



# ESXi Hosts

**Maximums (per host):** Logical CPUs (incl HT) = 160, RAM = 2TB, VMS = 512, vCPUs = 2048, vCPUs per core = 25

**Logs:** All logs in `/var/log/` directory (sym links from `/var/run/log/`). View host logs via: • DCUI • ESXi Shell • Extract `vm-support` bundle • `http://hostname/host` • `vcli vifs` • vSphere Client connected to host

**auth.log**: ESXi Shell authentication  
**esxupdate.log**: ESXi patches/updates  
**fdm.log**: Host management (VM & host events; Client, vpxa, SDK connections)  
**hostd.log**: ESXi Shell usage (enable/disable & commands)  
**shell.log**: VMkernel & module startup  
**syslog.log**: Management service initialization, watchdogs, scheduled tasks, DCUI  
**vmkernel.log**: Core VMkernel logs (devices, storage/network device/driver events & VM startup)  
**vmkwarning.log**: VMkernel warnings & alerts  
**vmksummary.log**: ESXi startup/shutdown, uptime, VMs running, service usage  
**vpxa.log**: vCenter vpxa agent

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--help for esxcli namespaces & commands relative to location. localcli bypasses host
Startup level for management services (& lists all services):   chkconfig --list
Restart all management services:                             /sbin/service.sh restart
Restart single service (& start/stop/status available):       /etc/init.d/<service> restart
Common services:  hostd (primary ESXi daemon) • vpxa (vCenter agent) • vmware-fdm (HA)
Backup host configuration:  (restore -f, force restore to different build number -f)
                                        (restore -i, force restore to different build number -f)
Export detailed configuration file:  esxcli config info > /tmp/esxcli-config.txt
Gather debugging report:             vm-support -w /tmp
List running VMs (before maintenance):  esxcli vm process list
Resource usage:  esxtop (Shell)  resxtop (VCL). Customize & save:  w (updates .esxtop50rc file)
List CPU details:  esxcli hardware cpu list
Show CPU supported functions:        esxcli hardware cpu global get
Show memory and NUMA nodes:         esxcli hardware memory get
List free memory allocated to ramdisks: esxcli system visorsf ramdisk list
Show version information for ESXi:    esxcli system version get
Show the host's acceptance level:    esxcli software acceptance get
Show all the installed VIBs:         esxcli software vib list
Detailed information on installed VIBs: esxcli software vib get
Show syslog configuration:          esxcli system syslog config get
Show logging config for each log:    esxcli system syslog config logger get
Show remote coredump config:        esxcli system coredump network get
List firewall status & actions:       esxcli network firewall get
List firewall rulesets:               esxcli network firewall ruleset list
Refresh firewall after adding new ruleset: esxcli network firewall refresh
Show description of VMkernel error:  vmkerrcode <error_code_number>
List drivers loaded at startup:       esxcli system module list
List advanced options:               esxcli system settings advanced -l
    
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**CPU Power management policies:** • Not Supported - no host support or disabled in BIOS • High Performance - only used when BIOS warning • Balanced (default) - conservative, shouldn't affect performance • Low Power - aggressive power management, can lower performance • Custom

**Memory:** Hosts reclaim memory from VM by: • TDS (Transparent Page Sharing) • "RAM dedupe", • PHARE in esxtop • Balloon driver (vmmemctl) - forces guest to use native algorithms (guest swap) • Memory compression - .vswp file (host level swapping), Local or networked SSD is tagged by VMkernel as optimal swap location to reduce impact. During contention, host memory allocated based on shares & working set size (recent activity). Idle memory is taxed progressively to prevent VM hoarding. Guest swap should be: (vRAM - Reservation) \* 65%, or balloon driver can cause guest kernel panic. Memory faults can be detected & quarantined to reduce chance of a PSDO (hardware dependent).

**NUMA (Non-Uniform Memory Access):** CPUs have localized memory. NUMA scheduler controls VM distribution across host memory to dynamically optimize CPU load & memory locality for VMs. **Firewall:** Define service ports/protocol rulesets. `/etc/vmware/firewall/service.xml` (then refresh)

**PAM (Pluggable Authentication Modules):** plugins: `/etc/pam.d/vmware-Authd`. Default password compliance plugin: `pam_password.so`. No restrictions on root password. Defaults for non-root users: password retries = 3, minimum password length = 8, shorter passwords if Characters Classes mixed upper, lower, digits & other) 1 or 2 CC - min 8, 3 CC - min 7, 4 CC - min 6. First character as upper or last character as digit not counted.

**DCUI (Direct Console UI):** • Configures host defaults • Sets up administrative access • Troubleshooting. High contrast video mode #4. Can redirect DCUI to serial cable via Client or boot option (Shift + 0). Restarting Mgt agents effects `/etc/init.d` processes: hostd (mgmt-vmware), ntpd (time, sctd (CIM broker), slpd (discover/advertise services), wsman (share mgmt info via SOAP), vobd (error forwarding) & fdm (HA agent) if installed. To isolate ESXi host from DRS/HA cluster, disable management network. Management Network Test pings D, primary DNS nameserver, secondary DNS, resolves hostname. VIBs: can update image profiles or 3rd party extensions. Updates firewall ruleset & refreshes host. **Repair mode:** On ESXi/Installable CD, overwrites all configuration data. Serial number lost on repair, but restored when backup configuration applied. Configuration reset deletes root password, removes configuration & reboots host. Storage needs reconfigured & re-register VMs. **Recovery Mode:** Invoked during boot with Shift + R. Reverts to previous image before last update. **SNMP agent** embedded in hostd (disabled by default). Enable via `vicfg-esxnmpp`. Can send traps & receive polling (GET) requests. **Syslog** service is vmxsyslog. **Host certificates:** `/etc/vmware/ssl/rui.crt` (public key) & `rui.key` (private key). Recreate: `/sbin/generate-certificates`

**Shutdown mode:** Forces operations via vCenter. Mode available only when host connected to vCenter. Enabling/disabling via DCUI wipes host permissions - set via vCenter. DCUI restricted to root. Shell & SSH disabled for all users, vSphere Client & CIM monitoring only via vCenter not direct to host. Normal Mode: DCUI, Shell, SSH & CIM access allowed to root & Admin role users. vSphere Client access based on ESXi permissions. Total lockdown mode: also disables root access to the DCUI, if vCenter access is lost you must reinstall ESXi to regain control. Root & vpxuser are only users not assigned No Access role on hosts by default, but have same rights as the Administrator role.

**Firewall Ports** <http://kb.vmware.com/kb/10102382>  
 Location of ESXi 5.0 log files <http://kb.vmware.com/kb/20042021>  
 Log file: Restarting management agents on an ESX/ESXi server <http://kb.vmware.com/kb/1003490>  
 Interpreting esxtop Statistics <http://communities.vmware.com/docs/DOC-9279>  
 Collecting diagnostic info using the vm-support command <http://kb.vmware.com/kb/1010705>  
 Decoding Machine Check Exception output after purple screen <http://kb.vmware.com/kb/1005184>

# vCenter

**Maximums (per vCenter):** Hosts = 1000, VMS = 15000, Running VMs = 10000, Clients = 100, MAC addresses = 65536, Datastore clusters = 256, Maximums (per datacenter): Hosts = 500, Maximums (Linked mode): vCenters = 10, VMS = 50000, Running VMs = 30000, Hosts = 3000

**HW:** Min - 2 CPU cores, 4GB RAM, 4GB disk space • Medium -> 50 hosts/500 VMs - 2 cores, 4GB RAM • Large -> 300 hosts/3000 VMs - 4 cores, 8GB RAM • Extra large -> 1000 hosts/10000 VMs - 8 cores, 16GB RAM

**SW:** 64bit Win (2003 SP2/R2 SP 1, 2008 SP2/R2) • 64bit DSN (SQL Native driver) • hostname <15 characters  
**Databases:** • SQL 2008 Express (<5 hosts/50 VMs) • SQL 2005 SP3 • SQL 2008 SP1 or R2 • Oracle 10g R2 or 11g R1 • IBM DB2 9.5 fix pack 5 or 9.7 fix pack 2. VUM only supports Oracle & MS SQL.  
 vCenter needs DBO rights. Default of max 50 simultaneous DBO connections. MS SQL don't use master DB.

**User Virtual Appliance (VCA):** Min 7GB disk, max 80GB. Supported DRS: • embedded (< 100 hosts & 1000 VMs) • Oracle RAC size -> 4GB for <100 hosts/100 VMs • <6GB for 100-1000 hosts/100-1000 VMs, <13GB for 1000-4000 hosts/1000-4000 VMs, <17GB for >4000 hosts/1000-4000 VMs. Limits: no IPv6, Linked Mode, MS SQL, DB2. Default username: root. Default password: vmware

**Extra vCenter DVD Tools:** • vSphere Update Manager (VUM) - needs 64bit OS but 32bit DSN - syslog server  
**ESXi Dump collector** (no DVS support) - collects PSOD memory dump, useful for Auto Deploy host without local diagnostic partition - Authentication Proxy (see below) - Pre-Upgrade checker - checks for potential host issues • Auto Deploy server (see ESXi install section) • Web Client server (see below)

Port	Source	Destination	Protocol	Description
80	Clients	vCenter	TCP	Redirect to HTTPS
389	vCenter	Other vCenters	TCP	Linked Mode LDAP
443	Clients	vCenter	TCP	vSphere Client access
443	vCenter	ESXi	TCP	vCenter agent
902	ESXi	vCenter	UDP	Heartbeat
902	Clients	vCenter	UDP	Host management, heartbeat
903	Clients	vCenter	TCP	VIM Console

Possible extras: 25 (SMTP), 53 (DNS), 80/443/623(DPM), 88(AD), 161/162(SNMP), 636(Linked VCenters), 1433(MSSQL), 1521(Oracle), 5988/5989(CIM), 6500/8000(Dump Collector), 8000(vMotion), 8080/8443/6099(webservices), 9443(Web Agent), 10109/10111/10443(Inventorieservice), 51915(Auto Proxy)

**Logs:** DB upgrade: `/TEMP/vcDatabaseUpgrade.log` • vCenter agent: `/var/log/vmware/vpx/vpxa.log` • vCenter (Win XP 2003/2008): `Application>Data/VirtualCenter/VirtualCenterClientLogs/vCenter` (Win 7, 2008). • `ALL USERS\PROFILES\vmware\logs\VirtualCenter\Logs` (see KB in links below for description of different log files) VCA logs: `/var/log/vmware/vpx` Windows Client Install: `/TEMP/vmmsi.log` Windows Client Service: `%USERPROFILE%\Local Settings\Application Data\VMX\client\vc\log (v=0-9)` Guest customization - Win: `%WINDIR%\Temp\vmware-vmc - Linux: /var/log/vmware/vmware-cms/ToolsDeployPkg.log`

**Default roles (System roles)** - permanent, cannot edit privileges, ESXi & vCenter. Sample roles: just vCenter: No access System - View state & details except console tab. Read only Administrator - All privileges. Default for members of the Admin Group, & AD ESX Admins. VM power user - Sample - Interact with, change VM HW settings, snapshots & schedule tasks. VM user - Sample - Interact with, insert media & power ops. Cannot change VM HW settings. Resource pool admin - Sample - Modify/assign tasks & assign VMS, but not RP itself. Datastore consumer - Sample - Allows space consumption of the datastore. Network consumer - Sample - Allows hosts or VMs to be assigned to network.

**Permissions:** 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 new 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 task created. vCenter Local Admins has Administrator role by default. Propagation is per permission, not universal. Child permissions override those propagated. User permissions override Group ones. Use No Access role to mask areas from users. Moving objects needs permission on object, source & destination parent.

License	Essential	Essential+	Standard	Enterprise	Enterprise+
vRAM (per socket license)	32GB	8 way	64GB	96GB	32 way
vCPU					
vpxa, Thin prof, VUM, VADP	Yes	Yes	Yes	Yes	Yes
vMotion, HA, VDR	Yes	Yes	Yes	Yes	Yes
SLES (SUSE Linux Ent Server) for VMware	Yes	Yes	Yes	Yes	Yes
DRS, DPM, Storage Motion, FT, VAAI, Hot add, Linked mode,					
3rd party MPP, Orchestrator, vShield Zones, Serial port concentrator			Yes	Yes	Yes
DVS, NICte, SIOC, Host Profiles, Auto Deploy, Policy-driven Storage, Storage DRS			Yes	Yes	Yes
vRAM - Memory configured on all powered-on VMs. Consumed vRAM capped at 96GB per VM. Only Essential & Essential+ has hard vRAM limit. CPU licenses from same license level are pooled across linked mode vCenters. Keys in vCenter not deployed add to entitlement. Add vRAM by adding licenses or upgrading existing. Consumed vRAM is 12% of total available. Can alerts report for consuming linked vRAM. Key assigned to host via vCenter is persistent. vSphere Hypervisor - free, no connection to vCenter. <32GB vRAM, only servers <32GB physical RAM, limited/read-only vCLI & PowerCLI support. no SNMP support. vSphere Desktop - for VDI, functionality of Enterprise+ & unlimited vRAM. Per powered-on desktops. Expiring licenses: vCenter - hosts are disconnected. ESXi - vms continue to run, cannot power-on new VMs. States: <code>vim-cmd /vsan/ha/hotadd storage policy -&gt;</code> CPS, HA, mgmt agents, system & VM ops. Collection Intervals (time period stats archived in DB) frequency/retention is 5 mins - 1 day, 30 mins - 1 week, 2 hrs - 1 month, 1 day - 1 year. Real-time stats (just performance charts) flat file on hosts & vCenter memory (not in DB), frequency/retention is 20 secs - 30 mins, only powered-on hosts & vms. Collection level 1 - 4 for each interval, most counters < 4 (default 1). Reports & Maps updated every 30 mins. VMware tools adds perform options to Windows guests. Alarms: notifications of selected events, conditions & states. Composed of Trigger & Action. Triggers: condition, state or event. Actions: responses to triggered alarms. Default alarms don't have actions set. Can disable action without disabling alarm, but effects actions on all alarms. Disable for selected object, child continues. Default alarms not preconfigured with actions. Acknowledging alarm stops action, but alarm still visible. Reduce alarms with <code>vim-cmd /vsan/ha/alarms disable</code> (default range: 10 mins). Alerts: hosts to suspend, suspend HA, mgmt agents, Linked mode: join VCS. Global data: IP. & ports, certificates, licensing server, 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. Server settings: Licensing (vCenter < 3 hosts), Statistics (intervals & DB size), Runtime Settings (unique ID, Managed IP, name, AD (timeouts, auto deploy limit, validation period), Mail, SNMP receivers, Ports - http(s) client timeouts, Logging detail, DB connections (default 50), DB retention, SSL host verification, Advanced Settings. <b>Host Profiles:</b> Policy to centrally configure & check compliance of hosts. Set at host or cluster level. Reference host - host which created profile. Exported profile format .vpr. When profile is detached, settings persist on host + configuration. Answer File contains host specific info required by Auto Deploy - 1 per host. Host must be in Maintenance Mode to apply profiles. Auto Deploy hosts need reboot. <b>Authentication Proxy:</b> No AD credentials on ESXi, just domain name & proxy IP. Installer creates AD account prefixed with CAM. Authenticate proxy to ESXi by importing SSL certificate, or push via Host Profiles. <b>Web Client server:</b> Alternative to Windows Client. Cross-platform & cross-browser (Adobe Flex plugin). Connects to vCenter (not to hosts directly), register client server first. Subset of Windows Client functionality - Monitoring & VMware network. <b>Guest Customization:</b> Admin tool <code>https://localhost:9443/admin-app</code> . Web client <code>https://servername:9443/vsphere-client</code> . <b>Guest Customization:</b> Guest OS must be on SCSI node 0.0. Requires Perl in Linux guests. Windows guest Admin password must be blank for customization to happen. <b>vService:</b> Service dependency for vApps or VMS. vService Manager monitors health: • Red - issue needs fixed in solution (the extension) • Yellow - vService Manager is repairing • Green - OK					

**Resolution Path Troubleshooting Licensing** <http://communities.vmware.com/docs/DOC-16082>  
 Collecting diagnostic information for vCenter <http://kb.vmware.com/kb/1011641>  
 Location of vCenter Server log files <http://kb.vmware.com/kb/2003790>  
 Installing vCenter Server 5.0 best practices <http://kb.vmware.com/kb/2003790>  
 Upgrading to vCenter Server 5.0 best practices <http://kb.vmware.com/kb/2003866>  
 Sysprep file locations and versions <http://kb.vmware.com/kb/1005593>  
 Firewall ports <http://kb.vmware.com/kb/10102382>  
 vCenter client shortcuts <http://kb.vmware.com/143-center/vsphere-client-shortcuts>  
 vSphere 5 Licensing, Pricing & Packaging [http://www.vmware.com/files/pdf/vsphere\\_pricing.pdf](http://www.vmware.com/files/pdf/vsphere_pricing.pdf)

# Cluster Resources

**Maximums (per DRS cluster):** Hosts = 32, VMS (powered on) = 3000 (512 per host)  
**Maximums (per Resource Pool):** Children = 1024, Tree depth = 8  
**Maximums (other):** Hosts per datacenter = 100, RPs per host = 1600, RPs per cluster = 1600

**Terminology:** Datacenters - mark organizational & vMotion boundaries. Clusters - gather host resources. Resource Pools - apply policies to clusters. DRS cluster is implicitly a resource pool. Resources include CPU, memory, power, storage & networking. EVC (Enhanced vMotion) - masks CPU features that prevent vMotions. Storage DRS, Profiles & Datastore Clusters - see Storage section. NIC & Network Resource Pools - see Networking section.

**List resource pool settings:** `esxcli resmgr -l`

**Resource pools:** Shares - low, normal, high & custom • Reservations - MHz/(CPU/MB/RAM) • Limits - MHz/MB • Expandable reservation - yes (can draw from parent's pool) - no (only from own pool). Shares - only apply during contention. Shares are relative to siblings (VMS or Resource Pool). Reservations - guarantee a minimum, can be allocated more. Only checked when VM is powered on. Limits - upper bound, never exceeded; manage user expectations but can waste idle resources. Resource Pool Admission Control - prevents violations when VM is powered on or child pool creates. Fixed reservations create strict isolation. Expandable reservations can borrow resources, don't automatically hunt upwards, but defines if admission control considers the reservation. More flexible but provides less protection. Child pools actively reserve resources from parent even if VMs are powered off. Hierarchical resource pools require DRS enabled. **DRS - Manual - Partial (initial VM placement) - Fully Automated (initial VM placement & Dynamic balancing).** Migration threshold slider sets available host load imbalance. **Current Host Load Standard Deviation** - load imbalance (higher number means priority level). **Current - Target** unless recommendations unapplied. Priority levels 1-5 (1 is highest). Grafted from pools created when adding host to DRS cluster & keeping host's resource pool hierarchy. Maintenance mode only clears VMS off host if DRS cluster is fully automated. Disabling DRS deletes resource pools & affinity rules - set DRS to manual to keep settings. DRS can be overcommitted/yellow (host failure) or invalid/red (usually direct client changes). **Affinity Rules:** VMs kept VMs together/apart. VM-host keep VMs on/off specific hosts. **Shuld rules** is best effort. Must rule is mandatory (for licensing). Rule conflicts - older wins, newer rule disabled. Obeying anti-affinity rules 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. **DRS Deep Dive** <http://www.yellow-bricks.com/drs-deepdive>  
 EVC (Enhanced vMotion Compatibility) FAQ <http://kb.vmware.com/kb/1005764>  
 EVC CPU compatibility <http://kb.vmware.com/kb/1003212>

# VMs

**Maximums (per VM):** vCPUs = 32, RAM = 1TB (64GB - FT VMS), Virtual swap file (.vswp) = 1TB  
 SCSI adapters = 5, Devices per SCSI adapter = 15, IDE devices (Disk/CD) = 4, VMKB = 2TB, 512 B VMKBs = 10, USB devices = 20 (USB 3.0 = 1), Floppy device = 3, Parallel ports = 4, Serial ports = 4, Remote consoles = 4, VMDirectPath devices = 4, Video RAM = 128MB

**Files:** .llog vMotion log file, .vmsd Snapshot metadata file, .lock-XXX Locking file on NFS datastore, .vmsn Snapshot state file, .log VM activity log, .vmsx Suspended state file, .#.log Old VM log, .vmtx Template header, .nvram BIOS or settings, .vpx Primary configuration file, .rdm RDM in Virtual Compatibility mode, .vmtx Extra configuration file for VMS in a team, .rdmp RDM in Physical Compatibility mode, .vswp Swap file for overcommitted memory, .vmdk Disk descriptor (also raw virtual disk for hosted products), .flat.vmdk Raw pre-allocated virtual disk, 00000#vmdk Snapshot child disk, #.#.#.#.#.vmdk Changed Block Tracking file, 00000#.#.#.#.#.vmdk Snapshot differential file

**--help** for esxcli namespaces & commands relative to location. localcli bypasses host

**List running VMs (before maintenance):** `esxcli vm process list`  
**List registered VMs (& displays <vmid>):** `vim-cmd /vsan/ha/getallvms`  
**Show VM's power state:** `vim-cmd /vsan/ha/power.getstate <vmid>`  
**Power on VM:** `vim-cmd /vsan/ha/power.on <vmid>`  
**Register a VM:** `vim-cmd /solo/register vms/volumes/vname/vname.vmx`  
**Unregister a VM:** `vim-cmd /vsan/ha/power.off <vmid>`  
**Forcefully kill VM:** `esxcli vm process kill --type <soft/hard/force> --world-id <id>`  
**Create/Delete/Modify VMDKs, RDMs, VMFS volumes & storage devices:** `vmfstools`  
**Power Off - hard off** • **Shutdown** - soft with VMware tools • **Reset** = hard • **Restart** = soft

**VM HW:** Memory/CPU/Hotplug - VMware Tools required. Multicore requires HW v6. BIOS based VM min 4MB RAM, EFI min 96MB. Mac OS VMS must run on Apple HW. CPU or Memory (NUMA) affinity not available VM DRS clusters. vMotion requires host NUMA to guess DVS to guess DVS. vMotion swap (Configured vRAM - Reservation) \* 65%, otherwise balloon driver could cause guest kernel panic. **HT sharing modes:** • Any - vCPUs can share cores with other VMS • None - vCPUs have exclusive use when scheduled - Internal - can share core itself if VM has 2 vCPUs, not 2 vCPUs then same as None. **Disk types:** • Thick Provision Lazy Zeroed - default, pre-allocates - Thick Provision Eager Zeroed - pre-allocates & zeros, better performance, slower creation • Thin Provision - allocates on-demand, monitor with 'datastore usage' alarm. NES - with HW acceleration supports all 3 types - without only Thin. **RDM:** can use SAN Snapshots, vMotion, SAN mgmt agents & NPIV. Includes whole LUN. Physical RDMs vs VM snapshots, clones, templates, only migrates mapping file. Virtual RDMs clones/templates copied into .vmdk snapshots, capture memory state, settings, disks. Can't snapshot physical RDMs or independent disks. **Independent Disk modes:** no snapshots. Persistent changes immediate & permanent. Nonpersistent changes lost on power-off or reset. **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 based to parent's snapshot VM memory reservation. **VMDirectPath I/O:** allows guest OS to access physical PCI/PCE devices, sets VM memory reservation to vRAM. Resources: • BusLogic Parallel - LSI Logic SAS - LSI Logic Parallel • PVSCSI (IDE is ATAPI) • PVSCSI (Paravirtual SCSI); at least HW v7, high-performance storage adapter. Not recommended for DAS. **Guests:** Win 2003, 2008, RHEL5. Not supported: Performance/Replay, FT, MSCS, RHEL5 boot disks. **NPIV (N-Port ID Virtualization):** share FC HBA port as multiple virtual ports, each with unique IDs. VMS assigned vNICs. VMs connected to HBA. MACs allocated from vMotion pool on each vNIC. vMotion requires vNIC enabled FC switch, only RDMs. Host HBA's vNICs also need access to LUN, NPIV capable HBAs, no Storage vMotion. VM can't power on if vNICs in use, vMotion requires all RDM files on same datastore. **vNICs:** • Flexible - 32-bit guests, vlane without VMware Tools or vMotion with VMware Tools. • e1000 - Emulates iE1000 NIC, default for 64-bit guests • vmxnet2 (Enhanced) - vmxnet with enhanced performance, requires VMware Tools. • enhanced vmxnet3 - enhanced performance, networking features, requires VMware Tools & at least HW v7. WOL supported on vmxnet, vmxnet2 or vmxnet3. **MAC address:** can manually assign in `vmx: ethernet.<number>.addressType="static" & ethernet.<number>.address=00:50:56:XX:YY:ZZ (XX only 00-3F)` **TSD (Top Segmentation Offload):** enabled in VMkernel by default. vNICs must be enabled at VM level. Needs enhanced vMotion, requires VMware Tools. **VDF:** templates imported from local file system by vCenter. VDF files are compressed. Client validates VDF file before importing. Can contain multiple VMS. OVA is single file version. **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. vCenter provides IPs to its VMs. Policies - manual core - manual core - manual core - manual core - manual core - manual core - manual core - manual core`

**Resolution Path** - Troubleshooting VMs <http://communities.vmware.com/docs/DOC-15963>  
 Recreate missing virtual disk (VMDK) header/description file <http://kb.vmware.com/kb/1002511>  
 Consolidating snapshots in vSphere 5 <http://kb.vmware.com/kb/2003638>