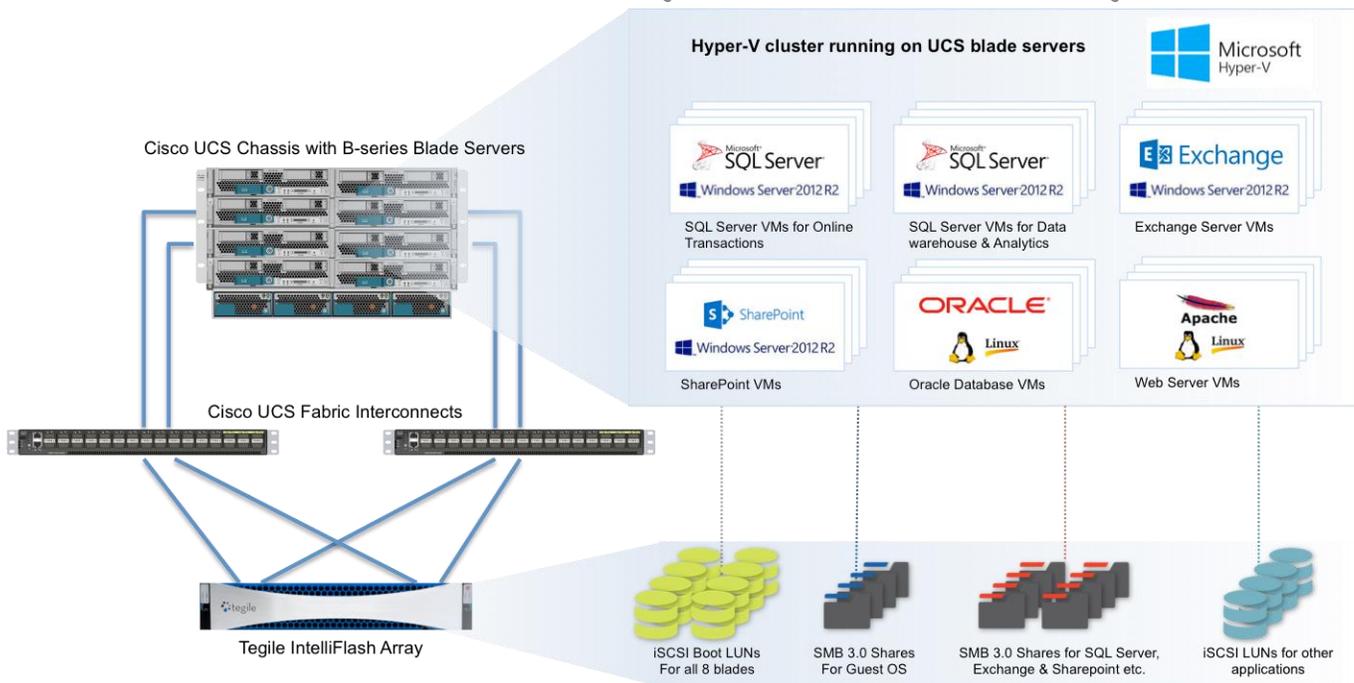


Figure 5 – Reference Architecture for SQL Server Mixed Workloads

As illustrated in the figure above, this architecture for mixed IT workloads contains:

Hardware:

- Server
  - 1x Cisco UCS 5518 chassis
  - 8x Cisco UCS B series blade, as the server
- Storage
  - 1x Tegile IntelliFlash storage array
  - Storage provisioning on the storage array:
    - 8x iSCSI LUNs for SAN boot of the 8 UCS blade servers
    - A number of SMB 3.0 file shares to store the guest OS image of the VMs;
    - A number of SMB 3.0 file shares to store the data and log files of the SQL Server, Exchange and SharePoint
    - A number of iSCSI LUNs to store the data for other applications, like Oracle and web servers etc.
- Network and Interconnect
  - 2x Cisco UCS Fabric Interconnects (FI)
  - The UCS chassis and the IntelliFlash arrays are connected directly through UCS FI in a no-single-point-of-failure fashion
  - Interconnect protocols: 10GbE iSCSI and SMB 3.0
- Total rack space: 9 RU

Software:

- 8x hypervisor host
  - Microsoft Windows Server 2012 R2 with Hyper-V is installed on the UCS blade
  - SAN boot is used. Each UCS blade has its own SAN boot LUN exclusively provisioned on the Tegile array.
- Multiple VMs running mixed application workloads
  - The guest OS can be Windows Server, Linux and the guest OS versions that Hyper-V supports
  - The mixed workload can be, but limited to:
    - SQL Server OLTP

- SQL Server for data warehouse or analytics
- Exchange Server
- SharePoint
- Oracle database
- Web server
- Databases
  - For SQL Server-based applications, such as SQL Server, Exchange and SharePoint, it can follow one of the 3 reference architectures mentioned above to access the database data and log hosted on the SMB3 shares on the Tegile array
  - For other databases, they can access their corresponding iSCSI LUNs on the Tegile array.

## *UCS and UCS Mini Considerations*

Based on the same architecture of UCS, Cisco introduced UCS Mini in 2014. UCS Mini combines the regular UCS chassis and the UCS Fabric Interconnects into one single solution. The blade servers are interchangeable between a regular UCS chassis and a UCS Mini chassis. It further reduces the networking complexity as well as cuts the cost. It's optimized for branch and remote offices, point-of-sale locations, and smaller IT environments. It's the ideal solution for customers who need fewer servers but still want the comprehensive management capability provided by Cisco UCS manager.

The reference architectures described in this document were illustrated based on the regular UCS. However, the same architectures apply to UCS Mini too. The only difference is:

- For regular UCS, the UCS chassis and the storage are connected through the separate UCS FIs;
- For UCS Mini, the UCS Mini chassis and the storage shall be directly connected through the built-in FI modules in the UCS Mini chassis.
- The customer can shrink the solution by 2RU using the FI modules integrated into the chassis.

## Best Practices

For detailed best practices of configuring a Tegile IntelliFlash storage array for SQL Server, please refer to the *Tegile SQL Server Best Practices Guide*.

For detailed configuration and best practices of Tegile IntelliFlash storage array and Cisco UCS, please refer to the *Tegile UCS Configuration and Best Practices Guide*.

## Conclusion

Cisco UCS paired with Tegile IntelliFlash storage arrays create a high-performance and cost-effective platform for SQL Server and mixed-application workload deployments. The highly differentiated architectures are well aligned to bring customers value for SQL Server application in a Microsoft Hyper-V virtual environment.

Critical Business Driver	UCS Enabling Technology	Tegile Enabling Technology
Performance and Capacity Optimization	Varying blade models with CPU, memory options. VIC virtual interfaces and 10G integrated fabric	Hybrid and All-Flash offerings, enterprise SSD, high-capacity HDD
Data Protection	Service Profile – stateless computing. Fully redundant HA fabrics	Snapshots with no overhead Replication Data block checksums Microsoft VSS support Application- and VM-consistent snapshots and replication
Time-to-Market for SQL Server-based Applications	Service Profile templates Export, Import of XML schema	Clones, read/write without performance or space overhead
Consolidation	Varying workloads on same fabric using instrumented QoS and virtual interfaces Multiprotocol via different port options	Store critical files on all flash pools Multiprotocol FC, iSCSI, SMB 3.0, and NFS (DNFS)
Reduce Infrastructure Costs	Stateless computing allows fewer spare systems Converged 10G fabric, FCoE reduces infrastructure	Thin Provisioning Inline Compression and deduplication, up to 90% space savings

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