

Configure VM Storage



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Topics in This Module



Creating virtual disks

Modifying and maintaining virtual disks

Checkpoints



Creating Virtual Disks





Virtual disk creation options:

Storage type

- Local, iSCSI, Fibre Channel, SMB

File formats

- VHDX, VHD, VHDS

Disk types

- Fixed, dynamic, differencing

Storage Quality of Service (QoS)

Pass-through disks

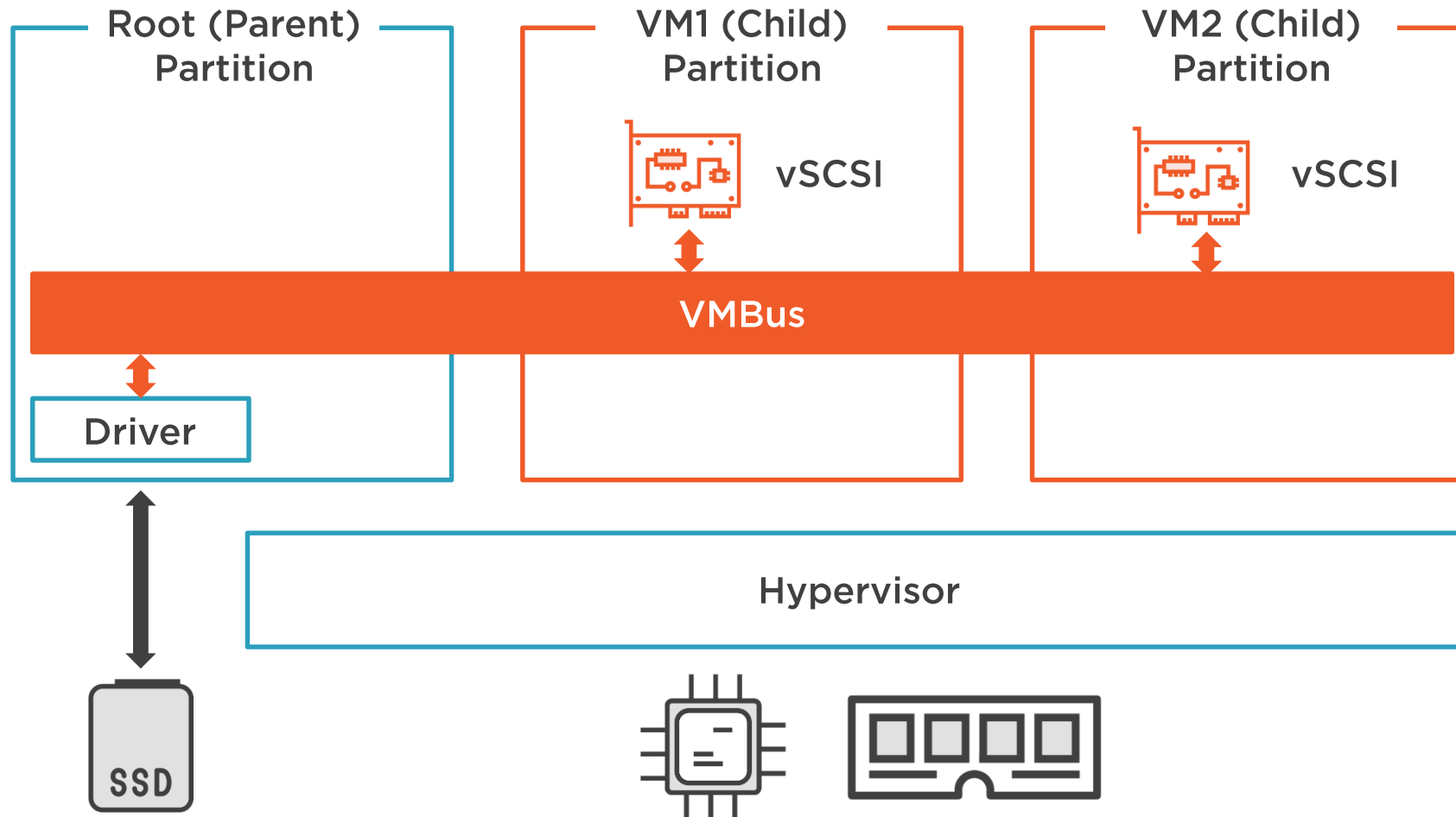


A virtual **disk** is not a virtual **machine**.

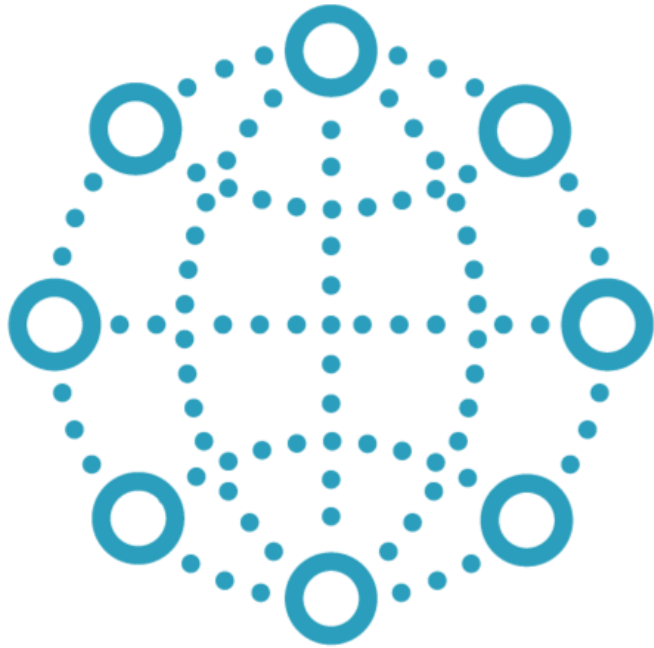
A virtual machine also has
configuration files (VMCX) and may
have checkpoints



Virtual Disks Use VMBus



Virtual Fibre Channel



Fibre Channel is a high-performance, high-cost SAN implementation

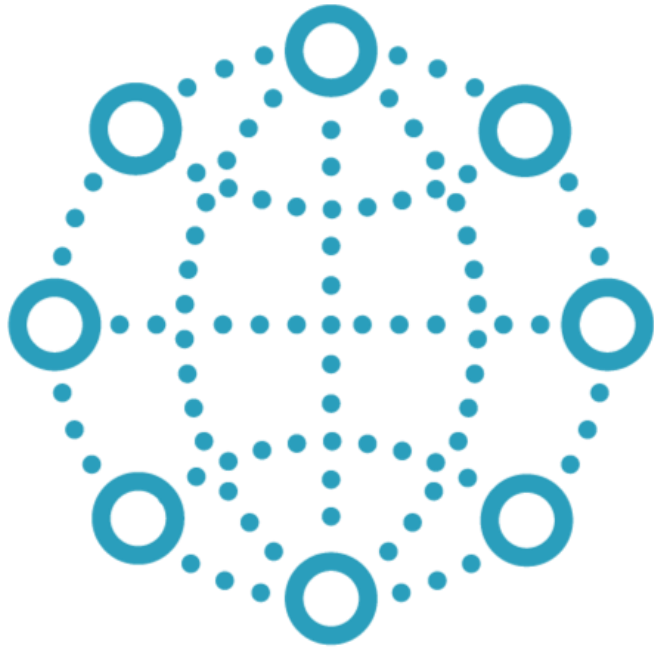
Virtual Fibre Channel allows LUNs to be available to a VM but not the host

- Hyper-V Manager (settings of VM)
- PowerShell (Add-VMFiberChannelHBA)

Virtual SAN(s) connect to HBA(s) on host

Virtual FCA(s) in guest connect to virtual SAN(s)

Virtual Fibre Channel



Live Migration works with vFC

VMs must understand the underlying storage architecture

Host-level VM backups will not include SAN content





Server storage is a complex topic

We cannot explore details of SANs, iSCSI, Cluster-Shared Volumes, Storage Spaces Direct, or SMB 3 file servers here, but all these technologies can be used to supply VMs with storage.





Server storage is a complex topic

Please take a look at Pluralsight's course on "Implementing Failover Clustering and Storage Spaces Direct in Windows Server 2019" for more on these topics!



Tools for Creating Virtual Disks



Hyper-V Manager

PowerShell, for example:

- New-VHD
- Add-VMHardDiskDrive

Disk Management console

Server Manager console

Windows Admin Center

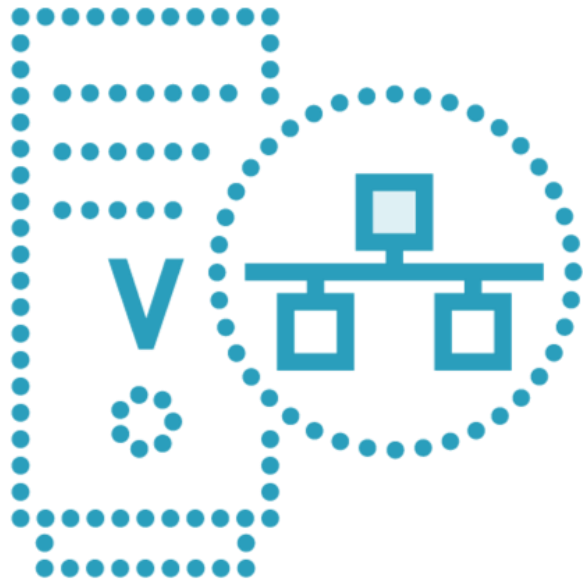


You can create a virtual disk as part of the “New Virtual Machine” wizard in Hyper-V Manager...

...but it’s better to use the “New Virtual Hard Disk” wizard, as you can make more settings.



Where to Store Virtual Disks



Local host file system

- Default: C\$\Users\Public\Documents\Hyper-V\Virtual Hard Disks

Storage Area Network

- iSCSI, Fibre Channel
- Configuration in host or in VM

Storage Spaces, Storage Spaces Direct

SMB 3.0

Virtual Disk Formats



VHD

- 2TB maximum
- Supports older systems

VHDX (the default)

- 64TB maximum
- Windows 8+, Server 2012+

VHDS (“VHD Set” for shared virtual disks)

- 64TB maximum
- Windows 10+, Server 2016+

Notes on VHD



Only use for older operating systems

- For example, Windows 7 and earlier

Avoid when using dynamic disks in on-premises systems

Must use with Azure VMs (at this writing)

- Azure converts for you if using Azure Site Recovery to move VMs to Azure

Notes on VHDS



Evolved from “shared VHDX”
(Server 2012 R2)

Permits simultaneous connection to
multiple VMs (e.g. in guest clusters)

VMs don’t need to understand underlying
storage architecture

Requires CSV backing storage

Advances in Server 2016:

- Dynamic resizing
- Host-level backup



Virtual Disk Types



Fixed

- Uses maximum space right away
- May be faster (does not fragment)

Dynamic

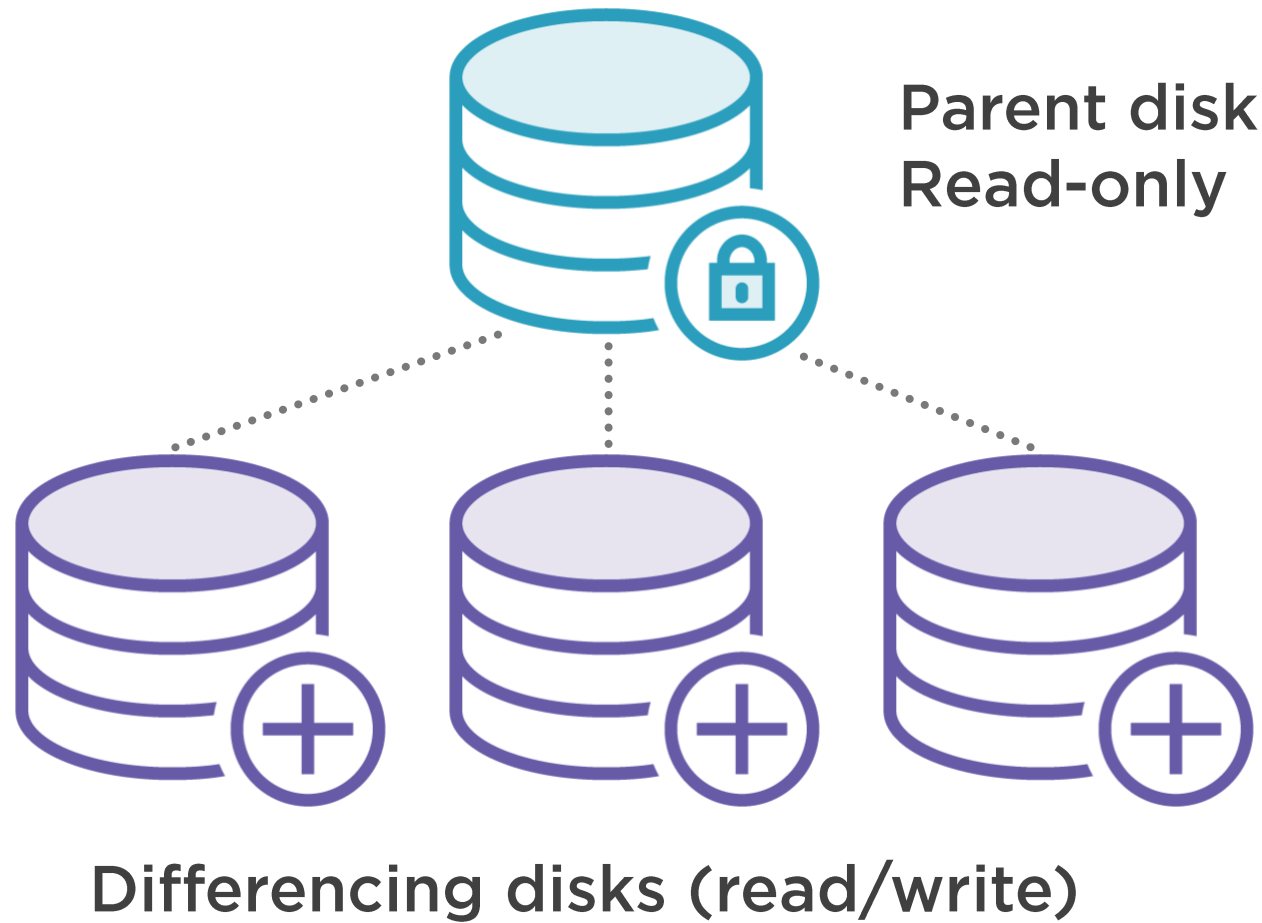
- Starts small, grows as needed
- VHDX recommended here

Differencing

- Links to a parent of same type
- Space savings, performance loss



Differencing Disks in Hyper-V





If you're making a group of VMs...

Think about using SysPrep on the parent disk. That way, all the child systems that you create from the parent will get their own unique security ID (SID) on first boot.





Differencing disks can be “collapsed into” their parent using Hyper-V Manager or PowerShell (**Merge-VHD**)



Storage Quality of Service



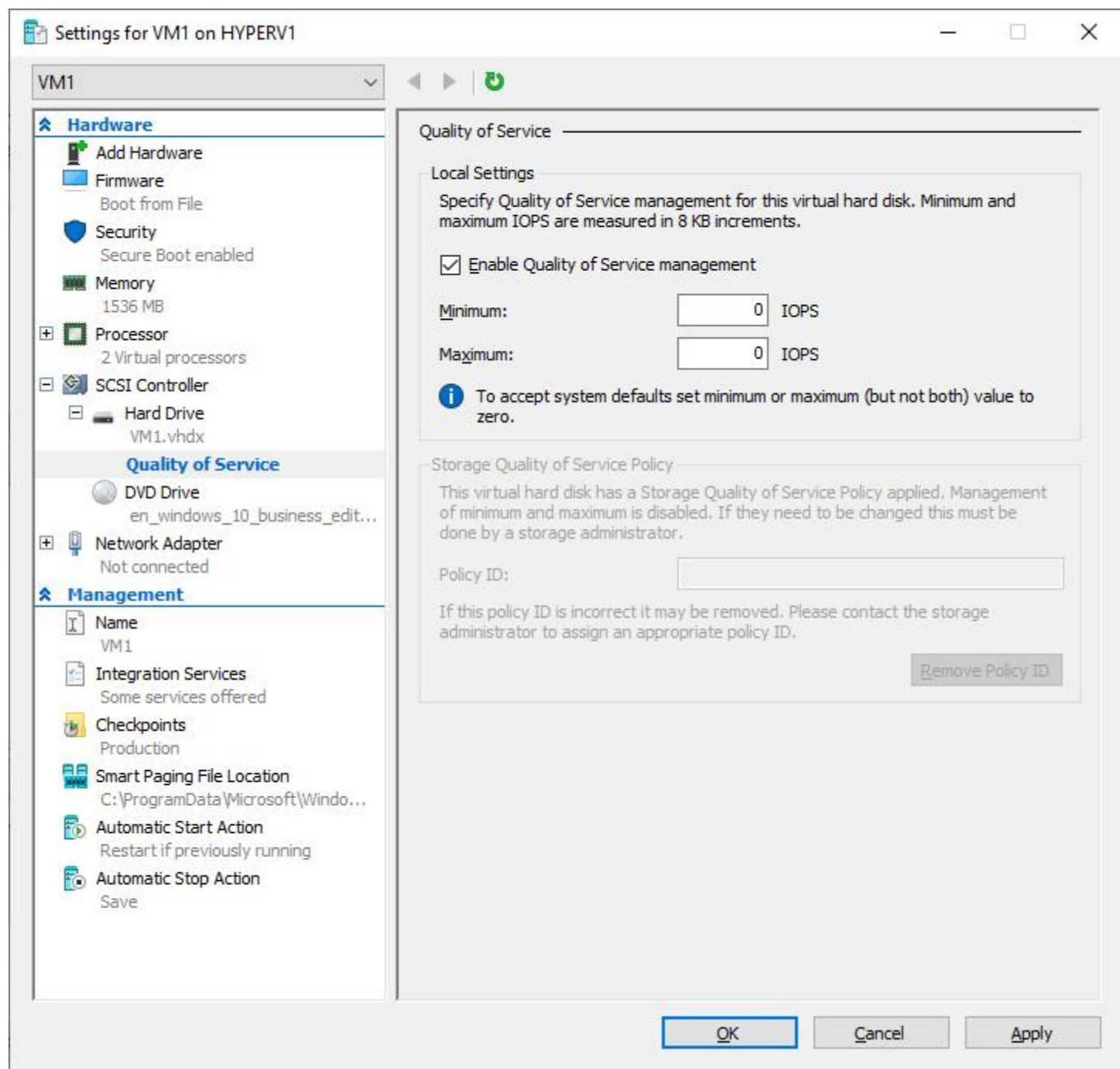
Scenario: VM2 is being greedy and affecting VM1's storage speed

We can set minimum and maximum IOPs values

- Per-VM basis
- Increments are 8KB

With clusters and Cluster Shared Volumes, consider QoS *policies*







Deduplication

Reducing redundant information storage on a device by detecting duplicate data chunks and only storing them once. Now supported with ReFS on Server 2019.



Pass-Through Disks



VM maps directly to *offline* physical disk

Disk inaccessible to other VMs and to host

Possibly better performance

- Less significant than in the past

Drawbacks are many:

- No checkpoints
- No Hyper-V Replica
- No VM backup by host
- etc.

Computer Management

FileActionViewHelp

Computer Management (HYPERV1)

> System Tools

> Storage

> Disk Management

> Services and Applications

Volume	Layout	Type	File System	Status	Capacity	Free Space
(C:)	Simple	Basic	NTFS	Healthy (Boot, Page File, Crash Dump, Primary Partition)	126.40 GB	98.25 GB
(Disk 0 partition 2)	Simple	Basic		Healthy (EFI System Partition)	99 MB	99 MB
Recovery	Simple	Basic	NTFS	Healthy (OEM Partition)	499 MB	74 MB

Disk 0

Basic

126.98 GB

Online

Recovery

499 MB NTFS

Healthy (OEM Partition)

99 MB

Healthy (EFI System

(C:)

126.40 GB NTFS

Healthy (Boot, Page File, Crash Dump, Primary Partition)

* Disk 1

Unknown

5.00 GB

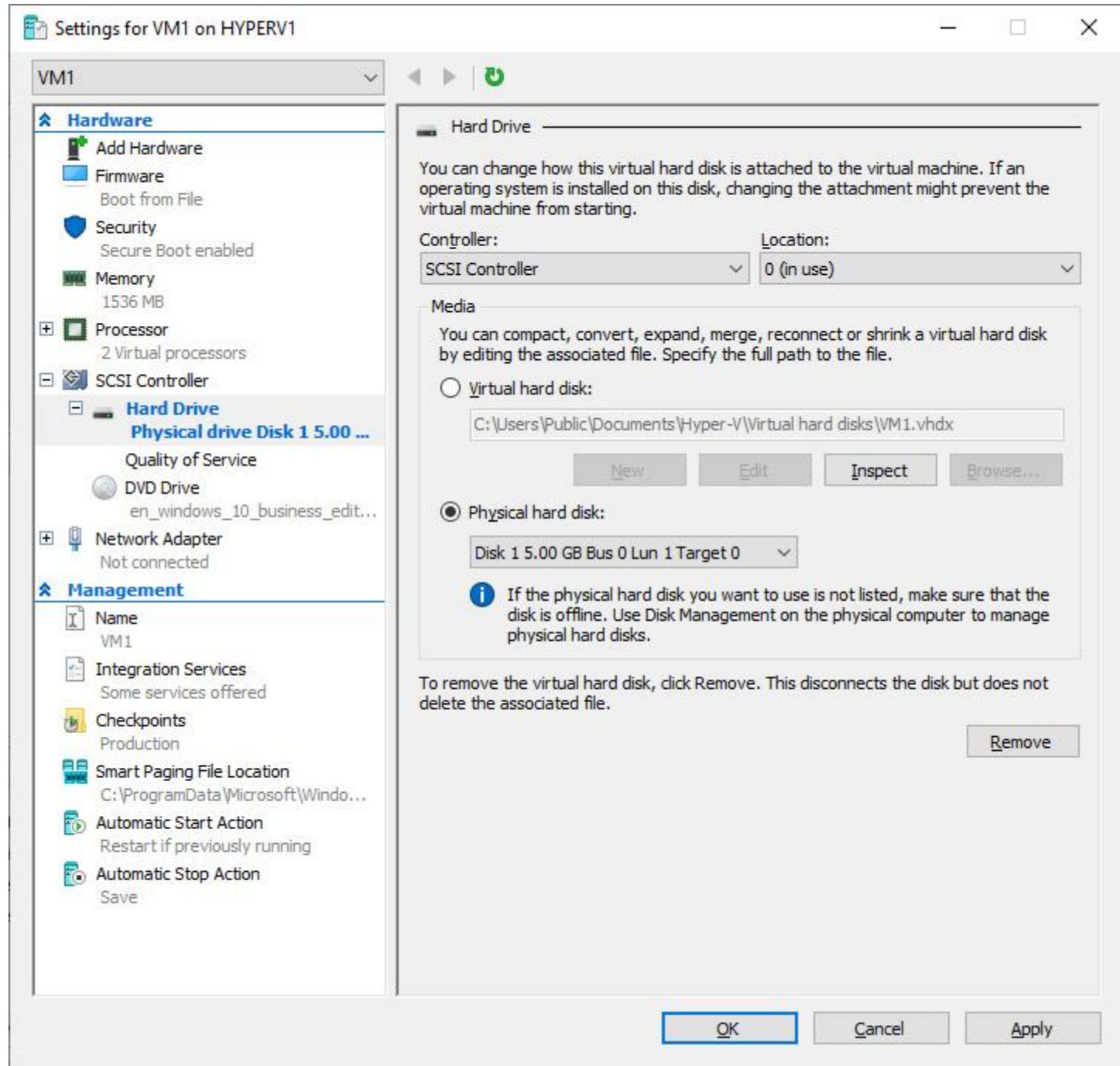
Offline

5.00 GB

Unallocated

Unallocated

Primary partition



Hyper-V Manager

FileActionViewHelp

Hyper-V Manager

HYPERV1

Virtual Machines

Name	State	CPU Usage	Assigned Memory	Uptime	Status
VM1	Off				

Checkpoints

The selected virtual machine has no checkpoints.

VM1

Created:

2/24/2020 8:29:11 PM

Configuration Version:

9.0

Generation:

2

Notes:

None

Clustered:

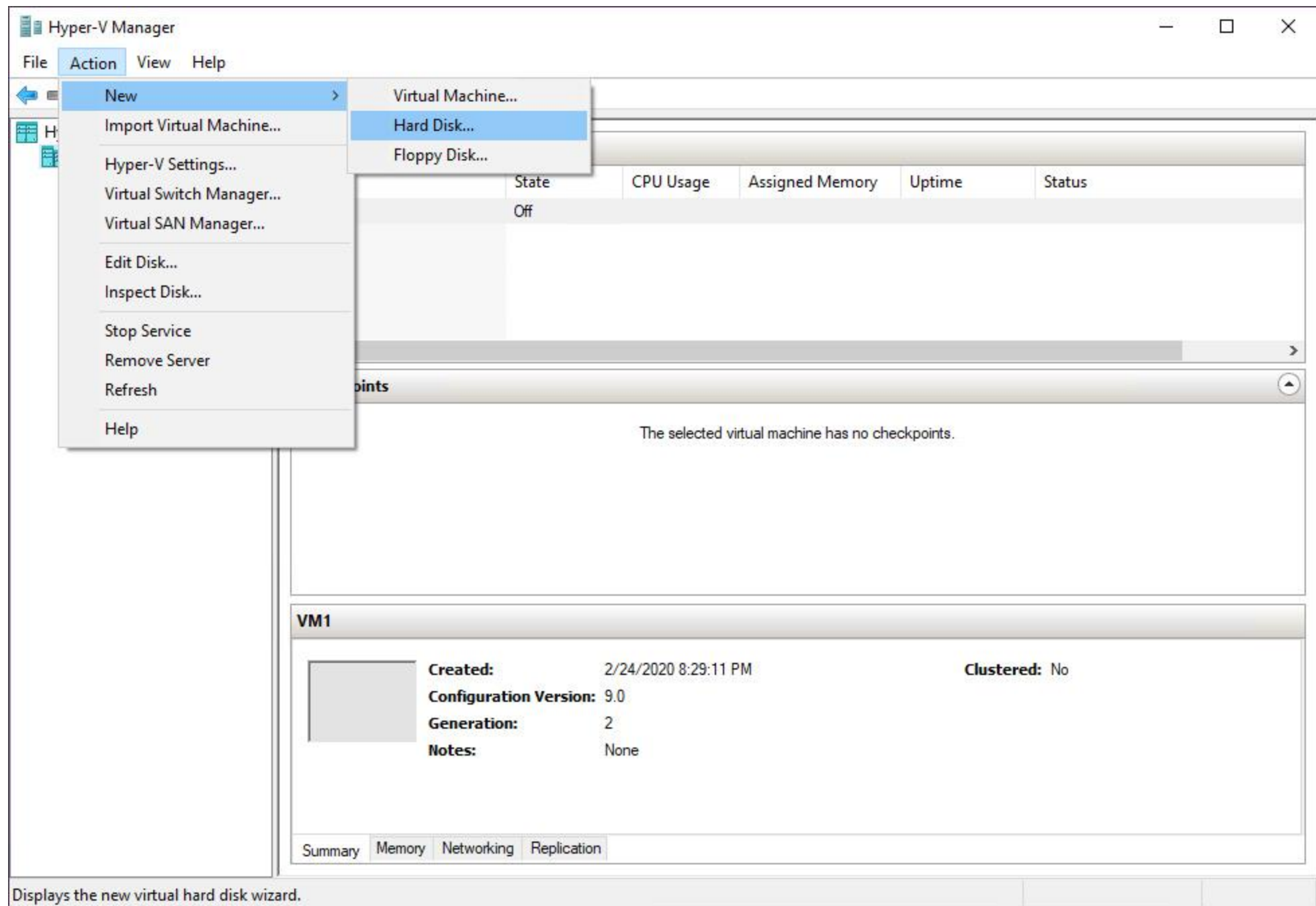
No

Summary

Memory

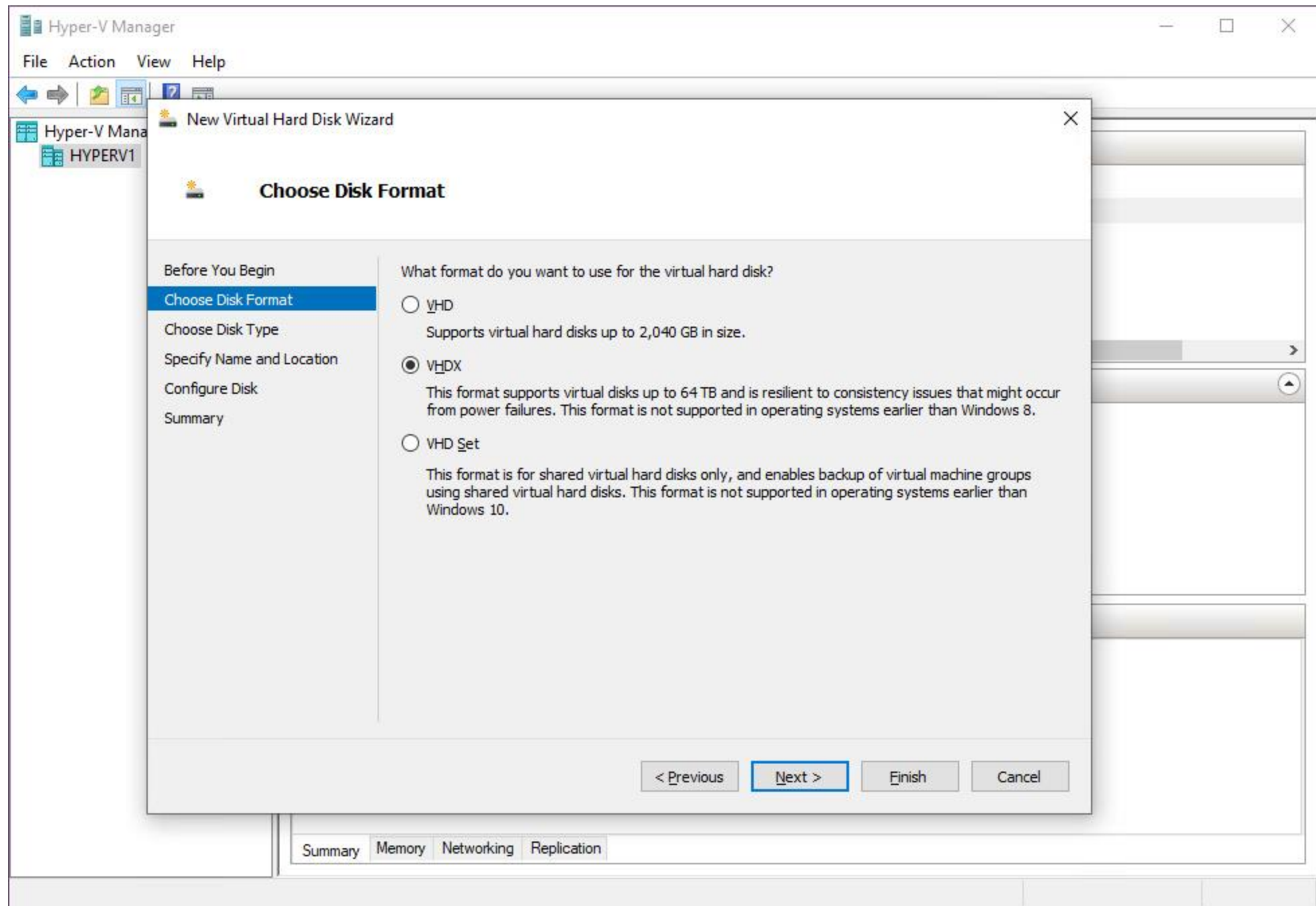
Networking

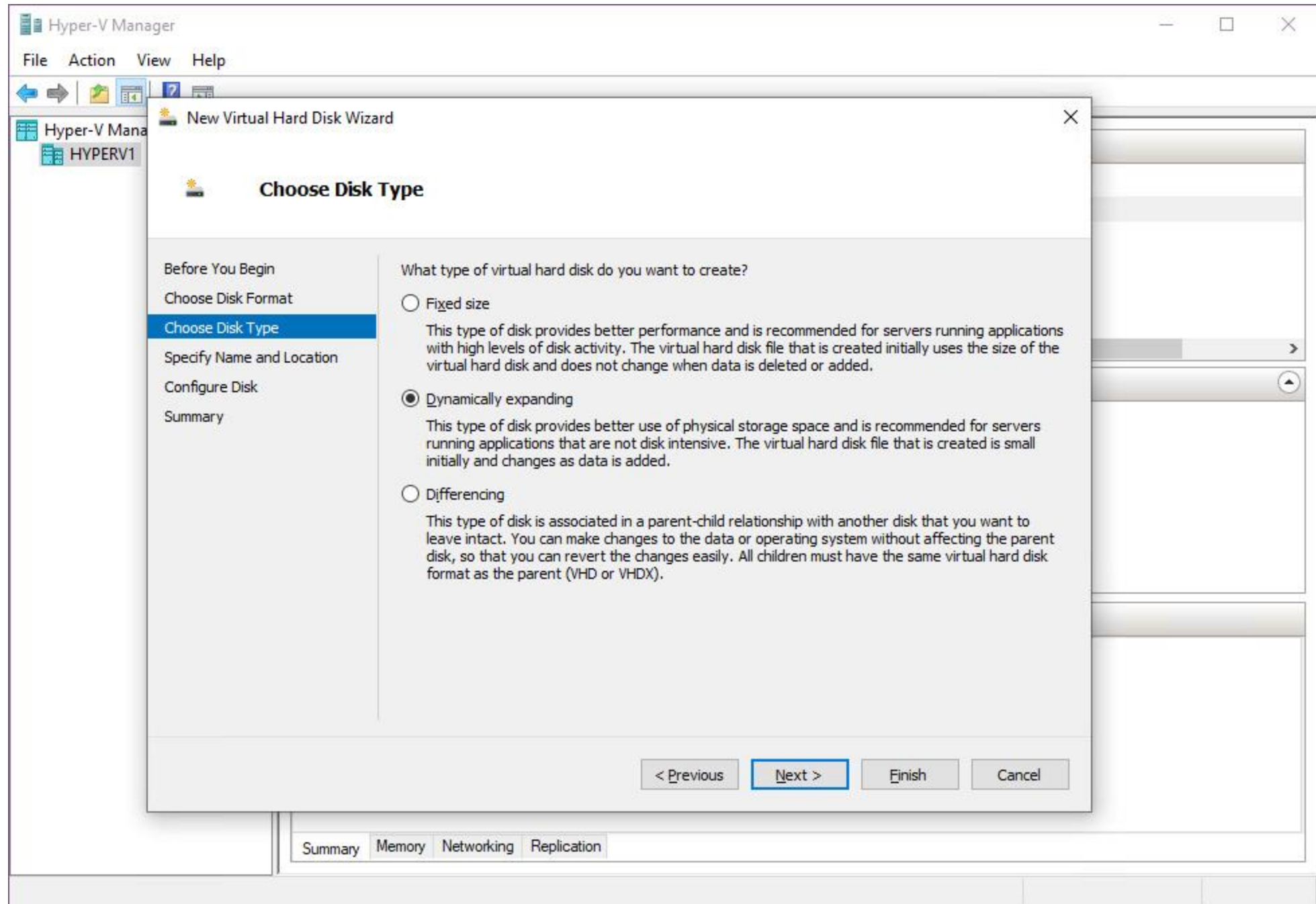
Replication

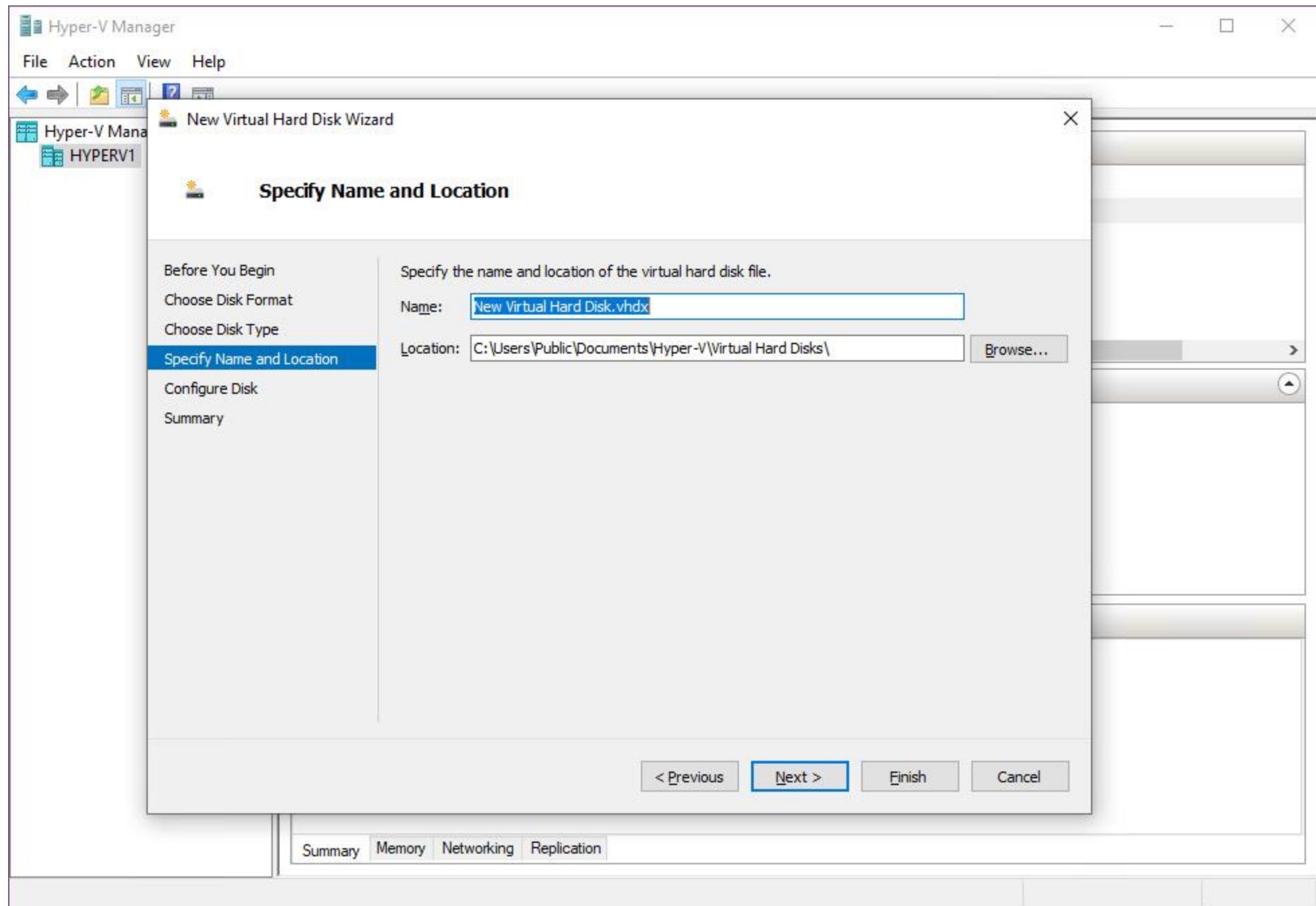


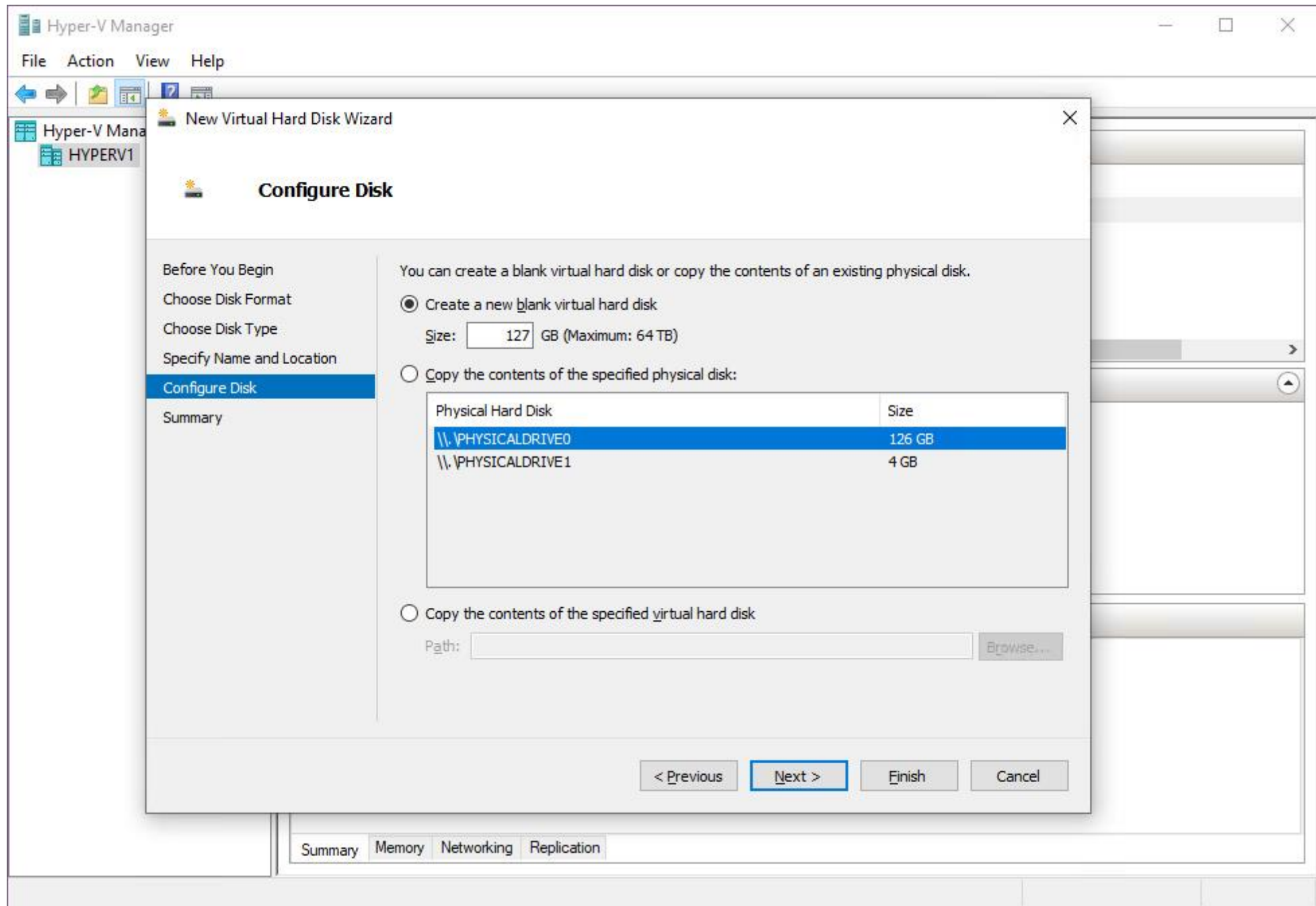
Displays the new virtual hard disk wizard.

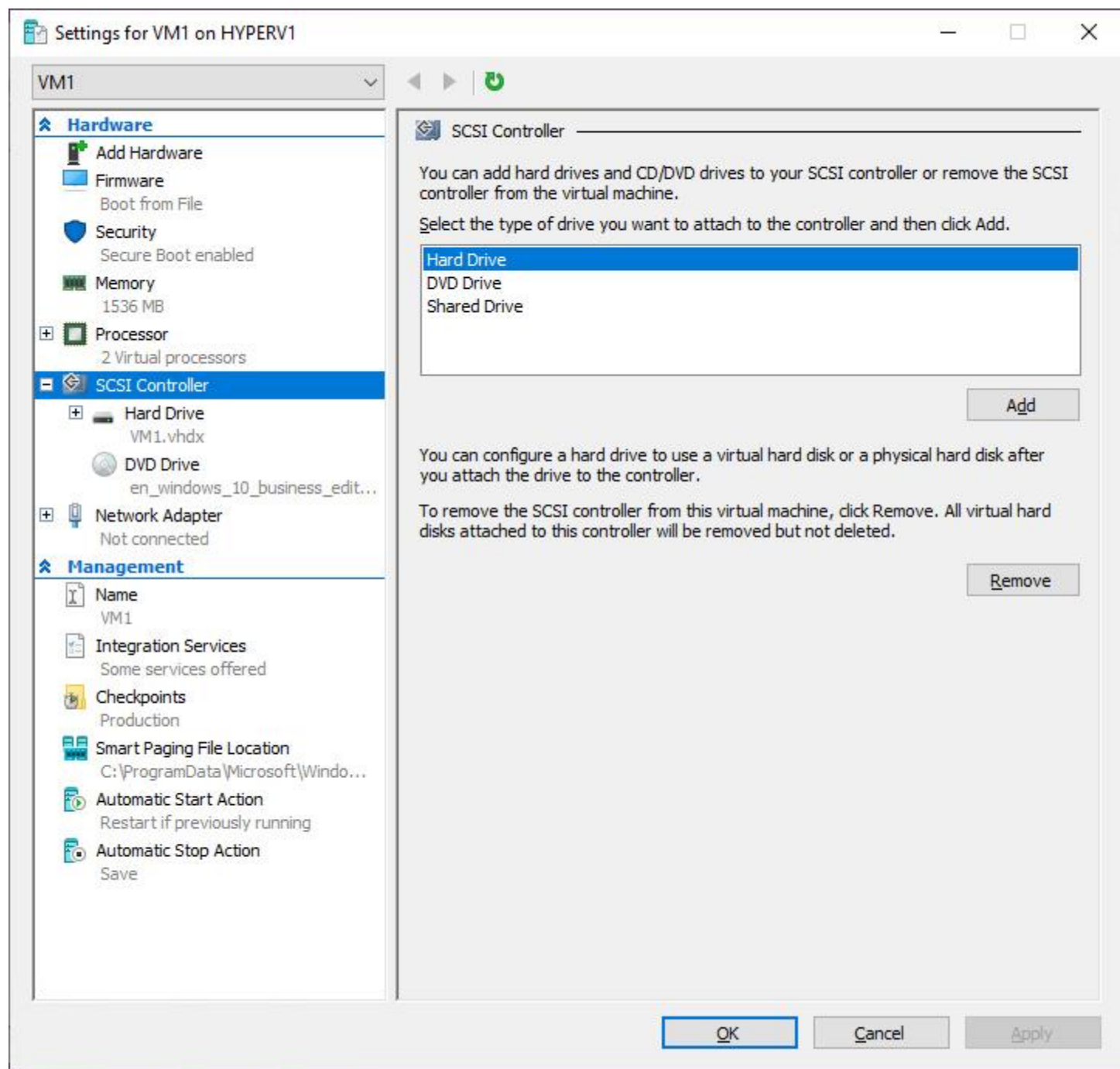






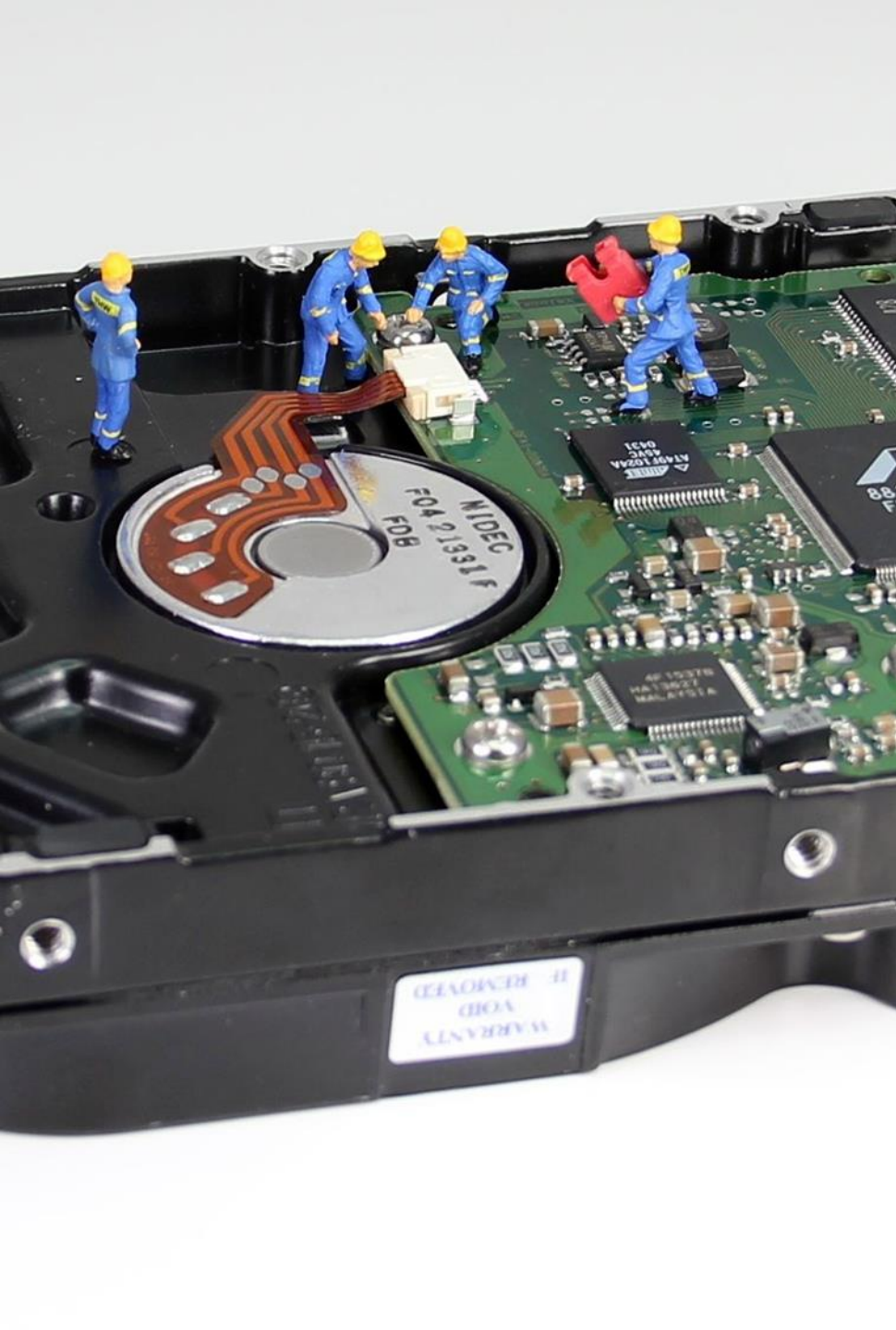






Modifying and Maintaining Virtual Disks





Virtual disk management:

Change format

Change type

Change size

Monitor health

Monitor performance

Optimize disk



Changing a Disk's Format



Remember to respect 2TB size limit

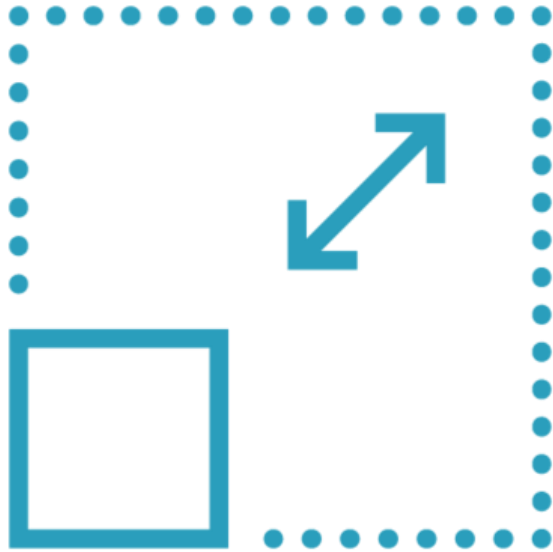
Hyper-V Manager:

- Edit Disk > Convert
- Keep same name

PowerShell:

- Convert-VHD -Path <path>
 - DestinationPath <path>
 - VHDFormat VHDX

Changing a Disk's Type



Dynamic <> fixed

Hyper-V Manager:

- Edit Disk > Convert
- Keep same format (e.g. VHDX)
- Keep same name

PowerShell:

- Convert-VHD -Path <path>
-DestinationPath <path>
-VHDType Dynamic

Changing a Disk's Size



Changing a Disk's Size



`Resize-VHD -Path <path>
-SizeBytes <targetsize>`

Alternatively, use `-ToMinimumSize`

You can expand a VHDX on a SCSI controller with the VM running

After resizing, use Disk Management or PowerShell *within* the VM

- Partitioning, formatting, etc.



Monitoring a VHD's Health



Test-VHD cmdlet

- Can alert us to some types of corruption
- Returns “true” if it thinks disk and disk chain is healthy
- False positives can occur

Hyper-V Manager “Inspect Disk”

- Lets us reconnect lost parent of differencing disk

Tip: Avoid mounting virtual disks outside of Hyper-V if they have checkpoints

Monitoring a Disk's Performance



Resource metering

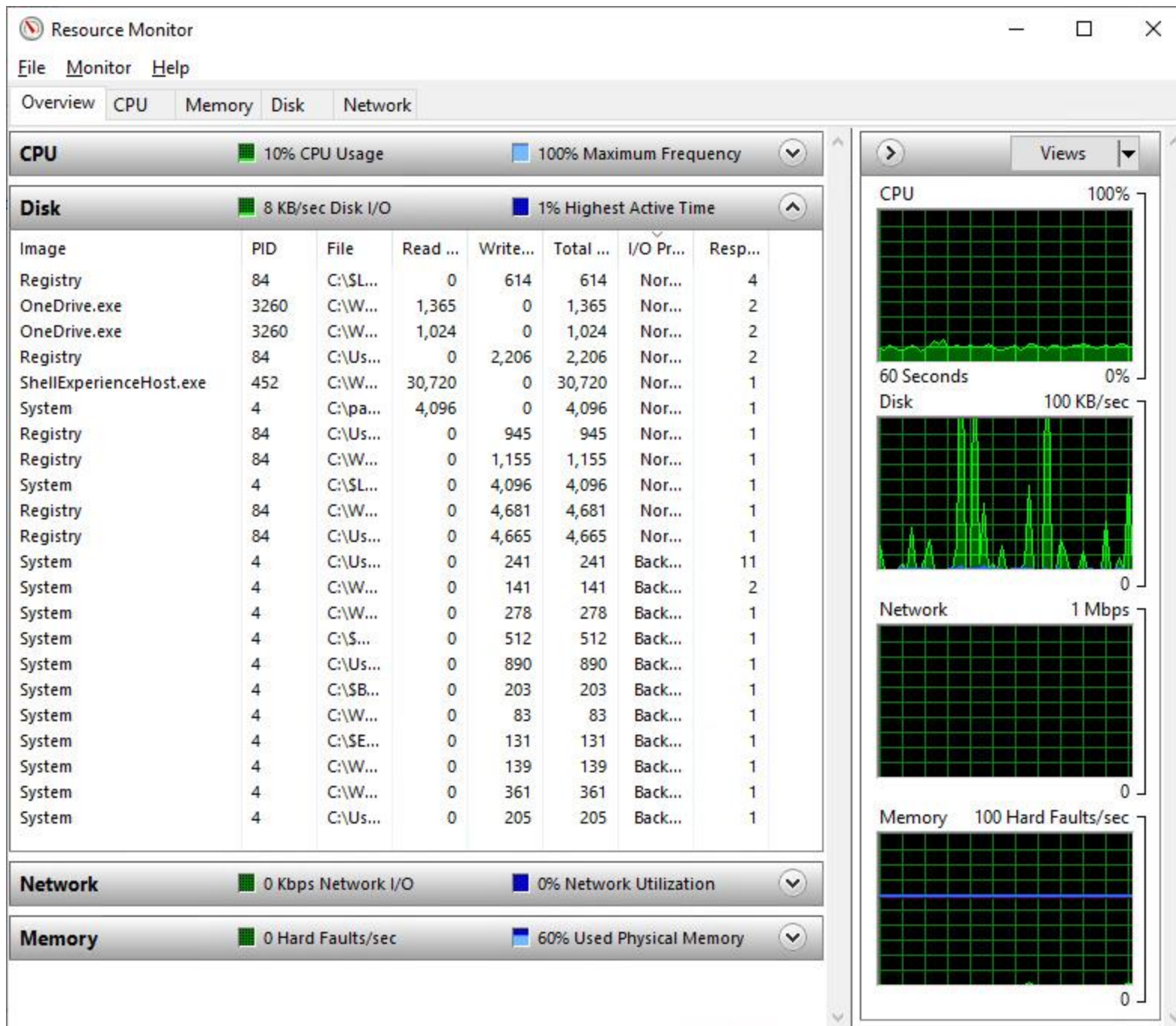
- Discussed in “Configure Virtual Machines” module

Tools inside a Windows guest

- Resource Monitor
- Performance Monitor

3rd-party tools





Available counters

Select counters from computer:

<Local computer>

Browse...

PhysicalDisk

% Disk Read Time

% Disk Time

% Disk Write Time

% Idle Time

Avg. Disk Bytes/Read

Avg. Disk Bytes/Transfer

Avg. Disk Bytes/Write

Avg. Disk Queue Length

Instances of selected object:

_Total

<All instances>

0 C:

Search

Add >>

☐ Show description

Added counters

Counter	Parent	Inst...	Computer
PhysicalDisk			
*	---	*	
% Disk Read Time	---	0 C:	
% Disk Time	---	0 C:	
% Disk Write Time	---	0 C:	
% Idle Time	---	0 C:	
Avg. Disk Bytes/Read	---	0 C:	
Avg. Disk Bytes/Tra...	---	0 C:	
Avg. Disk Bytes/Write	---	0 C:	
Avg. Disk Queue Len...	---	0 C:	
Processor			
*	---	*	

Remove <<

OK

Cancel



Optimizing a Disk



Compaction

- Reclaiming wasted space in dynamic disks and reducing VHDX size
- “Edit disk” in Hyper-V Manager
- `Optimize-VHD -Path <path>`
- `-Mode Full` does the best job but we must first mount disk read-only



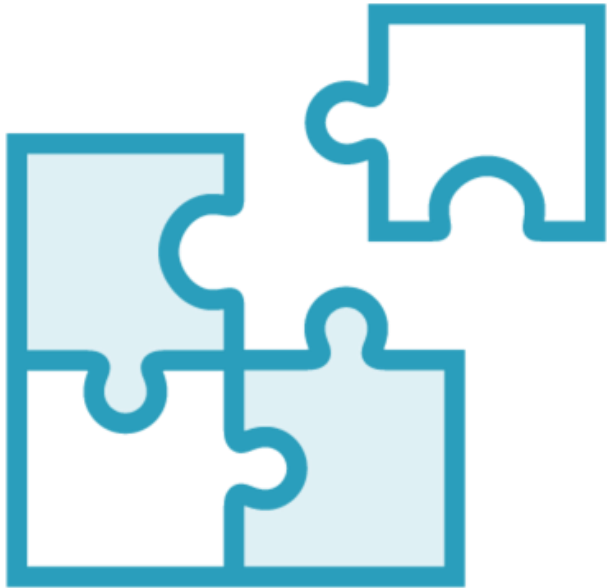


In my experience, compacting and shrinking operations in Hyper-V become less efficient over time.

For best capacity utilization, create a new VHD and copy the contents of the old one to the new one.



Optimizing a Disk: Defragmenting



Can be very complex! For hosts:

- Probably shouldn't for SSDs
- Probably good for dynamic VHDX
- Probably shouldn't for SANs or Storage Spaces

For guests:

- Probably shouldn't for SSDs or SANs
- Probably good for spinning disks
- Best benefit: combine with host defrag



At this writing, Windows Admin Center offers practically no commands to modify or maintain virtual disks.






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Tools

Search Tools

- PowerShell
- Processes
- Registry
- Remote Desktop
- Roles & features
- Scheduled tasks
- Services
- Storage
- Storage Replica
- Updates
- Virtual machines**
- Virtual switches
- Settings

Settings for Globomantics WS1 W10

 General Memory Processors **Disks** Networks Boot order Checkpoints Security

Disks

Hard Drive on SCSI controller number 0 at location 0 

Path: * D:\Globomantics VHDs\Globomantics WS1_1FA6131A-3F

Size (GB) * 127

+ Add disk

Save disks settings

Discard changes

Close



Demo



Inspecting and editing
virtual disks



Checkpoints





VM checkpoints:

Formerly known as “snapshots” in Windows Server 2012

- PowerShell supports both terms

Point-in-time capture of VM state

Included when exporting/importing VMs

Scenarios:

- Creating fallback position when making major changes to a VM
- Using successive states of a VM to illustrate a process
- Troubleshooting a dev issue



Tips on Checkpoints



You can create checkpoints while a VM is running or stopped, but not paused

A VM can have a maximum of 50 checkpoints

Default checkpoint name includes VM name, date, and time

You can enable *automatic* checkpoints

- Hyper-V Manager
- Set-VM -Name <VMName>
-AutomaticCheckpointsEnabled \$true





Automatic checkpoints get created when you start a VM, and deleted when you shut it down or stop it.



Standard Checkpoints



Capture both disk and memory state

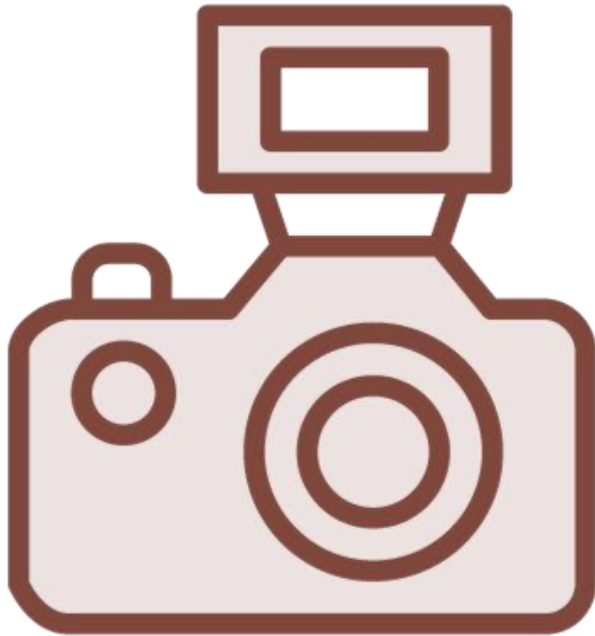
Not recommended by Microsoft for production use

Good for particular scenarios

- Dev
- Test
- Train



Production Checkpoints



Capture only disk state

- Volume Shadow Copy service (VSS) inside a Windows guest
- File System Freeze inside a Linux guest

Fine for production use

The new default type

If production checkpoint fails, standard checkpoint is created (optional)



Checkpoints are **not** recommended for virtual domain controllers.

DCs have several mechanisms for tracking state and these can be confused by checkpoint restoration.

Similar cautions apply with multiuser databases.



Tools for Using Checkpoints



Hyper-V Manager

Windows Admin Center

PowerShell



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Tools




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- Storage
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- Updates
- Virtual machines**
- Virtual switches
- Settings

60 Seconds ago

Now

Checkpoints

 Apply  Rename  Delete checkpoint

Name	Created	Applied
Before new build	2/17/2020, 10:22:53 AM	Yes

Related

VHDs Networks Server

Name	File path	Size used	Type
Globomantics WS1_1FA6131A-...	D:\Globomantics VHDs\Globoma...	0 %	Differencing

Checkpoints in PowerShell



Syntax is confusingly inconsistent...

```
Checkpoint-VM -Name <VMName>  
-SnapshotName <name>
```

```
Get-VMSnapshot -VMName <VMName>
```

```
Restore-VMSnapshot -Name  
  <CheckpointName> -VMName <VMName>
```

```
Rename-VMSnapshot -Name  
  <CheckpointName> -NewName <Name>
```

Good work! Up Next:
Configure Virtual Networks

