

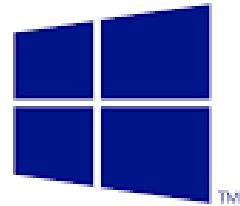


Hunan University of Arts and Science

Networking Theory & Applications

CIS 291

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Windows Server® 2012

Part 1



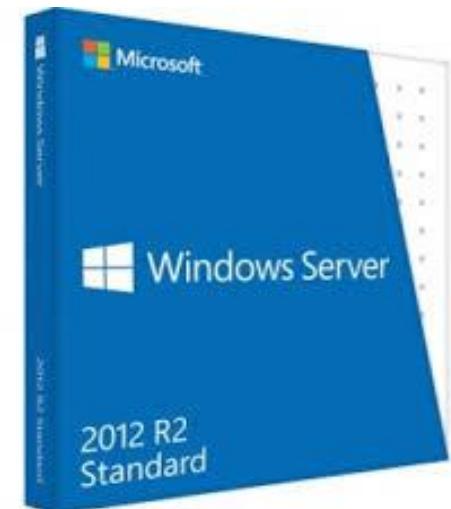
Chapter 3

Configuring Hyper-V

配置Hyper-V

Objectives in this chapter: 本章的目标

- 1- Create and configure virtual machine settings
- 2- Create and configure virtual machine storage
- 3- Create and configure virtual networks



Objective 3.1: Create and configure virtual machine settings

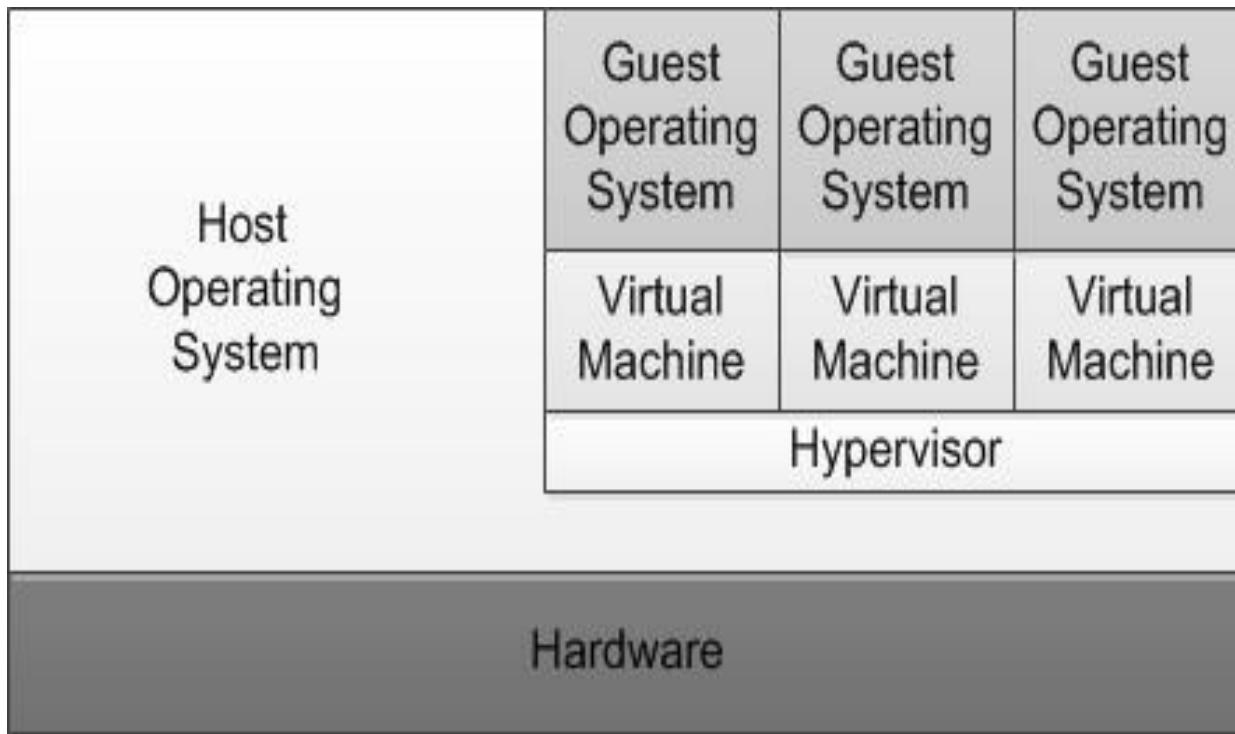
- Server virtualization in WS 2012 R2 is based on a module called a hypervisor. Sometimes called a virtual machine monitor (**VMM**).
- VMM is responsible for abstracting the computer's physical hardware and creating multiple virtualized hardware environments, called **VMs**. Each VM has its own (virtual) hardware configuration and can run a separate copy of an operating system (OS).
- A single computer running WS 2012 R2 with the Hyper-V role installed can support multiple VMs, which administrators can manage as if they were standalone computers.

1- Virtualization architectures

Type II Virtualization

- Requires a “host” operating system
- Using the Type II Hypervisor, you create a virtual hardware environment for each VM
- Install a “guest” operating system on each VM, just like installing a new computer
- The host operating system shares access to the computer’s processor with the hypervisor
- VM Does not provide the same performance as separate physical computers
- VM is providing a good testing or lab environment
- recommended for high-traffic servers in production environments.
- Examples: VirtualBox, VMWare Workstation

Virtualization Architectures

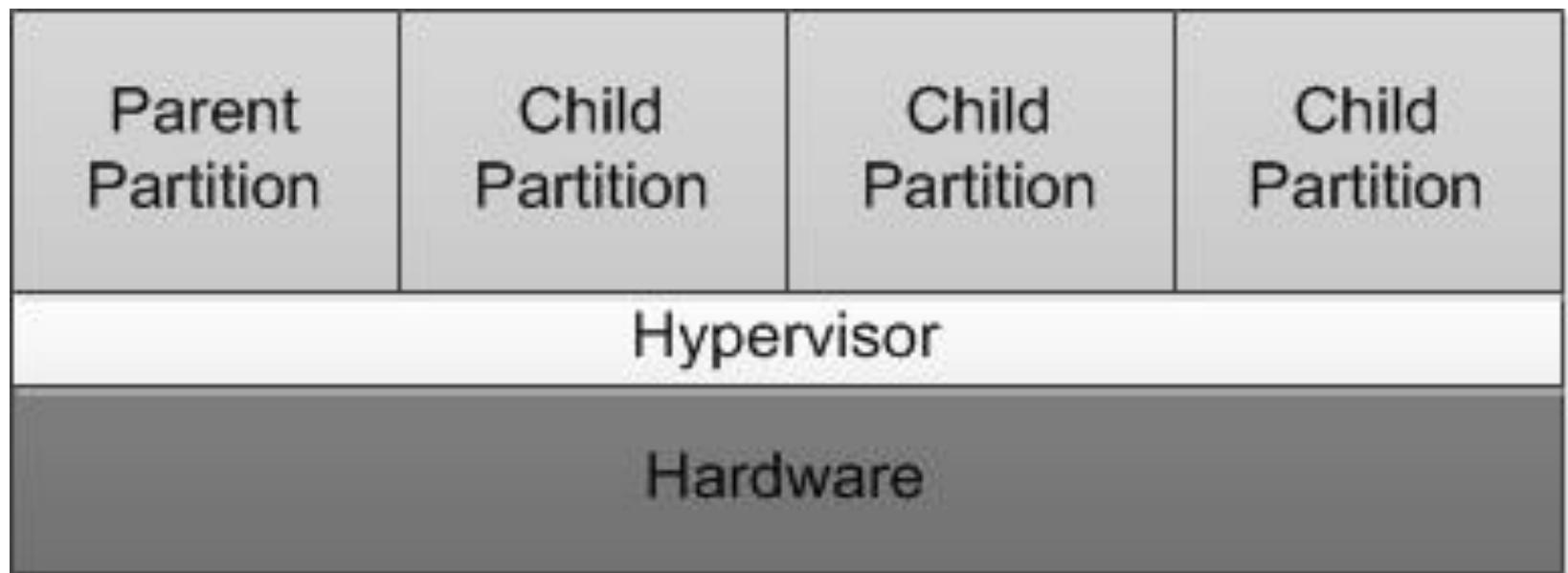


A hybrid VMM sharing hardware access with a host operating system

Type I Virtualization

- Hypervisor is an abstraction layer that interacts directly with the computer's physical hardware
- No host operating system required
- hypervisor is representing the level beyond the term supervisor, which is responsible for allocating a computer's processor clock cycles.
- Hypervisor creates Individual environments, called partitions have their own operating systems installed and accesses hardware through the hypervisor
- No host operating system is sharing processor
- Parent partition runs the virtualization stack which creates and manages the child partitions
- It is also responsible for the subsystems that directly affect the performance of the computer's physical hardware, such as Plug and Play, power management, and error handling.
- Examples: Microsoft 2012 R2 Hyper-V, VMWare ESXi vSphere Hypervisor

Virtualization Architectures



A Type 1 VMM, with the hypervisor providing all hardware access

2- Hyper-V Implementations

- Hyper-V role is required for the operating system to function as the computer's parent partition, enabling it to host VMs.
- Only Standard and Datacenter editions support Hyper-V in WS2012 R2.
- The Hyper-V role is required for the OS to function as a computer's primary partition, enabling it to host other VMs.
- No special requirements are needed for the guest operating systems (Microsoft or non-Microsoft).

3- Hyper-V Licensing

- You must have licenses for both physical and virtual instances of the operating system.
- Datacenter licensing allows you to create and run an unlimited number of VMs.
- Standard provides 2 virtual instances only.

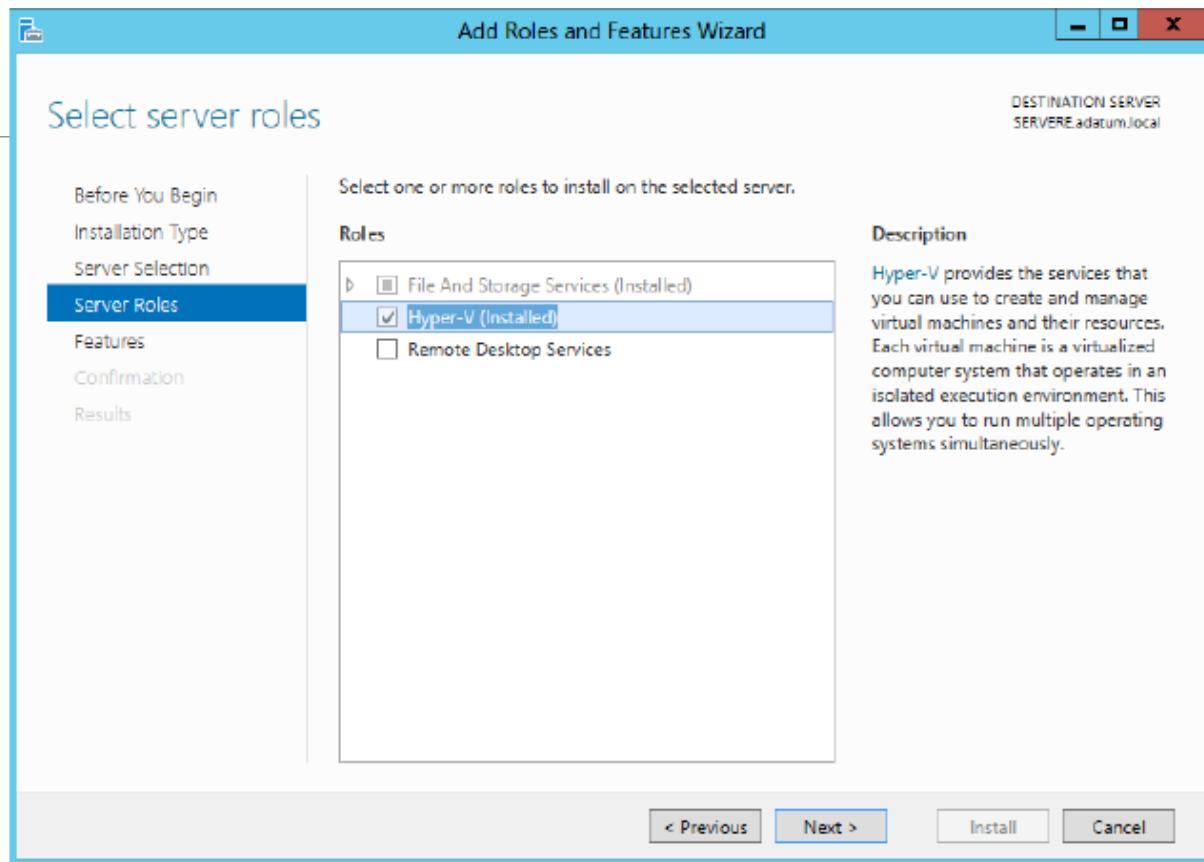
4- Hyper-V Hardware Limitations

- Windows Server 2012 Hyper-V host system:
 - system can have Up to 320 logical processors
 - Supporting up to 2,048 virtual CPUs
 - Up to 4 TB of physical memory
- One server can host as many as 1,024 active VMs
- Each VM can have up to 64 virtual CPUs and up to 1 TB of memory
- Hyper-V can support clusters with up to 64 nodes and 8,000 VMs

5- Hyper-V Server

- A dedicated Hyper-V Server product, which is a subset of Windows Server 2012
- Free downloadable product, but does not include licenses for operating systems installed in the VMs
- Includes the Hyper-V role and limited File and Storage services and Remote Desktop capabilities
- Hyper-V role is installed by default
- Only uses Server Core interface

Hyper-V Server



Roles available in Hyper-V Server

6- Installing Hyper-V

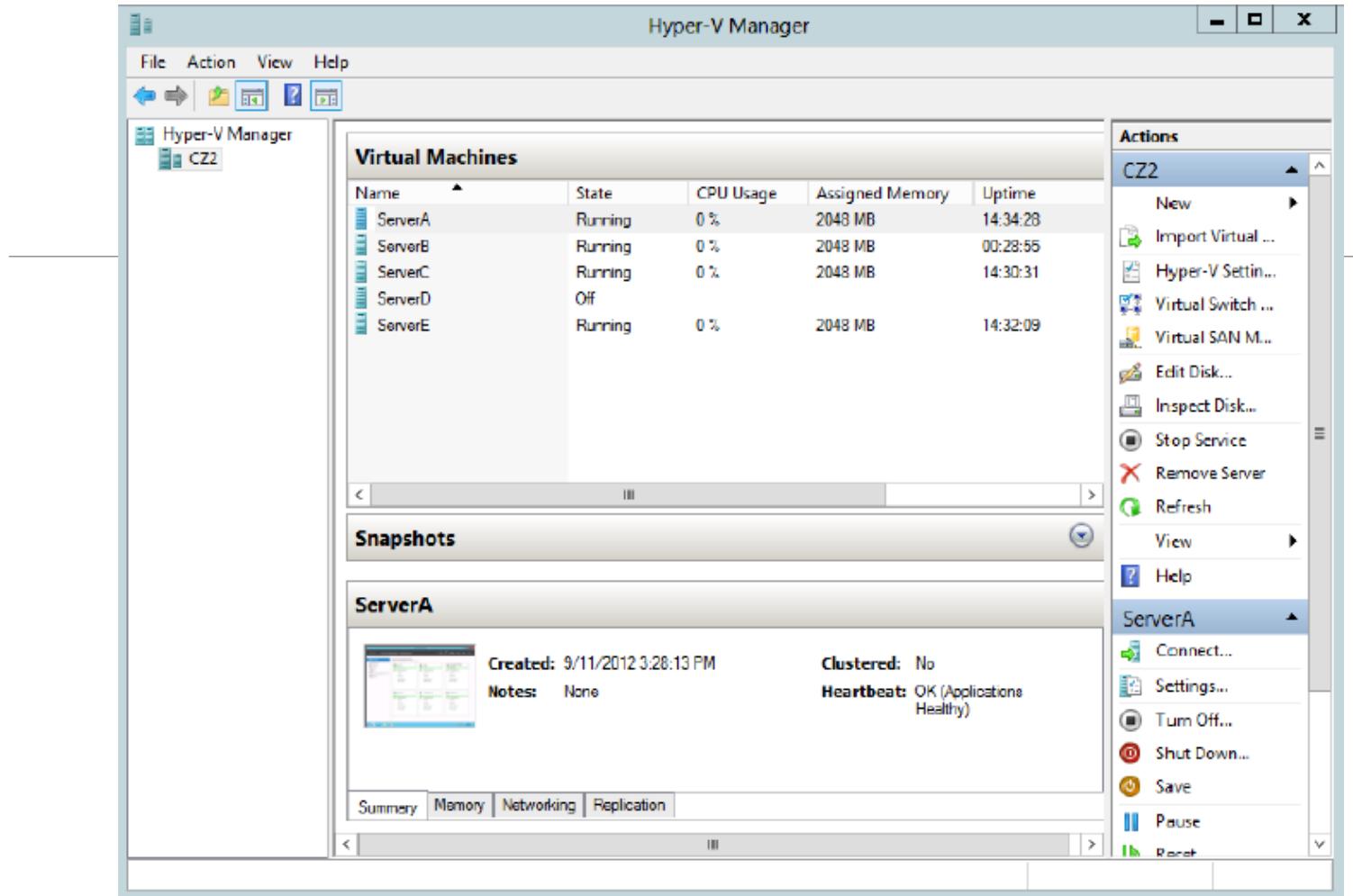
- You can add the Hyper-V role to WS 2012 R2 by using Server Manager, just as you would any other role.
- Installing the Hyper-V role installs the hypervisor software and in the case of a full GUI installation, also installs the management tools.
- The primary tool for creating and managing VMs and their components on Hyper-V servers is the Hyper-V Manager console.
- Microsoft Recommendations:
 - Use Hyper-V role on the host without any other roles
 - Better to put other roles on VMs
 - consider installing Hyper-V on a computer by using the Server Core installation option.

A- Hyper-V Hardware Requirements

- 64-bit processors that include hardware-assisted virtualization, such as Intel Virtualization Technology (Intel VT) or AMD Virtualization (AMD-V) technology.
- A system BIOS that supports the virtualization hardware, on which the virtualization feature has been enabled.
- Hardware-enforced Data Execution Prevention (DEP), which Intel describes as eXecuted Disable (XD) and AMD describes as No eXecute (NS). This is a technology used in CPUs to segregate areas of memory.

B- Using Hyper-V Manager

- The primary graphical tool for creating and managing VMs
- Can be used to manage VMs on multiple servers
- Installed with the Hyper-V Role, or you can install the Hyper-V Management Tools feature, or RSAT (Remote Server Administration Tools)package for Windows 8



The Hyper-V Manager console

Break

7- Creating a virtual machine

- To create a virtual machine (VM), you define the hardware resources (depending on the physical hardware available in the computer and the limitations of the guest OS) that the system should allocate to them:
 - Number of processors
 - The amount of memory allotted to a VM
 - Install Virtual network adapters
 - Create virtual disks
- Each virtual machine uses the following files:

Virtual machine configuration (.vmc) file: This file in XML format contains the VM configuration information, including all settings for the VM.

Virtual hard disk (.vhdx or .vhd) files: One or more files used to store the guest operating system, applications, and data for the VM.

Saved-state (.vsv) file: The VM may use this if it has been placed into a saved state.

A- Create a new VM procedures using Server Manager

To create a virtual machine (VM), use the following procedure:

1. In Server Manager, on the Tools menu, select Hyper-V Manager to open the Hyper-V Manager console.
2. In the left pane, select a Hyper-V server.
3. From the Action menu, select New, Virtual Machine. The New Virtual Machine Wizard starts, displaying the Before You Begin page.
4. Click Next to open the Specify Name And Location page.
5. In the Name text box, type a name for the VM, keeping in mind that the system will also use this name to create the VM files and folders.
6. To create the VM files in a location other than the default, select the Store The Virtual Machine In A Different Location check box and type an alternate path in the Location text box. Then click Next.
7. The Specify Generation page appears. Specify whether you want to create a Generation 1 or Generation 2 virtual machine and click Next.
8. The Assign Memory page opens. In the Startup Memory text box, type the amount of memory you want the VM to use and click Next. The Configure Networking page opens, as shown in Figure 3-8.

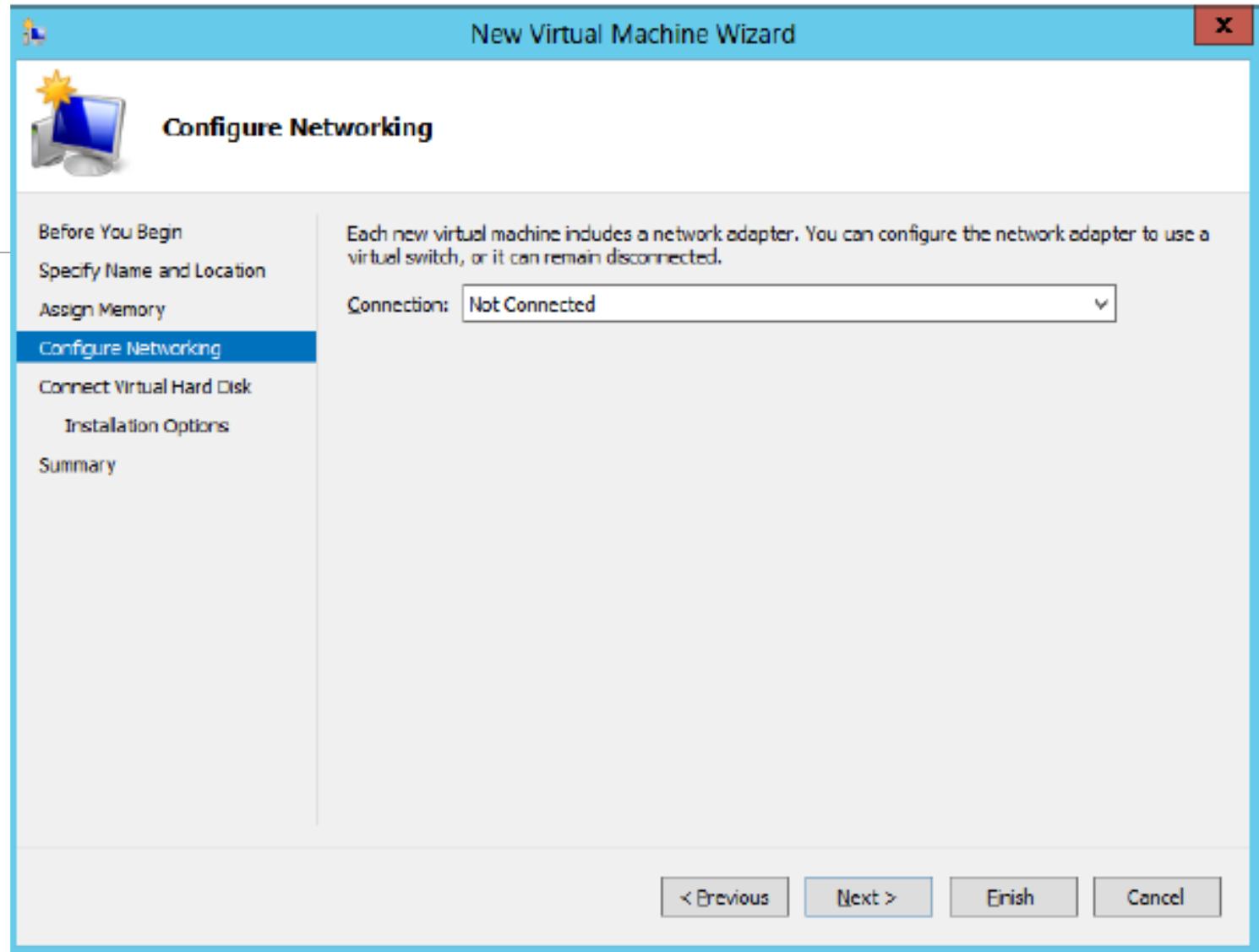


FIGURE 3-8 The Configure Networking page of the New Virtual Machine Wizard

9. From the Connection drop-down list, select a virtual switch and click **Next**. The Connect Virtual Hard Disk page opens, as shown in Figure 3-9.

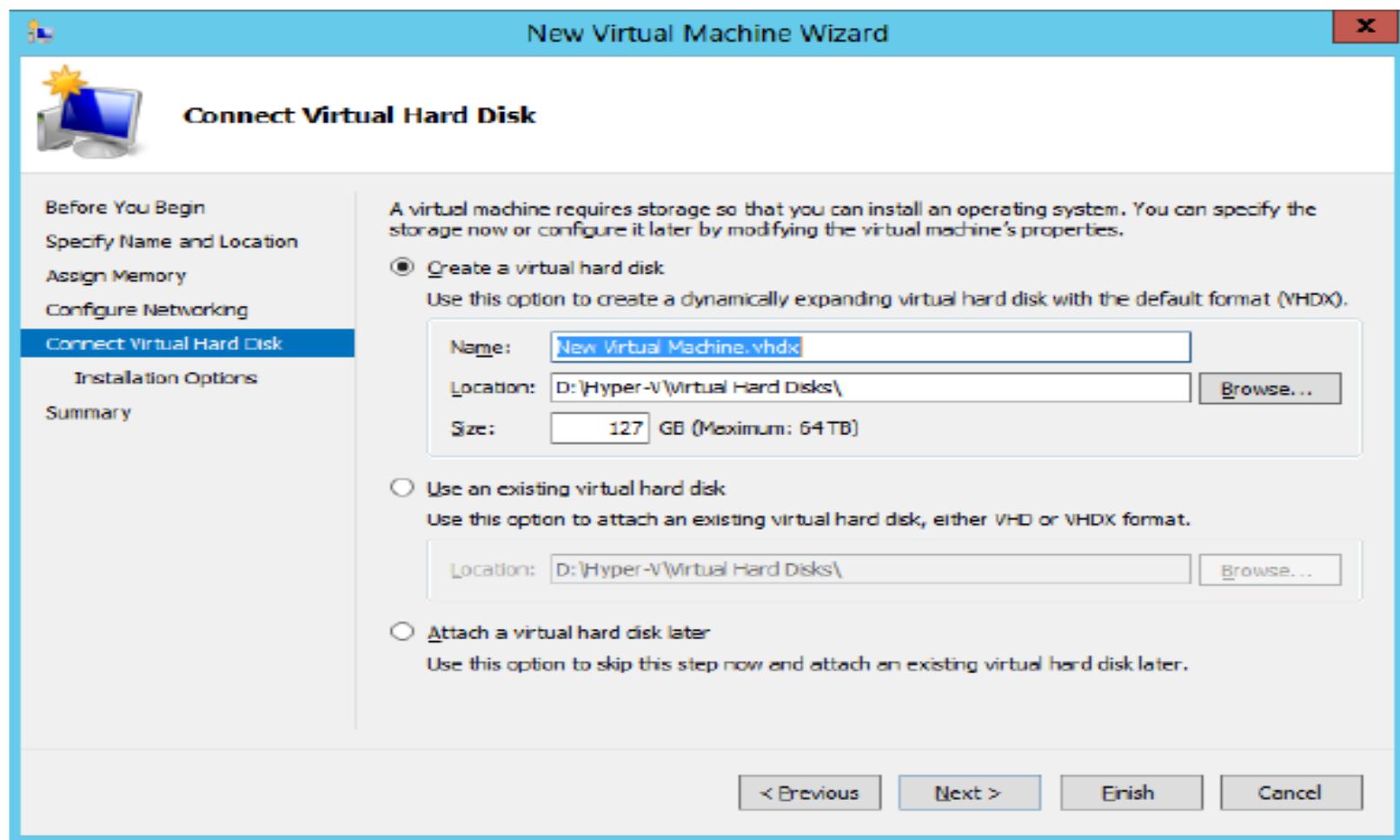


FIGURE 3-9 The Connect Virtual Hard Disk page of the New Virtual Machine Wizard

10. Leave the Create A Virtual Hard Disk option selected and type values for the following fields:
- **Name** Specifies the file name for the VHD, using the .vhdx format new to Windows Server 2012 R2
 - **Location** Specifies a location for the VHD other than the default you specified on the Default Stores page
 - **Size** Specifies the maximum size of the VHD(By default, the wizard creates a VHD file that starts small and dynamically expands up to the maximum size you specify.
11. Click **Next**. The Installation Options page opens.
12. Leave the **Install An Operating System Later Option selected** and click **Next**. The Completing The New Virtual Machine Wizard page opens.
13. Click **Finish**. The wizard creates the new VM and adds it to the list of VMs in Hyper-V Manager.

B- Create a new VM procedures using WINDOWS POWERSHELL

To create a new VM by using Windows PowerShell, use the New-VM cmdlet with the following basic syntax:

```
New-VM -Name "VM name" -MemoryStartupBytes <memory>
```

```
-NewVHDSizeBytes <disk size>
```

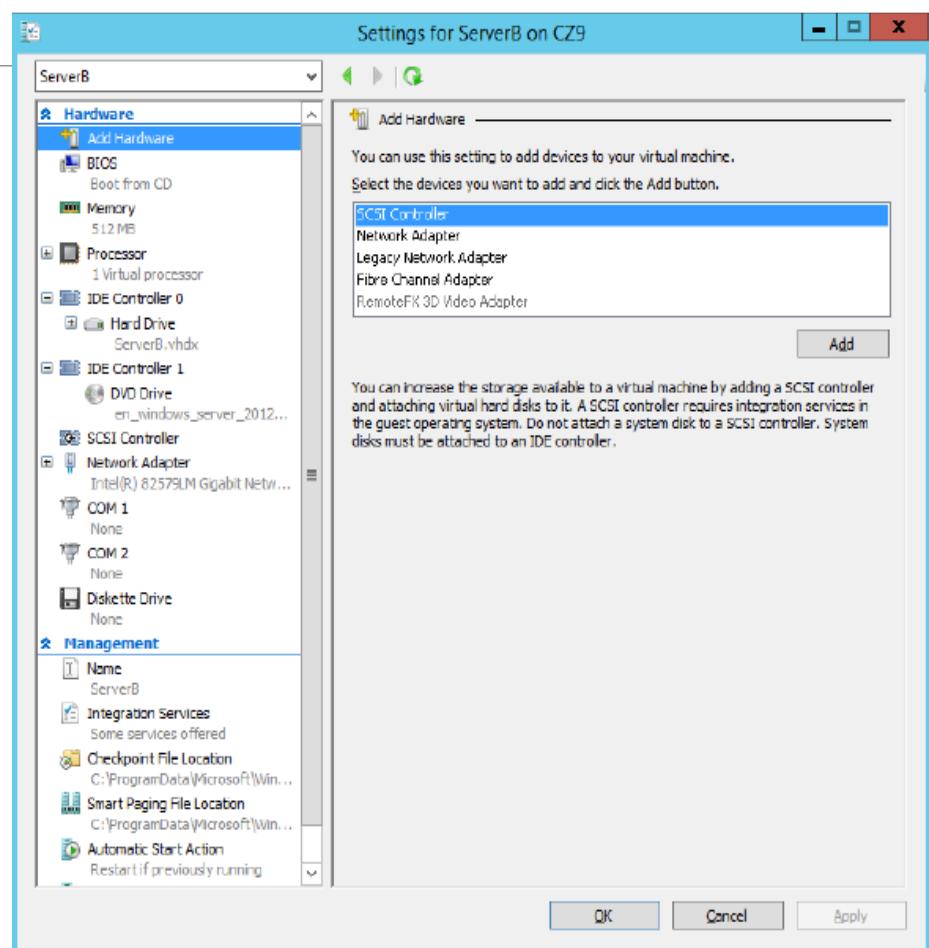
For example, the following command creates a new VM called ServerA with 1 GB of memory and a new 60-GB VHD drive:

```
New-VM -Name "ServerA" -MemoryStartupBytes 1GB
```

```
-NewVHDSizeBytes 60GB
```

- Each VM on a Hyper-V server consists of a collection of settings that specify the hardware resources in the machine and the configuration settings that control those resources.
- You can manage and modify those settings by using the Settings page for the particular VM.

- Selecting a VM from the list in Hyper-V Manager displays a series of icons in the Actions pane.
- Clicking the Settings icon opens the Settings dialog box which is the primary configuration interface for that VM.
- Here, you can modify any of the settings that the New Virtual Machine Wizard configured for you.



C- Creating Generation 1 and Generation 2 VMs

- In WS 2012 R2, Hyper-V includes a new type of virtual machine, which it refers to as Generation 2. The VM type created by all previous versions is called Generation 1.

- When you create a new virtual machine in the Hyper-V manager, the New Virtual Machine Wizard includes a new page (shown in Figure 3-11) on which you specify whether you want to create a Generation 1 or Generation 2 VM.

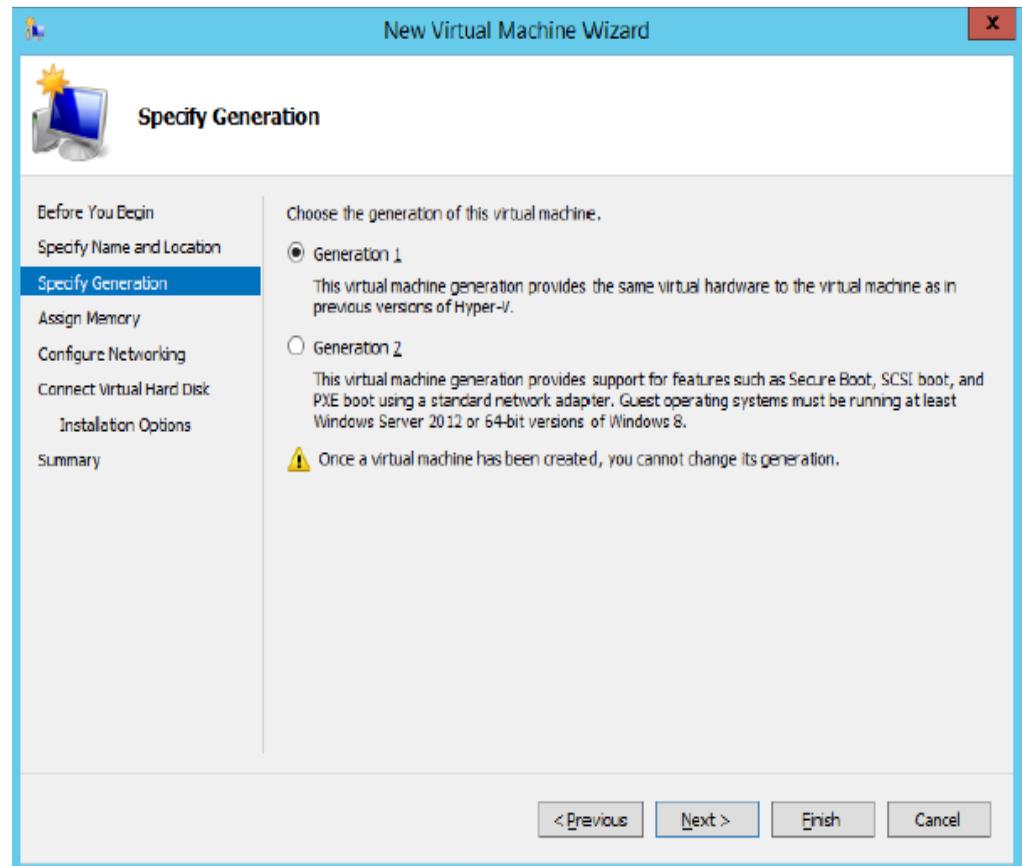


FIGURE 3-11 The Specify Generation page in the New Virtual Machine Wizard

| Generation 1 VMs | Generation 2 VMs |
|---|--|
| <p>Designed to simulate the hardware found in a typical computer.</p> | |
| <p>They use drivers for specific devices, such as</p> <ul style="list-style-type: none"> ❖ an AMI BIOS, ❖ an S3 graphics adapter, ❖ an Intel chipset and network adapter | <p>use synthetic drivers and software-based devices instead</p> |
| <p>Generation 1 VMs that created with WS 2012 R2 Hyper-V are completely compatible with all previous Hyper-V versions.</p> | <p>they provide advantages as :</p> <ul style="list-style-type: none"> ❖ UEFI boot Instead of using the traditional BIOS, they using support Secure Boot using the Universal Extensible Firmware Interface (UEFI). ❖ SCSI disks Generation 2 VMs omit the IDE disk controller used by Generation 1 VMs to boot the system and use a high- performance virtual SCSI controller for all disks, enabling the VMs to boot from VHDX files and support hot-disk adds and removes. |

-
- a Generation 2 virtual machine that deploys much faster than its Generation 1 counterparts and performs better.
 - Generation 2 VMs can only run the following guest operating systems:
 - Windows Server 2012
 - Windows Server 2012 R2
 - Windows 8 64-bit
 - Windows 8.1 64-bit

8- Installing an Operating System

Once you have created a VM, you can install an OS on it. Hyper-V in WS2012 R2 supports all the following as OSs you can install in Generation 1 VMs:

- Windows Server 2012
- Windows Server 2008 R2
- Windows Server 2008
- Windows Home Server 2011
- Windows Small Business Server 2011
- Windows Server 2003 R2
- Windows Server 2003 SP2
- Windows 8
- Windows 7 Enterprise and Ultimate
- Windows Vista Business, Enterprise, and Ultimate SP2
- Windows XP Professional SP3
- Windows XP x64 Professional SP2
- CentOS 6.0–6.2
- Red Hat Enterprise Linux 6.0–6.2
- SUSE Linux Enterprise Server 11 SP2

- To start an installation from a DVD, or image file, you must configure the VM's virtual DVD drive in the Settings dialog box. Enter one of the following options:

- None:** The equivalent of a drive with no disk inserted.
- Image file:** Points to a disk image file with an .iso extension stored on one of the host computer's drives or on a shared network drive.
- Physical CD/DVD drive:** Links the virtual DVD drive to one of the physical DVD drives in the host computer.

- When the VM boots from the disk you mounted, the OS installation proceeds just as if you were using a physical computer.
- During the installation process, you can work with the VHD drive just as you would a physical one, creating partitions of various sizes and selecting one for the OS.
- When the installation is complete, the VM restarts, and you can then log on and use it in the normal manner.

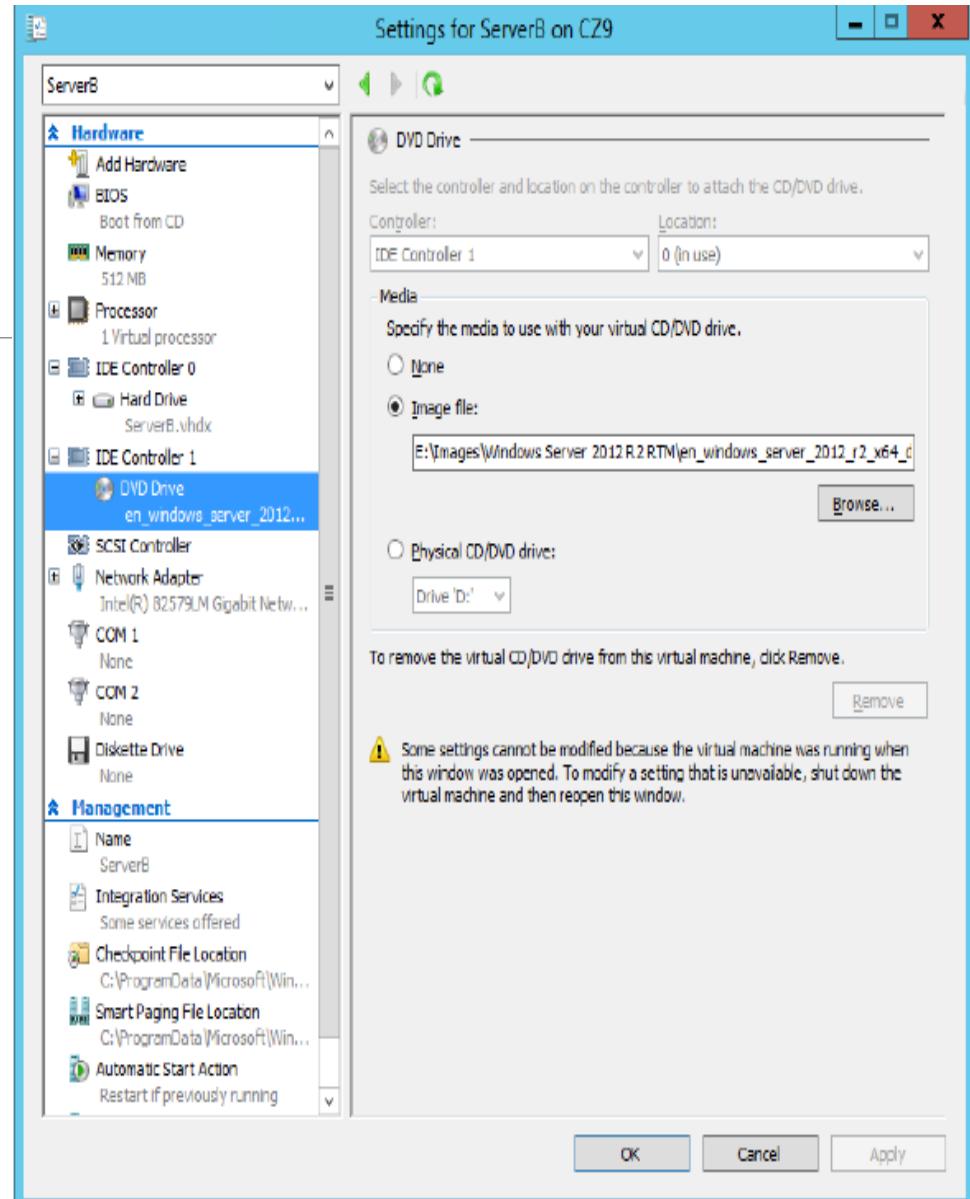


FIGURE 3-12 DVD drive settings for a VM

9- Configuring Guest Integration Services

Hyper-V, therefore, includes a software package called Guest Integration Services, which you can install on your VMs for compatibility purposes:

- **Operating system shutdown:** Enables the Hyper-V Manager console to remotely shut down a guest OS in a controlled manner, eliminating the need for an administrator to log on and manually shut the system down.
- **Time synchronization:** Enables Hyper-V to synchronize the OS clocks in parent and child partitions.
- **Data Exchange:** Enables the OSs on the parent and child partitions to exchange information, such as OS version information and fully qualified domain names.
- **Heartbeat:** Implements a service in which the parent partition sends regular heartbeat signals to the child partitions, which are expected to respond in kind. A failure of a child partition to respond indicates that the guest OS has frozen or malfunctioned.
- **Backup:** Allows backup of Windows VMs using Volume Shadow Copy Services.

-
- The Windows Server 2012, Windows Server R2, Windows 8, and Windows 8.1 operating systems have the latest Guest Integration Services software built in, so there is no need to
 - install the package on VMs running those OSs as guests.
 - Earlier versions of Windows have earlier versions of the Guest Integration Services package that need to be upgraded,
 - However, some Windows versions do not include the package at all.(like LINUX OS)
 - To upgrade Guest Integration Services on a Windows guest OS, use the following procedure: look P148 (Practice LAB)

10- Allocating Memory

- When you create a new VM you specify the amount of memory allocated to the VM.
- Based on the amount of physical memory on the computer.
- Change the allocated memory by shutting down the VM, opening Settings, and changing the Startup Ram setting. on the Memory page, as shown in Figure 3-15.
- This enables you to experiment with various amounts of memory, and set the optimum performance level for the system.

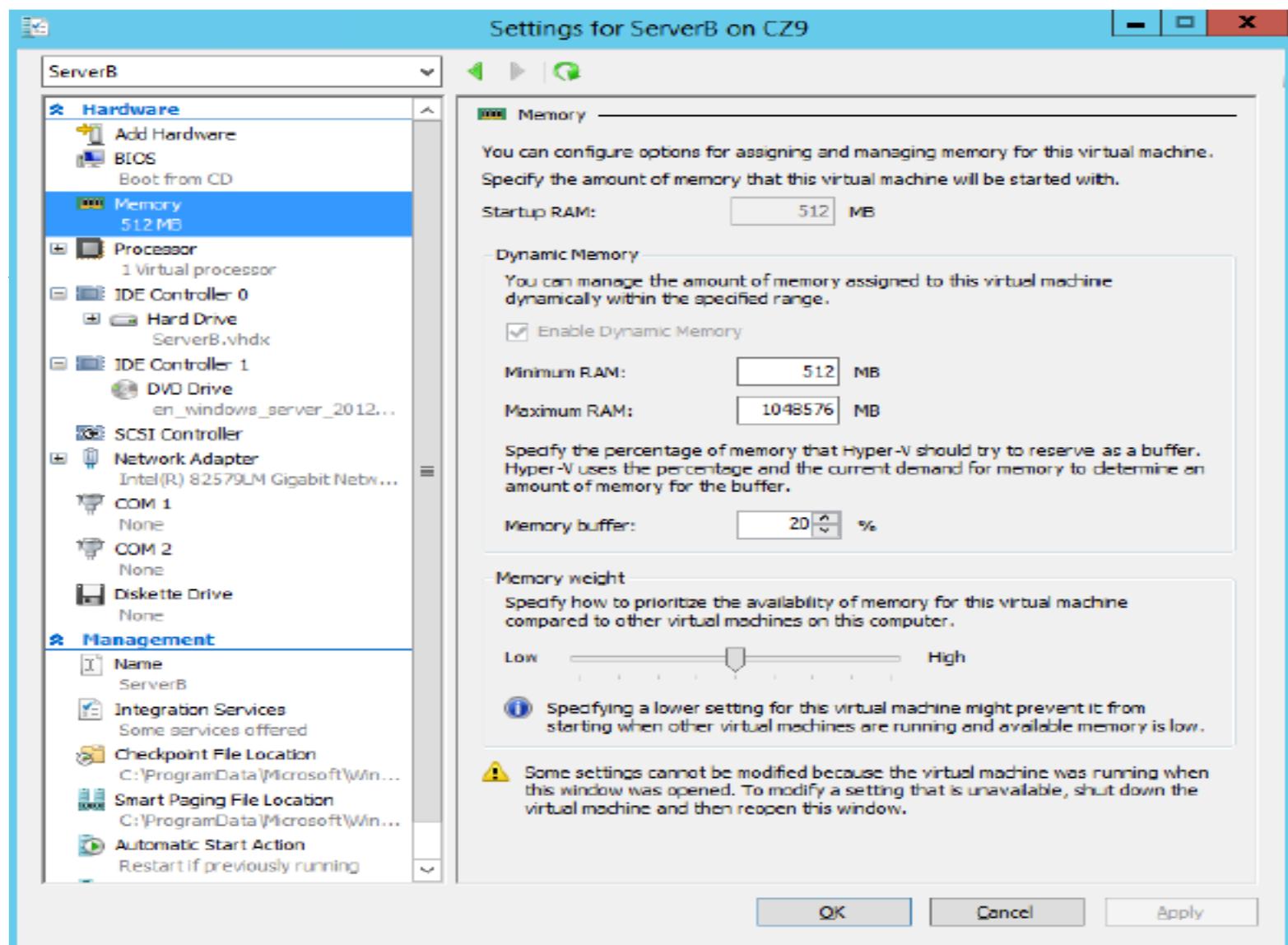


FIGURE 3-15 Memory settings for a VM

A- Using Dynamic Memory

- In the WS 2012 R2 , you can use a feature called Dynamic Memory to automatically reallocate memory to the VM from a shared memory pool as its demands change
- Must be enabled by selecting the Enable Dynamic Memory check box on the VM's memory page, and the following settings must be configured:
 - ❖ **Startup RAM** :can be the minimum amount of memory needed to boot the system.
 - ❖ **Minimum RAM** :OSs can require more memory to start up than to run, so this value can be smaller than the Startup RAM value.
 - ❖ **Maximum RAM**: The value can range from a low equal to the Startup RAM value to a high of 64 GB.
 - ❖ **Memory Buffer**: Specifies a percentage that Hyper-V uses to calculate how much memory to allocate to the VM, compared to its actual utilization, as measured by performance counters.
 - ❖ **Memory Weight**: Specifies the priority of this VM compared to the other VMs on the same computer. When the physical memory is insufficient to allocate the full-buffered amount specified for each VM, the VMs with the highest Memory Weight settings receive priority.
- In addition to configuring the VM settings, the guest VM must be running Windows Vista or later or Windows Server 2003 SP2 or later and have Windows Server 2012 R2 Guest Integration Services installed to use Dynamic Memory.

Monitor Memory Allocation

| ServerA | |
|-------------------------|---------|
| Startup Memory: | 512 MB |
| Dynamic Memory: | Enabled |
| Minimum Memory: | 256 MB |
| Maximum Memory: | 2048 MB |
| Assigned Memory: | 580 MB |
| Memory Demand: | 487 MB |
| Memory Status: | OK |

Summary Memory Networking Replication

Memory statistics for a virtual machine

NOTE : You can reduce the Minimum RAM, increase the Maximum RAM, or change the Memory Buffer value or the Memory Weight value at any time, but to enable or disable Dynamic Memory, you must shut down the VM.

B- Configure Smart Paging

- Dynamic Memory was introduced in WS 2008 R2 Hyper-V, but WS 2012 R2 improves on the concept by adding the Minimum RAM setting.
- The problem with having minimum RAM values that are lower than the startup RAM values is that it becomes possible to deplete the supply of physical memory with too many VMs running simultaneously at their minimum RAM values. If this occurs, a VM that has to restart might be unable to do so because there is not enough free memory to increase its memory allocation from its minimum RAM value to its startup RAM value.
- **Smart paging** is a new feature in Hyper-V.
- If a VM has to restart, and there is not enough memory available to allocate its Startup RAM value, the system uses hard disk space to make up the difference and begins paging memory contents to disk.
- Because of slow disk access, performance degrades.
- Select the fastest possible hard drive for the Smart Paging file.
- Hyper-V only uses smart paging in specific conditions: when a VM must be restarted, there is no free memory available, and there are no other means available to free up the necessary memory.

11- Configuring resource metering

- Resource metering uses PowerShell cmdlets to track a variety of performance metrics for individual VMs, including:
 - CPU utilization
 - Minimum/Maximum/Average memory utilization
 - Disk space utilization
 - Incoming/Outgoing network traffic
- There are various reasons why organizations might want to track the use of VMs:
 - For large corporations, it might be a matter of internal accounting and controlling ongoing expenses, such as wide area network (WAN) bandwidth.
 - For service providers, it might be necessary to bill customers based on the VM resources they use.

- To use resource metering, you must first enable it for the specific VM that you want to monitor by using the `Enable-VMResourceMetering` cmdlet with the following syntax:

Enable-VMResourceMetering –VMName <name>

- you can display a statistical report at any time by using the `Measure-VM` cmdlet with the following syntax:

Measure-VM –VMName <name>

- Administrators can also create resource pools that enable them to monitor specific VM components, such as processors, memory, network adapters, and VHDs.
- You create a resource pool by using the `New-VMResourcePool` cmdlet and then enable metering for the pool by using `Enable-VMResourceMetering`.