



 Windows Server

Server Virtualization Overview

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Just the facts

SCALE AND PERFORMANCE

Larger virtual machines support increased workloads

Hardware offloading offers better performance and scale

VIRTUAL MACHINE MOBILITY

Simultaneous live migrations ease management burdens

Shared-nothing live migration enables live migration between clusters

CONTINUOUS SERVICES

Clustering enhancements increase availability

Dynamic Memory increases capacity with no downtime

OPEN AND EXTENSIBLE

Open, extensible switch helps support security and management needs

Increased support for Windows PowerShell helps increase automation

ISOLATION AND MULTITENANCY

Network Virtualization supports multitenancy and IP portability

Resource Metering shows how many resources each tenant is using

Hyper-V host scale and scale-up workload support

System	Resource	MAXIMUM NUMBER		Improvement factor
		Windows 2008 R2	Windows Server 2012	
Host	Logical processors on hardware	64	320	5
	Physical memory	1 TB	4 TB	4
	Virtual processors per host	512	2,048	4
Virtual machine	Virtual processors per virtual machine	4	64	16
	Memory per virtual machine	64 GB	1 TB	16
	Active virtual machines	384	1,024	2.7
Cluster	Nodes	16	64	4
	Virtual machines	1,000	8,000	8

New virtual hard disk format

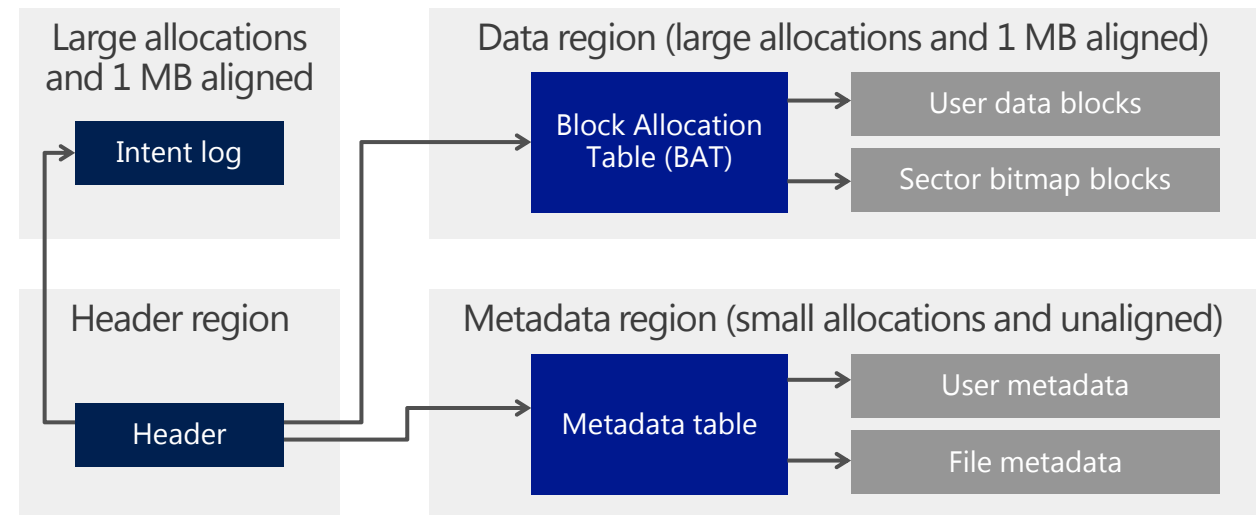
VHDX

Features

- Storage capacity up to 64 TBs
- Corruption protection during power failures
- Optimal structure alignment for large-sector disks

Benefits

- Increases storage capacity
- Protects data
- Helps to ensure quality performance on large-sector disks

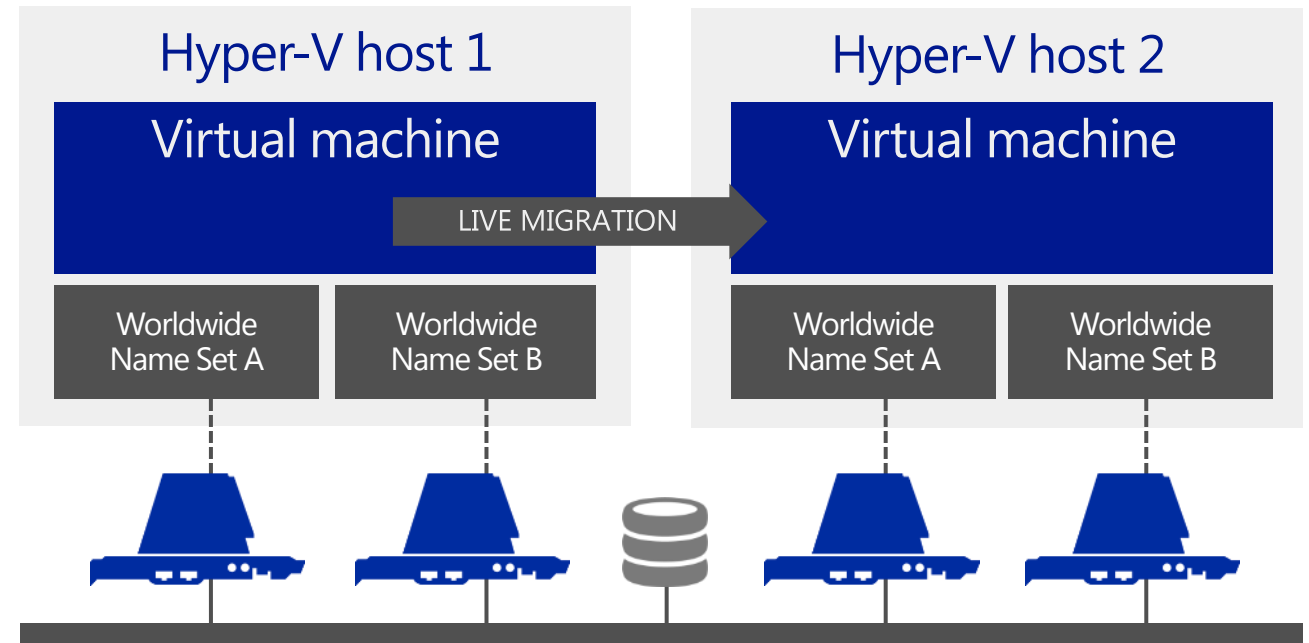


Virtual Fibre Channel in Hyper-V

SCALE AND
PERFORMANCE

Access Fibre Channel SAN data from a virtual machine

- Unmediated access to a storage area network (SAN)
- Hardware-based I/O path to virtual hard disk stack
- N_Port ID Virtualization (NPIV) support
- Single Hyper-V host connected to different SANs
- Up to four Virtual Fibre Channel adapters on a virtual machine
- Multipath I/O (MPIO) functionality
- Live migration



Live migration maintaining
Fibre Channel connectivity

Virtual machine mobility



Manage virtual machines independently from underlying infrastructure



Handle changing needs on demand



Live migration within a cluster

Live migration of storage

Shared-nothing live migration

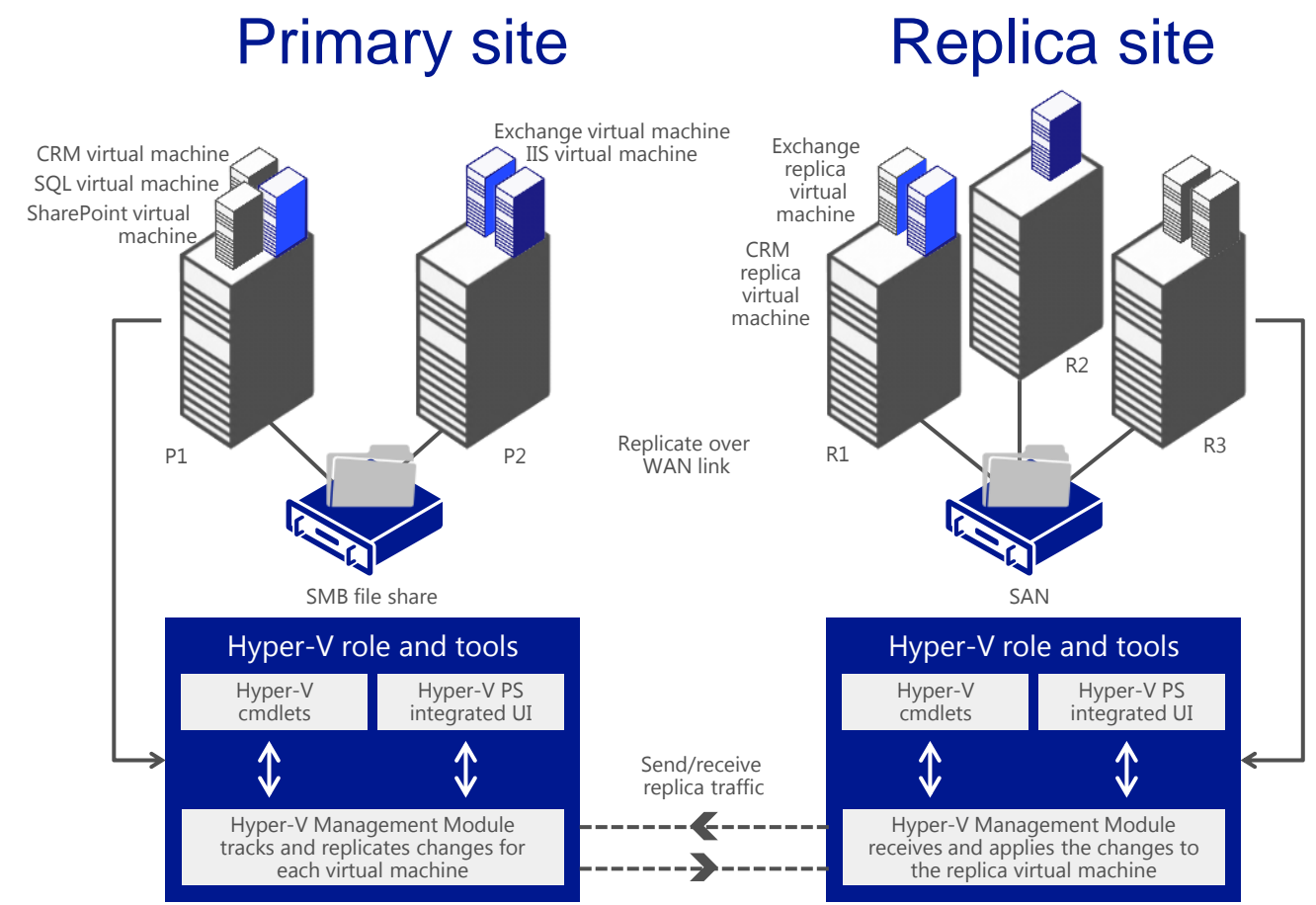
Hyper-V Replica

Hyper-V Replica

New feature
Replicate Hyper-V virtual machines from a primary site to a replica site

Benefits

- Affordable in-box business continuity and disaster recovery
- Failure recovery in minutes
- More secure replication across network
- No need for storage arrays
- No need for other software replication technologies
- Automatic handling of live migration
- Simpler configuration and management



Hyper-V clustering enhancements

Features

Guest clustering through Fibre Channel

- Connects to Fibre Channel directly from within virtual machines
- Virtualizes workloads that:
 - Use direct access to Fibre Channel storage
 - Cluster guest operating systems over Fibre Channel

Encrypted cluster volumes

Uses BitLocker Drive Encryption to enable better physical security for deployments



Clustered live migration enhancements



Uses higher network bandwidths (up to 10 GB) to complete migrations faster

Cluster Shared Volume (CSV) 2.0

- Simplifies the configuration and operation of virtual machines
- Provides greater security and performance
- Integrates with storage arrays for out-of-box replication and hardware snapshots



Hyper-V clustering enhancements

Features

Virtual machine failover prioritization

- Lets you configure virtual machine priorities
- Controls the order in which virtual machines fail over or start

In-box live migration queuing

Lets you perform large, multiselect actions to queue live migrations of multiple virtual machines

Affinity (and anti-affinity) virtual machine rules

- Lets you configure partnered virtual machines to migrate simultaneously during failover

Example: A Microsoft SharePoint virtual machine and partnered Microsoft SQL Server virtual machine can be configured to always fail over together to the same node.

- Allows you to specify that two virtual machines cannot coexist on the same node in a failover scenario (anti-affinity)



QoS minimum bandwidth

Features and mechanisms

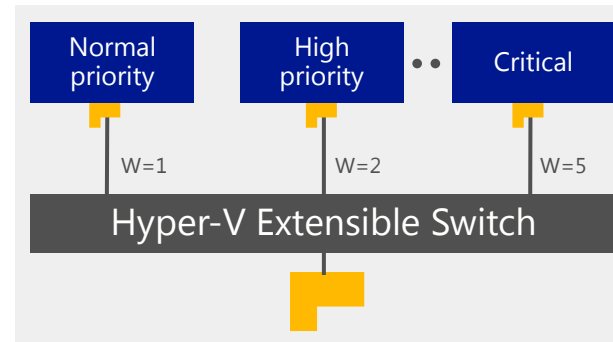
Features

- Establishes a bandwidth floor
- Assigns specified bandwidth for each type of traffic
- Helps to ensure fair sharing during congestion
- Can exceed quota with no congestion

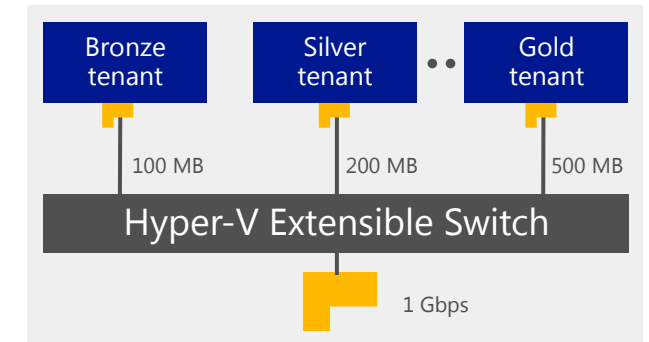
Two mechanisms

- Enhanced packet scheduler (software)
- Network adapter with DCB support (hardware)

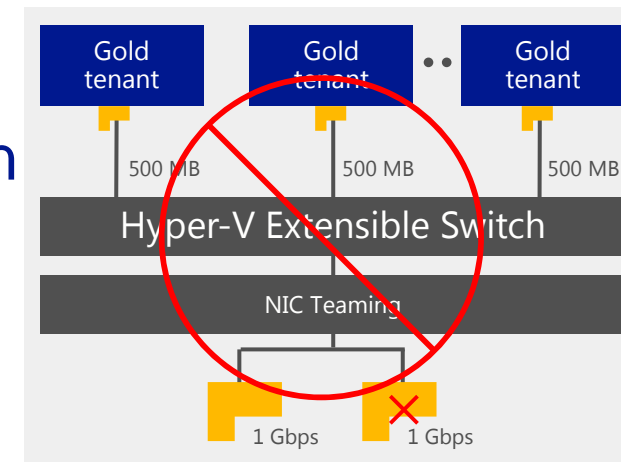
Relative minimum bandwidth



Strict minimum bandwidth



Bandwidth oversubscription



NIC Teaming



Benefits

- Higher reliability against failure
- Better throughput

Management

- Windows PowerShell
- Configuration UI for NIC Teaming Server Manager

What is NIC Teaming?

- Multiple parallel network connections
- Increases throughput
- Provides redundancy in case of link failure

NIC Teaming in a Hyper-V environment

- Uses virtual network adapters
- Can connect to more than one virtual switch
- Maintains connectivity if one switch disconnects
- Can support up to 32 network adapters in a team (*Example: SR-IOV*)

Extending the Hyper-V Extensible Switch

For new capabilities

Two platforms for extensions

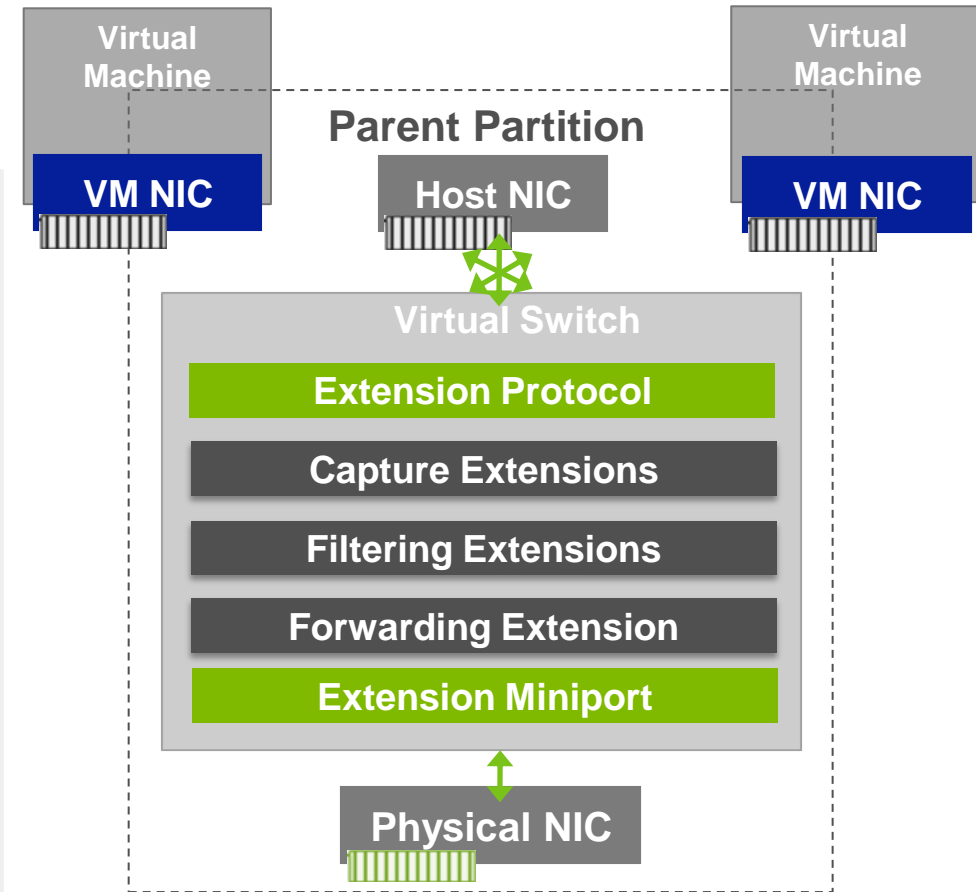
- Network Device Interface Specification (NDIS) filter drivers
- Windows Filtering Platform (WFP) callout

You can extend or replace

- NDIS filter drivers
- WFP callout drivers
- Ingress filtering
- Destination lookup and forwarding
- Egress filtering

Other features

- Extension monitoring
- Extension uniqueness
- Extensions that learn virtual machine life cycle
- Extensions that can veto state changes
- Multiple extensions on same switch



Hyper-V Extensible Switch architecture

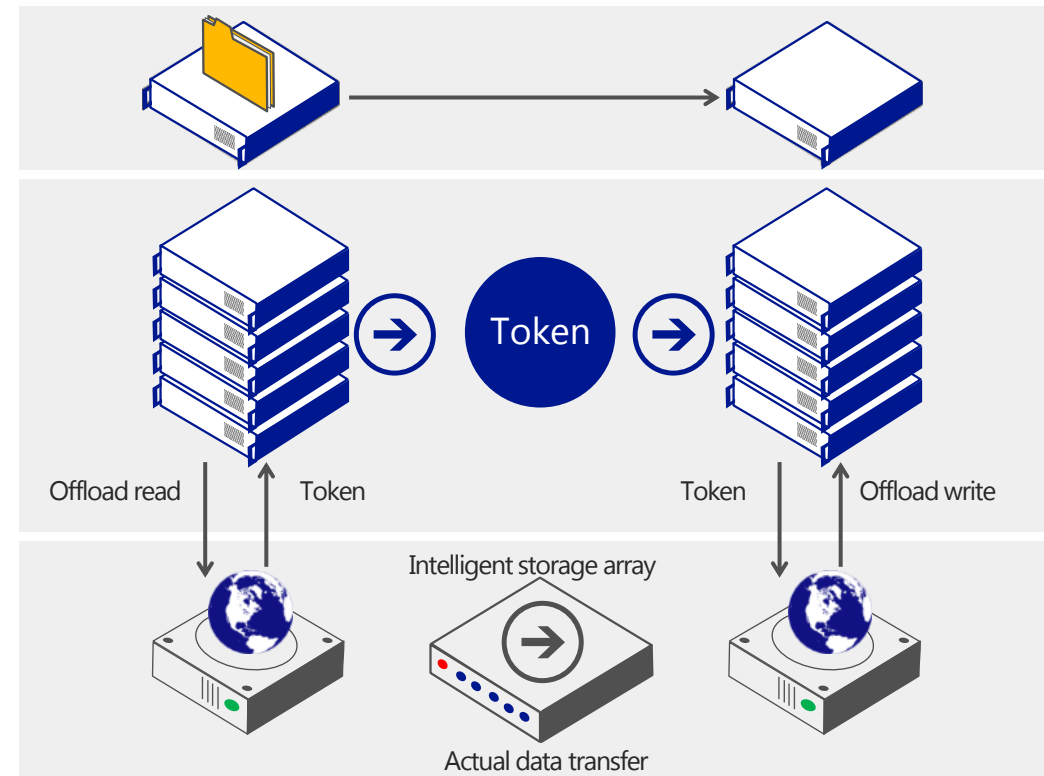
ODX support in Hyper-V

Offloaded Data Transfer (ODX)

Token-based data transfer between
intelligent storage arrays

Benefits

- Rapid virtual machine provisioning and migration
- Faster transfers on large files
- Minimized latency
- Maximized array throughput
- Less CPU and network use
- Performance not limited by network throughput or server use
- Improved datacenter capacity and scale
- Automation



Token-based copy operation

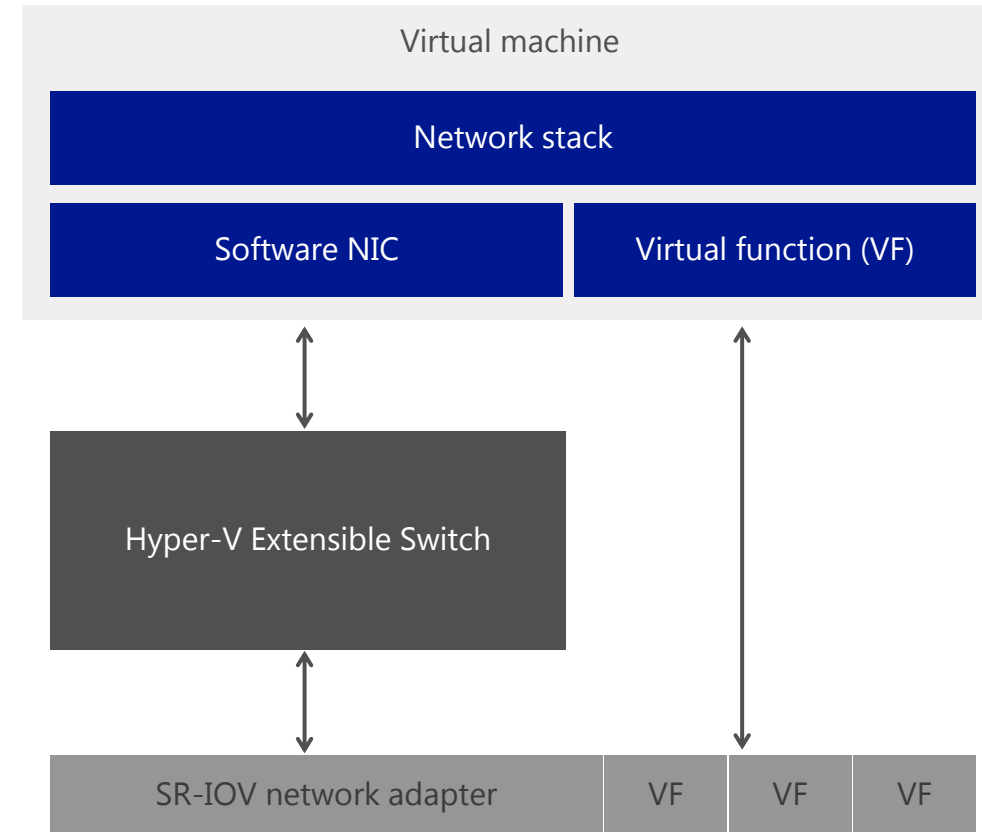
SR-IOV support in Hyper-V

Single Root I/O Virtualization (SR-IOV)

- Increases network throughput
- Reduces network latency
- Reduces host CPU overhead for processing network traffic

Benefits

- Maximizes use of host system processors and memory
- Handles the most demanding workloads



New Windows PowerShell automation support for Hyper-V



More than 150
cmdlets



Designed for IT
pros



Task-oriented
interface



Consistent
cmdlet nouns



Why Hyper-V?

Competitive Advantages of
Windows Server 2012 Hyper-
V over VMware vSphere 5.1

VMware Comparison

System	Resource	Windows Server 2012 Hyper-V	vSphere Hypervisor	vSphere 5.1 Enterprise Plus
Host	Logical Processors	320	160	160
	Physical Memory	4TB	32GB ¹	2TB
	Virtual CPUs per Host	2,048	2,048	2,048
VM	Virtual CPUs per VM	64	8	64 ²
	Memory per VM	1TB	32GB ¹	1TB
	Active VMs per Host	1,024	512	512
	Guest NUMA	Yes	Yes	Yes
Cluster	Maximum Nodes	64	N/A ³	32
	Maximum VMs	8,000	N/A ³	3,000

¹ Host physical memory is capped at 32GB thus maximum VM memory is also restricted to 32GB usage.

² vSphere 5.1 Enterprise Plus is the only vSphere edition that supports 64 vCPUs.

Enterprise edition supports 32 vCPU per VM with all other editions supporting 8 vCPUs per VM

³ For clustering/high availability, customers must purchase vSphere

Only Hyper-V allows the creation of VMs with up to 64 vCPUs & 1TB RAM, in all editions

VMware Comparison

Capability	Windows Server 2012 Hyper-V	vSphere Hypervisor	vSphere 5.1 Enterprise Plus
Virtual Fiber Channel	Yes	Yes	Yes
3 rd Party Multipathing (MPIO)	Yes	No	Yes (VAMP) ¹
Native 4-KB Disk Support	Yes	No	No
Maximum Virtual Disk Size	64TB VHDX	2TB VMDK	2TB VMDK
Maximum Pass Through Disk Size	256TB+²	64TB	64TB
Offloaded Data Transfer	Yes	No	Yes (VAAI) ³

¹ vStorage API for Multipathing (VAMP) is only available in Enterprise & Enterprise Plus editions of vSphere 5.1

² The maximum size of a physical disk attached to a virtual machine is determined by the guest operating system and

the chosen file system within the guest. More recent Windows Server operating systems support disks in excess of 256TB in size

³ vStorage API for Array Integration (VAAI) is only available in Enterprise & Enterprise Plus editions of vSphere 5.1

Hyper-V allows the creation of virtual disks that are **32 times the size** of those created on vSphere 5.1

VMware Comparison

Capability	Windows Server 2012 Hyper-V	vSphere Hypervisor	vSphere 5.1 Enterprise Plus
Dynamic Memory	Yes	Yes	Yes
Resource Metering	Yes	Yes ¹	Yes
Quality of Service	Yes	No	Yes ²
Data Center Bridging (DCB)	Yes	Yes	Yes

¹ Without vCenter, Resource Metering in the vSphere Hypervisor is only available on an individual host by host basis.

² Quality of Service (QoS) is only available in the Enterprise Plus edition of vSphere 5.1

Hyper-V provides QoS in all editions, unlike VMware, where QoS is only available in the Enterprise Plus edition of vSphere 5.1

VMware Comparison

Capability	Windows Server 2012	vSphere Hypervisor	vSphere 5.1 Enterprise Plus
Unified Management	Yes	VMware View ¹	VMware View ¹
Intelligent Patching	Yes	VMware View ²	VMware View ²
Rapid VM Provisioning	Yes	VMware View ²	VMware View ²
Hardware GPU Support	Yes	VMware View ³	VMware View ³
User Profile & Data Mgmt.	Yes	VMware View ²	VMware View ²

¹ VMware have no Remote Desktop Services technology of their own, but offer basic management of TS/RDS.

- No PCoIP Support | No Persona Management | No USB Support

² Intelligent Patching, Rapid Provisioning and Persona Management are features of VMware View 5.1 Premier, available at additional cost.

³ vSphere 5.1 introduces support for Hardware GPUs in the form of Virtual Shared Graphics Acceleration (vSGA) but will only be supported in a future version of VMware View (later than 5.1) and is restricted to a small number of NVIDIA GPUs only.

Windows Server 2012 provides powerful virtual desktop & remote session capabilities without additional, costly virtualization licensing

VMware Comparison

Capability	Windows Server 2012 Hyper-V	vSphere Hypervisor	vSphere 5.1 Enterprise Plus
Extensible vSwitch	Yes	No	Replaceable ¹
Confirmed Partner Extensions	4	No	2
Private Virtual LAN (PVLAN)	Yes	No	Yes ¹
ARP Spoofing Protection	Yes	No	vCNS/Partner ²
DHCP Snooping Protection	Yes	No	vCNS/Partner ²
Virtual Port ACLs	Yes	No	vCNS/Partner ²
Trunk Mode to Virtual Machines	Yes	No	No
Port Monitoring	Yes	Per Port Group	Yes ³
Port Mirroring	Yes	Per Port Group	Yes ³

¹ The vSphere Distributed Switch (required for PVLAN capability) is available only in the Enterprise Plus edition of vSphere 5.1 and is replaceable (By Partners such as Cisco/IBM) rather than extensible.

² ARP Spoofing, DHCP Snooping Protection & Virtual Port ACLs require the App component of VMware vCloud Network & Security (vCNS) product or a Partner solution, all of which are additional purchases

³ Port Monitoring and Mirroring at a granular level requires vSphere Distributed Switch, which is available in the Enterprise Plus edition of vSphere 5.1

vSphere Hypervisor / vSphere 5.x Ent+ Information: <http://www.vmware.com/products/cisco-nexus-1000V/overview.html>, <http://www-03.ibm.com/systems/networking/switches/virtual/dvs5000v/>, <http://www.vmware.com/technical-resources/virtualization-topics/virtual-networking/distributed-virtual-switches.html>, <http://www.vmware.com/files/pdf/techpaper/Whats-New-VMware-vSphere-51-Network-Technical-Whitepaper.pdf>, <http://www.vmware.com/products/vshield-app/features.html> and http://www.cisco.com/en/US/prod/collateral/switches/ps9441/ps9902/data_sheet_c78-492971.html

The Hyper-V Extensible Switch is open and extensible, unlike VMware's vSwitch, which is closed, and replaceable

VMware Comparison

Capability	Windows Server 2012 Hyper-V	vSphere Hypervisor	vSphere 5.1 Enterprise Plus
Dynamic Virtual Machine Queue	Yes	NetQueue ¹	NetQueue ¹
IPsec Task Offload	Yes	No	No
SR-IOV with Live Migration	Yes	No ²	No ²
Storage Encryption	Yes	No	No

¹ VMware vSphere and the vSphere Hypervisor support VMq only (NetQueue)

² VMware's SR-IOV implementation does not support vMotion, HA or Fault Tolerance. DirectPath I/O, whilst not

identical to SR-IOV, aims to provide virtual machines with more direct access to hardware devices, with network cards being a good example. Whilst on the surface, this will boost VM networking performance, and reduce the burden on host CPU cycles, in reality, there are a number of caveats in using DirectPath I/O:

- Very small Hardware Compatibility List
- No Memory Overcommit
- No vMotion (unless running *certain* configurations of Cisco UCS)
- No Fault Tolerance
- No Network I/O Control
- No VM Snapshots (unless running *certain* configurations of Cisco UCS)
- No Suspend/Resume (unless running *certain* configurations of Cisco UCS)
- No VMsafe/Endpoint Security support

SR-IOV also requires the vSphere Distributed Switch, meaning customers have to upgrade to the highest vSphere edition to take advantage of this capability. No such restrictions are imposed when using SR-IOV in Hyper-V, ensuring customers can combine the highest levels of performance with the flexibility they need for an agile infrastructure.

vSphere Hypervisor / vSphere 5.x Ent+ Information: http://www.vmware.com/pdf/Perf_Best_Practices_vSphere5.0.pdf

Unlike VMware, Hyper-V's SR-IOV support ensures the highest performance without sacrificing key features such as Live Migration

VMware Comparison

Capability	Windows Server 2012 Hyper-V	vSphere Hypervisor	vSphere 5.0 Enterprise Plus
VM Live Migration	Yes	No ¹	Yes ²
1GB Simultaneous Live Migrations	Unlimited ³	N/A	4
10GB Simultaneous Live Migrations	Unlimited ³	N/A	8
Live Storage Migration	Yes	No ⁴	Yes ⁵
Shared Nothing Live Migration	Yes	No	Yes ⁵
Network Virtualization	Yes	No	VXLAN ⁶

¹ Live Migration (vMotion) is unavailable in the vSphere Hypervisor – vSphere 5.1 required

² Live Migration (vMotion) and Shared Nothing Live Migration (Enhanced vMotion) is available in Essentials Plus & higher editions of vSphere 5.1

³ Within the technical capabilities of the networking hardware

⁴ Live Storage Migration (Storage vMotion) is unavailable in the vSphere Hypervisor

⁵ Live Storage Migration (Storage vMotion) is available in Standard, Enterprise & Enterprise Plus editions of vSphere 5.1

⁶ VXLAN is a feature of the vCloud Networking & Security Product, which is available at additional cost to vSphere 5.1. In addition, it requires the vSphere Distributed Switch, only available in vSphere 5.1 Enterprise Plus.

Only Hyper-V provides key VM migration features in the box, with no additional licensing costs

VMware Comparison

Capability	Windows Server 2012 Hyper-V	vSphere Hypervisor	vSphere 5.1 Enterprise Plus
Incremental Backups	Yes	No	Yes ¹
VM Replication	Yes	No	Yes ²
NIC Teaming	Yes	Yes	Yes
Integrated High Availability	Yes	No ³	Yes ⁴
Guest OS Application Monitoring	Yes	N/A	No ⁵
Failover Prioritization	Yes	N/A	Yes ⁶
Affinity & Anti-Affinity Rules	Yes	N/A	Yes ⁶
Cluster-Aware Updating	Yes	N/A	Yes ⁶

¹ VMware Data Protection is available in Essentials Plus and higher vSphere 5.1 editions

² vSphere Replication is available in Essentials Plus and higher vSphere 5.1 editions

³ vSphere Hypervisor has no high availability features built in – vSphere 5.1 is required.

⁴ VMware HA is built in to Essentials Plus and higher vSphere 5.1 editions

⁵ VMware have made APIs publicly available, but actual application monitoring is not included

⁶ Features available in all editions that have High Availability enabled.

Only Hyper-V provides Guest OS Application Monitoring in the box, with **no additional, expensive add-ons**

VMware Comparison

Capability	Windows Server 2012 Hyper-V	vSphere Hypervisor	vSphere 5.1 Enterprise Plus
Nodes per Cluster	64	N/A ¹	32
VMs per Cluster	8,000	N/A ¹	3000
Max Size Guest Cluster (iSCSI)	64 Nodes	16 Nodes ²	16 Nodes ²
Max Size Guest Cluster (Fiber)	64 Nodes	5 Nodes	5 Nodes
Max Size Guest Cluster (File Based)	64 Nodes	0 Nodes ³	0 Nodes ³
Guest Clustering with Live Migration Support	Yes	N/A ¹	No ⁴
Guest Clustering with Dynamic Memory Support	Yes	No ⁵	No ⁵

¹ High Availability/vMotion/Clustering is unavailable in the standalone vSphere Hypervisor

² Guest Clusters can be created on vSphere 5.1 using the in-guest iSCSI initiator to connect to the SAN, the same as would be configured in a physical cluster. Support of guest operating systems up to Windows Server 2008 R2 means 16 node clusters are the maximum size on vSphere 5.1

³ VMware does not support VM Guest Clustering using File Based Storage i.e. NFS

⁴ VMware does not support vMotion and Storage vMotion of a VM that is part of a Guest Cluster

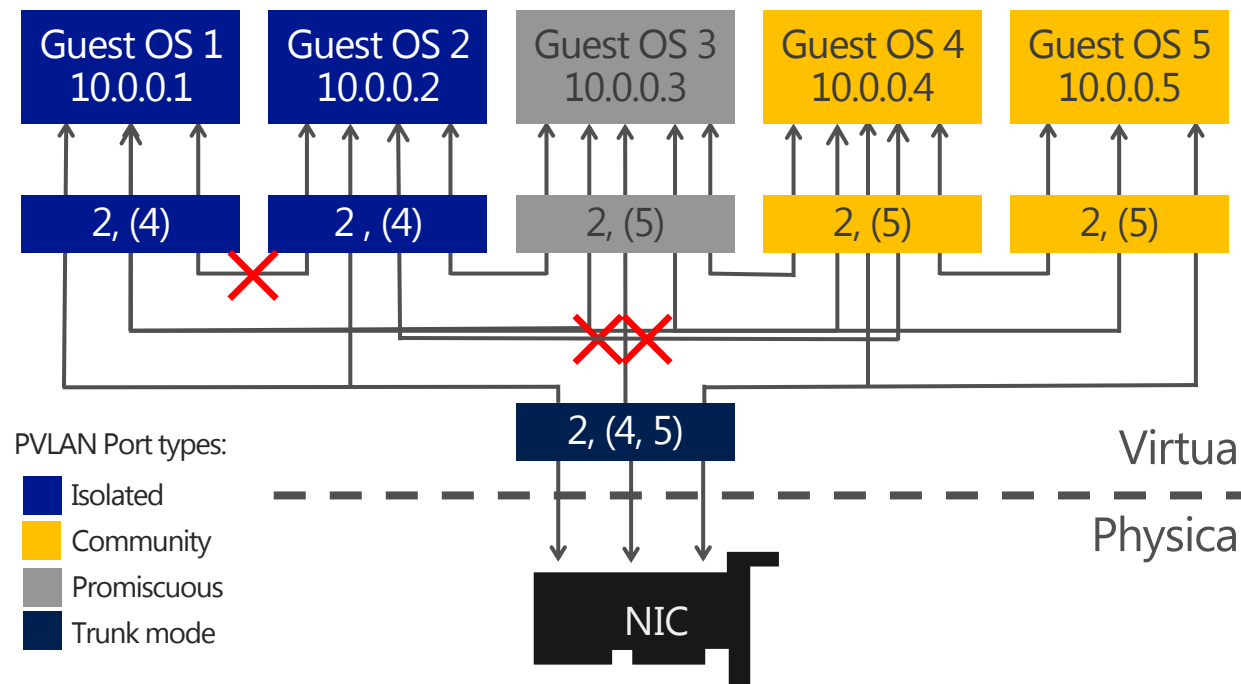
⁵ VMware does not support the use of Memory Overcommit with a VM that is part of a Guest Cluster

Hyper-V provides the **most flexible options** for guest-clustering, **without sacrificing agility & density**

Multitenant security and isolation

Private virtual LAN (PVLAN)

- Isolate some virtual machines from others in your datacenter
- Create community groups of virtual machines that can exchange data packets



Example PVLAN:

- Primary VLAN ID is 2
- Secondary VLAN IDs are 4 and 5

Scale beyond VLANs

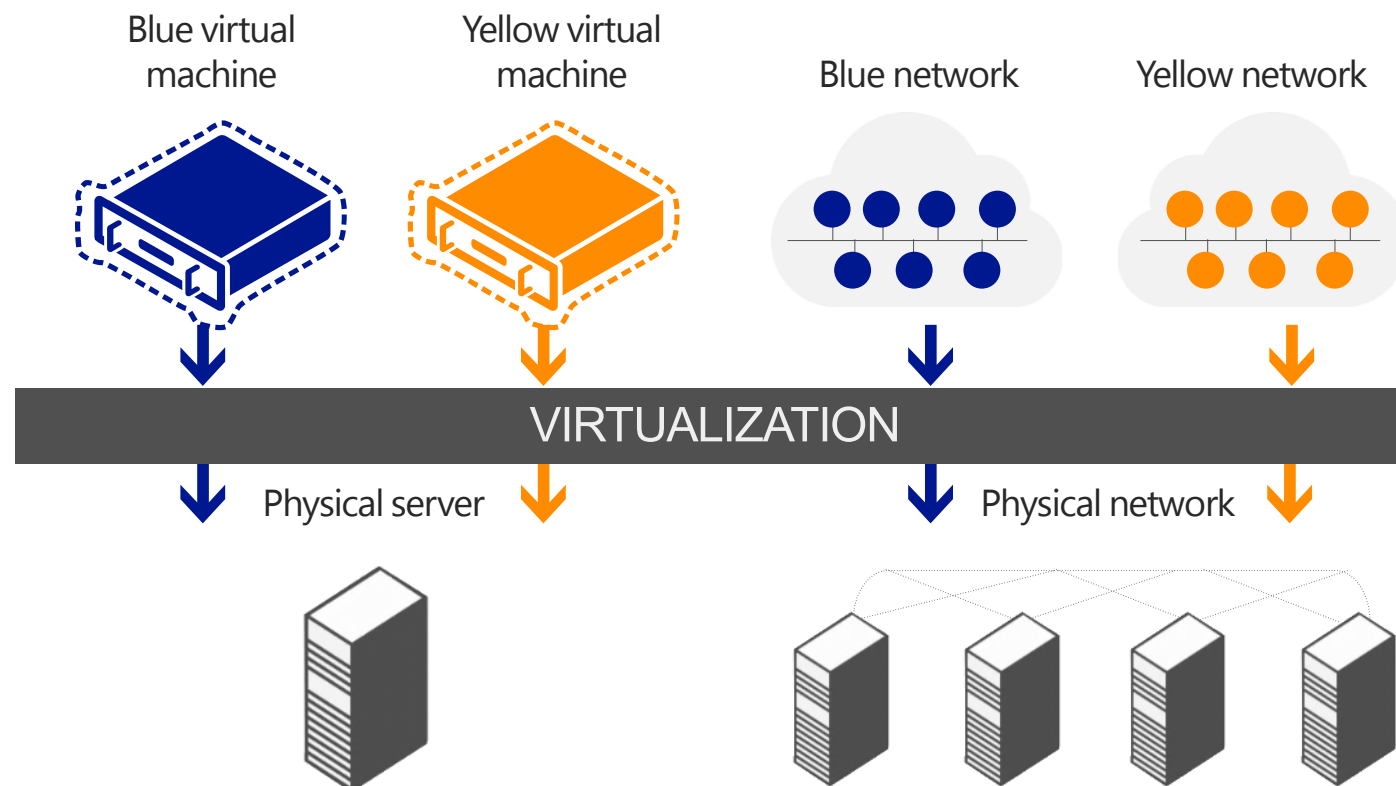
Hyper-V Network Virtualization

How network virtualization works

- Two IP addresses for each virtual machine
- General Routing Encapsulation (GRE)
- IP address rewrite
- Policy management server

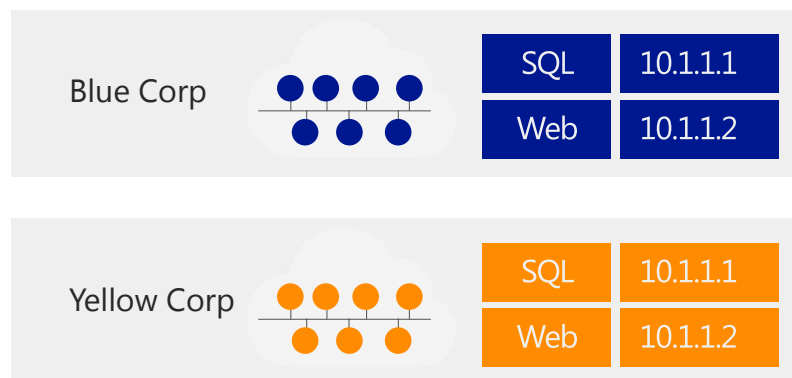
Problems solved

- Removes VLAN constraints
- Helps eliminate hierarchical IP address assignment for virtual machines



Hyper-V Network Virtualization

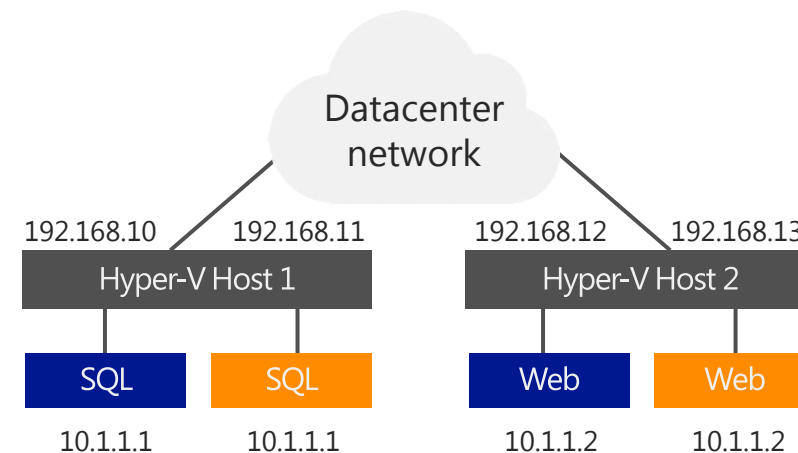
Example



Blue Corp	
Customer Address	Provider Address
10.1.1.1	192.168.1.10
10.1.1.2	192.168.1.12

Yellow Corp	
Customer Address	Provider Address
10.1.1.1	192.168.1.11
10.1.1.2	192.168.1.13

Policy settings



Customer address spaces

How IP address rewrite works

Maps each Customer Address (CA) to a unique Provider Address (PA)

Sends information in regular TCP/IP packets on the wire

Benefits

Requires no upgrade of network adapters, switches, or network appliances

Can be deployed today without sacrificing performance

Resource Metering

Features

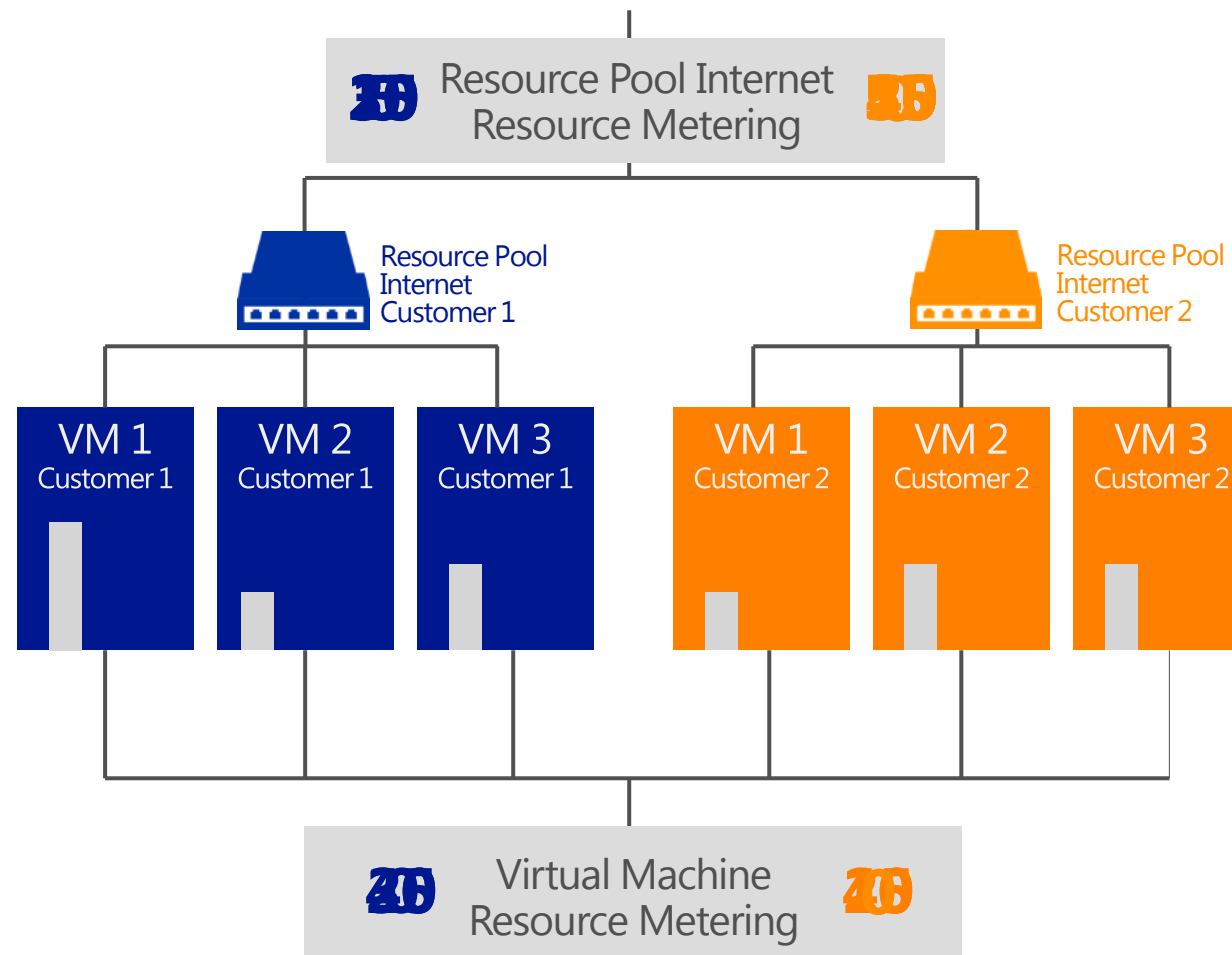
- Uses resource pools
- Compatible with all Hyper-V operations
- Unaffected by virtual machine movement
- Uses Network Metering Port ACLs

Benefits of Resource Metering

- Easier to track virtual machine use
- Can be used to aggregate data for multiple virtual machines
- Can be used to build accurate lookback and chargeback solutions
- Easier to obtain resource use data

Metrics

- Average CPU use
- Average memory use
- Minimum memory use
- Maximum memory use
- Maximum disk allocation
- Incoming network traffic
- Outgoing network traffic



A two-tenant environment built with
Hyper-V in Windows Server 2012

Microsoft[®]