

Configuration Maximums

vSphere 6.0

This document supports the version of each product listed and supports all subsequent versions until the document is replaced by a new edition. To check for more recent editions of this document, see <http://www.vmware.com/support/pubs>.

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Updated Information

This *Configuration Maximums* is updated with each release of the product or when necessary.

This table provides the update history of the *Configuration Maximums*.

| Revision | Description |
|--------------|---|
| EN-001717-04 | Included a note in “Networking Maximums,” on page 14. |
| EN-001717-03 | Updated the following: <ul style="list-style-type: none">■ Created a section for VMDirectPath maximums under ESXi Host Maximums and moved VMDirectPath values from Networking Maximums section.■ Updated VMDirectPath PCI/PCIe devices per virtual machine to 16. |
| EN-001717-02 | Structural change: Moved Storage DRS section under vCenter Server Maximums. |
| EN-001717-01 | Updated the following topics: <ul style="list-style-type: none">■ Included a new row on Non-vMotion provisioning operations per host and a footnote for Maximum number of subscribers per library in Chapter 4, “vCenter Server Maximums,” on page 17.■ Included a footnote for Maximum number of VMware Solutions in a vSphere Domain in Chapter 5, “Platform Services Controller,” on page 19.■ Included a new section on Graphics Maximums in GUID-C4649D4A-C493-4FCF-BD6E-D7FDD3CF7035#GUID-C4649D4A-C493-4FCF-BD6E-D7FDD3CF7035. |
| EN-001717-00 | Initial release. |

Introduction

When you select and configure your virtual and physical equipment, you must stay at or below the maximums supported by vSphere 6.0.

The limits presented in the following sections represent tested, recommended limits, and are fully supported by VMware.

- [Chapter 2, “Virtual Machine Maximums,”](#) on page 9
- [Chapter 3, “ESXi Host Maximums,”](#) on page 11
- [Chapter 4, “vCenter Server Maximums,”](#) on page 17
- [Chapter 5, “Platform Services Controller,”](#) on page 19
- [Chapter 6, “vCenter Server Extensions,”](#) on page 21
- [Chapter 7, “VMware vSphere Flash Read Cache,”](#) on page 23
- [Chapter 8, “VMware Virtual SAN,”](#) on page 25
- [Chapter 9, “Virtual Volumes,”](#) on page 27Virtual Volumes
- [Chapter 10, “Network I/O Control \(NIOC\),”](#) on page 29

The limits presented in the guide are applicable to ESXi host and vCenter Server. The limits can be affected by other factors, such as hardware dependencies. For more information about supported hardware, see the appropriate ESXi hardware compatibility guide. Consult individual solution limits to ensure that you do not exceed supported configurations for your environment.

Virtual Machine Maximums

The virtual machine maximums represent limits applicable to compute, memory, storage virtual adapters and devices, network virtual devices, virtual peripheral ports, and graphics video device.

Table 2-1. Virtual Machine Maximums

| Item | Maximum |
|--|---|
| Compute | |
| Virtual CPUs per virtual machine (Virtual SMP) | 128 |
| Memory | |
| RAM per virtual machine | 4 TB <i>The actual value supported is 4080 GB and not 4096 GB.</i> |
| Virtual machine swap file size | 4 TB <i>VMFS3 with 1MB block maximum swap size is 255 GB. Recommended solution is VMFS5, not VMFS3 with bigger block size.</i> |
| Storage Virtual Adapters and Devices | |
| Virtual SCSI adapters per virtual machine | 4 |
| Virtual SCSI targets per virtual SCSI adapter | 15 <i>Any combination of disk or VMDirectPath SCSI target.</i> |
| Virtual SCSI targets per virtual machine | 60 |
| Virtual disk size | 62 TB |
| IDE controllers per virtual machine | 1 <i>Supports two channels (primary and secondary) each with a master and slave device.</i> |
| IDE devices per virtual machine | 4 <i>Devices can be either CD-ROM or disk.</i> |
| Floppy controllers per virtual machine | 1 |
| Floppy devices per virtual machine | 2 <i>BIOS is configured for one floppy device.</i> |
| Virtual SATA adapters per virtual machine | 4 |
| Virtual SATA devices per virtual SATA adapter | 30 <i>Devices can be either CD-ROM or disk</i> |
| Networking Virtual Devices | |
| Virtual NICs per virtual machine | 10 <i>Any combination of supported virtual NICs.</i> |

Table 2-1. Virtual Machine Maximums (Continued)

| Item | Maximum |
|--|---|
| Virtual Peripheral Ports | |
| USB host controllers per virtual machine | 1 <i>USB 1.x, 2.x and 3.x supported. One USB host controller of each version 1.x, 2.x, or 3.x can be added at the same time.</i> |
| USB devices connected to a virtual machine | 20 <i>Guest operating systems might have lower limits than allowed by vSphere.</i> |
| Parallel ports per virtual machine | 3 |
| Serial ports per virtual machine | 32 |
| Miscellaneous | |
| Concurrent remote console connections to a virtual machine | 40 |
| Graphics video device | |
| Video memory per virtual machine | 512 MB |

ESXi Host Maximums

ESXi host maximums represents the maximums for compute, memory, storage, networking maximums, and cluster and resource pool.

This chapter includes the following topics:

- [“Compute Maximums,”](#) on page 11
- [“Memory Maximums,”](#) on page 12
- [“Storage Maximums,”](#) on page 12
- [“Networking Maximums,”](#) on page 14
- [“VMDirectPath Maximums,”](#) on page 15
- [“Cluster and Resource Pool Maximums,”](#) on page 15
- [“Using Maximum Values for More than One Configuration Option,”](#) on page 16

Compute Maximums

The ESXi host compute maximums represents the limits for host CPU, virtual machine, and fault tolerance.

Table 3-1. Compute Maximums

| Item | Maximum |
|----------------------------------|--|
| Host CPU maximums | |
| Logical CPUs per host | 480 |
| NUMA Nodes per host | 16 |
| Virtual machine maximums | |
| Virtual machines per host | 1024 |
| Virtual CPUs per host | 4096 |
| Virtual CPUs per core | 32 |
| | <i>The achievable number of vCPUs per core depends on the workload and specifics of the hardware. For more information, see the latest version of Performance Best Practices for VMware vSphere.</i> |
| Fault Tolerance maximums | |
| Virtual disks | 16 |
| Virtual CPUs per virtual machine | 4 |
| RAM per FT VM | 64 GB |

Table 3-1. Compute Maximums (Continued)

| Item | Maximum |
|---------------------------|---------|
| Virtual machines per host | 4 |
| Virtual CPU per host | 8 |

Memory Maximums

The ESXi host maximums represents the limits for ESXi host memory.

Table 3-2. ESXi Host Memory Maximums

| Item | Maximum |
|----------------------|--|
| RAM per host | 6 TB <i>12 TB is supported on specific OEM certified platform. See VMware Hardware Compatibility Limits for guidance on the platforms that support vSphere 6.0 with 12 TB of physical memory.</i> |
| Number of swap files | 1 per virtual machine |

Storage Maximums

The ESXi host storage maximums represents the limits for virtual disks, iSCSI physical, NAS, Fibre Channel, FCoE, Common VMFS, and VMFS5.

Table 3-3. Storage Maximums

| Item | Maximum |
|--|---------|
| Virtual Disks | |
| Virtual Disks per Host | 2048 |
| iSCSI Physical | |
| LUNs per server | 256 |
| Qlogic 1 Gb iSCSI HBA initiator ports per server | 4 |
| Broadcom 1 Gb iSCSI HBA initiator ports per server | 4 |
| Broadcom 10 Gb iSCSI HBA initiator ports per server | 4 |
| NICs that can be associated or port bound with the software iSCSI stack per server | 8 |
| Number of total paths on a server | 1024 |
| Number of paths to a LUN (software iSCSI and hardware iSCSI) | 8 |
| Qlogic iSCSI: dynamic targets per adapter port | 64 |
| Qlogic iSCSI: static targets per adapter port | 62 |
| Broadcom 1 Gb iSCSI HBA targets per adapter port | 64 |
| Broadcom 10 Gb iSCSI HBA targets per adapter port | 128 |

Table 3-3. Storage Maximums (Continued)

| Item | Maximum |
|--|--|
| Software iSCSI targets | 256 <i>The sum of static targets (manually assigned IP addresses) and dynamic targets (IP addresses assigned to discovered targets) may not exceed this number.</i> |
| NAS | |
| NFS mounts per host | 256 |
| Fibre Channel | |
| LUNs per host | 256 |
| LUN size | 64 TB |
| LUN ID | 1023 |
| Number of paths to a LUN | 32 |
| Number of total paths on a server | 1024 |
| Number of HBAs of any type | 8 |
| HBA ports | 16 |
| Targets per HBA | 256 |
| FCoE | |
| Software FCoE adapters | 4 |
| Common VMFS | |
| Volume size | 64 TB <i>For VMFS3 volumes with 1 MB block size, the maximum volume size is 50 TB.</i> |
| Volumes per host | 256 |
| Hosts per volume | 64 |
| Powered on virtual machines per VMFS volume | 2048 |
| Concurrent vMotion operations per VMFS volume | 128 |
| VMFS3 | |
| Raw device mapping size (virtual and physical) | 2 TB minus 512 bytes |
| Block size | 8 MB |
| File size (1 MB block size) | 256 GB |
| File size (2 MB block size) | 512 GB |
| File size (4 MB block size) | 1 TB |
| File size (8 MB block size) | 2 TB minus 512 bytes |
| Files per volume | Approximately 30,720 |
| VMFS5 | |
| Raw Device Mapping size (virtual compatibility) | 62 TB |
| Raw Device Mapping size (physical compatibility) | 64 TB |
| Block size | 1 MB <i>1MB is the default block size. Upgraded VMFS5 volumes inherit the VMFS3 block size value.</i> |

Table 3-3. Storage Maximums (Continued)

| Item | Maximum |
|------------------|-----------------------|
| File size | 62 TB |
| Files per volume | Approximately 130,690 |

Networking Maximums

Networking maximums represent achievable maximum configuration limits in networking environments where no other more restrictive limits apply (for example, vCenter Server limits, the limits imposed by features such as HA or DRS, and other configurations that might impose restrictions must be considered when deploying large scale systems).

NOTE For all NIC devices that are not listed in the table below, the maximum number of ports supported is 2.

Table 3-4. Networking Maximums

| Item | Maximum |
|---|---|
| Physical NICs | |
| e1000e 1 Gb Ethernet ports (Intel PCI-e) | 24 |
| igb 1 Gb Ethernet ports (Intel) | 16 |
| tg3 1 Gb Ethernet ports (Broadcom) | 16 <i>with NetQueue enabled</i> 32 <i>with NetQueue disabled</i> <i>NetQue is enabled by default in vSphere 6.0.</i> |
| bnx2 1 Gb Ethernet ports (QLogic) | 16 |
| nx_nic 10 Gb Ethernet ports (NetXen) | 8 |
| elxnet 10Gb Ethernet ports (Emulex) | 8 |
| ixgbe 10 Gb Ethernet ports (Intel) | 16 |
| bnx2x 10 Gb Ethernet ports (QLogic) | 8 |
| Infiniband ports (refer to VMware Community Support) | N/A <i>Mellanox Technologies InfiniBand HCA device drivers are available directly from Mellanox Technologies. Go to the Mellanox Web site for information about support status of InfiniBand HCAs with ESXi. http://www.mellanox.com .</i> |
| Combination of 10 Gb and 1Gb ethernet ports | Sixteen 10 Gb and four 1 Gb ports |
| nmlx4_en 40 GB Ethernet Ports (Mellanox) | 4 |
| VMDirectPath limits | |
| SR-IOV Number of 10 G pNICs | 8 |
| vSphere Standard and Distributed Switch | |
| Total virtual network switch ports per host (VDS and VSS ports) | 4096 |
| Maximum active ports per host (VDS and VSS) | 1016 |
| Virtual network switch creation ports per standard switch | 4088 |
| Port groups per standard switch | 512 |
| Static/Dynamic port groups per distributed switch | 10,000 |

Table 3-4. Networking Maximums (Continued)

| Item | Maximum |
|--|---------|
| Ephemeral port groups per distributed switch | 1016 |
| Ports per distributed switch | 60,000 |
| Distributed virtual network switch ports per vCenter | 60,000 |
| Static/dynamic port groups per vCenter | 10,000 |
| Ephemeral port groups per vCenter | 1016 |
| Distributed switches per vCenter | 128 |
| Distributed switches per host | 16 |
| VSS portgroups per host | 1000 |
| LACP - LAGs per host | 64 |
| LACP - uplink ports per LAG (Team) | 32 |
| Hosts per distributed switch | 1000 |
| NIOC resource pools per vDS | 64 |
| Link aggregation groups per vDS | 64 |

VMDirectPath Maximums

The ESXi host VMDirectPath maximums represent limits for VMDirectPath.

Table 3-5. VMDirectPath Maximums

| Item | Maximum |
|---|--|
| VMDirectPath PCI/PCIe devices per virtual machine | 16 |
| SR-IOV Number of virtual functions | 1024 <i>SR-IOV supports up to 43 virtual functions on supported Intel NICs and up to 64 virtual functions on supported Emulex NICs. The actual number of virtual functions available for passthrough depends on the number of interrupt vectors required by each of them and on the hardware configuration of the host. Each ESXi host has a limited number of interrupt vectors. When the host boots, devices on the host such as storage controllers, physical network adapters, and USB controllers consume a subset of the total number of vectors. Depending upon the number of vectors these devices consume, the maximum number of potentially supported VFs could be reduced.</i> |

Cluster and Resource Pool Maximums

The ESXi host cluster and resource pool maximums represent limits for cluster and resource pool.

Table 3-6. Compute Maximums

| Item | Maximum |
|--|---------|
| Cluster (all clusters including HA and DRS) | |
| Hosts per cluster | 64 |
| Virtual Machines per cluster | 8000 |
| Virtual machines per host | 1024 |

Table 3-6. Compute Maximums (Continued)

| Item | Maximum |
|--|---|
| Powered-on virtual machine config files per datastore in an HA cluster | 2048 <i>This limit does not apply to virtual disks. A virtual machine enabled with Fault Tolerance counts as two virtual machines.</i> |
| FT virtual machines per cluster | 98 |
| FT virtual machines vCPU per Cluster | 256 |
| Resource Pool | |
| Resource pools per host | 1600 |
| Children per resource pool | 1100 |
| Resource pool tree depth | 8 <i>Additional 4 resource pools are used by system internals.</i> |
| Resource pools per cluster | 1600 |

Using Maximum Values for More than One Configuration Option

If any one of the configuration options listed in the above tables is used at its maximum limit value, the ESXi host and vCenter Server with default configuration should be able to withstand the values.

If more than one configuration options (such as number of virtual machines, number of LUNs, and number of VDS ports) are used at their maximum limit, some of the processes running on the host might run out of memory. This might cause the host to keep disconnecting from the vCenter Server. In such a case, you need to increase the memory pool for these host processes so that the host can withstand the workload you are planning. You need to increase your memory pool size in correlation to the number of configuration options you are using at the maximum value.

vCenter Server Maximums

The vCenter Server maximums represents limits for vCenter Server scalability, user interface, concurrent operations, and vCenter Server Appliance.

Table 4-1. vCenter Server Maximums

| Item | Maximum |
|--|---------|
| vCenter Server Scalability | |
| Hosts per vCenter Server | 1000 |
| Powered-on virtual machines per vCenter Server | 10,000 |
| Registered virtual machines per vCenter Server | 15,000 |
| Linked vCenter Servers | 10 |
| Hosts in linked vCenter Servers | 4000 |
| Powered-on virtual machines in linked vCenter Servers | 30,000 |
| Registered virtual machines in linked vCenter Servers | 50,000 |
| Concurrent vSphere Web Clients connections to vCenter Server | 180 |
| Number of host per datacenter | 500 |
| MAC addresses per vCenter Server (using default VMware OUI) | 65,536 |
| User Interface | |
| USB devices connected per vSphere Client | 20 |
| Concurrent operations | |
| vMotion operations per host (1 Gb/s network) | 4 |
| vMotion operations per host (10 Gb/s network) | 8 |
| vMotion operations per datastore | 128 |
| Storage vMotion operations per host | 2 |
| Storage vMotion operations per datastore | 8 |
| Non-vMotion provisioning operations per host | 8 |
| vCenter Server Appliance | |
| Hosts (with embedded vPostgres database) | 1000 |
| Virtual machines (with embedded vPostgres database) | 15,000 |
| Hosts (with Oracle database) | 1000 |
| Virtual machines (with Oracle database) | 15,000 |

Table 4-1. vCenter Server Maximums (Continued)

| Item | Maximum |
|---|---|
| vCenter Server Windows embedded/packaged vPostgres | |
| Hosts (with embedded vPostgres database) | 20 |
| Virtual machines (with embedded vPostgres database) | 200 |
| Content Library | |
| Total CL items per VC (across all libraries) | 200 |
| Total number of libraries per VC | 20 |
| Total items per library | 200 |
| Maximum number of subscribers per library | 5 <i>This limit is applicable to libraries published by vCenter Server and not to third party libraries.</i> |
| Host Profile | |
| Hosts | 21 |
| Powered On virtual machines | 100 |
| Datastores | 120 |
| Profile Created | 1200 |
| Profile Attached | 1000 |

Storage DRS

Ensure that you configure storage DRS within the limits defined as storage DRS maximums.

Table 4-2. Storage DRS Maximums

| Item | Maximum |
|-------------------------------------|----------------|
| Virtual disks per datastore cluster | 9000 |
| Datastores per datastore cluster | 64 |
| Datastore clusters per vCenter | 256 |

Platform Services Controller

The Platform Services Controller maximums represent limits for domain or replication, identity source, enhanced linked mode or lookup service, and VMware Certificate Authority (VMCA).

Table 5-1. Platform Service Controller maximums

| Item | Maximum |
|--|---|
| Domain/Replication | |
| Maximum PSCs per vSphere Domain | 8 |
| Maximum PSCs per site, behind a load balancer | 4 |
| Maximum objects within a vSphere Domain (Users and Groups) | 1,000,000 |
| Maximum tolerance for time skew between PSC nodes | 5 minutes |
| Identity Source | |
| Maximum Active Directory or OpenLDAP Groups per User for best performance | 1015 |
| Enhanced Linked Mode/Lookup Service | |
| Maximum number of VMware Solutions connected to a single PSC | 4 <i>This limit is based on the test performed using only vCenter Server.</i> |
| Maximum number of VMware Solutions in a vSphere Domain | 10 <i>A VMware Solution is defined as a product that creates a Machine Account and one or more Solution User (a collection of vSphere services) within the VMware Directory Service when the product is joined to the PSC, thus the vSphere Domain. The Machine Account and Solution User(s) are used to broker and secure communication between other Solutions available within the vSphere environment. In order to count against these maximums, the Machine Account and Solution Users must be fully integrated with all of the PSC's available feature sets (Identity Management and Authentication Brokering, Certificate Management, Licensing, etc.) such that the product makes full use of the PSC. At this time, only vCenter Server is defined as a fully integrated solution and counts against these maximums. Partially integrated solutions, such as vCenter Site Recovery Manager, vCloud Director vRealize Orchestrator, vRealize Automation Center, and vRealize Operations, do not count against these defined maximums .</i> |
| VMCA/Certificate | |
| Maximum number of subordinate Certificate Authority servers in the chain within VMware Certificate Authority | 6 |

Table 5-1. Platform Service Controller maximums (Continued)

| Item | Maximum |
|---|----------------|
| Maximum cryptographic hash used for PSC Node certificate | 1 |
| Maximum RSA Public Key length used for PSC Node certificate | 16,384 |

vCenter Server Extensions

The vCenter Server Extensions represents limits for VMware vCenter Update Manager, VMware vCenter Orchestrator, and Storage DRS.

This chapter includes the following topics:

- [“VMware vCenter Update Manager,”](#) on page 21
- [“VMware vCenter Orchestrator,”](#) on page 22

VMware vCenter Update Manager

The VMware vCenter Update Manager maximums represent limits for concurrent operations.

Table 6-1. vCenter Update Manager Maximums

| Item | Maximum |
|---|---------|
| Concurrent Operations | |
| VMware Tools scan per ESXi host | 90 |
| VMware Tools upgrade per ESXi host | 24 |
| Virtual machine hardware scan per host | 90 |
| Virtual machine hardware upgrade per host | 24 |
| VMware Tools scan per VUM server | 90 |
| VMware Tools upgrade per VUM server | 75 |
| Virtual machine hardware scan per VUM server | 90 |
| Virtual machine hardware upgrade per VUM server | 75 |
| ESXi host scan per VUM server | 75 |
| ESXi host remediation per VUM server | 71 |
| ESXi host upgrade per VUM server | 71 |
| Cisco DVS update and deployment | 70 |

VMware vCenter Orchestrator

The VMware vCenter Orchestrator maximums represents limits for vCenter Server systems, ESXi instances, virtual machines and supported workflows.

Table 6-2. vCenter Orchestrator Maximums

| Item | Maximum |
|----------------------------------|--|
| Connected vCenter Server systems | 20 |
| Connected ESXi instances | 1280 |
| Connected virtual machines | 35,000 <i>15,000 per vCenter Orchestrator Cluster node.</i> |
| Concurrent running workflows | 300 |

VMware vSphere Flash Read Cache

Ensure that you configure VMware vSphere Flash Read Cache within the limits defined by flash read cache maximums.

Table 7-1. Flash Read Cache Maximums

| Item | Maximum |
|--|---------|
| Virtual flash resource per host | 1 |
| Maximum cache for each virtual disk | 400 GB |
| Cumulative cache configured per host (for all virtual disks) | 2 TB |
| Virtual disk size | 16 TB |
| Virtual host swap cache size | 4 TB |
| Flash devices per virtual flash resource | 8 |

VMware Virtual SAN

The VMware Virtual SAN maximums represents limits applicable for virtual SAN ESXi host, virtual SAN cluster, virtual SAN virtual machines, virtual SAN VM storage policy, and virtual networking.

Table 8-1. Virtual SAN Maximums.

| Item | Maximum |
|---|---|
| Virtual SAN ESXi host | |
| Virtual SAN disk groups per host | 5 |
| Magnetic disks per disk group | 7 |
| SSD disks per disk group | 1 |
| Spinning disks in all diskgroups per host | 35 |
| Components per Virtual SAN host | 9000 |
| Cache tier maximum devices per host | 5 |
| Capacity tier maximum devices per diskgroup | 7 |
| Capacity tier maximum devices | 35 |
| Virtual SAN Cluster | |
| Number of Virtual SAN hosts in a cluster | 64 |
| Number of datastores per cluster | 1 |
| Virtual SAN virtual machines | |
| Virtual machines per host | 200 |
| Virtual machines per cluster | 6400 |
| Virtual machine virtual disk size | 62 TB |
| Disk stripes per object | 12 |
| Percentage of flash read cache reservation | 100 |
| Failure to tolerate | 3 for VM virtual disk size <= 16 TB 1 for VM virtual disk size > 16 TB |
| Percentage of object space reservation | 100 |
| Virtual SAN networks/physical network fabrics | 2 |

Virtual Volumes

Ensure you configure the virtual volume size within the maximums defined.

Table 9-1. Virtual Volumes

| Item | Maximum |
|---|---|
| Data Virtual Volume Size | 62 TB |
| Number of Virtual Volumes bound to a host | 64,000 |
| Number of PEs per host | 256 |
| Storage Container size | 2 ⁶⁴ |
| Storage Container per host | 256 |
| Maximum outstanding PE I/O operations | 128 <i>The outstanding PE I/O operations is configurable up to 4096.</i> |
| Configured VPs per host | 128 |
| Maximum configured VVol managed storage arrays per host | 64 |

Network I/O Control (NIOC)

Ensure you configure VMware vSphere Network I/O Control within the maximums defined.

Table 10-1. NIOC

| Item | Maximum |
|----------------------------|--|
| Number of resource pools | 10000 |
| Number of uplinks per vds | 32 |
| Number of uplinks per host | 32 |
| Number of vNIC per host | 5120 |
| Max pNIC bandwidth | Approximately 10 Gbits/sec <i>for 10G pNIC</i> Approximately 1 Gbits/sec <i>for 1G pNIC</i> |

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