	Ava	ailab	oility	( FT &	MSCS	5)	
Maximums (FT	advice): Disks	per VM =16	FT VMs p	er host = 4	Minimu	n hosts per	cluster =
FW Port	Source	Dest	ination	Prot (ESX	port) Des	cription	
8100, 8200	Hosts	ESX	/ESXi	UDP (SC)	FT		
8100, 8200 (out)	) ESX/ESXi	Host	S	TCP/UDP(	SC) FT		
FT: uses anti-af	finity rules. <u>Req</u>	<u>uires</u> - HA & h	ost monitor	ring, host cert	tificate che	cking (on b	y defaul
dedicated loggin	ng NIC, compati	ble CPU, Hard	ware Virtua	lization (HV	), thick dis	sks on share	d storag
supported guest	OS. Not suppor	<u>ted</u> - snapshots	, storage Vl	Motion, DRS	features, l	notplugging.	, MSCS
VCB, SMP, phy	sical RDMs, Pa	ravirtualized V	Ms, NPIV,	VMDirectPa	th, EPT/R	VI.	
MSCS: • Win 20	000 SP4, 2003 S	5P2 & 2008 (Fa	ilover Clus	tering) • 32 8	& 64bit • o	nly 2 nodes	clusters
Not supported -	DRS/HA on VM	As, VMotion, F	T, NPIV, F	lound Robin	NMP, iSC	SI/NFS base	ed disks
		VMDK	Virtual	RDM		Physical F	DM
Cluster in a box	(CIB)	Yes (zeroed)	Yes			No (not su	pported)
Cluster across be	oxes (CAB)	No	Yes - n	ot Win2008, 1	not CCR	Yes (recon	nmende
Physical & VM	(n+1)	No	No			Yes	
Snapshots		Yes	Yes			No	
SCSI target soft	ware	No	No			Yes	
<ul> <li>Configure all F</li> </ul>	RDMs before co	nfiguring VM's	s network se	ettings, or ini	tialising L	UNs within	window
<ul> <li>Add all RDMs</li> </ul>	to a 2nd SCSI of	controller i.e. S	CSI(1:x). S	et sharing to	Physical o	r Virtual as	required
SCSI bus sharin	g • CIB = Virtua	al • CAB or N+	1 = Physica	al			
Links: http://kb.	.vmware.com/kl	<u>5/1010601</u> - Ur	derstanding	g FT			
http://kb.vmwa	are.com/kb/100	8027 - CPU &	guest OS th	at support F1	ſ		

Networking

 Maximums (per host): 1GB VMNICs = 2 - 32 dependent on HW (e1000/e=32)
 10GB VMNICs = 4

 PCI VMDirectPath devices=8
 vSS switches=248
 VEM switches=1
 vSwitch ports (vSS/vDS)=4,096

 Service Console ports = 16
 VMotion and IP storage (VMkernel) port group = 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
 vDS switch ports = 4,088

 Terminology: VMNICs - logical name for physical server NICs vNICs - virtual NICs assigned to VMs
 vSS - virtual Standard Switch
 vDs - virtual Distributed Switch
 vdPort - port group on a vDS

 dvDplink - uplink VMNICs on a vDS
 vEtwork VMotion - tracking of VM's network state on a vDS
 Common networking commands (-h switch for options or man page for detailed description):

List VMNICs: List vSwitches & Port Groups: List vSwitches & Port Groups: List VMkernel ports: List VMkernel Default Gateway: ch for options or man page for detailed description): \$ sudo /usr/sbin/esxcfg-nics -1 \$ sudo /usr/sbin/esxcfg-vswitch -1 \$ sudo /usr/sbin/esxcfg-vswif -1 \$ sudo /usr/sbin/esxcfg-vmknic -1 \$ 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. • <u>VST</u> (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. • <u>VGT</u> (Virtual Guest Tagging) - Rarely used. Install 802.1Q trunking driver software in the VMs, the vSwitch preserves the tags given by the VMs. VLAN ID of 905 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.
 • Eorged Transmits (default Accept) - won't drops outbound frames if source MAC address is different.
 Traffic Shaping - Status (default Disabled) <u>Average Bandwidth</u> (default 102400 Kbps) <u>Peak</u>
 <u>Bandwidth</u> (default 102400 Kbps) <u>Burst size</u> (default 102400 Kbps) <u>Peaks</u>
 <u>Bandwidth</u> (default) Disabled) <u>Average Bandwidth</u> (default 102400 Kbps) <u>Peaks</u>
 <u>Bandwidth</u> (default) Court Supers <u>Size</u> (default 102400 Kbps) <u>Peaks</u>
 <u>Bandwidth</u> (default) Court Supers <u>Size</u> (default 102400 Kbps) <u>Peaks</u>
 <u>Bandwidth</u> (default) Court Supers <u>Size</u> (default 102400 Kbps) <u>Peaks</u>
 <u>Bandwidth</u> (default) Court Supers <u>Size</u> (default) 102400 Kbps) <u>Beaks</u>
 <u>Bandwidth</u> (default) <u>Courtes</u> <u>Average</u> <u>Size</u> <u>Size</u> <u>Average</u> <u>Size</u> <u>Size</u> <u>Average</u> <u>Size</u> <u>Size</u> <u>Average</u> <u>Size</u> <u>Size</u>

MisConfigurations, <u>Deaton Proping</u> don't use with Prinsiphod Statistical and the second property of the second • Failover order Active - Standby - Unused. Don't use standby uplinks with IP-hash load balancing. VLAN (vDS only) • VLAN - set ID. Trunk range - restrict IDs on trunked links. PVLAN - see below. 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 into vSwitch Egress out of vSwitch • Allow live port **PVLAN** (Private VLAN): extention to VLAN standard, adds further segmentation. Not encapsulated. <u>Primary PVLAN</u> - Original VLAN divided into smaller groups. <u>Secondary PVLAN</u> - exists only within primary, has specific VLAN ID. Secondary types: Promiscuous - connect with VMs in primary. Community-connect to themselves & VMs on promiscuous Isolated-connect with VMs on promiscuous 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** (for vSS): (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 vCenter 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 http://kb.vmware.com/kb/1000258 - Configure networking from Service Console command line

## 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 -1 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: priority levels 1-5 (1 the highest). DRS cluster settings: • Manual • Partial (Initial VM placement) • Fully Automated (Initial VM placement & Dynamic balancing). Current Host Load Standard Deviation: load imbalance. Lower than Target value unless recommendations are unapplied. "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. Current host load standard deviation: DRS load imbalance. Current < Target unless advice unapplied 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 algorithm (guest swap) • VM Swap files (if vmmemctl not available/responsive) • Sharing memory across VMs Links: http://kb.vmware.com/kb/1005764 - Enhanced VMotion (EVC) FAO http://kb.vmware.com/kb/1003212 - EVC CPU compatibility

http://www.yellow-bricks.com/drs-deepdive/ - DRS Deep Dive

## Storage

Maximums (per host): Volumes = 256	Paths = 1024	NAS datastores	= 8 (64 with adv settings)
FC - HBAs = 8 (HBA ports = 16) targets	per HBA = $256$		paths to each LUN = $32$
iSCSI HW - HBAs = 4 targets	per HBA = 64 E	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 (DR	S limit, 2048 for lir	iked clones)
VMFS = 64TB (less 64KB) NFS =16TE	B File size (1/	2/4/8MB blocks) =	256GB/512GB/1TB/2TE
RDMs = 2TB (less 512B) Extents	s = 32	Extent size = 2TB	(less 512B)
FW Port Source	Destination	Prot (ESX port)	Description
2049 NFS server	ESX/ESXi	TCP (VMK)	NFS Client
2049 ESX/ESXi	NFS server	TCP (VMK)	NFS Client
3260 ESX/ESXi	iSCSI server	UDP (SC+VMK)	iSCSI Client
Common storage commands (-h switch	for options, or n	nan page for detaile	d description):
List all storage devices:	\$ sudo /u	sr/sbin/esxcf	g-scsidevs -c
List LUNs, paths & multipathing plugins:	\$ sudo /u	sr/sbin/esxcf	g-mpath -L
List all VMware SATPs:	\$ sudo /u	sr/sbin/esxcl	i nmp satp list
List claim rules: \$ sudo /usr/sb	in/esxcli c	orestorage cl	aimrule list
Lists datastores, dev names to VMFS:	\$ sudo /u	sr/sbin/ẽsxcf	g-scsidevs -m
List snapshot volumes:	\$ sudo /u	sr/sbin/esxcf	g-volume -l
Test VMkernel connectivity:	\$ /usr/sb.	in/vmkping	
Manage HW iSCSI (Qlogic) settings:	\$ sudo /u	sr/sbin/esxcf	g-hwiscsi -l
Manage SW iSCSI settings:	\$ sudo /u	sr/sbin/esxcf	g-swiscsi -g
List iSCSI LUNs: \$ sudo /	usr/sbin/vm	kiscsi-tool -	Ľ -l adapter
Rescan iSCSI LUNs:	\$ sudo /u	sr/sbin/esxcf	g-rescan <i>adapter</i>
List the NFS exports from the VMkernel:	\$ sudo /u	sr/sbin/esxcf	g-nas -l
Storage capabilities	F	C iSCSI	NAS
VMotion, DRS, HA, FT, VCB, SRM & TI	hin VMDKs Y	es Yes	Yes
VMFS volumes, RDMs & VMware's NMI	P Ye	es Yes	No
Boot ESX host	Y	es Yes (H	W initiator) No
VM MSCS clustering	Y	es 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 vmbba#:/C#:T#:H= adapter:channel:tareet.LUN

iSCSI iON interversed\_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. Remove dtargets 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 (MuliPathing Plugins): claim rules in /etc/rmware/esx.conf specify MPP to use for each path. NMP (Native MPP): eSATPS (Storage Array Type Plugins) - handles failovers. • PSPS (Path Selection Plugins) - handles load-balancing. NMP policies: Fixed - default for active/active, uses preferred path when available. <u>MRU</u> (Most Recently Used) - default for active/passive (& ISCSI), first working path found at boot. <u>RR</u> (Round Robin) - safe for all arrays, rotates through paths (not 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 millerabing & disk shares. **TPGS** (Target Port Group Support): storage shows path performances, so hosts can determine best path ALUA (Asymmetric Logical Unit Access): find/amanages multiple paths for failover & load balancing.

Links: 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) http://kb.vmware.com/kb/1011387 - ESX 4.x handling of LUNs detected as snapshot

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by **Forbes Guthrie** Version 2.0 for v4.0U1 released 10 Dec 2009



 $\square$ 

HW requirements: • 64-bit x86 CPUs • 2GB RAM minimum • see HCL (link below) IPv6 is not supported during the install. Installation log: /var/log/esx\_install.log Evaluation merind (66 dway) starts on first power-on even if host is license.

Evaluation period (60 days) starts on first power-on even if host is licensed. Install boot options: F2. Install via Media Depot: HTTP/ HTTPS, FTP, NFS - askmedia option. PXE Boot 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. <u>Default install scripts:</u> • ks-first.cfg installs on 1<sup>st</sup> 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.

Physical partitions: 7000t, Vinkcore & VMIS, esxconsole.vmak: 7, swap, 7var/10g, & optional ones. Size of /boot, vmkcore & VMFS cannot be defined/changed during Interactive install (can if Scripted). Mount point Format Default Location

/boot	ext3	1100MB	Primary physical partition				
	vmkcore	110MB	Primary physical partition				
/vmfs	vmfs3	fill remaining 1 <sup>st</sup> disk	Logical physical partition				
/ (root)	ext3	5GB (default min, may be larger)	esxconsole.vmdk file				
	swap	600MB 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 rec	ommends: <mark>/ho</mark>	ome, /opt, /tmp - min 2GB each, /var (no /var/l	og) - 5GB, swap - 1600MB				
If scripting inst	all, consider c	one VMFS for COS (esxconsole.vmdk) and a s	separate one for VMs.				
Disconnect Fib	re Channel co	nnections prior to installation.					
Post install tas	ks: • Reconne	ect FC connections.					
<ul> <li>Create user ac</li> </ul>	count & add t	to sudoer file ( <b>visudo</b> - add to "user privileg	e specification").				
<ul> <li>Test cables ar</li> </ul>	e in correct V	MNICs:\$ watch -n 1 'sudo /usr/s	bin/esxcfg-nics –l'				
<ul> <li>Rearrange VM</li> </ul>	/INICs in /etc/	<pre>/vmware/esx.conf if required (reboot required)</pre>					
<ul> <li>Adjust Servic</li> </ul>	e Console me	mory to 800MB (reboot required).					
Configure NTP (time) settings.							
• Patch (VUM or vihostupdate/esxupdate).							
<ul> <li>Connect vSph</li> </ul>	iere Client to l	host (not VC) & add extra users (the sudo user	s) to Administrators group.				
<ul> <li>Configure vS<sup>1</sup></li> </ul>	witches.						
<ul> <li>Configure sto</li> </ul>	rage (& set Di	iskMaxLUN as required).					
<ul> <li>Connect vSph</li> </ul>	ere Client to '	VC, add new host, move to required cluster.					
<ul> <li>License host.</li> </ul>							
<ul> <li>Enable Web a</li> </ul>	ccess if requi	red.					
Upgrade from	ESX3: (cann	ot use DVD) • <u>VUM (vCenter Update Manage</u>	er) - upgrades ESX/ESXi.				
Host Update	<u>Utility</u> - upgra	ades ESX/ESXi (& updates ESXi), small envi	conments (< 10 hosts, no				
VUM). Customize in %PROGRAMFILES%\VMware\Infrastructure\VIUpdate 4.0 \settings.config							
esxupgrad	le . Sh script l	http://kb.vmware.com/kb/1009440 - upgrades	ESX only.				
Upgrade logs:	/esx3-installa	tion/esx4-upgrade/ & /var/log/vmware/					
Unsuccessful u	pgrades: /esx4	i-upgrade/ & /var/log/vmware/					
Post upgrade:	<ul> <li>Upgrade VM</li> </ul>	Iware Tools before upgrading virtual hardwar	e • Re-install 3rd party				
agents/apps • C	onvert LUN r	nasking to claim rule format: esxcli core	storage claimrule				
convert•Su	ccesstul upgra	ade: cleanup-esx3 removes ESX3 boot o	ptions & ability to roll back				
I unize: http://www.	TOTAL TRADUCTORY OF	iona (second compatibility (conch php II and	vione Compatibility Childs				

Links: http://www.vmware.com/resources/compatibility/search.php - Hardware Compatil 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 to ESX 4.0 & VCenter 4.0 best practice
- http://kb.ymware.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	3, XP home SP2, 2000 SP	4, Linux - GTK+	2. Browsers - IE6	, 7 or $\geq$ , Firefox 2, 3 or $\geq$				
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 Ag	ent log /var/log/vmware/v	/px/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 • ESX - disabled Web Access semote 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 vCenter. Alarms tab available connected to vCenter (not ESX). Web Access allows only viewing tasks. Links: http://www.jume.nl/articles/vmware/143-vcenter-client-shortcuts - vCenter client shortcuts



	E	SX HO	DStS	
Maximums (p	er host): vCPUs = 512 Service Console l	vCPUs per physic	cal core = 25	Logical procs (incl HT) = $64$ VMs = $320$ (HA can limit)
FW Port	Source	Destination	Prot (ESX por	t) 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
902 002 (aut)	HOSTS, Clients, VC	ESA/ESAI	ICP (SC)	Auth, migrate, provision
902 (Out)	ESA/ESAI Clionts	ESV/ESV;	TCP (SC)	VM Consolo
5900-5964	2	ESX/ESXi	TCP (SC)	REB for mgt tools (VNC)
5900-5964 (ou	) 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),5	53(DNS),88/389/464	(AD),161/162(SI	NMP),445(SMB),5988(CIM)
Logs: Service	Console Availability &	VMkernel Message	s, Alerts, Availat	ility: /var/log/vmkernel
ESX service lo	g: /var/log/vmware/hos	td.log Sysl	log: /var/log/mes	sages
VMkernel warn	nings: /var/log/vmkwar	ning VM	kernel events: /va	ar/log/vmksummary
VC agent: /var/	log/vmware/vpx/vpxa.	log Pate	hing: /var/log/vn	1ware/esxupdate.log
Common ESX	host commands ( - h	switch for options or	man page for de	tailed description):
List status of a	II services:	\$ SUGO /SDIN/	services	tatus-all
List the service	runieveis:	\$ CHKCOHILG -	-IISt	(start stop status available)
Common sorvi	e.φ suuo /spin/: coc:•mamt_vmware	(hostd) • Vmware-V	INVA (VContor a	(start, stop, status available)
vmkauthd (a	thentication) • netwo	rk (vewif changes)	• vmware-web	
Show build nu	mber	\$ vmware -v	· viiwar c - web/	(Web Access)
Check the files	vstem usage.	\$ sudo vdf -h	P	
List diagnostic	partitions:	\$ sudo /usr/s	hin/esxcfa-	dumppart -l
Show descripti	on of VMkernel error:	\$ vmkerrcode e	error code numb	er
Export detailed	config file:	<pre>\$ sudo esxcfg</pre>	-info > /tm	p/esxcfg-info.txt
Gather debugg	ing report:	\$ sudo /usr/Ď	in/vm-suppo	rt -w /ťmp
Configure auth	entication settings:	<pre>\$ sudo /usr/s</pre>	bin/esxcfg-	auth
Lists drivers lo	aded at startup:	<pre>\$ sudo /usr/s</pre>	bin/esxcfg-	module -l
Set advanced o	ptions: \$ sudo /us	r/sbin/esxcfg-	advcfg opti	on -s value (-g to get)
Update bootstr	ap settings:	\$ sudo /usr/s	bin/esxcfg-	boot (treat with caution)
Initialization ro	outines (resets things):	\$ sudo /usr/s	bin/esxcfg-	<b>init</b> (treat with caution)
Internal firew	all commands (iptable	s on Service Console	e): bip/covofo	firevell a
Show all firewa	all settings:	\$ sudo /usr/s	bin/esxcrg-	firewall -q
Enable a correio	inamed services:	φ Suuo /usi/s sin/osycfa fir	DITI/ ESXCIY-	ica nama ( d to disable)
To open a port	s suuo /usi/si s sudo /usr/si	in/estory-iii	ewall -e servi	protocol direction name
Security Level	s High - in/out blocke	d Medium - in block	ced out open Lo	w - in/out open
By default all t	raffic blocked in & out	except 22, 123, 427	7 443 902 5989	5988 pings DHCP & DNS
Master config	file: /etc/vmware/esx.c	onf Certificate fi	les: hostd regener	rates new files if not present.
Certificate pub	lic key /etc/vmware/ssl	/rui.crt Cert	ificate private ke	y /etc/vmware/ssl/rui.key
Set certificate l	ocation /etc/vmware/ho	ostd/proxy.xml SSL	settings /etc/vm	ware/hostd/config.xml
PAM (Pluggab	le Authentication Mod	ules) configuration:	/etc/pam.d/vmwa	re-authd
Default authen	tication method is /etc/	passwd. vpxuser is f	or vCenter Serve	r permissions.
Passwords: ES	SX uses pam_cracklib.s	o plug-in by default.	No restrictions	on root password. Defaults
for non-root us	ers: password retries =	3, minimum passwo	rd length = 9, sho	orter passwords if Characters
Classes mixed	(upper, lower, digits &	other) $M - CC = E$ .	pam_passwdqc.s	o provides more options.
User Password	Aging: enabled by de	fault, set to never ex	pire (max days) a	& change anytime (min days
= 0, warning =	7) Change nost settin Iniform Momory According	gs: esxcig-auti	<ul> <li>Change user se</li> </ul>	tings: chage
NOMA (NOI-	DIL offinity is set <b>UT</b>	ss). controls vivi me	izo idlo rocourco	across nost memory. Only
VMware MIR	s: uses embedded SNM	IP agent (disabled by	<i>i</i> default) Enable	vicfa-snmn
syslogd: to con	figure • ESX - edit /etc	svslog.conf • ESXi	- use Client or V	icfg-syslog
Links: http://k	.vmware.com/kb/653	- Collecting diagnost	tic information for	or ESX Servers
http://kb.vmwa	re.com/kb/1005184 - D	Decoding Machine C	heck Exception o	utput after purple screen
http://kb.vmwa	re.com/kb/1012514 - E	Determining detailed	build number inf	ormation for ESX hosts
http://kb.vmwa	re.com/kb/1000258 - V	ideo: Configure Ser	vice Console net	working from CLI
http://kb.vmwa	re.com/kb/1991 / 1992	- VMotion compatib	oility for Intel / A	MD processors
http://www.vm	ware.com/pdf/Perf_Be	st_Practices_vSpher	e4.0.pdf - Perform	nance best practices
http://commu	inities.vmware.com/do	<u>cs/DOC-9279</u> - Inter	preting esxtop St	atistics

## 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, but stores vmsupport). 110MB diagnostic for core dumps, VMFS3 on free space. Not supported: • ESXi Installable & Embedded on same host • Booting multiple servers from 1 image

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 (error reporting) & AAM (HA agent) if installed. To isolate ESXi host from DRS/HA cluster disable mgt network. Management Network Test: pings DG, primary DNS nameserver, secondary DNS, resolves hostname. Lockdown mode: prevents remote access by root account, but not other accounts. Disabled by default. Vicfg-cfgbackup, • Backup host configuration: -s • Restore: -1 (-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 - Tech Support Mode KB

vCenter

G.

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: • 3251ti 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 & 11g • 1BM DB2 9.5. Not SQL 2000 nor Oracle9i. VC needs 2-bit ODBC DSN, if VC 64-bit use C:WINDOWS/SYSWOW640dbcad32.exe. User needs DBO rights. Default of max 10 simultaneous DB connections. MSSQL - don't use master DB.

Pre-Opgrade	Checker 1001: On VC	enter DVD, checks to	r potentiai isst	les with nosis prior to upgrade.
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	VC	Hosts	TCP	vCenter agent
902	Hosts	VC	UDP	Heartbeat
902	VC	Hosts	UDP	Heartbeat
200	Hosts Clients	VC	TCD	VM Consolo

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), 808/0843(webservices),8181/8182(collector service),27000/27010(license 3.x hosts).

 
 808/843(webservice), 102(3100F), 305(LDAF), 000(Linket) VCS), 1435(0135(L), 132(10140F),

 808/8443(webservice), 8181/8182(collector service), 27000/27010(licenes 3.x hosts).

 Logs: DB upgrade: %TEMP%/WCDatabaseUpgrade.log

 VC install: %TEMP%/ directory of user installing VC

 VC logs: %TEMP%/wither volume installing VC
 No access System - Default except users in Admin Group. Cannot view or change. Read only System - View state & details except console tab. System - All privileges. Default for members of the Admin Group. Administrator Sample - Interact with, change VM settings, snapshots & schedule tasks. VM power user 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. Sample - Allows use of the datastore. Datastore consumer Sample - Allows network to be assigned to hosts or VMs. Network consumer 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 i	s per permiss	ion, not u	iversal. Chil	d permissio	ons override	those propa	ıgated. Üsei
permissions override Group ones. Can't set vDS permissions, set on parent & propagate.							
Licenses	ESXi Single	Essential	Essential+	Standard	Advanced	Enterprise	Enterprise+
vCenter	No	Esse	entials	Four	ndation & Sta	andard editi	ons
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	256GB	256GB	256GB	256GB	256GB	no limit
Thin provisioning	Yes	Yes	Yes	Yes	Yes	Yes	Yes
vpxa,Up Mgr,VMSafe,vS	torage	Yes	Yes	Yes	Yes	Yes	Yes
HA	-		Yes	Yes	Yes	Yes	Yes
Data Recovery			Yes		Yes	Yes	Yes
Hot Add, FT, vShield	l, VMotion				Yes	Yes	Yes
Storage VMotion, DRS						Yes	Yes
DS. Host Profiles. 3rd party MMP Yes					Yes		

Licensing: 25-character license keys, managed in VC. vSphere (ESX/ESXi) & vCenter Licenses. Expiring licenses: <u>vCenter</u> - hosts are disconnected. <u>ESX/ESXi</u> - VMs run, but cannot power-on/reset. Statistics: CPU, memory, disk, network, system, & VM ops. <u>Collection Intervals</u> (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. Server settings: licensing (vCenter & 3.x), statistics (intervals & DB size), runtime settings (unique ID, managed IP, name), AD (timeouts, query limit, validation period), mail, SNMP receivers, http(s) ports, client timeouts, logging detail, DB connections, DB retention, SSL host verification, advanced settings. 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/1005593 - sysprep file locations and versions http://kb.vmware.com/kb/1010579 - Comparison of vSphere 4.0 & VI 3.x licensing http://kb.vmware.com/kb/1010839 - Video: Licensing management http://kb.vmware.com/kb/1010550 - Setting up vCenter Server in a MSCS

SCS1 adapters = 4 Devices per SCS1 adapter = 15 Dis devices (disk or CD) = 4 Floppy drives = 2 vNLCs = 10 Parallel ports = 3 Serial ports = 4 Remote consoles = 40 VMDirectPath devices = 2 VMDirectPath SCS1 targets = 60 Files. cfg Earlier version of .vmk filevmem VM's memory dsk Earlier version of .vmk filevmem VM's memory dsk Earlier version of .vmk filevmem VM's memory log VM activity logvmem VM's memory and RDM in Physical Compatibility mode .vmm V Camplate header .vmm RDM in Physical Compatibility mode .vmt V C template header .vmm RDM in Physical Compatibility mode .vmt V Camplate header .vmt Sapshot metadata .vmt Sapshot metadata .vmt Sapshot metadata .vmt V Camplate header .vmt Sapshot metadata .vmt V Camplate header .vmt Sapshot metadata .vmt V Camplate header .vmt Sapshot metadata .vmt Sapshot Mark NA	Maximums (per VM): vCPUs = 8 RA	M = 255GB Swap file = 255GB (1 per VM)
Proppy Unives - 2         VMLS - 101         Painter poils - 3         Strint poils - 4           Premote consoles = 40         VMDirectPath devices = 2         VMDirectPath SCSI targets = 60           Files: .cfg Earlier version of .vmkt file         .vmm         Snapshot medata           .hlog         VMotion log file         .vmms         Snapshot medata           .vmram         BIOS settings         .vmmt         The earlier version of .vmkt file           .vmram         RDM in Virtual Compatibility mode         .vmx         Ym Primary configuration file         The earlier version of .vmkt file           .vmrdk         Disk descriptor (also raw virtual disk for hosted products)         Snapshot medata         .vmmt           .rdt         Earlier version of .vmst file         .vmst         State configuration file for VMs in a team           .vmdk         Disk descriptor (also raw virtual disk for hosted products)         Snapshot metadata         .vmst           .rdt         List all registered VMs on a host: \$ studo / Usr/Fln//Wmkare.cdg         2           Commands: List all registered VMs on a host: \$ studo / Usr/Fln//Wmkare.cdg         2           VM HW: Memory/CPU Hoplug – VMmare Tools must be installed.         .Mmory/CPU Hoplug – VMst           VM HW: Memory/CPU Hoplug – VMst Tools, Select "Support clustering features such as FT", re-allocates & gearaneadthick, select "Support clustering features such as F	SCSI adapters = 4 Devices per SCSI adapt	er = 15 IDE devices (disk or CD) = 4
Files: .cfg       Earlier version of vmx file       Vmem       Vmem       VMemory         .dsk       Earlier version of vmx file       vmem       VMemory       Snapshot metadata         .log       VMotion log file       vms       Snapshot state file       vmem       VM's memory         .log       VM activity log       vmms       Snapshot metadata       Vmem       VM activity log         .nvram       BIOS settings       vmms       Snapshot metadata       Vmem       VM's memory         .nvm       RAW device e.g. tape device       vmm       Vmt       VT       VT       Template header         .nvm       RAW device e.g. tape device       vmm       Vmt       VT       Vm Primary configuration file       vmm         .ndm       RAW device e.g. tape device       vmm       VM to to tape tape tape tape tape tape tape tape	Remote consoles = 40 VMDirectPath devices	= 2 VMDirectPath SCSI targets = 60
dsk       version of vmdk file       .vms       Snapshot medatata         hog       VMotion log file       .vms       Snapshot state file       .vms         Lock-XXX       Locking file on NFS datastore       .vms       Suspended state file       .vms         Juram       BIOS settings       .vms       Suspended state file       .vms         Juram       BIOS settings       .vmt       VE template header       .vms         REDO       Earlier version of -delta.vmkf file       .vmt       VE template header       .vms         Stat       Earlier version of -delta.vmkf file       .vmt       VE template header       .vms         .vmdk       Disk descriptor (also raw virtual disk for hosted products)       .nfstore       .nfstore       .nfstore         -flat.vmdk       Raw virtual disks       00000#.delta.vmdk       Snapshot metadata       .nfstore         -ctk.vmdk       List all registered VMs on a botts       Sudo U/U Usware tools       Nfstore       .ndstore         -flat.wmok       Raw virtual disk       store       store       .nd       .ndstore       .ndstore <td< td=""><td>Files: .cfg Earlier version of .vmx file</td><td>vmem VM's memory</td></td<>	Files: .cfg Earlier version of .vmx file	vmem VM's memory
.htog       VMotion log file       .vmsm       Snapshot state file         .lck.XXL Locking file on NFS datastore       .vmsm       Suspended state file         .nvram       BIOS settings       .vmtw       Earlier version of VC template         .rdm       RDM in Physical Compatibility mode       .vmtx       VC template header       .vmtx       VC template header         .vmtx       REDO       Earlier version of -delta.vmdk file       .vmtx       Ftara onfiguration file for VMs in a team         .vmtd       Logis VM       Raw virtual disk       00000#.dmtk       Snapshot metadata         .vmtd       Canaged Block Tracking file       00000#.dmtk       Snapshot differential file         Logs: VM       Disk descriptor (also raw virtual disk for hosted products)       .fterate/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 swith Hwe ariter ran 4 have reduced performance, slower creation. thin allocates on snapshots. Perisitent changes immediate & permanent. Nonpersistent changes slow on opwer-off.         DMs       Disk types: zerodethick (also raves, page attracking iffe start rever to snapshot by aray. Independent disks: no snapshots. Perisitent changes immediate & permanent. Nonpersistent changes lost on power-off.         DMM: Benefity USer - Friend Starte rever to snapshot bok to paret. Stastot by are here.       VMotion, SAN	.dsk Earlier version of .vmdk file	.vmsd Snapshot metadata
Jck-XXX Locking file on NFS datastore Jog VM activity log , with Earlier version of VC template Jraw Row device e.g. tape device , Jraw RDM in Virual Compatibility mode , Jram RDM in Physical Compatibility mode , Jram VC template header , Jram VC template , Jram VM templater than V have reduced performance & topplater , Jram VM templater than V have reduced performance & topplater , Jram VM templater than V have reduced performance & topplater , Jram VM templater	.hlog VMotion log file	.vmsn Snapshot state file
Jog VM activity log	.lck-XXX Locking file on NFS datastore	.vmss Suspended state file
<ul> <li>Javram BIOS settings</li> <li>Javram BIOS settings</li> <li>Javram Raw device e.g. tape device</li> <li>Jawr Raw device e.g. tape device</li> <li>Jawr Raw device e.g. tape device</li> <li>Jawr Rom in Physical Compatibility mode</li> <li>Jawr Statistical Compatibility mode</li> <li>Jawr Sta</li></ul>	.log VM activity log	.vmtd Earlier version of VC template
<ul> <li>Taw Raw device e.g. Lape device</li></ul>	.nvram BIOS settings	.vmtm Team data
Addition       Filling Vindia Compatibility mode       SMLX       Filling Vindia Compatibility mode         REDO       Earlier version of -delta.vmdk file       wmsf       Extra configuration file for VMs in a team         .vmdk       Disk descriptor (also raw virtual disk for hosted products)       -flat.wmdk       Snapshot metadata         .edit.wmdk       Raw virtual disks       00000#-delta.vmdk       Snapshot metadata         .edgs: VM log       /vmfs/volumes/dotastore name/vm_name/vm_name/vm_ware.log         Commands:       List all registered VMs on a host: \$ sudo /usr/bln/vmware.log         Commands:       List all registered VMs on a host: \$ sudo /usr/bln/vmware.log         Commands:       List all registered VMs on a host: \$ sudo /usr/bln/vmware.log         VMs with We arlier than 4 have reduced performance & capabilities. Cannot add/remove devices.         Manually MAC addresses: 00:50:56:x;vz. Set in vmx: ethernet <number>.addressf ype="static".         Disk types: zeroedthick (lazy) default, pre-allocates. eagerzeroedthick select "Support clustering features such as FT", pre-allocates &amp; zeros, better performance, slower creation. thin allocates on-demand, monitor with "datastore usage" alarm. NFS: type determined by aray. Independent disks: no apashots. Features thanges immediate &amp; permanet. Nonpersistent changes lost on power-off.         RDM:       Benefits User-Friendly Persistent Names, Dynamic Name Resolution, Distributer File Locking, stations, File System Ops, SAN Snapshots. Cant snapshot physical RDMs or independent disks</number>	.raw Raw device e.g. tape device	.vmtx VC template header
ABDD       Earlier version of -delta.wmdk file         NREDO       Earlier version of -delta.wmdk file         vmdk       Disk descriptor (also raw virtual disk for hosted products)         -flatwmdk       Changed Block Tracking file         00000#.wmdk       Snapshot metadata         -ctk.wmdk       Changed Block Tracking file         00000#.wmdk       Snapshot differential file         Logs:       VM HW: Memory/CPU Hotplup         VM HW: Memory/CPU Hotplup       Storage dvice.wmke*.com/dots/manage/memory         VM HW: Memory/CPU Hotplup       VMware Tools storage dvice.storage dvice.storestorage dvice.storestorage dvice.storage dv	rdmp PDM in Physical Compatibility mode	.vmx Primary configuration file for VMs in a team
std       Earlier version of vinss file       First provide the order of the order order or order order order or order order order or order order order order or order order order order order or order ord	REDO Farlier version of _delta vmdk file	vswp Swap file for overcommitted memory
ymdk       Disk descriptor (also raw virtual disk for hosted products)         -flat.vmdk       Raw virtual disks       00000#.vmdk       Snapshot metadata         -ctk.vmdk       Charged Block Tracking file       00000#.vmdk       Snapshot differential file         Logs: VM log       /vmfs/volumes/datastore_name/vm_name/vmware.log         Commands: List all registered VMs on a host:       Sudo / Usr/Din/Vmware-ce.cmd -1         Creater/modify VMDKs, RDMs, VMFS volumes & storage devices: vmkf stools (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::v;:z:. Set in wms: tethernet-number>.addressType="static".         Disk types: zeroedthick (lazy) default, pre-allocates. zegerzeroedthick select "Support clustering features such as FT", pre-allocates & zeros, better performance, slower creation. thin allocates on-demand, monitor with "datastore usage" alarm. NFS: type determined by aray. Independent disks: no snapshots: Persistent changes immediate & permanent. Nonpersistent changes lost on power-off.         DME: Benefits User-Friendly Persistent Names, Dynamic Name Resolution, Distributed File Locking, File System Ops, SAN Snapshots, vMotion, SAN mgt agents & NPIV. Limitations: Not on a susphot by with physical RDMs, no partito mapping, needs whole LUN.         Snapshot Manager: Delete commits napshot to parent. Delet	.std Earlier version of .vmss file	.vswp - swap me for overcommitted memory
-rdt.vmdk       Raw virtual disks       00000#.vmdk       Snapshot metadata         -ctk.vmdk       Changed Block Tracking file       00000#.delta.vmdk       Snapshot differential file         Logs: VM log       /vmt5×volumes/datastore_nome/vm_name/vm_ware_log         Commands: List all registered VMs on a host: \$ sudo /usr/bin/vmware_log         Commands: List all registered VMs on a host: \$ sudo /usr/bin/vmware_cond -1         Create/modify VMDKs, RDMs, VMFS volumes & storage devices: vmkfr\$stools (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;yz. Set in vmx: ethernet <number>.addressType="static".         Disk types: zeroedthick (lazy) default, pre-allocates. <u>eager2reordthick</u> select "Support clustering         features such as FT", pre-allocates &amp; zeros, better performance, slower creation. thin allocates on-         demand, monitor with "datastore usage" alarm. NFS: type determined by array. Independent disks: no         snapshots.persistent Changes immediate &amp; permanent. Nonpersistent changes lost on power-off.         RDM: Benefits User-Friendly Persistent Names, Dynamic Name Resolution, Distributed File Locking, File Permissions, File System Ops, SAN Snapshots, vMotion, SAN mgt agents &amp; NPIV. Limitations: Not aloo a suspended VM, new host must meet CPU compatibility requ</number>	.vmdk Disk descriptor (also raw virtual disk	for hosted products)
<ul> <li>-ctk.vmdk Changed Block Tracking file <sup>1</sup>00000#-delta.vmdk Snapshot differential file</li> <li>Logs: VM log /vmfs/volumes/datastore_name/vm_name/vmware.log</li> <li>Commands: List all registered VMs on a host: <sup>5</sup> sudo /usr/bin/vmware-cnd -1</li> <li>Create/modify VMDKs, RDMs, VMFS volumes &amp; storage devices: vmkfst001s (check man page)</li> <li>Power Off = hard power off • Shut Down = soft with VMware tools • Reset = hard • Restart = soft</li> <li>VM With HW earlier than v4 have reduced performance &amp; capabilities. Cannot add/remove devices.</li> <li>Manually MAC addresses: 00:50:56:x;:2. Set in vmx: ethernet<number>.addressType="static".</number></li> <li>Disk types: zeroedthick (lazy) default, pre-allocates. eagerzeroedthick select "Support clustering features such as FT", pre-allocates &amp; zeros, better performance, slower creation. thin allocates on-demand, monitor with "datastore usage" alarn. NFS: type determined by array. Independent disks: no snapshots. Persistent changes immediate &amp; permanent. Nonpersistent (changes lost on power-off.</li> <li>RDM: Benefits User-Friendly Persistent Names, Dynamic Name Resolution, Distributed File Locking, File Permissions, File System Ops, SAN Snapshots, vMotion, SAN mgt agents &amp; NPIV. Limitations not for block devices, no snapshots with physical RDMs, no partition mapping, needs whole LUN.</li> <li>Snapshot Manager: Delete commits snapshot to parent. Delete all commits all snapshots You are here.</li> <li>VMotion: To VMotion a suspended VM, new host must meet CPU compatibility requirements.</li> <li>Storage VMotion: can transform thick &gt; thin or thin &gt; thick. Limitations: VMs cannot have snapshots, only persistent VMDKs or RDMs, requires license, ESX3.5 hosts need VMotion licensed/configured.</li> <li>VMI (VM Interface) paravirtualization: standard to improve performance, only Linux 32bit guests.</li> <li>Uses a PCI slot. VMI VM must be of to move to an unsupported host; can reduce performance.</li> <li>VMDirect</li></ul>	-flat.vmdk Raw virtual disks	00000#.vmdk Snapshot metadata
Logs: VM log /vmfs/volumes/datastore_name/vm_name/vmware.og Commands: List all registered VMs on a host: S: Sudo /usr/bin/vmware.cmd -1 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:xvy:z. Set in vmx: ethemer(=number:_addressType="static", Disk types: zeroedthick (lazy) default, pre-allocates. eagerzeroedthick select "Support clustering features such as FT", pre-allocates & zeros, better performance, slower creation. thin allocates on- demand, monitor with 'datastore usage" alarm. NFS: type determined by array. Independent disks: no snapshots. Persistent changes immediate & permanent. Nonpersistent changes lost on power-off. RDM: <u>Benefits</u> User-Friendly Persistent Names, Dynamic Name Resolution, Distributed File Locking, File Permissions, File System Ops, SAN Snapshots, vMotion, SAN mgt agents & NPIV. <u>Limitations</u> 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 g	-ctk.vmdk Changed Block Tracking file	00000#-delta.vmdk Snapshot differential file
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<ul> <li>The Filmsholts, inte Oyaen Dep, SrAT on paralos, Witholin, SrAT ingragenes &amp; Writh <u>Limitations</u> not for block devices, no snapshots with physical RDMs, no partition mapping, needs whole LUN.</li> <li>Snapshots:capture memory state, settings &amp; disks. Can't snapshot physical RDMs or independent disks</li> <li>Snapshot Manager: Deleg commits snapshot to parent. Delete all commits all snapshots before <i>You are here</i>.</li> <li>VMotion: To VMotion a suspended VM, new host must meet CPU compatibility requirements.</li> <li>Storage VMotion: can transform thick &gt; thin or thin &gt; thick. Limitations: VMs cannot have snapshots, only persistent VMDKs or RDMs, requires license, ESX3.5 hosts need VMotion licensed/configured.</li> <li>VMI (VM Interface) paravirtualization: standard to improve performance, only Linux 32bit guests.</li> <li>Uses a PCI slot. VMI VM must be off to move to an unsupported host; can reduce performance.</li> <li>VMDirectPath: I/O allows guest OS to access physical PCI/PCIe devices. Intel Nehalem platforms.</li> <li>Restrictions: VMotion, hot add/remove, suspend, record/replay, FT, HA, DRS (but allowed in cluster).</li> <li>SCSI controllers: BusLogic Parallel • LSI Logic SAS • LSI Logic Parallel • PVSCSI</li> <li>PVSCSI (Paravirtual SCSI): high-performance storage adapter. Not recommended for DAS. <u>Guests</u>: Win 2003, 2008, RHEL5. Not supported: Record/Replay, FT, MSCS, (2003/8 boot disks OK since U1).</li> <li>NPIV (N-port ID virtualization): share FC HBA port as multiple virtual ports, each with unique IDs.</li> <li>VMS assigned 4 WWNs, NPIV capable HBAs, no Storage VMotion, VM can't power on if WWNs in use vINCs: • <u>Elexible</u> - 32-bit guests, vlance without VMware Tools or wmxnet with UMware Tools • <u>entomater</u> with UMware Tools • <u>Wmxnet3</u>.</li> <li>OWF: emplates can be deployed from a local file system via the Climat, or from a web server.</li> <li>OVF: files are compressed. Client validates the OVF file before importing it.</li></ul>	File Permissions File System One SAN Spapsho	ts vMotion SAN mot agents & NPIV Limitations
<ul> <li>Snapshots:capture memory state, settings &amp; disks. Can't snapshot physical RDMs or independent disks</li> <li>Snapshot Manager: <u>Delete</u> commits snapshot to parent. <u>Delete all</u> commits all snapshots before You are here. Go to reverts to that snapshot. <u>Revert to snapshot back</u> to parents: snapshot You are here.</li> <li>VMotion: To VMotion a suspended VM, new host must meet CPU compatibility requirements.</li> <li>Storage VMotion: can transform thick &gt; thin or thin &gt; thick. Limitations: VMs cannot have snapshots, only persistent VMDKs or RDMs, requires license, ESX3.5 hosts need VMotion licensed/configured.</li> <li>VMI (VM Interface) paravirtualization: standard to improve performance, only Linux 32bit guests.</li> <li>Uses a PCI slot. VMI VM must be off to move to an unsupported host; can reduce performance.</li> <li>VMDirectPath: I/O allows guest OS to access physical PCI/PCIe devices. Intel Nehalem platforms.</li> <li>Restrictions: VMotion, Hot add/remove, suspend, record/replay, FT, HA, DRS (but allowed in cluster).</li> <li>SCSI controllers: • BusLogic Parallel • LSI Logic SAS • LSI Logic Parallel • PVSCSI</li> <li>PVSCSI (Paravirtual SCSI): high-performance storage adapter. Not recommended for DAS. <u>Guests</u>: Win 2003, 2008, RHELS. Not supported: Record/Replay, FT, MSCS, (2003/8 boot disks OK since U1)</li> <li>NPIV (N-port ID virtualization): share FC HBA port as multiple virtual ports, each with unique IDs.</li> <li>VMS assigned 4 WWNs. Limitations: NPIV enabled FC switch, only RDMs, HBAs need access to 1UN using its WWNs, NPIV capable HBAs, no Storage VMotion, VM can't power on if WWNs in use *1000 - Emulates E1000 NIC, default for 64-bit guests • <u>Enhanced vmxnet</u> + vmxnet with enhanced performance, requires VMware Tools • <u>vmxnet</u> - vmxnet with enhanced performance &amp; networking features, requires VMware Tools &amp; HW V7, doesn't support FT.</li> <li>TSO (TCP Segmentation Offload): enabled in VMkernel by default, must be enabled at VM level.<td>not for block devices no snapshots with physical</td><td>RDMs no partition mapping needs whole LUN</td></li></ul>	not for block devices no snapshots with physical	RDMs no partition mapping needs whole LUN
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PVSCSI (Paravirtual SCSI): high-performance storage adapter. Not recommended for DAS. <u>Guests</u> : Win 2003, 2008, RHEL5. <u>Not supported</u> : Record/Replay, FT, MSCS, (2003/8 boot disks OK since U1) <b>NPIV</b> (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 cart power on if WWNs in use <b>vNICs:</b> • <u>Flexible</u> - 32-bit guests, vlance without VMware Tools or vmxnet with VMware Tools • <u>e1000</u> - Emulates E1000 NIC, default for 64-bit guests • <u>Enhanced vmxnet</u> - vmxnet with thenced performance, requires VMware Tools • <u>vmxnet</u> - vmxnet with enhanced performance, requires VMware Tools • <u>vmxnet</u> - vmxnet with enhanced performance, requires VMware Tools • <u>vmxnet</u> - vmxnet with enhanced performance, requires VMware Tools • <u>vmxnet</u> - vmxnet with enhanced performance, requires VMware Tools • <u>Vmxnet</u> - vmxnet with enhanced vmxnet or VMsret <b>TSO</b> (TCP Segmentation Offload): enabled in VMkernel by default, must be enabled at VM level. Needs enhanced vmxnet, might change the MAC. <b>Jumbo frame</b> requires enhanced vmxnet or vmxnet3. <b>OVF</b> : 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. <b>YApp</b> : container containing one or more VMs, can power on & off, & be cloned. Metadata in VC's DB. <b>IP</b> pool - network confliguration assigned to network used by vApp. VC then provides IPs to its VMs. <b>Links</b> : <u>http://kb.vmware.com/kb/1010048</u> - Set all VMs to upgrade tools at next power on <u>http://kb.vmware.com/kb/1002311</u> - Recreate missing virtual disk (VMDK) header/description file <u>http://kb.vmware.com/kb/1002310</u> - Committing snapshot if no snapshot entries in snapshot manager <u>http://kb.vmware.com/kb/1002310</u> - Committing snapshots if no snapshot netries in snapshot manager <u>http://kb.vmware.com/kb/1002310</u> - Commiting snapshots if no	SCSI controllers: • BusLogic Parallel • LSI Logi	c SAS • LSI Logic Parallel • PVSCSI
Win 2003, 2008, RHEL5. Not supported: Record/Replay, FT, MSCS, (2003/8 boot disks OK since U1) <b>NPIV</b> (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 <b>vNICs:</b> + Fixible - 32-bit guests, vlance without VMware Tools or vmxnet with VMware Tools + <u>e1000</u> - Emulates E1000 NIC, default for 64-bit guests + <u>Enhanced vmxnet</u> - vmxnet with enhanced performance, requires VMware Tools + <u>vmxnet3</u> - vmxnet with enhanced performance & networking features, requires VMware Tools + <u>VMvret0</u> - vmxnet with enhanced performance & networking features, requires VMware Tools + <u>VMvret0</u> - vmxnet with enhanced vmxnet or vmxnet3. <b>OVF</b> : 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. <b>vApp</b> : 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. <b>Links</b> : <u>http://kb.vmware.com/kb/1010241</u> - Stel II VMs to upgrade tools at next power on <u>http://kb.vmware.com/kb/1002511</u> - Recreate missing virtual disk (VMDK) header/description file <u>http://kb.vmware.com/kb/1002310</u> - Committing snapshots if no snapshot entries in snapshot manager <u>http://kb.vmware.com/kb/1007849</u> - Consolidating snapshots	PVSCSI (Paravirtual SCSI): high-performance st	orage adapter. Not recommended for DAS. Guests:
<ul> <li>NPIV (N-port ID virtualization): share FC HBA port as multiple virtual ports, each with unique IDs.</li> <li>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 vNIGs: • <u>Flexible</u> - 32-bit guests, vlance without VMware Tools or vmxnet with VMware Tools • <u>e1000</u> - Emulates E1000 NIC, default for 64-bit guests • <u>Enhanced vmxnet</u> - vmxnet with PMware Tools • <u>e1000</u> - Emulates E1000 NIC, default for 64-bit guests • <u>Enhanced vmxnet</u> - vmxnet with PMare Tools • <u>vmxnet3</u>.</li> <li>TSO (TCP Segmentation Offload): enabled in VMkernel by default, must be enabled at VM level.</li> <li>Needs enhanced vmxnet, might change the MAC. Jumbo frame requires enhanced vmxnet or vmxnet3.</li> <li>OVF: templates can be deployed from a local file system via the Client, or from a web server.</li> <li>OVF files are compressed. Client validates the OVF file before importing it.</li> <li>VApp: container containing one or more VMs, can power on &amp; off, &amp; be cloned. Metadata in VC's DB.</li> <li>IP pool - network configuration assigned to network used by vApp. VC then provides IPs to its VMs.</li> <li>Links: http://kb.vmware.com/kb/1010248.</li> <li>Set all VMs to upgrade tools at next power on <a href="http://kb.vmware.com/kb/1002311">http://kb.vmware.com/kb/1002310</a>. Committing snapshots if no snapshot netries in snapshot maleer in the system via the solution of sile scription file http://kb.vmware.com/kb/1002310</li> </ul>	Win 2003, 2008, RHEL5. Not supported: Record/	Replay, FT, MSCS, (2003/8 boot disks OK since U1)
VMs assigned 4 WWNs, Limitations: WPIV enabled FC switch, only RDMs, HBAs need access to LUN using its WWNs, NPIV capable HBAs, no Storage VMotion, VM cart power on if WWNs in use <b>vNCs:</b> • <u>Flexible</u> - 32-bit guests, vlance without VMware Tools or vmxnet with VMware Tools • <u>e1000</u> - Emulates E1000 NIC, default for 64-bit guests • <u>Enhanced vmxnet</u> - vmxnet with enhanced performance, requires VMware Tools • <u>vmxnet</u> - vmxnet with enhanced performance, nequires VMware Tools • <u>vmxnet</u> - vmxnet with enhanced performance, requires VMware Tools • <u>vmxnet</u> - vmxnet with enhanced performance, requires VMware Tools • <u>vmxnet</u> - vmxnet with enhanced performance, requires VMware Tools • <u>vmxnet</u> - vmxnet with enhanced performance, nealed in VMkernel by default, must be enabled at VM level. Needs enhanced vmxnet, might change the MAC. <b>Jumbo frame</b> requires enhanced vmxnet or vmxnet3. <b>OVF</b> : 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. <b>vApp</b> : 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. <b>Links</b> : <u>http://kb.vmware.com/kb/1002511</u> - Recreate missing virtual disk (VMDK) header/description file http://kb.vmware.com/kb/1002310 - Committing snaphots if no snapshot entries in snapshot manager <u>http://kb.vmware.com/kb/1007849</u> - Consolidating snapshots in some some some some some some some some	<b>NPIV</b> (N-port ID virtualization): share FC HBA I	port as multiple virtual ports, each with unique IDs.
FLON using its WWNS, NPTV capable PISAS, ito Storage V Motion, VM Calit power for M WWNS in the VNICs: Flexible 3.2-bit guests, vlance without VMware Tools or wmxnet with VMware Tools • e1000 - Emulates E1000 NIC, default for 64-bit guests • Enhanced vmxnet - vmxnet with enhanced performance, requires VMware Tools • <u>vmxnet3</u> - vmxnet with enhanced performance, requires VMware Tools • <u>WMV7</u> , 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 requires enhanced vmxnet or vmxnet3. 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. <b>vApp</b> : 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: <a href="http://kb.vmware.com/kb/1002510">http://kb.vmware.com/kb/1002510</a> - Committing snapshots if no snapshot entries in snapshot manager http://kb.vmware.com/kb/1002310 - Committing snapshots	VMs assigned 4 WWNs. Limitations: NPIV enab	led FC switch, only RDMs, HBAs need access to
<ul> <li>e1000 - Emulates E1000 NIC, default for 64-bit guests • Enhanced vmxnet - vmxnet with of whate 1001s • e1000 - Emulates E1000 NIC, default for 64-bit guests • Enhanced vmxnet - vmxnet with enhanced performance, requires VMware Tools • vmxnet3 - vmxnet with enhanced performance, requires VMware Tools 8. HW v7, doesn't support FT.</li> <li>TSO (TCP Segmentation Offload): enabled in VMkernel by default, must be enabled at VM level. Needs enhanced vmxnet , might change the MAC. Jumbo frame requires enhanced vmxnet or vmxnet3. 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.</li> <li>vApp: container containing one or more VMs, can power on &amp; off, &amp; be cloned. Metadata in VC's DB. IIP pool - network configuration assigned to network used by vApp. VC then provides IPs to its VMs. Links: http://kb.vmware.com/kb/1010241 - Set all VMs to upgrade tools at next power on http://kb.vmware.com/kb/1002511 - Recreate missing virtual disk (VMDK) header/description file http://kb.vmware.com/kb/1002310 - Committing snapshots if no snapshot entries in apshot manager http://kb.vmware.com/kb/1007849 - Consolidating snapshots</li> </ul>	<b>NIC</b> : • Elovible 22 bit quests vience without	WMware Tools or umynet with WMware Tools
<ul> <li><u>Divisional Finder Network</u> (Scham for or or or or geta setable)</li> <li><u>Divisional Finder Network</u> (Scham for or or or or or geta setable)</li> <li><u>Divisional Finder Network</u> (Scham for or or or or or or or setable)</li> <li><u>Provider Scham Finder Network</u> (Scham for or o</li></ul>	e1000 - Emulates E1000 NIC default for 64-bit g	uests • Enhanced vmynet - vmynet with enhanced
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 requires enhanced vmxnet or vmxnet3. 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/1002511 - Recreate missing virtual disk (VMDK) header/description file http://kb.vmware.com/kb/1002310 - Committing snapshots if no snapshot entries in snapshot manager http://kb.vmware.com/kb/1007849 - Consolidating snapshots	performance, requires VMware Tools • vmxnet3 ·	vmxnet with enhanced performance & networking
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	http://kb.vmware.com/kb/1007849 - Consolidatin	g snapshots

VMs & vApps

Availability (HA)

Maximums (per HA cluster): Hosts = 32 VMs = 1280 (max 160 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
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HÅ 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 host: & cat /var/log/vmware/aam/aam\_config\_util listnodes.log Seconday host promoted if 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) HA 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. Control policies • Host Failures Cluster Tolerates (1-4 hosts) - adds Advanced Runtime Info box showing slot size, total, used, available slots, total VMs on, hosts, good hosts •% of Cluster Resources (up to 50%) • Specify a Failover Host. <u>Policy Factors</u> • 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