

# VMware

- VMware je **vodeći proizvođač** softvera za virtuelizaciju
- Osnovan je 1998. godine
- VMware proizvodi mogu se pokretati na **operativnim sistemima Windows, Linux i Mac OS X**
- Takođe, dostupan je i **korporativni VMware ESX server** koji se izvršava direktno na hardveru čime se značajno poboljšavaju performanse
- Virtuelizacija emulira celokupni hardver, tj. mrežne uređaje, video kartice, USB priljučke, itd. VMware Workstation, Server i ESX proizvodi ne prevode mašinske naredbe, odnosno koriste isti skup instrukcija koji koristi stvarni hardver
- To značajno poboljšava performanse sistema, ali može stvarati probleme kod prenošenja virtuelnih mašina na druge fizičke arhitekture
- Na primer, virtuelna mašina se mora zaustaviti pre nego se prebaci na drugi procesor

# 7.1. VMware

## ■ Neki od VMware proizvoda su:

- ❖ *VMware Workstation*
- ❖ *VMware Fusion*
- ❖ *VMware Player*
- ❖ *VMware ESX*
- ❖ *VMware Server*
- ❖ *Vmotion* u radnom stanju i bez prekida u radu sa jednog na drugi fizički host

## ■ Drugi VMware alati omogućuju:

- ❖ virtuelizaciju programa/aplikacija (*VMware ThinApp*)
- ❖ upravljanje ESX/ESXi okolinom (*VMware Infrastructure*)
- ❖ druge primene

# VMware





<b><u>Type</u></b>	<a href="#">Public</a> , partial <a href="#">subsidiary</a> of <a href="#">EMC Corporation</a>
<b><u>Traded as</u></b>	<a href="#">NYSE: VMW</a>
<b>Industry</b>	<a href="#">Computer software</a>
<b>Founded</b>	<a href="#">Palo Alto, California, USA</a> , 1998
<b>Headquarters</b>	Palo Alto, California, USA
<b>Key people</b>	<a href="#">Paul Maritz</a> (President & CEO) <a href="#">Diane Greene</a> <a href="#">Mendel Rosenblum</a> <a href="#">Edouard Bugnion</a>
<b>Products</b>	<a href="#">vSphere</a> <a href="#">ESX Server</a> <a href="#">ESXi Server</a> <a href="#">Workstation</a> <a href="#">Fusion</a> <a href="#">Player</a> <a href="#">Server</a> VMware Service Manager <a href="#">ThinApp</a> <a href="#">View</a> ACE Lab Manager <a href="#">Infrastructure</a> Converter Site Recovery Manager Stage Manager vCenter Orchestrator <a href="#">VMFS</a>
<b>Revenue</b>	▲US\$ 3.77 <a href="#">billion</a> (2011)
<b><u>Operating income</u></b>	▲US\$ 735 million (2011)
<b><u>Net income</u></b>	▲US\$ 724 million (2011)
<b><u>Total assets</u></b>	▲US\$ 4.51 <a href="#">billion</a> (2011)
<b>Employees</b>	11,200
<b><u>Parent</u></b>	<a href="#">EMC Corporation</a>
<b><u>Website</u></b>	<a href="#">VMware.com</a>

# VMware

- VMware, Inc. (NYSE: VMW) is a company providing virtualization software, founded in 1998 and based in Palo Alto, California, USA.
- The company **was acquired by EMC Corporation in 2004**, and operates as a **separate software subsidiary**.
- **VMware's desktop software**
  - ❖ runs on Microsoft Windows, Linux, and Mac OS X
- while
- **VMware's enterprise software hypervisors for servers**,
  - ❖ **VMware ESX and VMware ESXi**,
  - ❖ are **bare-metal embedded hypervisors**
  - ❖ that run directly on server hardware
  - ❖ without requiring an additional underlying operating system.

# VMware - Core product design

- VMware software provides
  - ❖ a **completely virtualized set of hardware**
  - ❖ to the guest operating system
- VMware software **virtualizes the hardware for:**
  - ❖ a video adapter
  - ❖ a network adapter
  - ❖ and hard disk adapters
- The host provides **pass-through drivers** for
  - ❖ guest USB
  - ❖ serial and parallel devices
- In this way,
  - ❖ VMware virtual machines become
  - ❖ **highly portable between computers,**
  - ❖ because every host looks nearly identical to the guest.

# VMware - Core product design

- In practice, a system administrator
  - ❖ **can pause** operations on a virtual machine guest,
  - ❖ move or copy that guest to another physical computer,
  - ❖ and there resume execution exactly at the point of suspension.
- Alternatively,
- for **enterprise servers**,
- a feature called **vMotion**
  - ❖ allows the migration of operational guest virtual machines between similar
  - ❖ but separate hardware hosts sharing the same storage
  - ❖ (or, with vMotion Storage, separate storage can be used, too).
- Each of these transitions is **completely transparent** to any users on the virtual machine at the time it is being migrated

# VMware - Core product design

- VMware Workstation, Server, and ESX
- take a more optimized path
- to running target operating systems on the host
- than emulators (such as Bochs)
  - ❖ which simulate the function of each CPU instruction
  - ❖ on the target machine one-by-one,
  - ❖ or **dynamic recompilation** which compiles blocks of machine-instructions the first time they execute,
  - ❖ and then uses the translated code directly
  - ❖ when the code runs subsequently
  - ❖ (**Microsoft Virtual PC** for Mac OS X takes this approach)

# VMware - Core product design

- VMware software
  - ❖ **does not emulate**
  - ❖ an instruction set
  - ❖ for different hardware not physically present
- This significantly **boosts performance**,
- but can cause **problems**
  - ❖ **when moving virtual machine guests**
  - ❖ between hardware hosts using different instruction-sets
  - ❖ (such as found in 64-bit Intel and AMD CPUs),
  - ❖ or between hardware hosts with a differing number of CPUs.
- Software that is CPU agnostic can usually survive such a transition,
  - ❖ unless it is agnostic by forking at startup,
  - ❖ in which case,
  - ❖ the **software or the guest OS must be stopped before moving it**,
  - ❖ then restarted after the move

# VMware - Core product design

- VMware's products **predate**
  - ❖ **the virtualization extensions** to the x86 instruction set,
  - ❖ **and**
  - ❖ **do not require virtualization-enabled processors**
  
- On newer processors,
  - ❖ **the hypervisor is now designed**
  - ❖ **to take advantage of the extensions**

# VMware - Core product design

- However,
- unlike many other hypervisors,
- VMware **still supports older processors.**
  
- In such cases,
  - ❖ **it uses the CPU to run code directly**
  - ❖ **whenever possible**
  - ❖ (as, for example,
  - ❖ when running user-mode and virtual 8086 mode code on x86)
  
- When direct execution cannot operate,
  - ❖ such as with kernel-level and real-mode code,
  - ❖ VMware products **re-write the code dynamically,**
  - ❖ a process VMware calls "**binary translation**" or **BT**

# VMware - Core product design

- The **translated code gets stored in spare memory**,
  - ❖ typically at the end of the address space,
  - ❖ which segmentation mechanisms can protect and make invisible.
- For these reasons,
  - ❖ **VMware operates dramatically faster than emulators**,
  - ❖ **running at more than 80% of the speed**
  - ❖ that the virtual guest operating-system would run directly on the same hardware.
- In one study
  - ❖ VMware claims a slowdown over native **ranging from 0–6 percent**
  - ❖ **for the VMware ESX Server**

# VMware - Core product design

- VMware's approach avoids
  - ❖ some of the difficulties of virtualization
  - ❖ on x86-based platforms.
- Virtual machines may deal
  - ❖ with offending instructions
  - ❖ **by replacing them,**
  - ❖ or **by simply running kernel-code in user-mode**
- Replacing instructions
  - ❖ **runs the risk that the code may fail**
  - ❖ to find the expected content if it reads itself;
  - ❖ one cannot protect code against reading
  - ❖ while allowing normal execution,
  - ❖ and replacing in-place becomes complicated

# VMware - Core product design

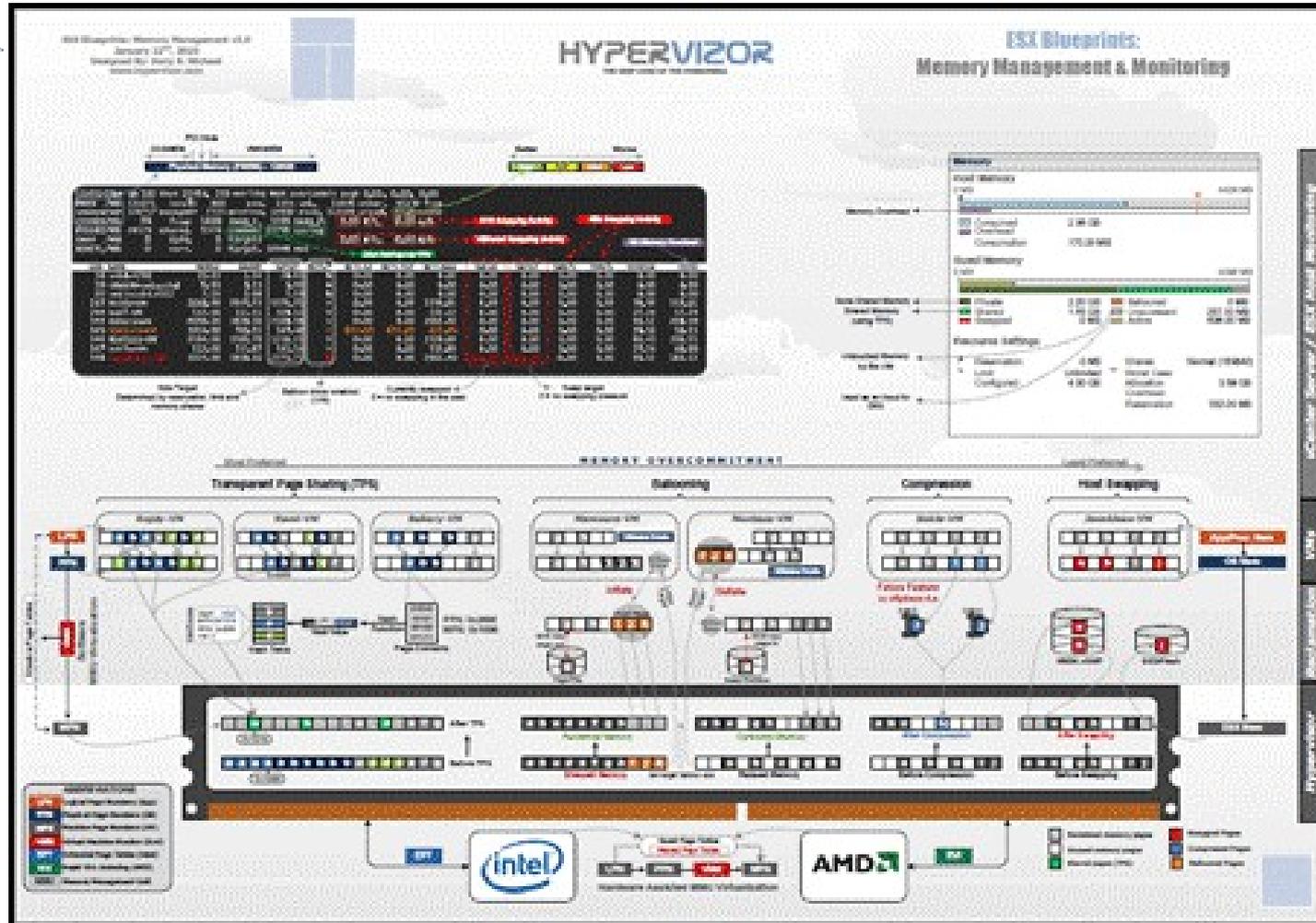
- **Running the code unmodified in user-mode will also fail,**
  - ❖ as most instructions which just read the machine-state
  - ❖ do not cause an exception
  - ❖ and will betray the real state of the program,
  - ❖ and certain instructions silently change behavior in user-mode
  
- **One must always rewrite;**
  - ❖ performing a simulation of the current program counter
  - ❖ in the original location when necessary
  - ❖ and (notably) remapping hardware code breakpoints

# VMware - Core product design

- Although VMware virtual machines run in user-mode,
- VMware Workstation **itself requires**
  - ❖ the **installation of various drivers in the host operating-system**,
  - ❖ notably to **dynamically switch the Global Descriptor Table (GDT)**
  - ❖ and
  - ❖ the **Interrupt Descriptor Table (IDT)**
  
- The VMware product line
  - ❖ can also run different operating systems
  - ❖ on **a dual-boot system simultaneously**
  - ❖ by booting one partition natively
  - ❖ while using the other as a guest within VMware Workstation

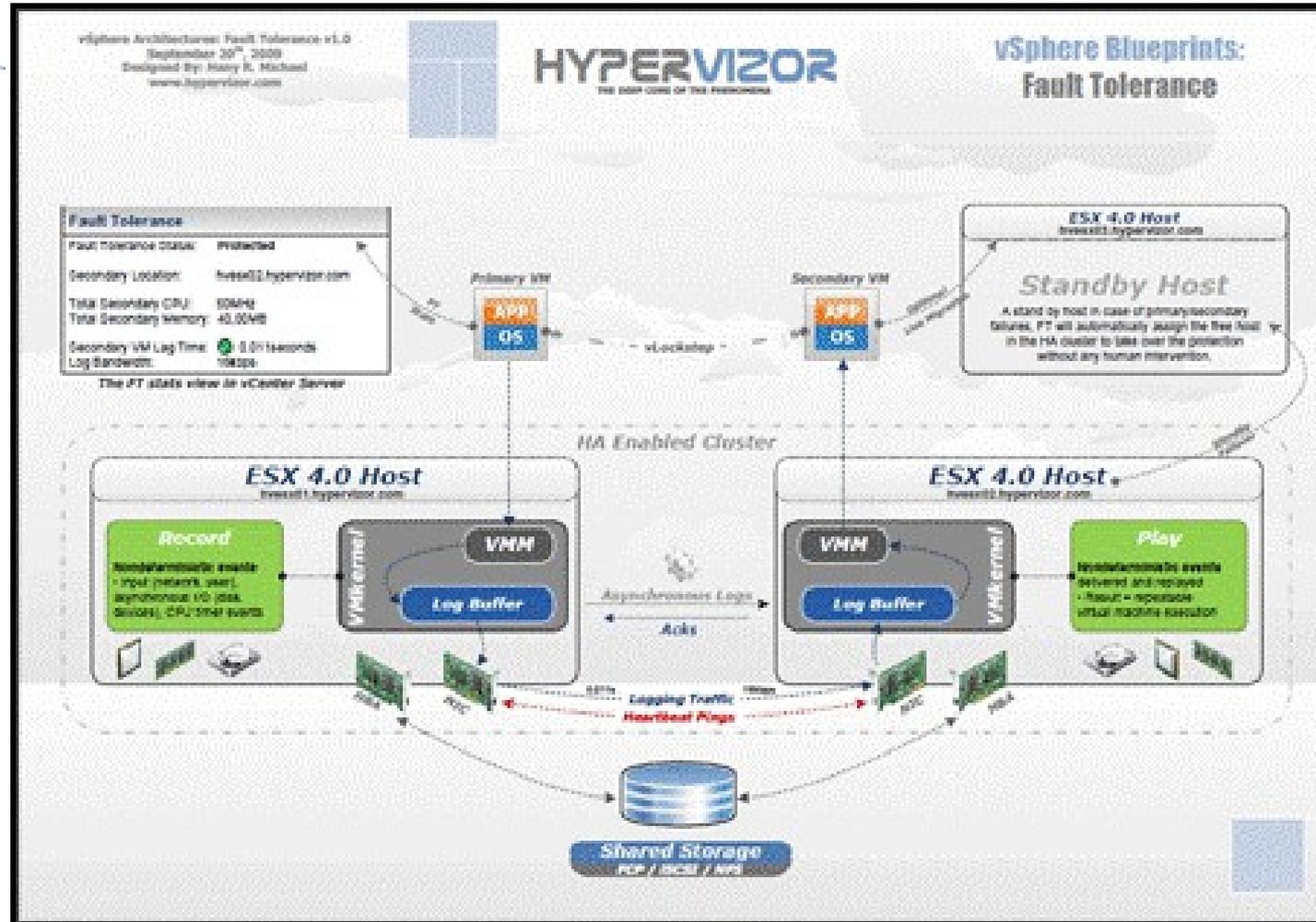
# VMware -Technology Architecture

## VMware ESX Memory Management and Monitoring



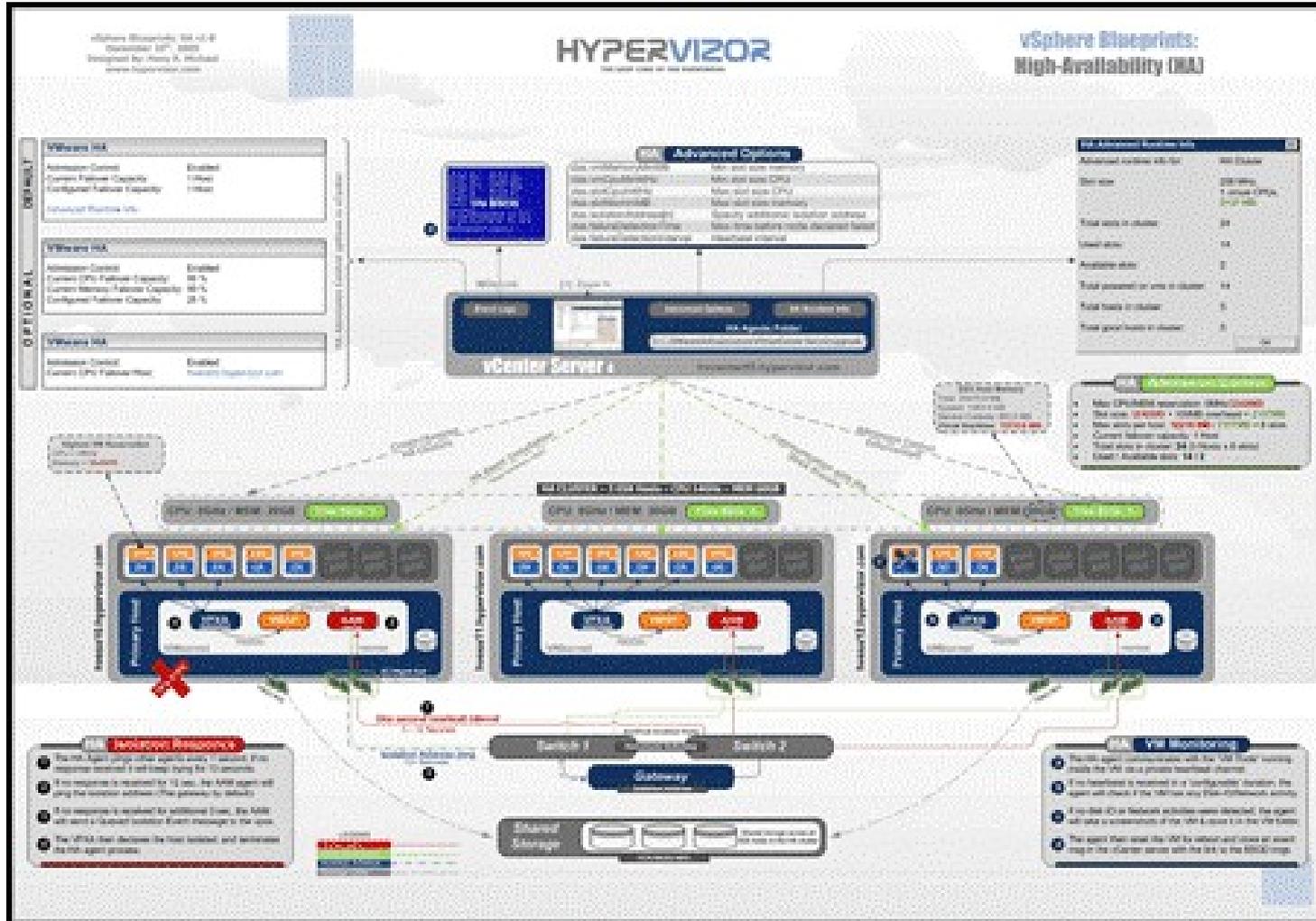
# VMware-Technology Architecture

## VMware Fault Tolerance



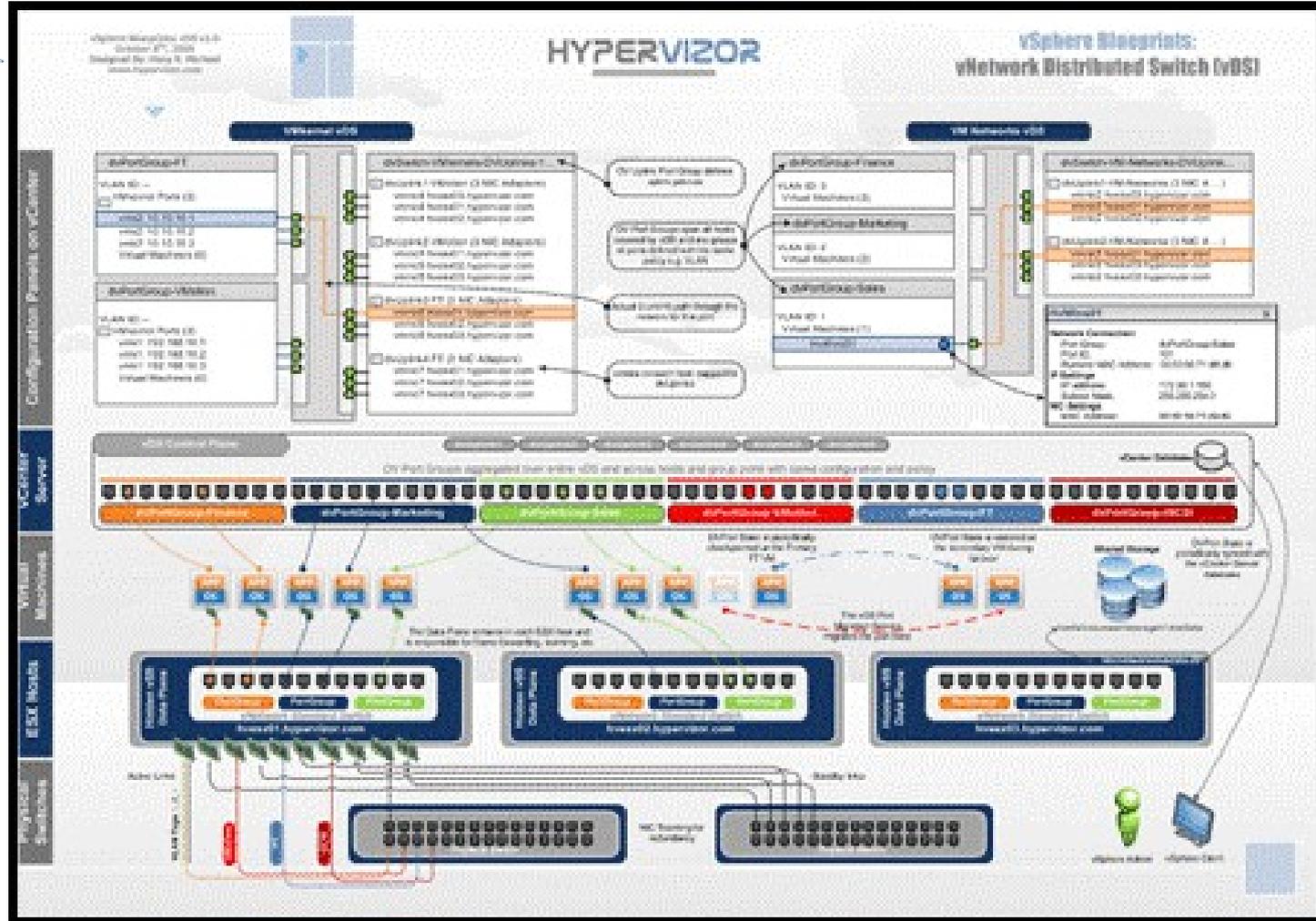
# VMware -Technology Architecture

## VMware High Availability



# VMware -Technology Architecture

## VMware vNetwork Distributed Switch





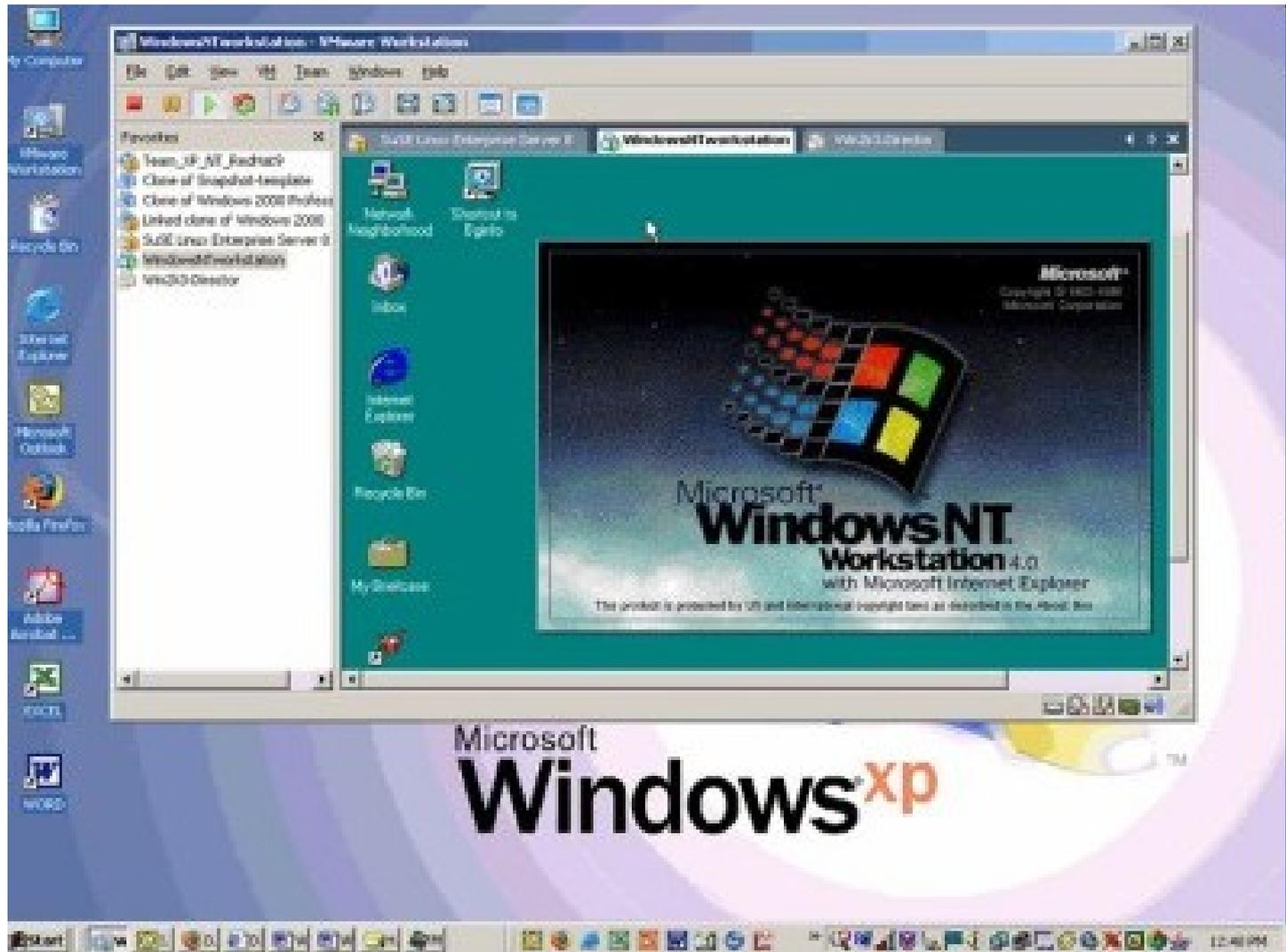
# VMware

vCenter Server (\$) (license manager)	Server	ESX (\$) (vMotion, DRS, HA, Storage vMotion)		
	hardware	ESXi (freeware) (ESXi freeware is managed by the Virtual Infrastructure (or vSphere) Client) ESXi (\$) (vMotion, DRS, HA, Storage vMotion)		Guest OS Guest OS Guest OS...
Workstation hardware	Windows or Linux OS	User session	<a href="#">VMware Server</a> (freeware)	Guest OS
			<a href="#">VMware Workstation</a> (\$)	Guest OS
			<a href="#">VMware Player</a> (freeware)	Guest OS...
			vSphere Client for managing ESX(i) hosts (freeware)	

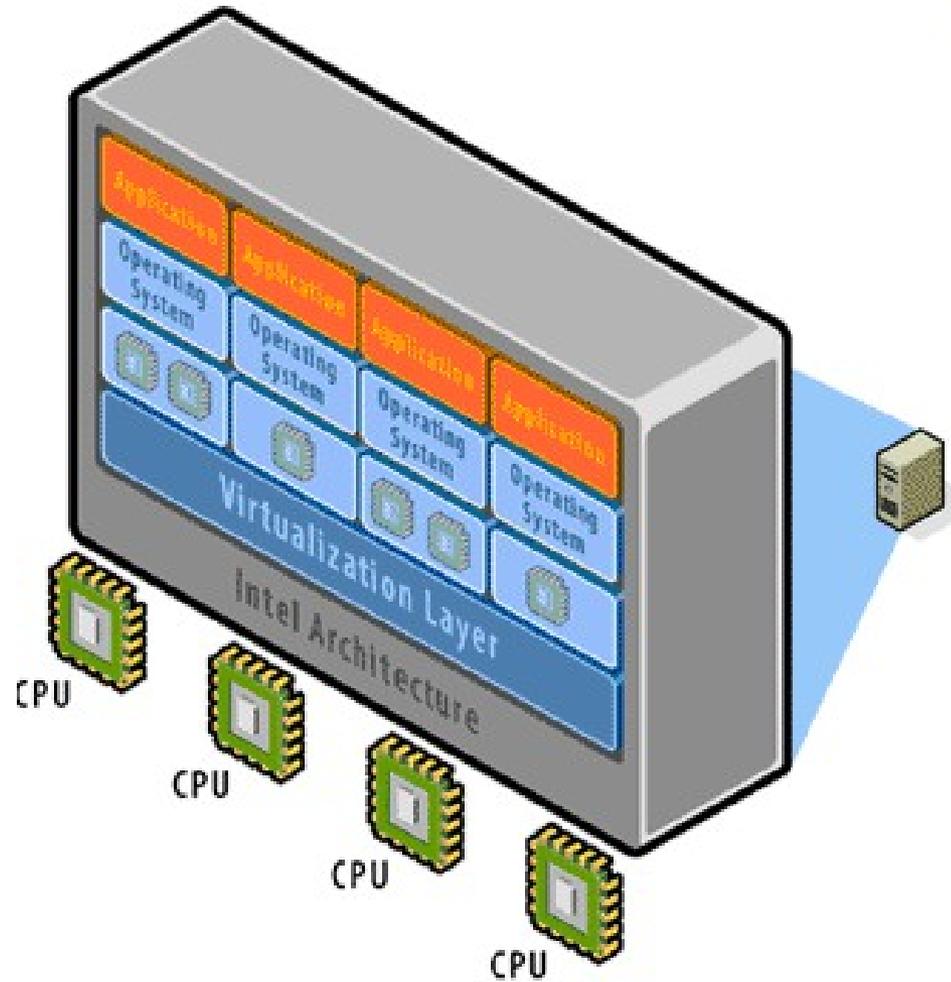
# VMware-Desktop software & End-User Computing

- **VMware ThinApp** (formerly known as Thinstall), an application virtualization solution designed to accelerate application deployment and simplify application migration.
- **VMware ACE** (Assured Computing Environment)
- **VMware Express** (for accessing Windows applications from a Linux desktop)
- **VMware Fusion** (for Mac Desktops), a solution for Apple users to seamlessly run Windows and Windows applications on an Intel processor-powered Apple OS X Macintosh computer.
- **VMware Player**, is a free software used to run multiple operating systems at the same time on your PC.
- **VMware View** (formerly VMware VDM), an enterprise desktop virtualization platform designed to optimize application and desktop management and enable flexibility for end-users.
- **VMware Workstation**, a solution that enables multiple operating systems to run at the same time on a single endpoint device.
- **VMware Zimbra**, an enterprise-class, calendar and collaboration platform based on the popular Zimbra open source project.
- **SlideRocket**, is an online presentation platform that lets users create, manage, share and measure presentations.

# VMware



# VMware



# VMware-Server software and datacenter products

- VMware vSphere 5
- VMware vSphere 4 (rebranded version VMware Infrastructure)
- VMware Infrastructure 3
- VMware ESXi (formerly VMware ESX Server ESXi edition)
- VMware ESX (formerly VMware ESX Server)
- VMware Server (formerly VMware GSX Server)
- VMware vCenter Application Discovery Manager VMware vCenter AppSpeed
- VMware vCenter Converter (formerly VMware P2V)
- VMware vCenter Lab Manager (formerly VMware Lab Manager)
- VMware vCenter Lifecycle Manager
- VMware vCenter Operations Standard / Advanced / Enterprise
- VMware vCenter Orchestrator
- VMware vCenter Server (formerly VMware VirtualCenter)
- VMware vCenter Server Heartbeat
- VMware vCenter Site Recovery Manager
- VMware vCenter Stage Manager (formerly VMware Stage Manager)
- VMware vCenter Update Manager (ESX/ESXi Host, Guest OS (Windows & Linux) and Virtual Appliance Patch Management)
- VMware Capacity Planner
- VMware Data Recovery

# VMware-Cloud Management Software

## ■ VMware vCloud

- ❖ **VMware vCloud Director** enables self-service access to logical pools of compute, network and storage resources with policy driven controls and service level agreements
- ❖ **VMware vCloud Request Manager**
- ❖ **VMware vCloud Datacenter Services**
- ❖ **VMware vCloud Express**
- ❖ **VMware vCloud Consulting Services**
- ❖ **VMware vCloud API**

## ■ **VMware Go** is a web-based service

- to guide users of any expertise level through the installation and configuration of **VMware vSphere Hypervisor**

# VMware- Application Platform

- **VMware vFabric tcServer**, an enterprise **Tomcat App server**.
- **VMware vFabric Enterprise Ready**, an enterprise **Apache Web server**.
- **VMware vFabric Hyperic** provides web and custom application monitoring and performance management for physical, virtual and cloud environments.
- **VMware vFabric GemFire** enables real-time data distribution, caching and management for modern applications.
- **RabbitMQ** provides robust and reliable inter-system messaging for modern applications.
- **VMware vFabric SQLFire** is memory-oriented data management software delivering application data at runtime with horizontal scale and lightning-fast performance while providing developers with the well-known SQL interface and tools.
- **VMware vFabric Web Server** increases your web tiers performance, scalability and security while reducing deployment times and complexity with VMware vFabric Web Server, the HTTP server and load-balancing component of the vFabric Cloud Platform

# VMware- Backup software

- In April 2011, EMC transferred control of **Mozy to VMware**, a move which will assist VMware in targeting its increasing number of cloud-based offerings towards small and medium-sized business
- Mozy produces two products: MozyHome and MozyPro
  - ❖ **MozyHome** is the consumer version of the Mozy backup service. It is available to buy on a monthly subscription
  - ❖ **MozyPro** is the business class version of the Mozy backup service. MozyPro requires a separate license for each computer that is being backed up, as well as a server license for any server that is being backed up. Customers then pay per gigabyte of data they have in the data center