# Windows Server 2012 R2 Hyper-V Component Architecture

## Live Migration

### Improved Live Migration

required to live migrate virtual machines. It is now faster and easier to manage and maintain and your private cloud infrastructure. When maintenance or upgrades are required on your server running Hyper-V, live migration enables you to quickly migrate your virtual machines. This reduces the time it takes to monitor lengthy migration operations. You can also quickly and efficiently balance your virtual machine workloads.

In Windows Server 2012 R2, live migration provides three options to reduce the time required to live migrate your virtual machines. You can choose to use memory compression. Alternatively, you can choose to use Remote Direct Memory Access (RDMA) functionality (which requires RDMA-enabled adapters) or multichannel network adapters.

These live migration options can support your private cloud infrastructure by:

- Increasing the efficiency of live migration when your hardware resources are constrained (memory compression).
- Increasing the scalability of live migration when your hardware resources are not constrained (multi-channel and RDMA-enabled network adapters).

## Faster Live Migration (less than 10 GB)

In environments where hardware and networking resources are constrained, live migration delivers performance improvements for migrating virtual machines by compressing the memory data before sending it across the network. This utilizes spare CPU capacity available in the server running Hyper-V. Hyper-V closely monitors the CPU requirements of the virtual machine and only consumes an appropriate amount of CPU resources to guickly move virtual machines from one server to the next



## Faster Live Migration (greater than 10 GB)

Windows Server 2012 R2 takes full advantage of your hardware to reduce the time In environments where networking resources are not constrained, you can configure live migration to use multi-channel network adapters or RDMA-enabled network adapters, which reduces the time required to live migrate virtual machines.

### Live Migration with RDMA-enabled Network Adapters

Computers that are running Windows Server 2012 R2 can be equipped with RDMAenabled network adapters that deliver significantly faster live migrations for your virtual machines. RDMA is able to perform a direct memory access from the memory of one computer into that of another without involving the operating system. This permits high throughput, low-latency networking and delivers greater effeciency with live migration.



Live Migration with Multi-Channel Network Adapters Windows Server 2012 R2 servers running multi-channel network adapters installed can perform faster live migrations for your virtual machines. Large virtual machines can be migrated simultaneously, utilizing multiple network adapters and hence achieving faster migration efficiencies.



## per-V Storage

### Hyper-V with Virtual Hard Disk Sharing

Windows Server 2012 R2 enables you to share a virtual hard disk file (VHDX format). which provides shared storage for a virtual machine failover cluster (also known as a guest cluster). By making shared storage available to virtual machines, you can can easily use a virtual machine failover cluster to protect your application services (for example, SQL or file server services) running inside your virtual machines.

Virtual Machine Clustering Using Cluster Shared Volumes



Supported Scenarios for Virtual Hard Disk Sharing

- Supported scenarios include: Fast virtual hard disk sharing using SMB Direct and SMB Multichannel.
- Migrating shared virtual hard disks using live migration. Saving and restoring virtual machines.
- Protecting against the failure of a guest node, Hyper-V host, or file server node. Using Windows Server 2012 R2 for file server nodes and Hyper-V hosts.
- Using Windows Server 2012 R2 and Windows Server 2012 for guest nodes.

### Virtual Machine Clustering with SMB Storage in a Scale-Out File Server One option for using virtual hard disk sharing is to use a scale-out file server.



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## Upgrading Your Private Cloud

### Live Migration

Hyper-V live migration in Windows Server 2012 R2 updates live migration with new capabilities that enable you to easily upgrade and manage your private cloud. You can now live migrate your virtual machines from Windows Server 2012 to Windows Server 2012 R2 in a simple, automated process that delivers zero downtime for your virtual machines.

You can now easily upgrade your private cloud infrastructure, which eliminates impact to your virtual machine workloads and helps you avoid the cost and inconvenience associated with unwanted downtime. Live migration delivers a more robust and automated upgrade path for large-scale environments and makes it easy to adapt to a faster upgrade cadence as different versions of Windows Server are released. It also makes it easier for you to manage and deliver on your service level agreements.

## Simple Live Migration











## In-Place Upgrades

In Windows Server 2012 R2, in-place upgrades are easier than before. Hyper-V now supports restoring virtual machines from a saved state created on Windows Server 2012 in Windows Server 2012 R2. You simply save your virtual machine state prior to upgrading your host computer, upgrade the host, and then restore the virtual machine. The ability to save and restore virtual machine states across different releases is supported across all Hyper-V features—including import/export, backup and restore, in-place upgrades and checkpoints (snapshots). This can significantly reduce the downtime associated with release upgrades.





A virtual machine failover cluster using a shared virtual hard disk is not limited to a specific storage topology. It is supported on Fibre Channel, iSCSI, Storage Spaces, and SMB.



Storage Quality of Service

parameters for storage on a virtual machine.

value for your virtual hard disk. nt from consuming excessive storage

prage Quality of Service (QoS)

every 8 KB of data is counted as an I/O.



specified virtual disk is below a thresho

These maximum and minimum values are specified in terms of normalized IOPS where

You can monitor storage-related parameters for the virtual hard disk of the virtual

## Online Virtual Hard Disk Resizing

Windows Server 2012 R2 enhances your capability to manage virtual machine storage resources. You can increase or decrease the size of a virtual hard disk while the virtual machine is still running.

rink virtual harc

sk files (VHE

Online resizing is intended exclusively for SCSI-attached VHDX files.



You can expand the operating system volume to include the unallocated volume space and make the expanded virtual hard lisk capacity available to the operating system within the virtual machine.







threshold to efficiently run your virtual machine workloads.



Hyper-V in Windows Server 2012 R2 includes the ability to set certain Quality of Service (QoS)

Storage QoS provides storage performance isolation in a multi-tenant environment and

mechanisms to notify you when the storage I/O performance does not meet the defined

## Session Modes

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The Hyper-V Virtual Machine Connection tool (VMConnect) provides you access to the desktop or console environment of running virtual machines. Windows Server 2012 R2 and Windows 8.1 introduce a new enhanced session mode to connect to virtual machines. Basic mode connections are supported.

Basic session mode provides a basic console view for the virtual machine, which allows you to send mouse and keyboard information and to view the graphics displayed by the virtual machine. This is analogous to plugging in a monitor to a physical computer.



In enhanced session mode, VMConnect provides you with a high-fidelity experience when connecting to Hyper-V virtual machines. It delivers the ability to share a clipboard between the client computer and virtual machine—and supports redirected audio, redirected USB, multi-touch, multi-monitor, and the use of smartcards for logon authentication. Enhanced session mode provides similar capabilities to Remote Desktop Services without the need for a network connection to the virtual machine.



USB device redirection requires that Group Policy is configured on the client computer.

Enhanced session mode support requires a guest operating system that supports Remote Desktop Services. Device redirection capabilities might differ depending on the operating system running in the virtual machine.

Remote Desktop Services does not need to be enabled in the guest operating system.

## Hyper-V and Failover Clustering

## **Storage Failure Detection for Virtual Machines**

Windows Server has always allowed you to cluster your virtual machines using storage managed by the failover cluster. If a storage failure was detected, the failover cluster responded in an appropriate manner and ensured that your virtual machine maintained access to its storage. In Windows Server 2012 R2, Hyper-V and Failover Clustering have been enhanced to detect physical storage failures on storage devices that are not managed by the failover cluster (for example, SMB 3.0 shares).

Storage failure detection can detect the failure of a virtual machine boot disk or any secondary data disk associated with the virtual machine. If such an event occurs, Failover Clustering ensures that the virtual machine is relocated and restarted on another node in the cluster. This eliminates situations where unmanaged storage failures would not be detected and where virtual machines resources may become unavailable. For example, a SQL data store failing on a secondary drive is now detected.



Storage failure detection supports VHD and VHDX file formats, differencing disks, virtual hard disks connected to IDE controllers, virtual hard disks connected to SCSI controllers, virtual machine checkpoints (snapshots), and virtual machines using storage and network resource pools.

## Generation 2 Virtual Machines

## Generation 2 Virtual Machines

Windows Server 2012 R2 introduces a new class of virtual machines that are optimized for virtualization—generation 2 virtual machines. They provide advanced features that deliver significant management, storage and security benefits.

In Windows Server 2012 R2, generation 2 virtual machine hardware removes most of the emulated ("legacy") devices, or replaces them with optimized software-based devices.

Generation 2 virtual machines lay the foundation for advanced virtual machine features, including a reduced attack surface for the platform and faster boot times for virtual machines.

## Booting Generation 2 Virtual Machines

Generation 2 virtual machines use a Unified Extensible Firmware Interface (UEFI) and software-based devices when turning on your computer. UEFI is an alternate firmware interface and delivers improved boot time performance and flexibility.

Generation 2 virtual machines provide the following boot capabilities.



Running simultaneous virtual machines on the same server. Windows Server 2012 R2 supports creating and running generation 1 and generation 2 virtual machines on the same server simultaneously This ensures you can easily migrate virtual machines running on an earlier version of Hyper-V to Windows Server 2012 R2.



**Network boot.** Generation 2 virtual machines use the optimized virtual network adapter. This eliminates the need for an emulated network adapter. It simplifies the process of booting a virtual machine and decreases problems associated with configuring virtual machine network adapters. IPV4 and IPV6 addressing schemes are supported.



**Secure Boot.** Generation 2 virtual machines use UEFI firmware, which provides support for Secure Boot. Secure Boot functionality prevents unauthorized" operating systems and software from loading during the startup process.



**Boot from a SCSI CD/DVD.** Generation 2 virtual machines can boot from a SCSI CD/DVD drive using an ISO image file.



**Boot from a SCSI-attached virtual hard disk.** Using UEFI firmware support, generation 2 virtual machines can boot from SCSI-attached virtual hard disks (VHDX). The VHDX file format supports volumes up to 64 TB.



Vindows Store





In previous releases, Failover Clustering has monitored and managed network connectivity among cluster nodes, and between clients and cluster nodes. It detects problems with a network adapter or other network device and takes appropriate action to ensure connectivity is uninterrupted. In Windows Server 2012 R2, Hyper-V and Failover Clustering have been enhanced to detect network connectivity issues for virtual machines. If the physical network assigned to the virtual machine suffers a failuresuch as a faulty switch port, network adapter, or a disconnected network cable—then the failover cluster moves the virtual machine to another node in the failover cluster in order to restore network connectivity

You can use network failure detection to monitor the health of a physical cluster node as well as the health of the virtual machine and ensure that you can provide a robust environment to host private cloud environments.



ent log entries indicate the reason for a virtual machine being moved when a network failure is detected.

Network failure detection works with any virtual machine. It supports legacy and software-based network adapters, SR-IOV–enabled network adapters, virtual machine checkpoints, storage or network resource pools, and advanced networking features enabled on virtual machines.



erstanding Generation 2 Virtual Ma **Generation 2 Virtual Machine** Generation 2 virtual machines in Windows Server 2012 R2 support the same Hyper-V features s generation 1 virtual machines in Windows Server 2012. These include checkpoints napshots), state transitions (for example Saved or Paused), import/export, backup/restore failover replication, clustering and advanced networking features such as Quality of Service(QoS), Single-Root I/O Virtualization (SR-IOV) and virtual machine queuing. Generation 2 virtual machines do not support RemoteFX. Generation 2 virtual machines use Generation 2 virtual machines can UEFI firmware instead of the BIOS. use software-based Fibre Channe and network adapters. Generation 2 virtual machines use Generation 2 virtual machines oftware-based devices for video. Th have faster boot times. pport the same video modes as ation 1 virtual machines. Generation 2 virtual machines support the VHDX file format and support large boot volumes up to 64 TB. You can also use online resizing to expand or shrink your virtual hard disk files (VHDX). This includes the operating system (boot drive) and data volumes. Online resizing is only available for SCSI-attached VHDX files. Generation 2 virtual machines support 64-bit versions of Windows 8 or Windows Server 2012 and Windows Server 2012 R2. CD/DVD devices can be hot-added and hot-removed from a generation 2 virtual machine. No CD/DVD devices are present by default. neration 2 virtual machines support ISO format images. eneration 2 virtual machines are available for integration services setup. You can manage generation 2 virtual machine boot order using Windows PowerShell, Hyper-V Manager, or Windows Management Interface (WMI). Secure Boot is not available in generation 1 virtual machines. Generation 1 virtual machines use the BIOS and emulated IDE before software-based devices can be utilized.