# Availability ( FT & MSCS)

**Maximums (FT advice)**: Disks per VM =16 FT VMs per host = 4 Minimum hosts per cluster = 3

| FW Port | Source | Destination | Prot (ESX port) | Description |
|---|---|---|---|---|
| 8100, 8200 | Hosts | ESX/ESXi | UDP (SC) | FT |
| 8100, 8200 (out) | ESX/ESXi | Hosts | TCP/UDP(SC) | FT |

**FT** uses anti-affinity rules. Requires - HA & host monitoring, host certificate checking (on by default), dedicated logging NIC, compatible CPU, Hardware Virtualization (HV), thick disks on shared storage, supported guest OS. Not supported - snapshots, storage VMotion, DRS features, hotplugging, MSCS, VCB, SMP, physical RDMs, Paravirtualized VMs, NPIV, VMDirectPath, EPT/RVI.

**MSCS** • Win 2000 SP4, 2003 SP2 & 2008 (Failover Clustering) • 32 & 64bit • only 2 nodes clusters Not supported - DRS or HA cluster, VMotion, FT, NPIV, Round Robin NMP, iSCSI/NFS based disks

| | VMDK | Virtual RDM | Physical RDM |
|---|---|---|---|
| Cluster in a box (CIB) | **Yes** (zeroed) | Yes | No (not supported) |
| Cluster across boxes (CAB) | No | Yes - not Win2008, not CCR | **Yes** (recommended) |
| Physical & VM (n+1) | No | No | **Yes** |
| Snapshots | **Yes** | **Yes** | No |
| SCSI target software | No | No | **Yes** |

• Configure all RDMs before configuring VM's network settings, or initialising LUNs within windows.
• Add all RDMs to a 2nd SCSI controller i.e. SCSI(1:x). Set sharing to Physical or Virtual as required. SCSI bus sharing • CIB = Virtual • CAB or N+1 = Physical

**Links**: http://kb.vmware.com/kb/1010601 - Understanding FT
http://kb.vmware.com/kb/1008027 - CPU & guest OS that support FT
http://kb.vmware.com/kb/1010550 - vCenter server in a MSCS

# Networking

**Maximums (per host)**: 1GB VMNICs = 2 - 32 dependent on HW (e1000/e=32) 10GB VMNICs = 4
PCI VMDirectPath devices = 8 vSS switches = 248 vSwitch ports (vSS or vDS) = 4,096
Service Console ports = 16 VMotion (VMkernel) ports = 1 IP storage (VMkernel) ports = 1
**Maximums (per vCenter)**: vDS switches = 16 vDS port groups = 512 vDS switch ports = 6,000
**Maximums (per switch)**: Hosts (per vDS) = 64 vSS port groups = 512 vSS switch ports = 4,088

**VMNIC**s - logical names for physical NICs on server, **vNICs** - virtual NICs assigned to VMs.
**vSS** - virtual Standard Switch, **vDS** - virtual Distributed Switch, **vdPort** - port group on a vDS

**Common networking commands** (`-h` switch for options or man page for detailed description):

| | |
|---|---|
| List VMNICs: | `$ sudo /usr/sbin/esxcfg-nics -l` |
| List vSwitches & Port Groups: | `$ sudo /usr/sbin/esxcfg-vswitch -l` |
| List Service Console ports: | `$ sudo /usr/sbin/esxcfg-vswif -l` |
| List VMkernel ports: | `$ sudo /usr/sbin/esxcfg-vmknic -l` |
| List VMkernel Default Gateway: | `$ sudo /usr/sbin/esxcfg-route` |

**Common networking configuration files**: Name resolution order: /etc/nsswitch.conf
Local host file: /etc/hosts DNS servers: /etc/resolv.conf DG: /etc/sysconfig/network

**Ethernet tagging**: • EST (External Switch Tagging) - Default. No trunking required. 1-1 relationship from VMNICs to physical switch ports. Each VMNIC can only see 1 subnet. VLAN ID of 0 or blank.
• VST (Virtual Switch Tagging) - Commonly used. VMNICs connected to a vSwitch can span several VLANs. Each Port Group has a VLAN ID of 1-4094. Set the VLAN ID to blank to use Native VLAN.
• VGT (Virtual Guest Tagging) - Rarely used. Install 802.1Q trunking driver software in the VMs, & the vSwitch preserve the tags given by the VMs. VLAN ID of 4095 on vSS, VLAN policy on vDS. Avoid using a **VLAN ID of 1**, as this is the native Cisco VLAN ID.

**vSS & vDS options** (options can also be overridden on individual Port Groups):
**General** • Number of ports - by default 56 for vSS, 64 for vDS, 128 when created on Sevice Console. (not a Port Group option) • Network label & VLAN ID - only on Port Groups not vSwitches.
**Security** • Promiscuous mode (default Reject) - only listens to traffic destined for its MAC address.
• MAC Address Changes (default Accept) - accepts inbound frames when VM changes MAC address.
• Forged Transmits (default Accept) - won't drops outbound frames if source MAC address is different.
**Traffic Shaping** • Status (default Disabled) Average Bandwidth (default 102400 Kbps) Peak Bandwidth (default 102400 Kbps) Burst size (default 102400 KB) - shapes out on vSS, in/out on vDS.
**NIC Teaming** • Load Balancing (spreads outbound traffic from vNICs across VMNICs) - Originating port ID (default) uses VMNIC based on where traffic entered - ip hash based on source & destination IP address of each packet. Use when physical switch ports are etherchannel - Source MAC hash based on source MAC address - Use explicit failover order. Incoming traffic is load balanced by physical switch.
• Network Failover Detection Link status only (default) detects cable pulls & switch power failures, not misconfigurations. Beacon Probing don't use with IP-hash load balancing.
• Notify Switches - No or Yes (default) updates lookup tables. Disable for MS NLB in unicast mode.
• Failback - No or Yes (default) VMNIC will return after recovering from a failure.
• Failover order Active - Standby - Unused. Don't use standby uplinks with IP-hash load balancing.
**VLAN** (vDS only) • VLAN - Trunk range - Private VLAN. Join private VLAN to physical VLANs.
**Miscellaneous** (vDS only) • Port blocking - selected or unselected (default) block all ports.

**dvPort options**: • Port Binding Static when initially connected Dynamic when connected/powered-on Ephemeral no binding • Traffic shaping Ingress vNIC to vSwitch Egress vSwitch to vNIC • Allow live port moving • Config reset at disconnect • Host can assign port if vCenter is down • Name format

**TSO** (TCP Segmentation Offload): enabled by default on VMkernel ports, allows very large frames (up to 64KB), even with smaller MTU. To enable on VMs, they need enhanced vmxnet vNIC.
**Jumbo frames** up to 9kB. Must be enabled for each vSwitch. VMs need enhanced vmxnet to use it.
**NetQueue** enabled by default, allows certain VMNICs to spread processing across multiple CPUs.

**Configure networking**: (1) add a vSwitch `esxcfg-vswitch -a` (2) add a port group to the vSwitch `esxcfg-vswitch -A` (3) set the port group's VLAN ID `esxcfg-vswitch -p -v` (4) add the VMNIC to the vSwitch `esxcfg-vswitch -L`
• VM connections: set the VM's NIC to use the port group.
• Service Console: create interface & add it to the port group `esxcfg-vswif -a -p -i -n`, set the DG in /etc/sysconfig/network, then restart networking `service network restart`.
• VMkernel ports: add the port `esxcfg-vmknic -a -i -n` & set the VMkernel DG `esxcfg-route`. VMotion should be be enabled in VC if required.

**Links**: http://kb.vmware.com/kb/1010812 - Configure IPv6
http://vmware.com/files/pdf/vsphere-vnetwork-ds-migration-configuration-wp.pdf - vDS whitepaper

# Resources

**Maximums (per DRS cluster)**: Hosts = 32 VMs (powered on) = 1280 (limit of 256 per host)
**Maximums (per Resource Pool)**: Children = 1024 Tree depth = 12 (10 when in a DRS cluster)
**Maximums (other)**: Datacenters per host = 100 RPs per host = 4096 RPs per cluster = 512

**Datacenters** mark organisational & VMotion boundaries. **Clusters** gather host CPU & memory resources. **Resource Pools** apply policies to clusters. A DRS cluster is also implicitly a resource pool.
**Resource pools**: • Shares - low, medium & high (1,2,4) • Reservations - MHz(CPU)/MB(RAM) • Limits - MHz/MB • Expandable reservation - yes (can draw from parent's pool) - no (can only draw from own pool). List the resource group settings: `$ sudo /usr/sbin/esxcfg-resgrp -l`
Shares only apply during contention. Shares are relative to siblings. Reservations guarantee a minimum, are only checked when a VM is powered on. Limits are an upper bound, never exceeded; manage user expectations but can waste idle resources. Expandable reservations do not automatically hunt upwards, define if reservations are considered by admission control. Child pools actively reserve resources from parent even if VMs are powered off. Hierarchical resource pools require DRS enabled.

**DRS** has 5 priority levels 1-5 (1 the highest). DRS cluster settings: • Manual • Partial (Initial VM placement) • Fully Automated (Initial VM placement & Dynamic balancing)
"**Grafted from**" pools created when adding a host to a DRS cluster & keeping the host's resource pool hierarchy. **Maintenance mode** only clears VMs off host if DRS cluster is fully automated.
**Affinity Rules** keep VMs together or apart in a DRS cluster. Anti-affinity rule limited to 2. Rule conflicts - older wins, newer rule disabled. Anti-affinity wins over affinity. Disabled rules ignored.

**DPM** uses IPMI, iLO or WOL (in that order). DRS & DPM thresholds are independent. Verify host's DPM Last Time Exited Standby. DPM level - Off, Manual (makes recommendations) & Automatic.
Hosts reclaim memory from VMs by: • Balloon driver (vmmemctl) force guest to use native algorithms (guest swap) • VM Swap files (if vmmemctl not available/responsive) • Sharing memory across VMs

**Links**: http://kb.vmware.com/kb/1005764 - Enhanced VMotion (EVC) FAQ
http://kb.vmware.com/kb/1003212 - EVC CPU compatibility

# Storage

**Maximums (per host)**: Volumes = 256 Paths = 1024 NAS datastores = 8 (32 with adv settings)
FC - HBAs = 8 (HBA ports = 16) targets per HBA = 256 paths to each LUN = 16
iSCSI HW - HBAs = 4 targets per HBA = 64 Dynamic (61 Static) paths to each LUN = 8
iSCSI SW - NICs = 8 targets = 256 paths to each LUN = 8
**Maximums (per volume)**: VMs = 256 Hosts = 64 (DRS limit, 2048 for linked clones)
Volume size = 64TB (NFS=16TB) File size (1/2/4/8MB block size) = 256GB/512GB/1TB/2TB
RDMs = 2TB (less 512B) Extents = 32 Extent size = 2TB (less 512B)

| FW Port | Source | Destination | Prot (ESX port) | Description |
|---|---|---|---|---|
| 2049 | NFS server | ESX/ESXi | TCP (VMK) | NFS Client |
| 2049 (out) | ESX/ESXi | NFS server | TCP (VMK) | NFS Client |
| 3260 (out) | ESX/ESXi | iSCSI server | UDP (SC+VMK) | iSCSI Client |

**Common storage commands** (`-h` switch for options, or man page for detailed description):

| | |
|---|---|
| List all storage devices: | `$ sudo /usr/sbin/esxcfg-scsidevs -c` |
| List LUNs, paths & multipathing plugins: | `$ sudo /usr/sbin/esxcfg-mpath -L` |
| List all VMware SATPs: | `$ sudo /usr/sbin/esxcli nmp satp list` |
| List claim rules: | `$ sudo /usr/sbin/esxcli corestorage claimrule list` |
| Lists datastores, dev names to VMFS: | `$ sudo /usr/sbin/esxcfg-scsidevs -m` |
| List snapshot volumes: | `$ sudo /usr/sbin/esxcfg-volume -l` |
| Test VMkernel connectivity: | `$ /usr/sbin/vmkping` |
| Manage HW iSCSI (Qlogic) settings: | `$ sudo /usr/sbin/esxcfg-hwiscsi -l` |
| Manage SW iSCSI settings: | `$ sudo /usr/sbin/esxcfg-swiscsi -q` |
| List iSCSI LUNs: | `$ sudo /usr/sbin/vmkiscsi-tool -L -l` *adapter* |
| Rescan iSCSI LUNs: | `$ sudo /usr/sbin/esxcfg-rescan` *adapter* |
| List the NFS exports from the VMkernel: | `$ sudo /usr/sbin/esxcfg-nas -l` |

| Storage capabilities | FC | iSCSI | NAS |
|---|---|---|---|
| VMotion, DRS, HA, FT, VCB, SRM & Thin VMDKs | Yes | Yes | Yes |
| VMFS volumes, RDMs & VMware's NMP | Yes | Yes | **No** |
| Boot ESX host | Yes | Yes (HW initiator) | **No** |
| VM MSCS clustering | Yes | **No** | **No** |

**Zoning**: at the switch. **LUN masking**: done at the SP or server.
**Active-active**: access to the LUNs similtanously through all ports, without performance degradation.
**Active-passive**: one port actively providing access, other as backup. Path thrashing can occur.
**NPIV** (N-Port ID Virtualization): FC HBA port assigns dedicated virtual port (WWPN) to VM (RDM)
**LUN addressing** FC: Runtime Name vmhba#:C#:T#:L# - adapter:channel:target:LUN
iSCSI: IQN iqn.*year-mo.reversed_domain_name:string* or EUI eui.*string*
**iSCSI discovery methods**: Static - can manually add/remove items, only with hardware initiators.
Dynamic - uses "SendTargets", target responds with list. Removed targets return after HBA rescan/reset
**CHAP**: HW iSCSI 1-way CHAP, initiator level. SW iSCSI 1-way & mutual CHAP, initiator or target
VMkernel Port is required to use iSCSI or NFS storage. (S.C. port not required for iSCSI anymore)
**MPP** (MultiPathing Plugins): claim rules in /etc/vmware/esx.conf specify MPP to use for each path.
**Claim rules**: indicate which MPP, native or 3rd party, manages a given physical path.
**NMP** (Native MPP): includes SATPs (Storage Array Type Plugins) & PSPs (Path Selection Plugins)
**NMP policies**: Fixed - default for active/active, uses preferred path when available
MRU (Most Recently Used) - default for active/passive (& iSCSI), first working path found at boot
RR (Round Robin) - safe for all arrays - load balances by rotating through paths (not for MSCS LUNs)
**Disk.MaxLUN**: reduce number of LUNs scanned. **Disk.MaskLUN**: convert to claim rule format.
**VMFS volumes**: Large=less LUNs to create, less to manage, flexible resizing & snapshots. Small=less contention (locking), less wasted space, different RAIDs, more flexible multipathing & disk shares.

**Links:** http://kb.vmware.com/kb/1003659 - Troubleshooting shared storage issues (ESX3)
http://kb.vmware.com/kb/1009553 - Lost connectivity to storage
http://media.netapp.com/documents/tr-3749.pdf - Storage best practices whitepaper (NetApp)
http://media.netapp.com/documents/tr-3747.pdf - File System alignment whitepaper (NetApp)

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# vReference.com
# vSphere 4.0

by **Forbes Guthrie** Version 1.0 for v4.0

# ESX Install

**HW requirements**: • 64-bit x86 CPUs • 2GB RAM minimum • see HCL (link below)
**IPv6** is not supported. **Installation log**: /var/log/esx_install.log
**Evaluation period** (60 days) starts on first power-on even if host is licensed. Install **boot options**: `F2`.
Install **Media Depot** can be accessed via HTTP/ HTTPS, FTP, or NFS - `askmedia` boot option.
**PXE Boot** the install: (1) Install TFTP server software (2) Put menu.c32 file in accessible place (3) Install PXELINUX (4) Configure DHCP server (5) Copy vmlinuz & initrd.img from /isolinux on DVD (6) Create /tftpboot/pxelinux.cfg on TFTP server.
**Install script** can be: Default script (on DVD), FTP, HTTP/HTTPS, NFS, USB flash drive, local disk.
**Default install scripts**: • ks-first.cfg installs on 1st disk • ks-first-safe.cfg same but keeps VMFS. Root password is "mypassword". Interactive install creates /root/ks.cfg from choices made.
**Physical partitions**: • /boot, vmkcore & /vmfs • **esxconsole.vmdk**: /, swap, /var/log, & optional ones. Size of /boot, vmkcore & VMFS cannot be defined/changed during Interactive install (can in Scripted). Disconnect Fibre Channel connections prior to installation.

| Mount point | Format | Default | Location |
|---|---|---|---|
| /boot | ext3 | 1100MB | Primary physical partition |
| | vmkcore | 110MB | Primary physical partition |
| /vmfs | vmfs3 | fill remaining 1st disk | Logical physical partition |
| / | ext3 | 5GB (if /usr in own partition, may be larger) | esxconsole.vmdk file |
| | swap | 1200MB default (max 1600MB) | esxconsole.vmdk file |
| /home | ext3 | optional - recommended 512MB | esxconsole.vmdk file |
| /tmp | ext3 | optional - recommended 1024MB | esxconsole.vmdk file |
| /usr | ext3 | optional - no recommendation | esxconsole.vmdk file |
| /var/log | ext3 | optional - recommended 2000MB | esxconsole.vmdk file |

vReference recommends: /home, /opt, /tmp - min 2GB each, /var (no /var/log) - 5GB, swap - 1600MB

**Post install tasks**: • Reconnect FC connections.
• Create user account & add to sudoer file (`visudo` - add to "user privilege specification").
• Test cables are in correct VMNICs: `$ watch -n 1 'sudo /usr/sbin/esxcfg-nics -l'`
• Rearrange VMNICs in /etc/vmware/esx.conf if required (reboot required).
• Adjust Service Console memory to 800MB (reboot required).
• Configure NTP (time) settings.
• Patch (see ESX Hosts section).
• Connect vSphere Client to host (not VC) & add extra users (the sudo users) to Administrators group.
• Configure vSwitches.
• Configure storage (& set DiskMaxLUN as required).
• Connect vSphere Client to VC, add new host, move to required cluster.
• License host.
• Enable Web access if required.

**Upgrade** from ESX3: • VUM (vCenter Update Manager) - upgrades ESX & ESXi (see VUM section)
• Host Update Utility - upgrades ESX & ESXi (& updates ESXi), small environments (< 10 hosts, no VUM). Customize in %PROGRAMFILES%\VMware\Infrastructure\VIUpdate 4.0\settings.config
• `esxupgrade.sh` script http://kb.vmware.com/kb/1009440 - upgrades ESX only.
• Updates only (not upgrades): `vihostupdate` updates ESX & ESXi, `esxupdate` updates ESX.
**Upgrade logs**: /esx3-installation/esx4-upgrade/ & /var/log/vmware/
Unsuccessful upgrades: /esx4-upgrade/ & /var/log/vmware/
**Post upgrade**: • Upgrade VMware Tools before upgrading virtual hardware.
• Convert LUN masking to claim rule format: `esxcli corestorage claimrule convert`
• Successful upgrade: `cleanup-esx3` removes ESX3 boot options & ability to roll back.

**Links**: http://www.vmware.com/resources/compatibility/search.php - Hardware Compatibility Guide
http://kb.vmware.com/kb/1009080 - Installing ESX 4.0 & vCenter 4.0 best practices
http://kb.vmware.com/kb/1009039 - Upgrading to ESX 4.0 & vCenter 4.0 best practices
http://kb.vmware.com/kb/1010675 - Upgrading an ESX 3.x VM to ESX 4.0
http://kb.vmware.com/kb/1011712 - See if Intel VT or AMD-V is BIOS enabled without rebooting

# Clients

**SW requirements**; vSphere Client: Windows with .NET 3.0 SP1 framework. Web Access: Win - 2003 SP1, XP pro SP3, XP home SP2, 2000 SP4, Linux - GTK+ 2. Browsers - IE6, 7 or +, Firefox 2, 3 or +

| FW Port | Source | Destination | Protocol | Description |
|---|---|---|---|---|
| 22 | SSH client, WebAccess | ESX | TCP | SSH access |
| 80 | WebAccess | ESX, VC | TCP | Redirect to HTTPS |
| 427 | Clients, Web Access | ESX/ESXi | TCP | CIM SLP client |
| 443 | Clients, Web Access | ESX/ESXi, VC | TCP | HTTPS |
| 902 | Clients, Web Access | ESX/ESXi | TCP | Authentication |
| 903 | Clients, Web Access | ESX/ESXi | TCP | VM Console |
| 5989 | Clients, Web Access | ESX/ESXi | TCP | CIM transactions |

**Logs**: Client Agent log /var/log/vmware/vpx/vpxa.log Client Install log %TEMP%\vmmsi.log
Client Service log C:\Docs and Settings*username*\Local Settings\App Data\vpx\viclient-x.log (x=0-9)
Web Access to ESX or VC: https://hostname.domain.com/ui • ESXi - no WebAccess • ESX - disabled
Web Access status check: `$ sudo /sbin/service vmware-webAccess status`
Web Access Remote Console URLs: • Limit view to remote console - hides details like event logs • Limit view to single VM - disables inventory navigation. Permission to VMs still granted in ESX or VC
Web Access alarms tab available connected to VC (not ESX). Web Access allows only viewing tasks.

# ESX Hosts

**Maximums (per host)**: vCPUs = 512 vCPUs per physical core = 20 Logical procs (incl HT) = 64
RAM = 1TB Service Console RAM = 800MB (min=400?, default=600) VMs = 320 (HA can limit)

| FW Port | Source | Destination | Prot (ESX port) | Description |
|---|---|---|---|---|
| 22 | SSH client | ESX | TCP (SC) | SSH server |
| 53 (out) | ESX/ESXi | DNS server(s) | UDP (SC) | DNS requests |
| 80 | Clients | ESX/ESXi | TCP (SC) | HTTP access |
| 123 (out) | ESX/ESXi | NTP source | UDP (SC) | NTP (time) client |
| 427 | Hosts, Client | ESX/ESXi | UDP (SC) | CIM SLP client/server |
| 427 (out) | ESX/ESXi | Hosts | UDP (SC) | CIM SLP client/server |
| 443 | Hosts, Clients, VC | ESX/ESXi | TCP (SC) | HTTPS access |
| 902 | Hosts, Clients, VC | ESX/ESXi | TCP (SC) | Auth, migrate, provision |
| 902 (out) | ESX/ESXi | Hosts, VC | UDP (SC) | Auth, migrate, provision |
| 903 | Clients | ESX/ESXi | TCP (SC) | VM Console |
| 5900-5964 | ? | ESX/ESXi | TCP (SC) | RFB for mgt tools (VNC) |
| 5900-5964 (out) | Hosts | ? | TCP (SC) | RFB for mgt tools (VNC) |
| 5989 | Clients | ESX/ESXi | TCP (SC) | CIM server over HTTPS |
| 5989 (out) | ESX/ESXi | Hosts | TCP (SC) | CIM server over HTTPS |
| 8000 | Hosts | ESX/ESXi | TCP (VMK) | VMotion requests |
| 8000 (out) | ESX/ESXi | Hosts | TCP (VMK) | VMotion requests |

Possible extras:21(FTP),22out(SSH),53(DNS),88/389/464(AD),161/162(SNMP),445(SMB),5988(CIM)

**Logs**: Service Console Availability & VMkernel Messages, Alerts, Availability: /var/log/vmkernel
ESX service log: /var/log/vmware/hostd.log Syslog: /var/log/messages
VMkernel warnings: /var/log/vmkwarning VMkernel events: /var/log/vmksummary
VC agent: /var/log/vmware/vpx/vpxa.log Patching: /var/log/vmware/esxupdate.log

**Common ESX host commands** (`-h` switch for options or man page for detailed description):
List status of all services: `$ sudo /sbin/service --status-all`
List the service runlevels: `$ chkconfig --list`
Restart a service: `$ sudo /sbin/service` *service_name* `restart` (start, stop, status available)
Common services: `mgmt-vmware` (hostd) • `vmware-vpxa` (vCenter agent) • `vmware-vmkauthd` (authentication) • `network` (vswif changes) • `vmware-webAccess` (Web Access)
Show build number: `$ vmware -l`
Check the filesystem usage: `$ sudo vdf -h`
List diagnostic partitions: `$ sudo /usr/sbin/esxcfg-dumpart -l`
Show description of VMkernel error: `$ vmkerrcode` *error_code_number*
Export detailed config file: `$ sudo esxcfg-info > /tmp/esxcfg-info.txt`
Gather debugging report: `$ sudo /usr/bin/vm-support -w /tmp`
Configure authentication settings: `$ sudo /usr/sbin/esxcfg-auth`
Lists drivers loaded at startup: `$ sudo /usr/sbin/esxcfg-module -l`
Set advanced options: `$ sudo /usr/sbin/esxcfg-advcfg option -s` *value* (`-g` to get)
Update bootstrap settings: `$ sudo /usr/sbin/esxcfg-boot` (treat with caution)
Initialization routines (resets things): `$ sudo /usr/sbin/esxcfg-init` (treat with caution)
**Internal firewall commands** (iptables on Service Console):
Show all firewall settings: `$ sudo /usr/sbin/esxcfg-firewall -q`
List the firewall named services: `$ sudo /usr/sbin/esxcfg-firewall -s`
Enable a service: `$ sudo /usr/sbin/esxcfg-firewall -e` *service_name* (`-d` to disable)
To open a port: `$ sudo /usr/sbin/esxcfg-firewall -o` *port, protocol, direction, name*
By default all traffic blocked in & out, except 22, 123, 427, 443, 902, 5989, 5988, pings, DHCP & DNS

**Master config file**: /etc/vmware/esx.conf. **Certificate files**: hostd regenerates new files if not present
Certificate public key /etc/vmware/ssl/rui.crt Certificate private key /etc/vmware/ssl/rui.key
Set certificate location /etc/vmware/hostd/proxy.xml SSL settings /etc/vmware/hostd/config.xml
**PAM** (Pluggable Authentication Modules) configuration: /etc/pam.d/vmware-authd
Default authentication method is /etc/passwd. vpxuser is for vCenter Server permissions.
**Passwords**: ESX uses pam_cracklib.so plug-in by default. No restrictions on root password. Defaults for non-root users: password retries = 3, minimum password length = 9, shorter passwords if Characters Classes mixed (upper, lower, digits & other) M – CC = E. pam_passwdqc.so provides more options.
**User Password Aging**: enabled by default, set to never expire (max days) & change anytime (min days = 0, warning = 7) • Change host settings `esxcfg-auth` • Change user settings `chage`
**NUMA** (Non-Uniform Memory Access): controls VM memory distribution across host memory. Only use NUMA if CPU affinity is set. HT can help better utilize idle resources.
**VMware MIBs**: • uses embedded SNMP agent (disabled by default). Enable: `vicfg-snmp`
**syslogd**: to configure • ESX - edit /etc/syslog.conf • ESXi - use Client or `vicfg-syslog`

**Links**: http://kb.vmware.com/kb/653 - Collecting diagnostic information for ESX Servers
http://kb.vmware.com/kb/1010821 - Changing the name of an ESX host (ESX 3.x)
http://kb.vmware.com/kb/1012514 - Determining detailed build number information for ESX hosts
http://kb.vmware.com/kb/1991 / 1992 - VMotion compatibility for Intel / AMD processors
http://www.vmware.com/pdf/Perf_Best_Practices_vSphere4.0.pdf - Performance best practices

# ESXi hosts

**HW requirements**: 64bit x86 CPUs, 2GB RAM, SATA, SAS or SCSI disks. No ESXi WebAccess.
ESXi Installable starts in eval mode (60 days). If no DHCP at install, link local IP used 169.254.x.x/16.
**ESXi Installable Partitions**: 4GB VFAT scratch for system swap (not required, also stores vm-support) , 110MB diagnostic for core dumps, VMFS3 on free space.
**Not supported**: • ESXi Installable & Embedded on same host • Booting multiple servers from 1 image
**Direct Console**: • Configuring host defaults • Set up administrative access • Troubleshooting
**Restarting Mgt agents** effects /etc/init.d processes: hostd (mgmt-vmware), ntpd (time), sfcbd (CIM broker), slpd (discover/advertise services), wsman (share mgt info via SOAP), vobd (???) & AAM (HA agent) if installed. To isolate ESXi host from DRS/HA cluster disable mgt network.
`vicfg-cfgbackup` • Backup host configuration: `-s` • Restore: `-l` (`-f` if different build number)
**Repair mode** on ESXi Installable CD overwrites all configuration data. VMFS is preserved if VMFS is original location on boot disk (or beyond 900MB partition), or another disk.
**Tech Support Mode**: • login to console • Alt+F1 • `# unsupported` • enter root password
Return to console: • `# exit` • Alt+F2 http://kb.vmware.com/kb/1003677

# vCenter

**Maximums (per 32bit vCenter)**: Hosts = 200 VMs = 3000 Running VMs = 2000 Clients = 15
**Maximums (per 64bit vCenter)**: Hosts = 300 VMs = 4500 Running VMs = 3000 Clients = 30
**Maximums (Linked mode)**: vCenters = 10 VMs = 15000 Running VMs = 10000 Hosts = 1000
**Maximums (operations per host)**: provisioning = 8 VMotions = 2 Storage VMotions = 2
**Maximums (operations per datastore)**: provisioning = 8 VMotions = 4 Storage VMotions = 4
**Maximum** operations per vCenter = 96

**HW requirements**: Min - 2 CPUs, 3GB RAM • Medium (50 hosts, 250 VMs) 2 CPUs, 4GB RAM • Large (200 hosts, 2000 VMs) 4 CPUs, 4GB RAM • Extra large (300 hosts, 3000 VMs) 4 CPUs, 8GB
**SW requirements**: • 32bit Windows up to 200 hosts, 64bit 200-300 • hostname - 15 characters or less.
**Databases**: • SQL 2005 Express (up to 5 hosts & 50 VMs) • SQL 2005 (use SQL Native Client v9) • SQL 2008 (SQL Native Client v10) • Oracle 10g • Oracle 11g. Not SQL 2000 & not Oracle9i.
VC needs 32-bit ODBC DSN, if VC 64-bit use C:\WINDOWS\SYSWOW64\odbc32.exe. User needs DBO rights. Default of max 10 simultaneous DB connections. MSSQL - don't use master DB.

| FW Port | Source | Destination | Protocol | Description |
|---|---|---|---|---|
| 80 | Clients | VC | TCP | Redirect to HTTPS |
| 389 | VC | AD DCs | TCP | AD lookup |
| 443 | Clients | VC | TCP | VIC & WebAccess |
| 443 (out) | VC | Hosts | TCP | vCenter agent |
| 902 | Hosts | VC | UDP | Heartbeat |
| 902 (out) | VC | Hosts | UDP | Heartbeat |
| 903 | Hosts, Clients | VC | TCP | VM Console |

Possible extras: 22/135/137-139/445/9089(guided consolidation),25(SMTP),53(DNS),80(redirects), 88/445(AD),161/162(SNMP),389(LDAP),636(Linked VCs),1433(MSSQL),1521(Oracle), 8080/8443(webservices),8181/8182(collector service),27000/27010(license 3.x hosts).

**Logs**: DB upgrade: %TEMP%\VCDatabaseUpgrade.log VC agent: /var/log/vmware/vpx/vpxa.log
VC install: %TEMP%\ directory of user installing VC VC logs: %TEMP%\vpx\vpxd-#.log

**Default roles** (System roles - permanent, cannot change privileges, ESX/ESXi & VC. Sample just VC):
No access System - Default except users in Admin Group. Cannot view or change.
Read only System - View state & details except console tab.
Administrator System - All privileges. Default for members of the Admin Group.
VM power user Sample - Interact with, change VM settings, snapshots & schedule tasks.
VM user Sample - Interact with, insert media & power ops. Not changeVM settings.
Resource pool admin Sample - Create, modify child pools & assign VMs, but not RP itself.
Consolidated backup user Sample - Used by Consolidated Backup product, don't modify.
Datastore consumer Sample - Allows use of the datastore.
Network consumer Sample - Allows network to be assigned to hosts or VMs.
**Permissions**: Assigning - pair user/group with role & associate with object. Role - predefined set of privileges. Users initially granted No Access role on new objects, including datastores/networks. Logged in users removed from domain keep permissions until next validation period (default 24 hrs). Tasks - activities that don't complete immediately. All roles allow schedule tasks by default. Can schedule tasks if user has permission when tasks created. VC Local Administrators have same rights as Administrator role by default. root & vpxuser are only users not assigned No Access role on hosts by default. Propagation is per permission, not universal. Child permissions override those propagated. User permissions override Group ones. Can't set vDS permissions, set on parent & propagate.

| Licenses | ESXi Single | Essential | Essential+ | Standard | Advanced | Enterprise | Enterprise+ |
|---|---|---|---|---|---|---|---|
| vCenter | No | ---- Essentials ---- | | ---- Foundation & Standard editions ---- | | | |
| Cores per socket | 6 | 6 | 6 | 6 | 12 | 6 | 12 |
| vSMP | 4-way | 4-way | 4-way | 4-way | 4-way | 4-way | 8-way |
| Physical RAM | 256GB | 56GB | 256GB | 256GB | 256GB | 256GB | no limit |
| Thin provisioning | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| vpxa,Up Mgr,VMSafe,vStorage | | Yes | Yes | Yes | Yes | Yes | Yes |
| HA | | | Yes | Yes | Yes | Yes | Yes |
| Data Recovery | | | Yes | | Yes | Yes | Yes |
| Hot Add, FT, vShield, VMotion | | | | | Yes | Yes | Yes |
| Storage VMotion, DRS | | | | | | Yes | Yes |
| vDS, Host Profiles, 3rd party MMP | | | | | | | Yes |

**Licensing**: 25-character license keys, managed in VC. vSphere (ESX/ESXi) & vCenter Licenses. Expiring licenses: vCenter - hosts are disconnected. ESX/ESXi - VMs run, but cannot power-on/reset.
**Statistics**: CPU, memory, disk, network, system, & VM ops. Collection Intervals (time stats - archived in DB): 5mins - 1 day, 30 mins - 1 week, 2 hrs - 1 month, 1 day - 1 year. Real-time stats stored in flat file on hosts & VC memory (not in DB), collected every 20 seconds. ESX - kept for 1 hr, ESXi - kept for 30 mins. Collection level 1-4 for each interval, 4 has most counters (default is 1). Datastore metrics only available in overview charts (not advanced charts). Reports & Maps updated every 30 mins.
**Alarms**: notifications of selected events, conditions & states. Composed of trigger & action. Triggers: condition/state triggers (monitor VMs, hosts & datastores - equal to/not equal to & above/below) & event triggers (any object, VC or license server - arguments, operators & values). Actions: responses to triggered alarms. Default alarms don't have actions associated. Can disable action without disabling alarm, but effects actions on all alarms. Disable for selected object, child continues. Reduce alarms with tolerance range & trigger frequency (default 5 mins). Disconnect hosts to suspend monitoring.
**Linked mode**: joins VCs. Global data: IP & ports, certificates. licensing, user roles. Uses ADAM (AD App Mode) to store & sync data. Instances can run under different domain accounts. Installed by domain user who is admin on both machines. Requirements: DNS, 2-way trust if different domains, time sync, DNS name matches hostname. Roles are replicated, assignments of roles are not.
**Host profiles**: eliminates per-host configuration & enforces consistency. Requires Enterprise + license. Exported profiles are .vpf files.

**Links**: http://kb.vmware.com/kb/1011641 - Collecting diagnostic information for vCenter
http://kb.vmware.com/kb/1009080 - Installing ESX 4.0 & vCenter 4.0 best practices
http://kb.vmware.com/kb/1009039 - Upgrading to ESX 4.0 & vCenter 4.0 best practices
http://kb.vmware.com/kb/1010550 - Setting up vCenter Server in a MSCS
http://kb.vmware.com/kb/1010686 - Split & Combine license keys on vSphere
http://kb.vmware.com/kb/1010579 - Comparison of vSphere 4.0 & VMware Infrastructure 3.x

# VMs & vApps

**Maximums (per VM)**: vCPUs = 8 RAM = 255GB Swap file = 255GB (1 per VM)
SCSI adapters = 4 Devices per SCSI adapter = 15 IDE devices (disk or CD) = 4
Floppy drives = 2 vNICs = 10 Parallel ports = 3 Serial ports = 4
Remote consoles = 40 VMDirectPath devices = 2 VMDirectPath SCSI targets = 60

**Files**: .cfg Earlier version of .vmx file
.dsk Earlier version of .vmdk file
.hlog VMotion log file
.lck-XXX Locking file on NFS datastore
.log VM activity log
.nvram BIOS settings
.raw Raw device e.g. tape device
.rdm RDM in Virtual Compatibility mode
.rdmp RDM in Physical Compatibility mode
.REDO Earlier version of –delta.vmdk file
.std Earlier version of .vmss file
.vmdk Disk descriptor (also raw virtual disk for hosted products)
-flat.vmdk Raw virtual disks
00000#.vmdk Snapshot metadata
00000#-delta.vmdk Snapshot differential file
.vmem VM's memory
.vmsd Snapshot metadata
.vmsn Snapshot state file
.vmss Suspended state file
.vmtd Earlier version of VC template
.vmtm Team data
.vmtx VC template header
.vmx Primary configuration file
.vmxf Extra configuration file for VMs in a team
.vswp Swap file for overcommitted memory

**Logs**: VM log /vmfs/volumes/*datastore_name*/*vm_name*/vmware.log
**Commands**: List all registered VMs on a host: `$ sudo /usr/bin/vmware-cmd -l`
Create/modify VMDKs, RDMs, VMFS volumes & storage devices: `vmkfstools` (check man page)
Power Off = hard power off • Shut Down = soft with VMware tools • Reset = hard • Restart = soft
**VM HW**: Memory/CPU Hotplug – VMware Tools must be installed.
VMs with HW earlier than v4 have reduced performance & capabilities. Cannot add/remove devices. Manually MAC addresses: 00:50:56:x:y:z. Set in vmx: ethernet<number>.addressType="static".
**Disks**: Thick provisioned - default format, required for clustering such as FT or MSCS, cannot convert to thin (can via storage VMotion). Thin provisioned - saves space, can manually convert to thick.
**RDM**: Benefits User-Friendly Persistent Names, Dynamic Name Resolution, Distributed File Locking, File Permissions, File System Ops, SAN Snapshots, vMotion, SAN mgt agents & NPIV. Limitations not for block devices, no snapshots with physical RDMs, no partition mapping, needs whole LUN.
**Snapshots**:capture memory state, settings & disks. Can't snapshot physical RDMs or independent disks
**Snapshot Manager**: Delete commits snapshot to parent. Delete all commits all snapshots before *You are here*. Go to reverts to that snapshot. Revert to snapshot back to parent's snapshot *You are here*.
**VMotion**: To VMotion a suspended VM, new host must meet CPU compatibility requirements.
**Storage VMotion**: can transform thick > thin or thin > thick. Limitations: VMs cannot have snapshots, only persistent VMDKs or RDMs, requires license, ESX3.5 hosts need VMotion licensed/configured.
**VMI** (VM Interface) paravirtualization: standard to improve performance, only Linux 32bit guests. Uses a PCI slot. VMI VM must be off to move to an unsupported host; can reduce performance.
**VMDirectPath**: I/O allows guest OS to access physical PCI/PCIe devices. Intel Nehalem platforms. Restrictions: VMotion, Hot add/remove, suspend, record/replay, FT, HA, DRS (but allowed in cluster).
**SCSI controllers**: • BusLogic Parallel • LSI Logic SAS • LSI Logic Parallel • PVSCSI
**PVSCSI** (Paravirtual SCSI): high-performance storage adapter. Not recommended for DAS. Guests: Win 2003, 2008, RHEL5. Not supported: Boot disks, Record/Replay, FT, MSCS.
**NPIV** (N-port ID virtualization): share FC HBA port as multiple virtual ports, each with unique IDs. VMs assigned 4 WWNs. Limitations: NPIV enabled FC switch, only RDMs, HBAs need access to LUN using its WWNs, NPIV capable HBAs, no Storage VMotion, VM can't power on if WWNs in use
**vNICs**: • Flexible - 32-bit guests, vlance without VMware Tools or vmxnet with VMware Tools • e1000 - Emulates E1000 NIC, default for 64-bit guests • Enhanced vmxnet - vmxnet with enhanced performance, requires VMware Tools • vmxnet3 - vmxnet with enhanced performance & networking features, requires VMware Tools & HW v7, doesn't support FT.
**TSO** (TCP Segmentation Offload): enabled in VMkernel by default, must be enabled at VM level. Needs enhanced vmxnet, might change the MAC. **Jumbo frame** support requires enhanced vmxnet.
**OVF**: templates can be deployed from a local file system via the Client, or from a web server. OVF files are compressed. Client validates the OVF file before importing it.
**vApp**: container containing one or more VMs, can power on & off, & be cloned. Metadata in VC's DB. IP pool - network configuration assigned to network used by vApp. VC then provides IPs to its VMs.

**Links**: http://kb.vmware.com/kb/1010048 - Set all VMs to upgrade tools at next power on
http://kb.vmware.com/kb/1004231 - Recreate missing disk header file

# Availability (HA)

**Maximums (per HA cluster)**: Hosts = 32 VMs = 1280 (max 100 per host, but > 40 limits hosts to 8)
Failover hosts = 4 (only 5 primaries), or 50% of hosts if less than 8

| FW Port | Source | Destination | Prot (ESX port) | Description |
|---|---|---|---|---|
| 2050-2250 | Hosts | ESX/ESXi | UDP (SC) | HA |
| 2050-2250 (out) | ESX/ESXi | Hosts | TCP/UDP(SC) | HA |
| 8042-8045 | Hosts | ESX/ESXi | UDP (SC) | HA |
| 8042-8045 (out) | ESX/ESXi | Hosts | TCP/UDP(SC) | HA |

**Logs**: HA logs: /var/log/vmware/aam/
**HA primary hosts** (first 5): maintain & replicate cluster state and initiate failover actions.
**Active primary host**: decides where to restart VMs, tracks & effects failed restart attempts.
**List primary hosts**: `$ cat /var/log/vmware/aam/aam_config_util_listnodes.log`
**Seconday host** promoted after primary is: • maint mode • disconnected • removed - not on failure
**Host isolated**: no heartbeat for 12 seconds, then cannot ping isolation addresses. **Isolation response:** • power off • leave powered on • shut down (default). However **Host Failure** is only after 15 seconds.
**Admission Control types**: • Host • Resource Pool • HA (only HA admission control can be disabled)
**Admission Control**: rules if VMs can power on when they violate availability constraints at HA failover. Actions that change a reservation must satisfy admission control.
**HA Admission Ctrl policies**: Host Failures Cluster Tolerates (1-4 hosts), % of Cluster Resources (up to 50%), Specify a Failover Host. Policy Factors • resource fragmentation • flexibility • VM diversity
**Slot size**: represents VM CPU & memory resources needed for any powered on VM. Distorted by large VM reservations. Avoided with advanced attributes das.slotCpuInMHz or das.slotMemInMB

**Links**: http://www.yellow-bricks.com/vmware-high-availability-deepdiv - HA deep dive