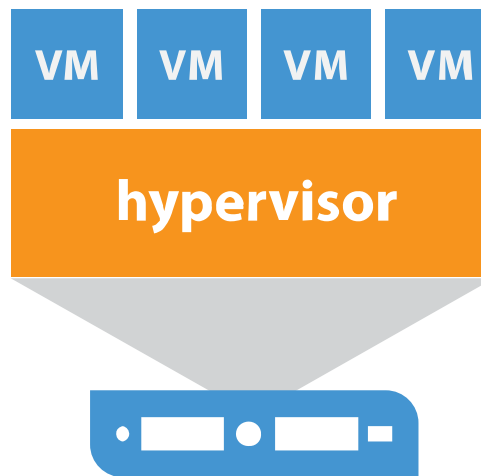# Hyper-V
Špecializované IKT systémy Windows

Ing. Stanislav Lukac, PhD.

Agenda

1. Installing and configuring Hyper-V role
2. Configuration of storage for hosting VMs
3. Configuration of vNetworks
4. Configuration of VMs
5. Checkpoints and VM backup concept
6. Daily VM operations and PowerShell

Installing and configuring: Hyper-V

Hypervisor

VM **VM** **VM** **VM**

hypervisor

Bare metal (Type1)

VM **VM** **VM**

Application Virtualization SW

operating system
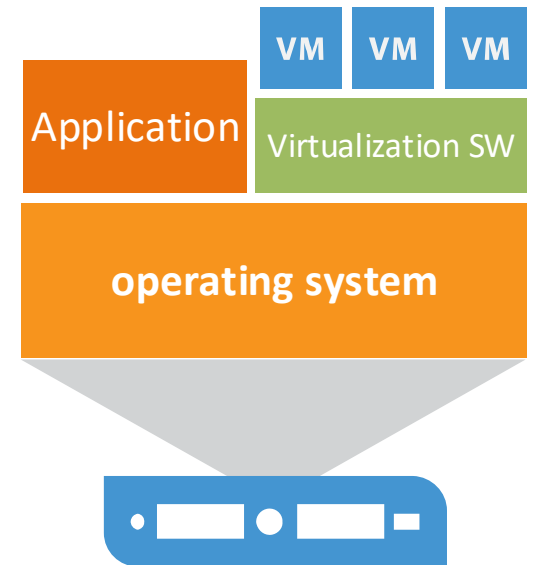
Guest OS based (Type2)

Comparison with Server 2012 R2

Feature description	Windows Server 2012/2012 R2	Windows Server 2016
Physical (host) memory support	Up to 4 TB per physical server	Up to 24 TB per physical server (6x)
Physical (host) logical processor support	Up to 320 LPs	Up to 512 LPs
Virtual machine memory support	Up to 1 TB per virtual machine	Up to 12 TB per virtual machine (12x)
Virtual machine virtual processor support	Up to 64 VPs per virtual machine	Up to 240 VPs per virtual machine (3.75x)

Not supported in previous version

- Shielded VM
- Enhanced threat detection
- Hot add and remove for disk, memory, and network
- RDS RemoteFX vGPU
- VM Load balancing
- VM storage resiliency

Licensing

Hyper-V server 2016
- Standalone product
- is available for free

Licensing Windows server 2016
- Standard 2 OSEs
- Datacenter unlimited OSEs

Windows Server 2016 edition	Ideal for	Licensing model	CAL requirements[1]	Pricing Open NL ERP (USD)[3]
Datacenter[2]	Highly virtualized and software-defined datacenter environments	Core-based	Windows Server CAL	$6,155
Standard[2]	Low density or non-virtualized environments	Core-based	Windows Server CAL	$882

From https://www.microsoft.com/en-us/cloud-platform/windows-server-pricing

Requirements (vHost)

Hardware (min)

- *64bit CPU with SLAT and support virtualization tech (IntelVT or AMD-V)*

- *DEP enabled (XD or XN tech)*

- *4 GB RAM*

- *100 GB HDD*

Software

Installed Windows server 2016 w Hyper-V feature or Hyper-V Server 2016

Configuration max

Maximum	
Logical CPU	512
Memory	24 TB
Running VM	1024
Virtual CPU	2048
Nodes in CLU	64
Running VM in CLU	8000
vMemory	12TB for GEN2	1TB for GEN1
vFC adapters	4
vHDD	64 for VHDX	2048 GB for VHD
vCPU	240 for Gen 23
	64 for Gen 1
vNIC	12 (8 HyperV + 4Legacy)
vSCSI adapters	4
vIDE adapters	4

Guest OS support

- **Windows 7 SP1 and newer**

- **Windows server 2008R2 and newer**

- **CentOS**

- **Debian**

- **Oracle**

- **Suse**

- **Ubuntu**

- **FreeBSD**

https://docs.microsoft.com/en-us/windows-server/virtualization/hyper-v/supported-linux-and-freebsd-virtual-machines-for-hyper-v-on-windows

Major/Core feature

Run hyper-v inside VM

supported for Windows 10 / Server 2016

Configuration

- You will need install hyper-v on Windows 10 / Server 2016
- *Over PoweredOff VM run cmdset Set-VMProcessor -VMName <VMName> - ExposeVirtualizationExtensions $true*
- Intall hyper-v role inside VM

Major/Core feature

Hot ADD / REM

Hot add / rem network adapter

Hot add / rem RAM

Hot add / rem CPU

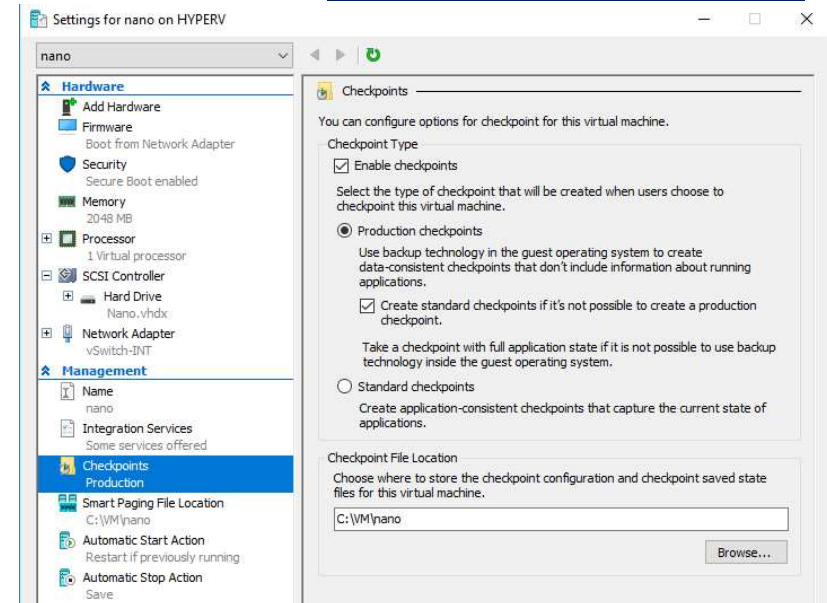Only for generation 2 VM

Major/Core feature

Production checkpoint (new)

- Default option

- Point-in-time image

- VSS inside VM is used

Standard checkpoint

- Chose capturing SAVE state of VM

- Usable for test, development, resistant APP

Major/Core feature

VM Backup

You can backup single VM instead of VM group

Major/Core feature

What it is ?

Run PowerShell cmdlets from vHost to hosted VM without network connection

Applicable for

Windows 10, Server 2016 or Server 2019

Use VMName param with Enter-PSSEssion or Invoke-Command

Major/Core feature

What it is ?

Optimize load over Hyper-V cluster nodes

How it works

Heuristics data analyze from CPU and RAM utilization of node

Configuration

Enabled by default.

Granular control: Can be activated on-demand or at a periodic interval

3 level of tresholds for load balancing

(Get-Cluster).AutoBalancerLevel = <value 1-3>

Installation of vHost

1. Buy and built vHost hardware (min)
   - *64bit CPU with SLAT and support virtualization tech (IntelVT or AMD-V)*
   - *DEP enabled (XD or XN tech)*
   - *4 GB RAM*
   - *100 GB HDD*

2. Download installation media
   https://www.microsoft.com/en-us/evalcenter/evaluate-hyper-v-server-2016

3. Installation of hypervisor or Windows server Hyper-V role

4. Run systeminfo and see result at the end

5. Configure Hyper-V host settings (hostname, IP, Time, Activation, Updates, ...etc)

Configuring Hyper-V STORAGE

Storage type

Supported TECH
- iSCSI
- FC
- SMB 3.0 shares
- Shared VHDX

Supported partition format
- NTFS
- ReFS

Cluster shared volume

Enable multiple nodes in a MS FC to simultaneously have read-write access to the same LUN

Requirements: MS Failover cluster role installed

NFTS or ReFS file system format

NTLM enabled on Nodes (default settings)

Used for: Storage of VM harddisks

ScaleOut file server configuration (only with NTFS)

Limitations: No usable for Witness disk

Data compression and Data deduplication is not supported in 2012

Configuring Hyper-V NETWORK

Hyper-V Networking

pSwitch

Hyper-V host

VM

Mgmt vNIC

vSwitch
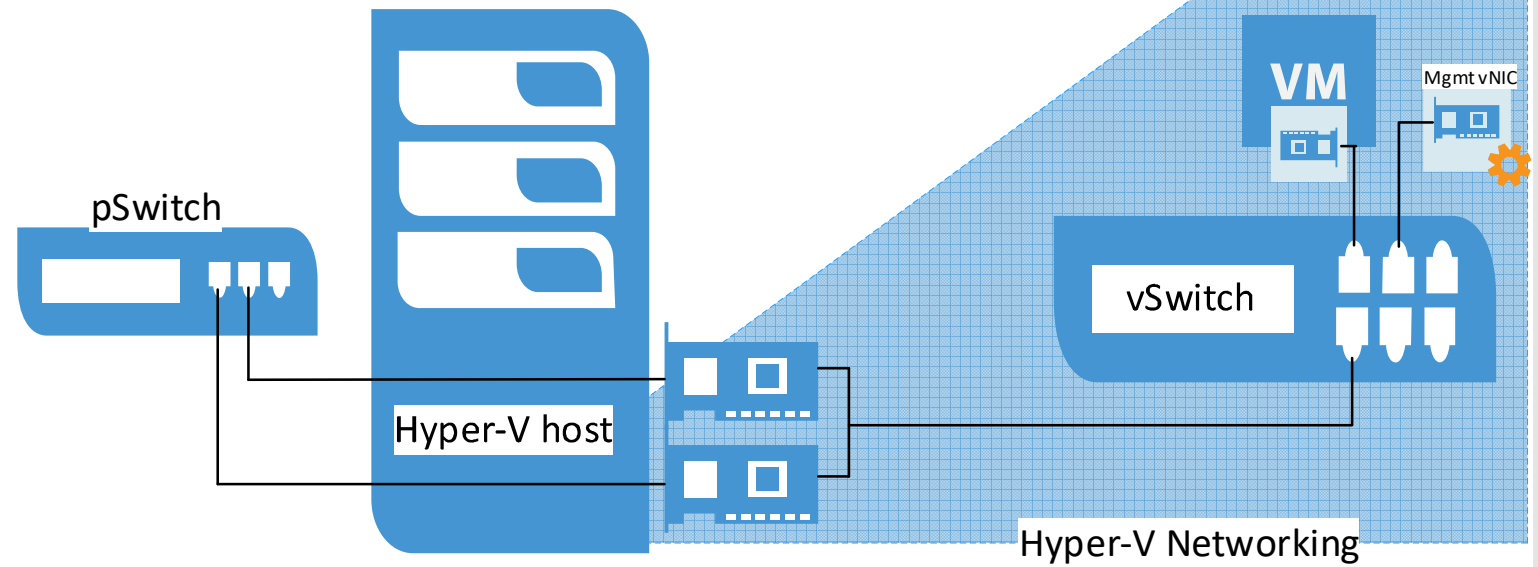
Hyper-V Networking

Hyper-V vSwitch: Overview

- Software-based layer-2 Ethernet network switch

- Traffic connectivity
  - **EXTERNAL**

    Allow communication outside vHost (physical network)
  - **INTERNAL**

    Allow communication only with VMs connected to same switch and vHost
  - **PRIVATE**

    Allow communication only with VMs connected to same switch
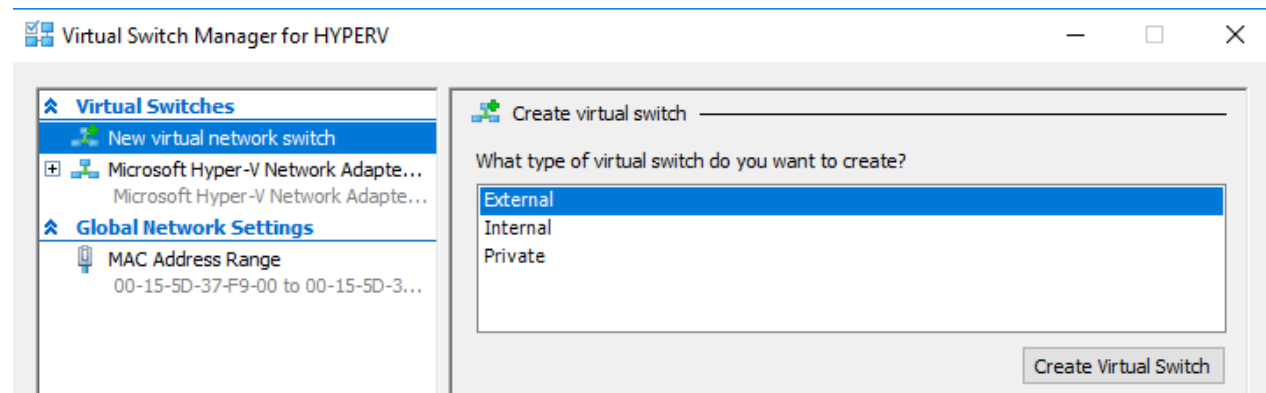
Hyper-V vSwitch: Limitations

- vHost needs to have at least one physical adapter
- You cannot attache pNIC to multiple vSwitches
- You cannot configure multiple tagging over vSwitch
- You can use VLAN tagging over vSwitch level or vNIC level
- You can share vSwitch VM traffic with vHost traffic
- Keep number of vSwitches to minimum

Hyper-V vNICs: Teaming

NIC teaming

- Windows NIC teaming
- Switch embedded teaming (Hyper-V)

Windows NIC Teaming

- NIC vendor independent solution (WHQL passed)
- Up to 32 to create one software based virtual network adapters
- Load balancing and high availability
    a) Switch depend mode
    b) Switch in-depended mode
    c) Dynamic mode (recommended by MS; cover Inbound and Outbound trafic)

    https://docs.microsoft.com/en-us/windows-server/networking/technologies/nic-teaming/create-a-new-nic-team-on-a-host-computer-or-vm#bkmk_teaming

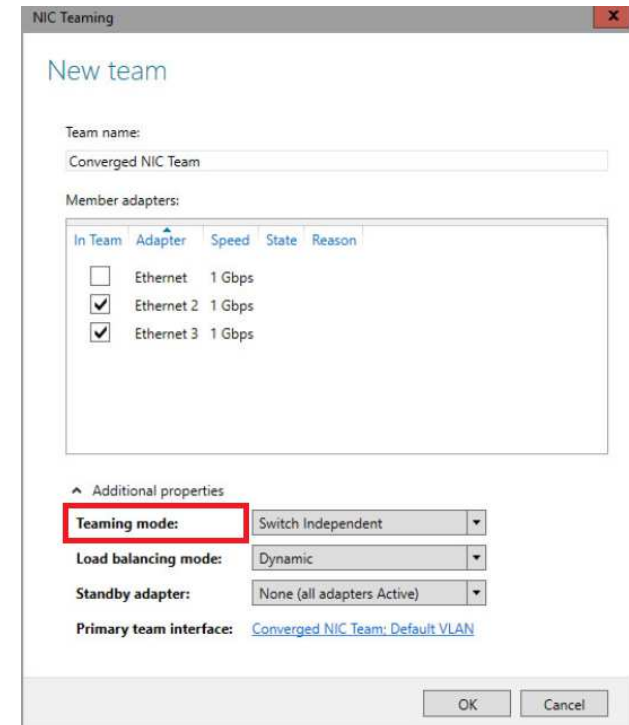# Hyper-V vNICs: NIC Teaming mode

A. Switch **Independent** mode
   - No relation or configuration required on pSwitch
   - pNIC can be connected to different pSwitches
   - Often used for Failover across multiple NICs

B. Switch **Static teaming** mode (switch depended)
   - Used if you switch doesn't support 802.1ax but you needed
   - Used if server generate heavy inbound and outbound traffic or VMs generated traffic higher like bandwidth of one NIC in team
   - requires us to configure the individual switch ports

C. LACP (switch depended)
   - If switch support Link aggregation control protocol (802.1ax)
   - Used if server generate heavy inbound and outbound traffic or VMs generated traffic higher like bandwidth of one NIC in team

Hyper-V vNICs: NIC Teaming LB

A. **Address hash** (switch independet)
   - LB used for outbound traffic across active NICs
   - Cannot LB inbound traffic across active NICs
   - Typically used for Web or FTP servers which has huge outbound traffic

B. **Hyper-V port** (switch independent)
   - LB used for VM inbound and outbound traffic
   - VM should not exceed bandwidth of one NIC in team
   - The most preferred with Hyper-V role and VM(s)

C. **Dynamic**
   - Recommended by MS
   - Provide advantages both previous
   - it uses address hashing for outbound and Hyper-V port balancing for inbound with additional logic

Configuring Hyper-V **Hyper-V**

Configuring Hyper-V VMs

VM Components

vComponents
- vCPU
- vRAM
- vNIC
- vHDD
- vOther hardware

VM Integrated services
- Improve VM performance and console actions
- Guest OS drivers installation
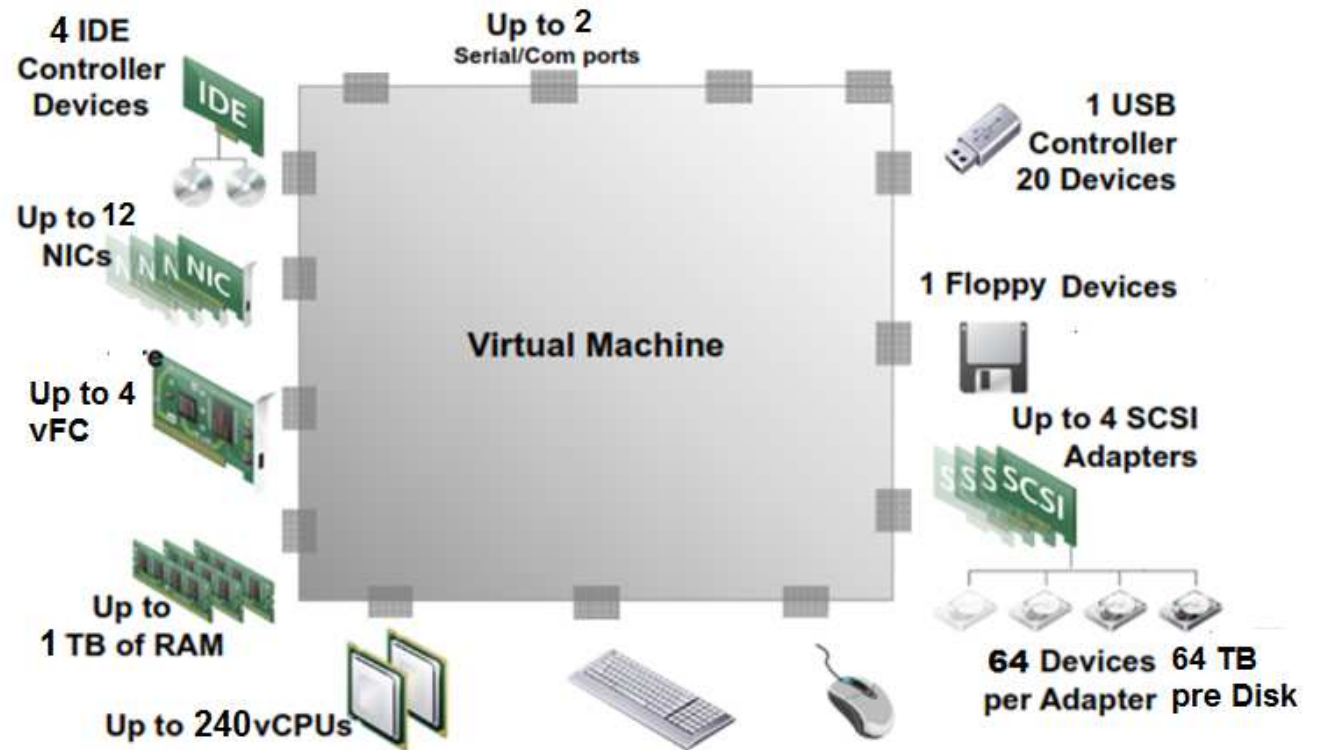- Improve share between vHost and VM

VM version

VM Components HotAdd/Remove

Generation 2 VM

	Hot plugged	Hot unplugged
vCPU	Yes	No
vRAM	Yes	Yes
vNIC	Yes	Yes
vHDD	Yes	Yes

VM configuration maximums

VM Generation

Generation 1
- Support all guest OS including 32 bit
- Support boot with legacy vNIC
- Support boot from IDE controller or Floppy
- Boot volume max 2 TB

Generation 2
- Support newer guest OS only 64 bits
- Support PXE boot
- Support boot from SAN
- Support secure boot
- Support larger boot volumes (64 TB)
- Support 64 SCSI devices
- No emulation for keyboard, mouse, video
- You can resize VHDX file

VM files

VHDX

New vDisk format available from server 2012

AVHDX

Differencing disk used if checkpoint is created

VMRS

Runtime state file containing memory of VM

VMCX

Configuration file of VM

VM Guest deployment

- From ISO
- PXE boot
- Via physical media and vHost optical drives
- CD/DVD
- Floppy
- Deploying from template

VM Checkpoints

Max 50 per VM

Located in defined checkpoint file location
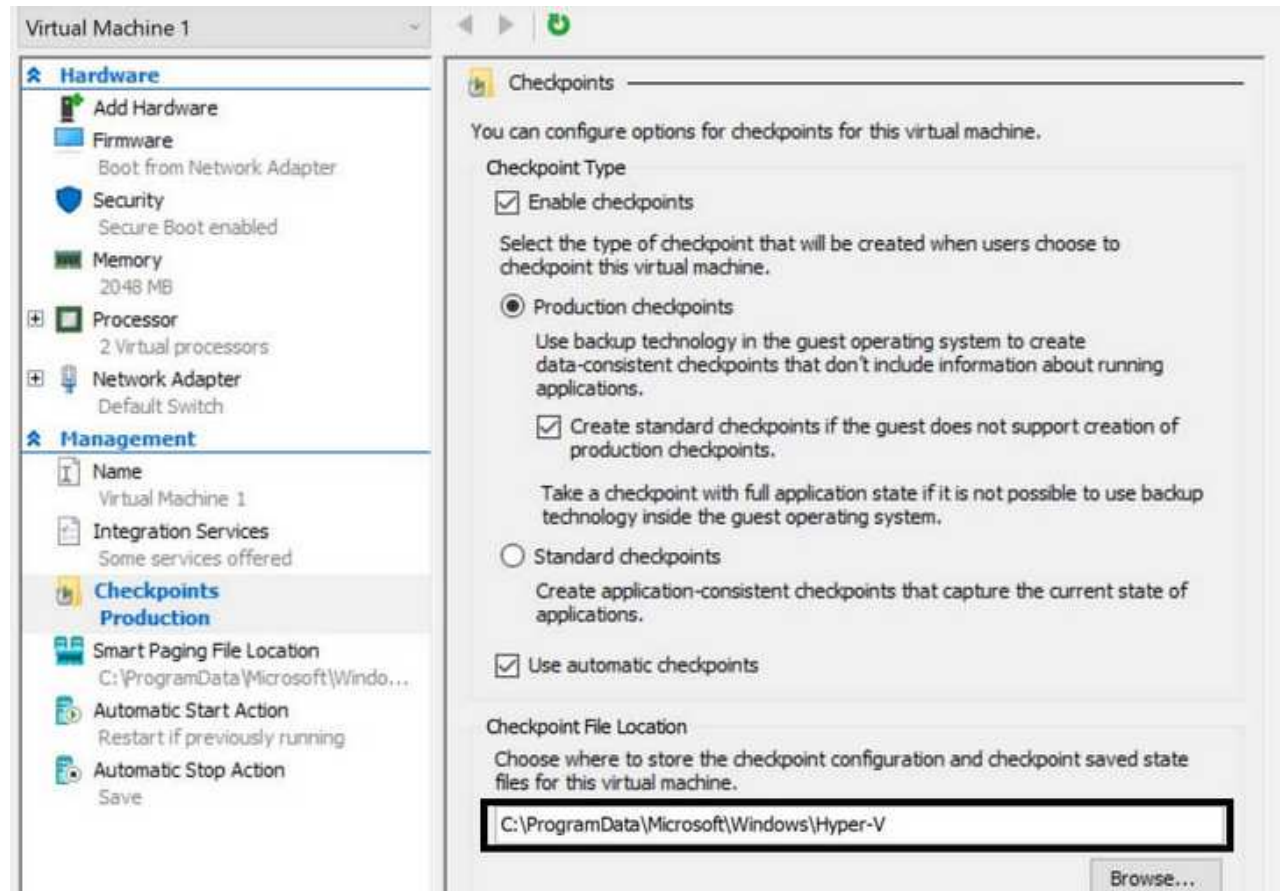
Using differencing disk

Production
- Point in time image of VM hosted any production workloads
- Using bck tech inside Guest (incl VSS)
- Can be used for AD DS or AD LDS services inside VM

Standard
- Point in time image for development and test scenario
- Using save state technology
- Used If application is not VSS aware

VM Checkpoints

VM Backup

3rd party tools

Storage box snapshots

Via Windows Server Backup feature
- Full backup Hyper-V host with VMs included
- Backup Hyper-V host without VMs
- Backup individual VM from the host level
- Backup from inside VM guest OS

VM Backup

CORE files are
- VMCX / XML
- VHD/VHDX
- AVHD/AVHX

VM Restore

Recover to original location: This scenario is suitable to use when the original host is still available. This is the most simple method, VMs will be restored to the original host and we don't need to re-create VMs or reinstall Hyper-V.

Recover to alternate location: This scenario is suitable to use when the original host is not available anymore. The Administrator can restore VMs and register it to other available Hyper-V hosts.

Copy to folder: This scenario is used when we don't have another Hyper-V hosts. It will recover the virtual hard disks of the VMs as files that we can use to re-create VMs after reinstalling Hyper-V.

VM Restore

- If the restore is performed while the virtual machine is running, it will actually turning off and delete the VM before VM is restored.

- When restoring a VM from live backup, a message that the system was not properly shut down may appear on the guest OS on the VM.

Merge vhdx and avhdx

1. Select Hyper-V server in **Hyper-V Manager**

2. On left-hand side, select **Inspect Disk**

3. Browse to location of restored AVHD/AVHDX files

4. Select one of the AVHD/AVHDX files > **OK**

5. Record parent disk name

6. Repeat steps 2-5 for each AVHD/AVHDX file, and record their order (from newest to oldest)
   1. Note: do not use timestamps to determine which files to merge, as this could lead to overwriting the incorrect parent file

7. Select Hyper-V server in **Hyper-V Manager**

8. On left-hand side, select **Edit Disk**

9. **Next** > Select newest AVHD/AVHDX file

10. **Next** > Select **Merge**

11. **Next** > **To the parent virtual hard disk**

12. **Finish**

13. Repeat steps 7-12 for each AVHD/AVHDX disk, until only the VHD/VHDX disk is left for the machine

14. Mount VHD/VHDX in new virtual machine in Hyper-V and boot

Merge vhdx and avhdx

Note parent AVHDX from command output

Get-VHD .\<name of AVHDX file>.avhdx
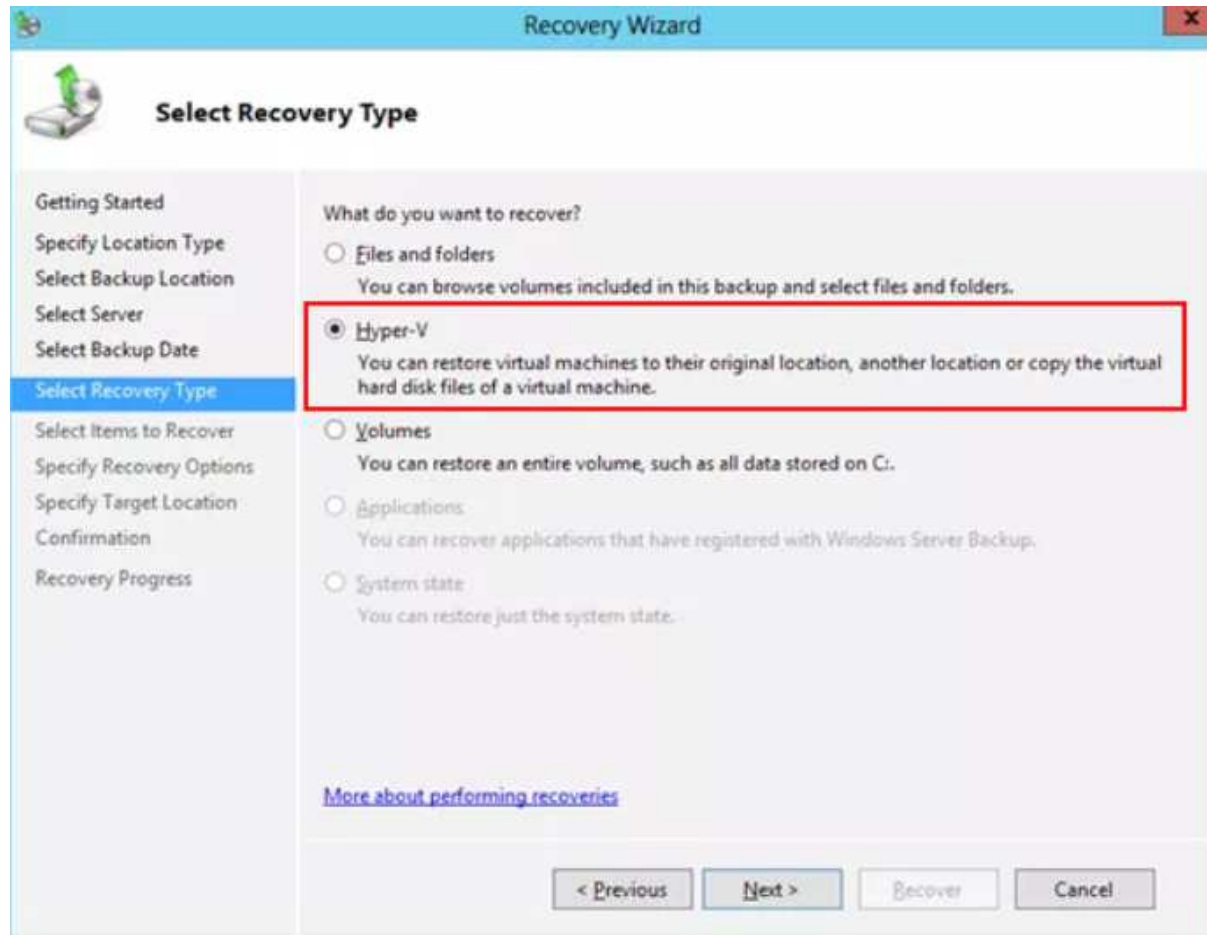
From the newest to oldest you can merge files

Merge-VHD -Path '<path to AVHDX>' -DestinationPath '<path to parent AVHDX'

Merge last AVHDX with parent VHDX file

Merge-VHD -Path '<path to AVHDX>' -DestinationPath '<path to main VHDX disk'

VM Restore

DEMO::

Configuring Hyper-V Monitoring

Performance

User performance baseline

User Hyper-V specific counters

- Hyper-V Hypervisor Logical Processor% Total Run Time counter
- Hyper-V Hypervisor Virtual Processor% Guest Run Time
- MemoryAvailable Mbytes on the host (less than 5 % can be issue)
- MemoryCommitted Bytes (see how much memory each VM is using when planning your VM memory allocation)
- LogicalDisk(*)Average Disk SecRead / Write (healthy is less then 10ms, over 25ms can be situation critical)
- Network Interface (*)OutputQueue Length (than 1 on average is healthy, the warning is when it's above 1 on average, and critical is when it's 2 or more on average.)

Buffer size 20 %

Performance

https://docs.microsoft.com/en-us/windows-server/administration/performance-tuning/role/hyper-v-server/

NEXT

::Hyper-V on windows 10

https://docs.microsoft.com/en-us/virtualization/hyper-v-on-windows/about/

::Hyper-V

https://docs.microsoft.com/en-us/windows-server/virtualization/hyper-v/hyper-v-technology-overview