

IaaS, Private Cloud și Virtualizare

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(Online ☺)

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 - Cloud and Datacenter Management MVP (Microsoft)
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2018 Partner of the Year Winner
Romania Partner of the Year

Microsoft
Partner



Gold Application Development
Gold Cloud Productivity
Gold Cloud Platform
Gold ISV
Silver Datacenter
Silver Small and Midmarket Cloud Solutions

ITCAMP™

C | E H™
Certified Ethical Hacker



Agenda

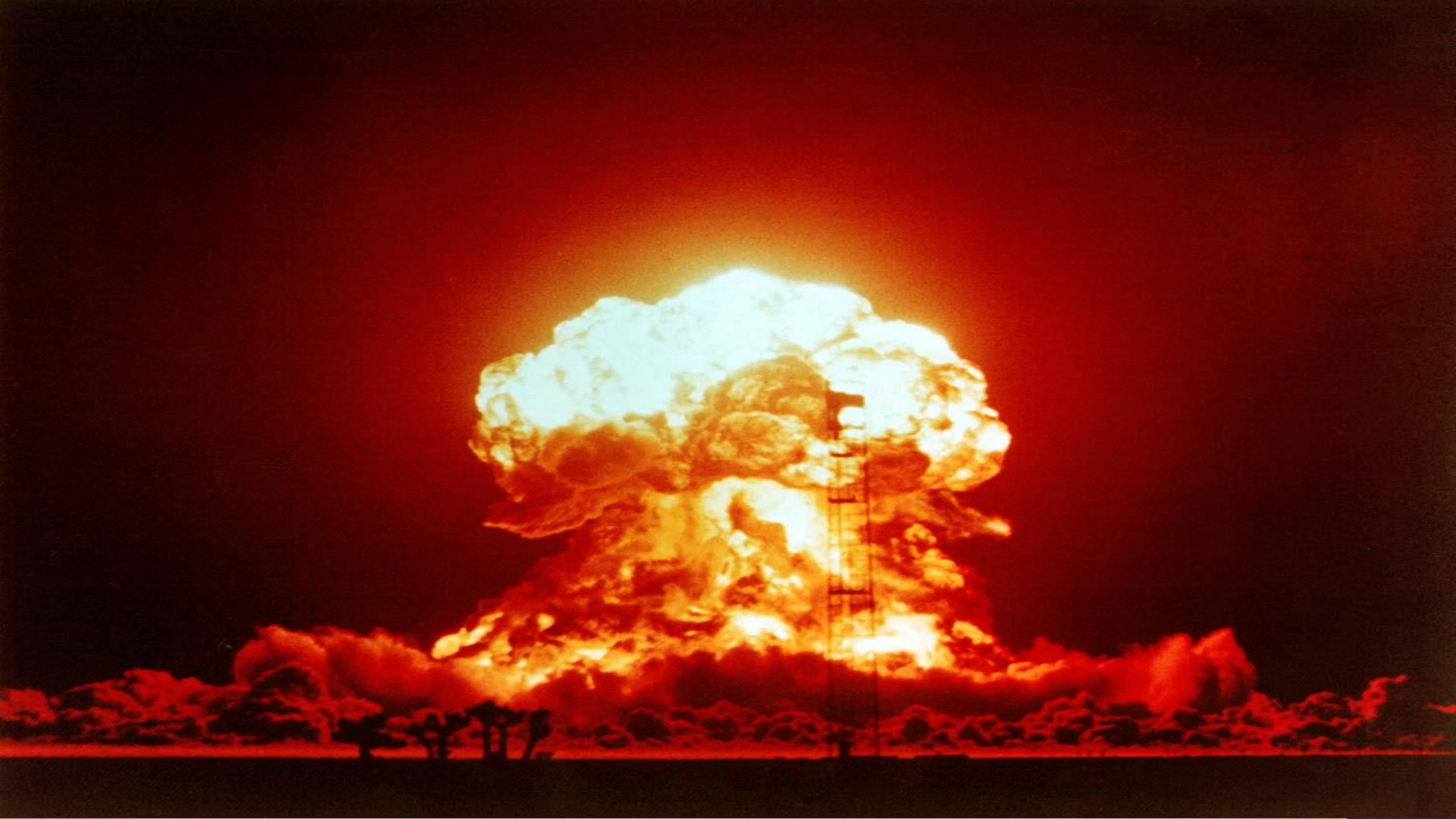
- Private Cloud și IaaS - introducere
- Arhitecturi de virtualizare
- Soluții existente
 - Type 1 (bare-metal)
 - Full / paravirtualized (VMWare, Hyper-V, Xen)
 - Type 2 (hosted)
 - OS-assisted (KVM, VirtualBox, Virtuozzo/OpenVZ)
- Studiu de caz: Hyper-V & System Center
- Azure Stack
- PowerShell

Private Cloud şı IaaS

A word cloud centered around the words "private", "cloud", and "virtual". The words are in various sizes and colors, including shades of brown, green, and blue. The word "private" is at the top left, "cloud" is in the center, and "virtual" is at the bottom right. Other prominent words include "computing", "solution", "policy", "isolation", "protection", "redundancy", "shared", "processes", "people", "hardware", "funding", "elasticity", "monitoring", "adaptability", "cpu", "storage", "memory", "metering", "scalability", "budget", "change", "technology", "management", "obsolescence", "3rd-party", and "target".

target
computing
private
ownership
solution
policy
isolation
protection
redundancy
shared
processes
people
hardware
funding
elasticity
monitoring
adaptability
cpu
security
storage
memory
metering
scalability
budget
change
technology
management
obsolescence
3rd-party
cloud
virtual





dacă la început lumea
era destul de reticentă...

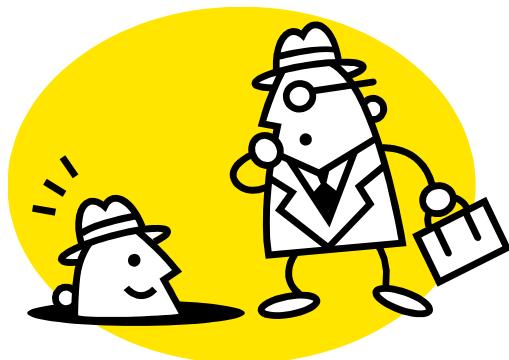


...acum toti mulți vor să se mute...

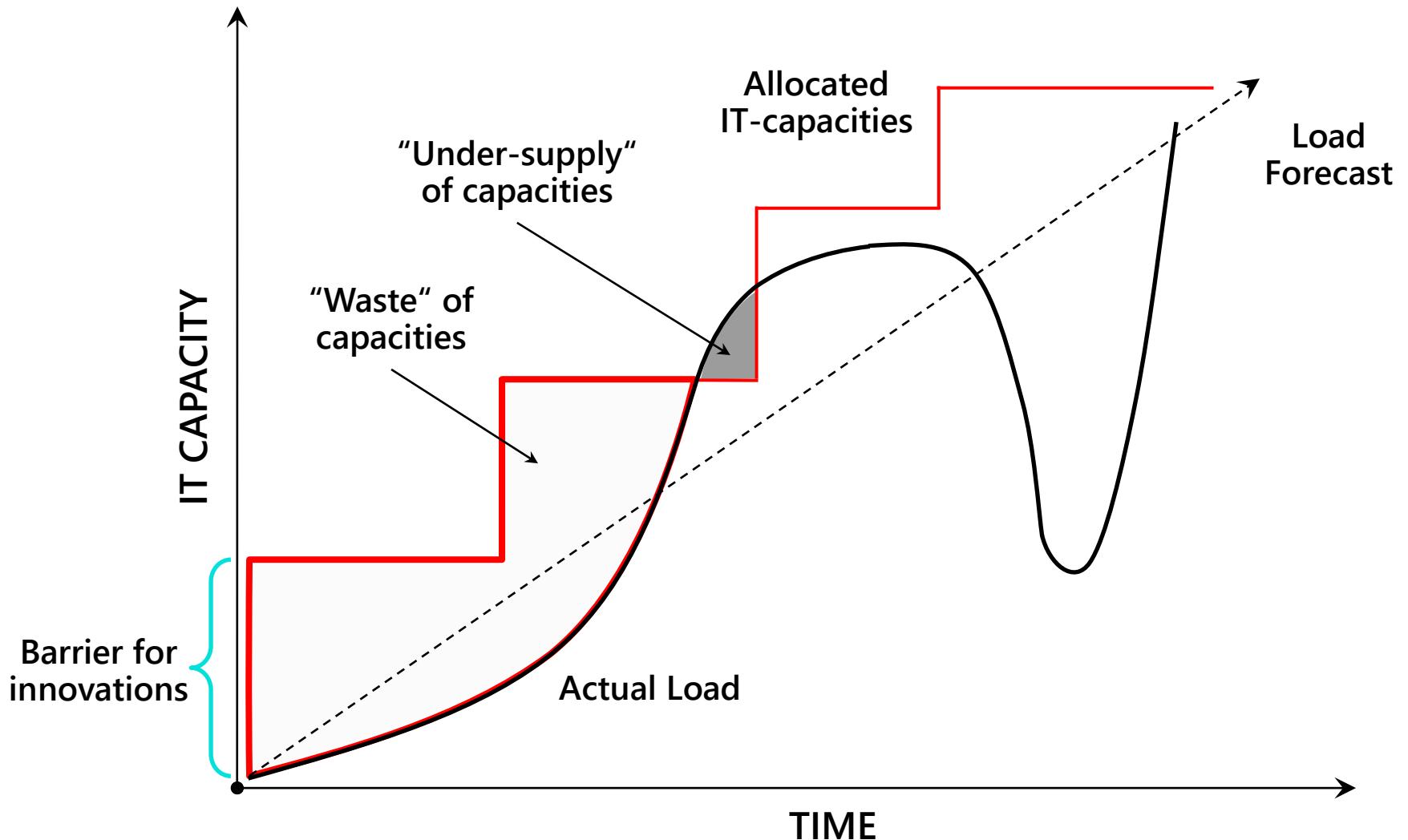


în “nori”

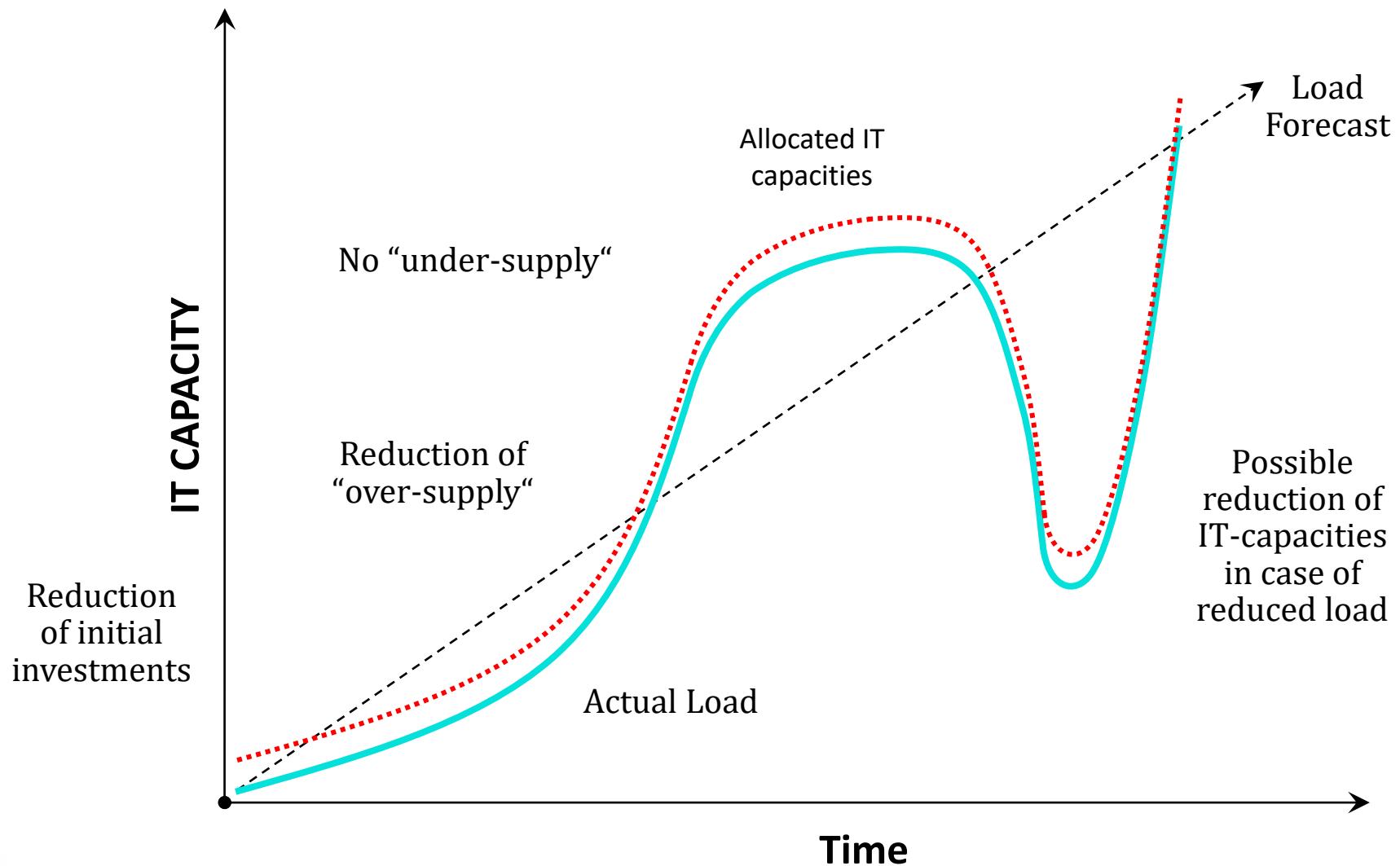
...dar ştiu toti la ce să se aştepte?



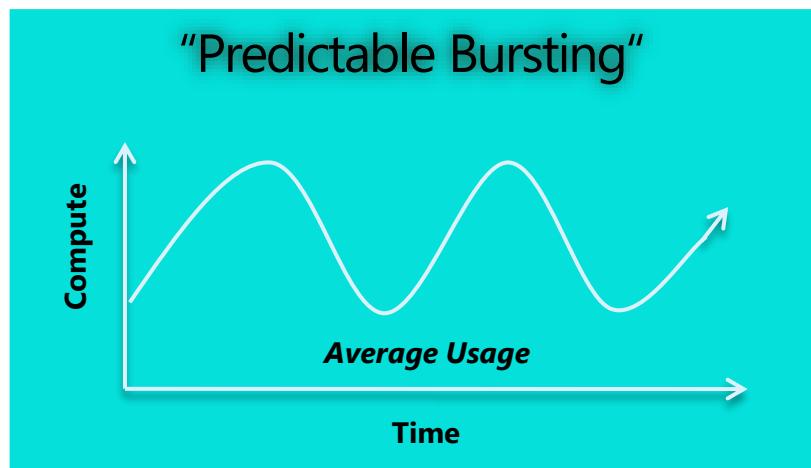
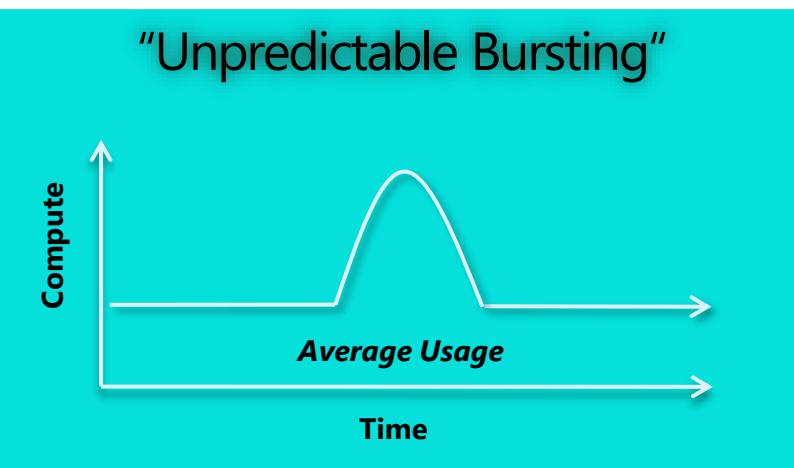
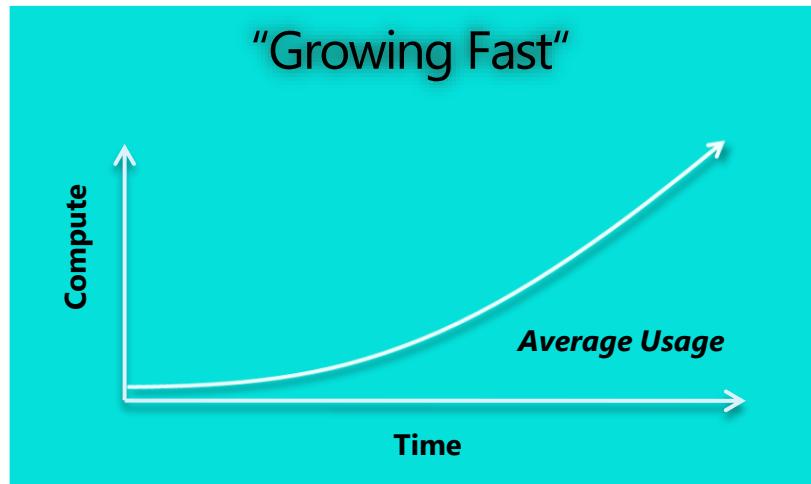
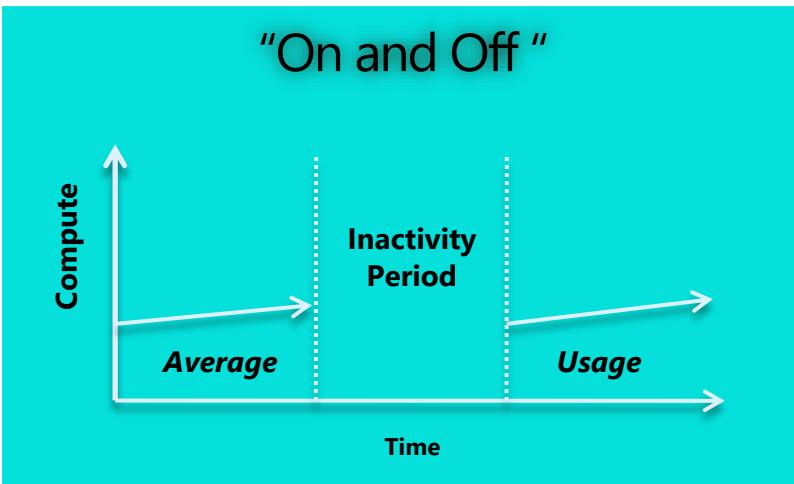
Varianta tradițională, ineficientă



Într-un Cloud, totul e mult mai dinamic

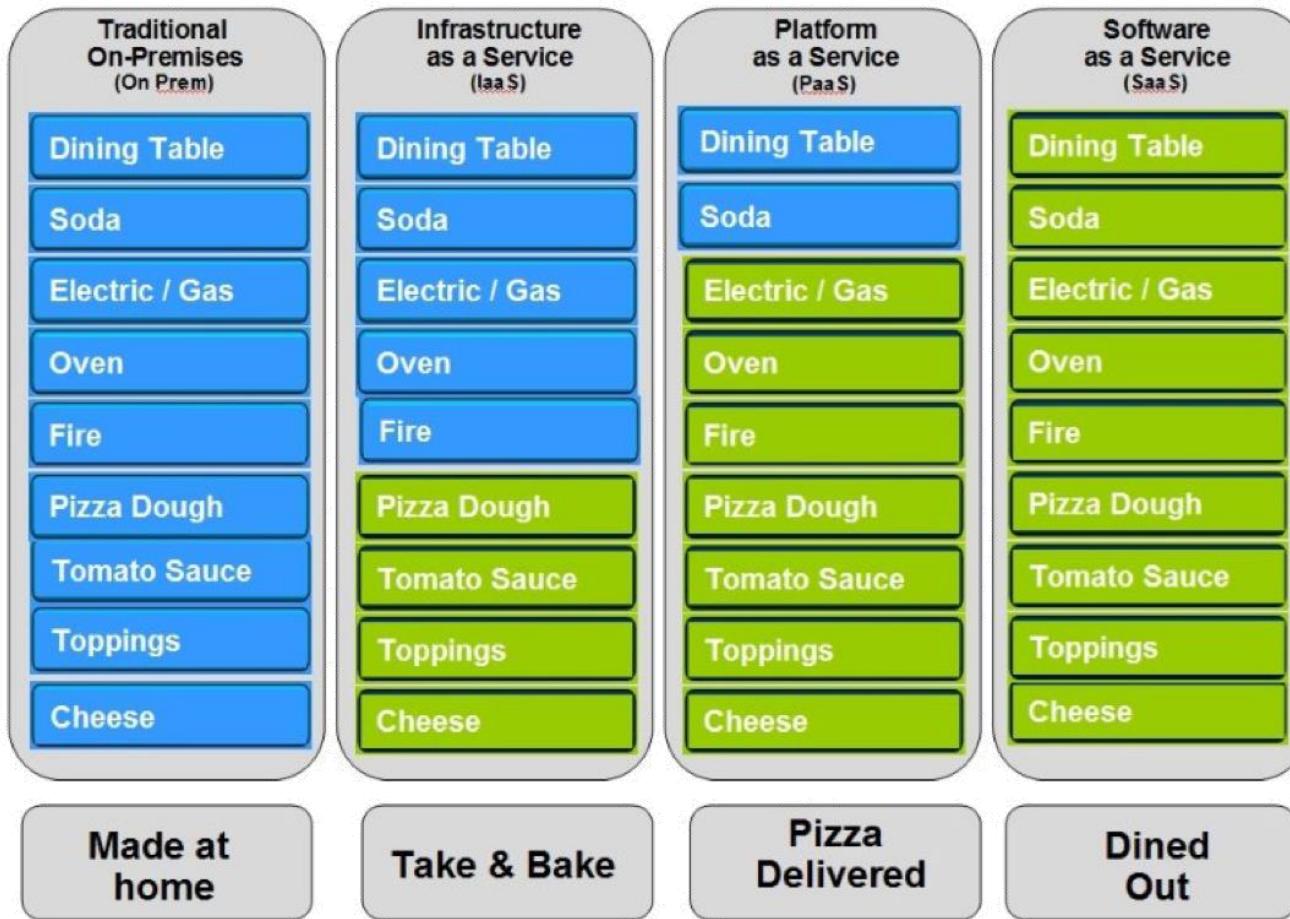


Workload patterns in Cloud



Tipuri de servicii

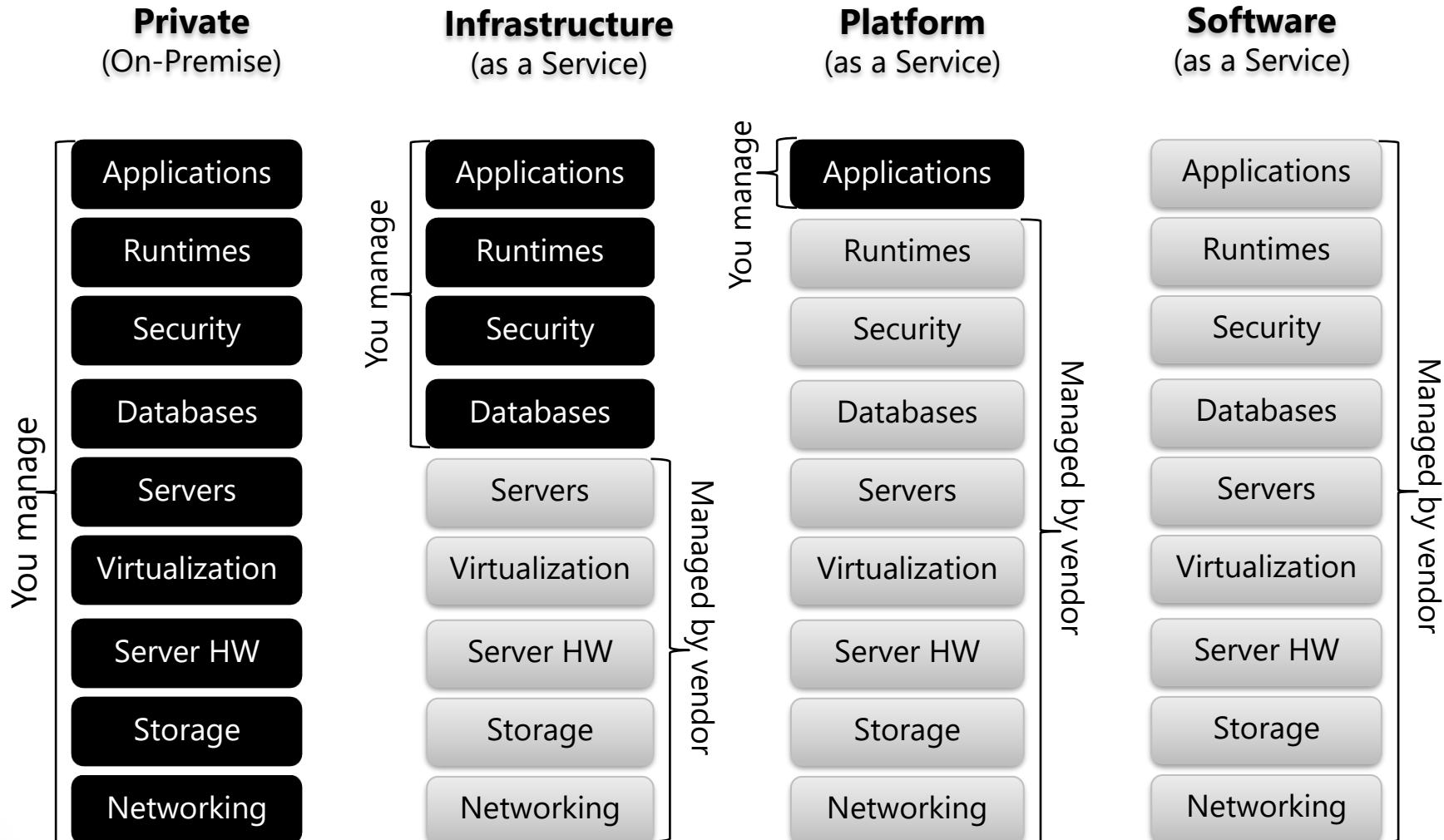
Pizza as a Service



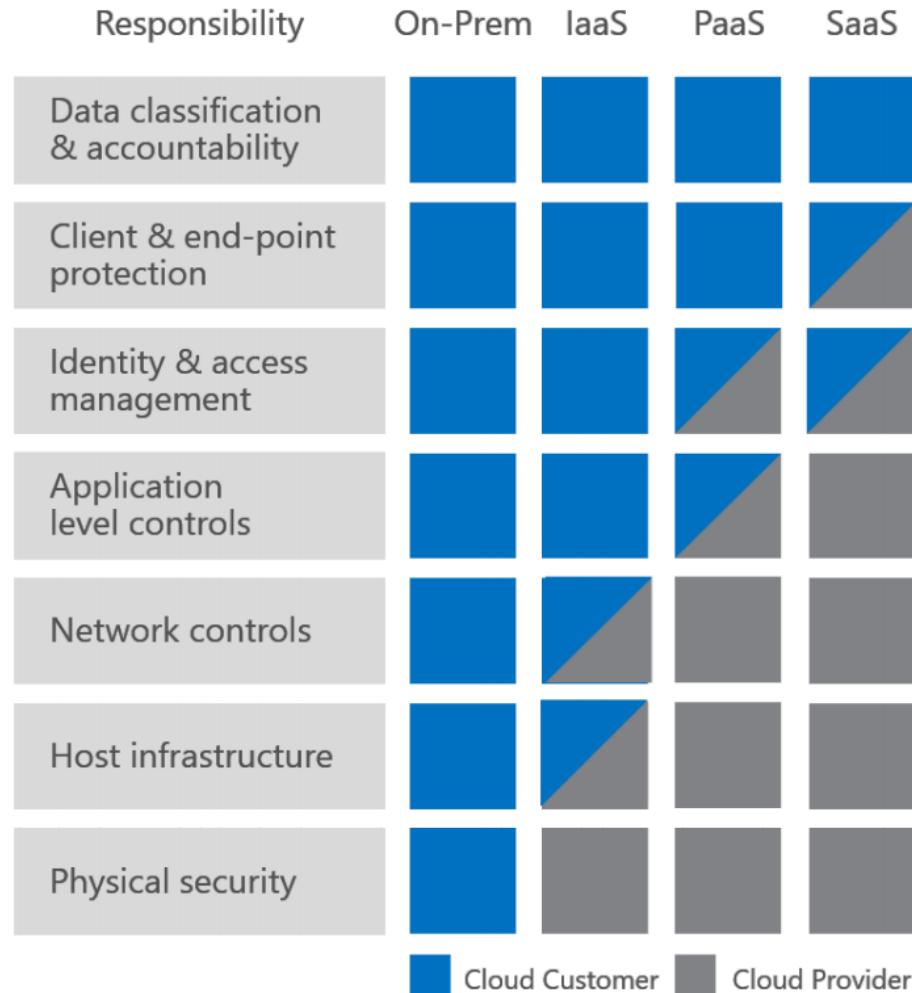
■ You Manage

■ Vendor Manages

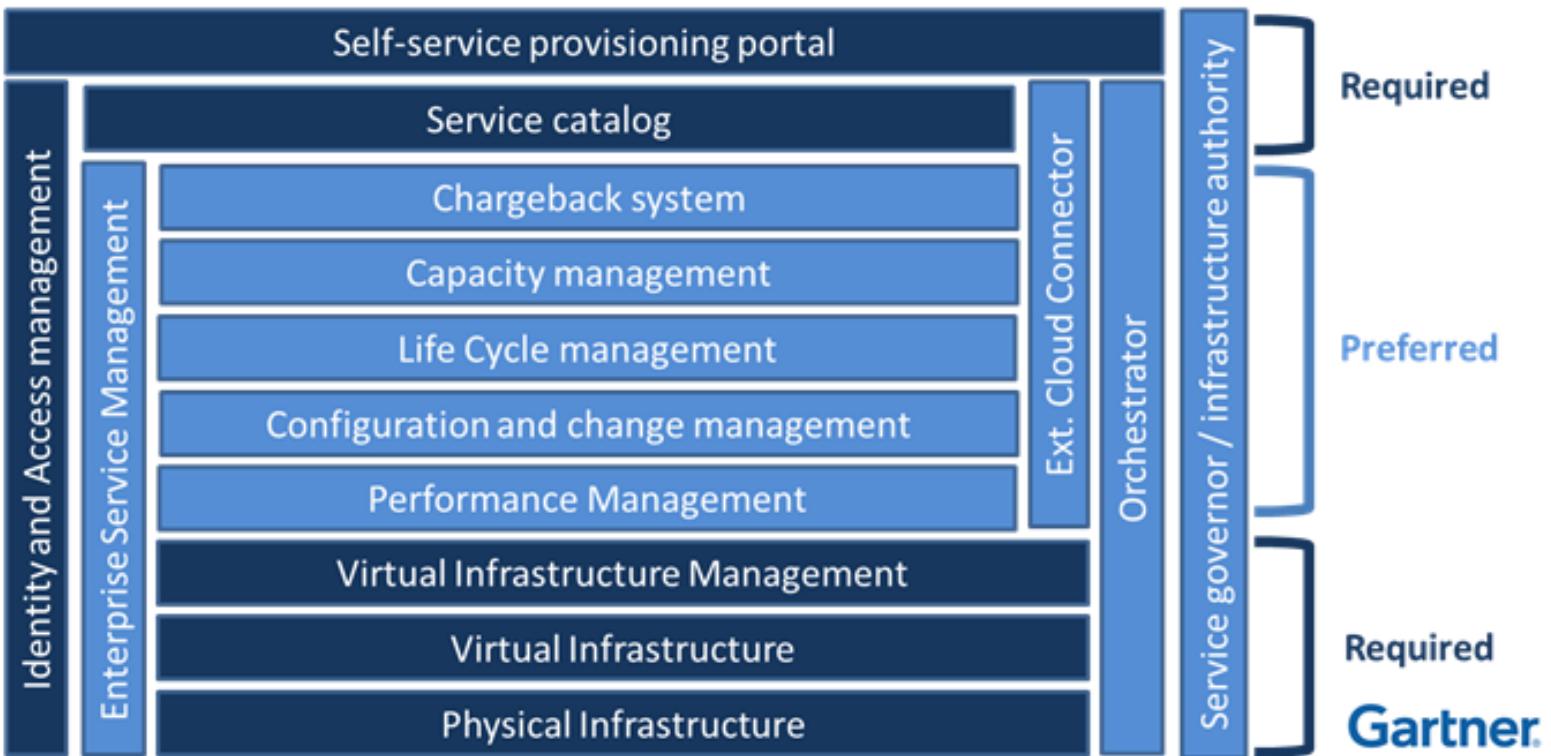
Tipuri de servicii "Cloud"



Shared Responsibility in the Cloud



Ce spune industria IT?



Componentele unui "Private Cloud"

3rd party extensions

Management

Virtualization



Compute



Network



Storage

- Pooled Resources
- Virtualization
- Elasticity
- Scalability
- Continuous Availability
- Predictability
- Usage-Based
- Multi-Tenancy
- Security
- Automation
- Service management

VIRTUAL? PRIVATE? CLOUD?

a. de ce vreau să fac asta?



b. pentru cine fac asta?

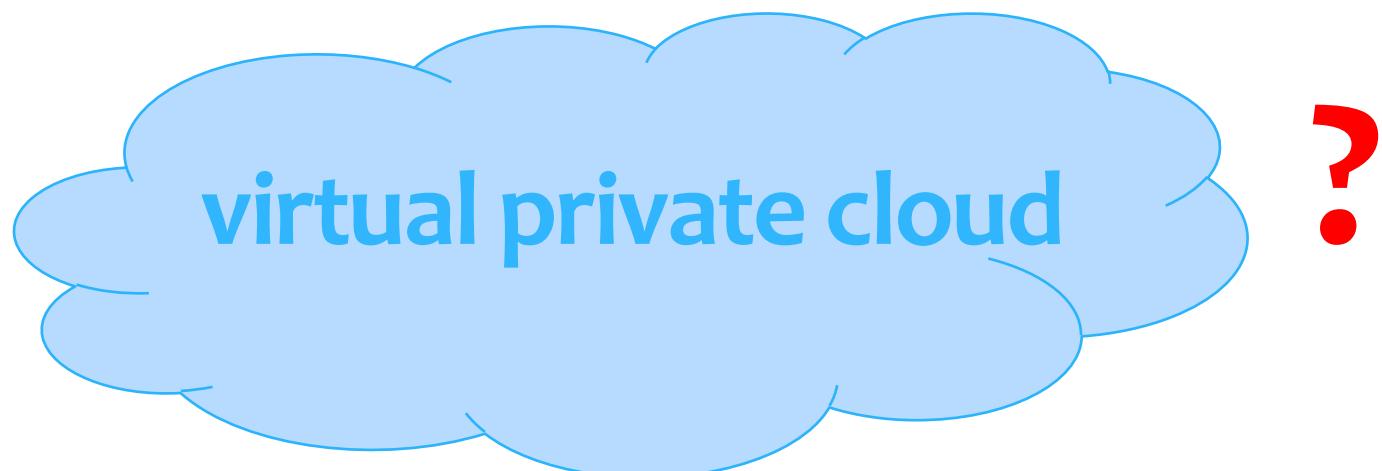


c. ce vreau să ofer?

SLA, compliance (PCI, ISO)

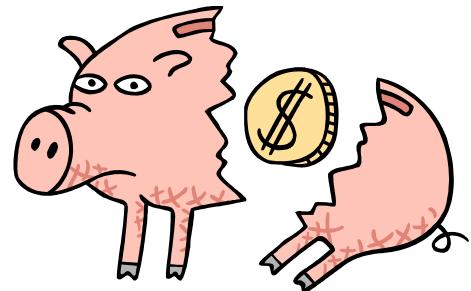


la ce ne uităm când construim un



1. buget

cost per kWh, preț per U, costuri legate de
bandă/conectivitate, personalul tehnic, etc.



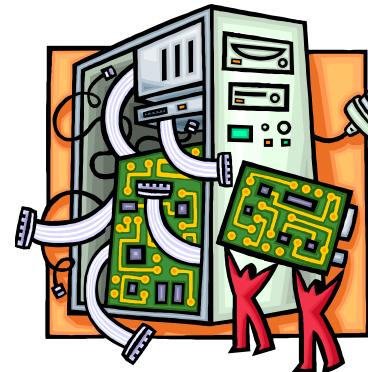
2. arhitectură

structură, scalabilitate, fiabilitate, redundanță,
securitate, flexibilitate

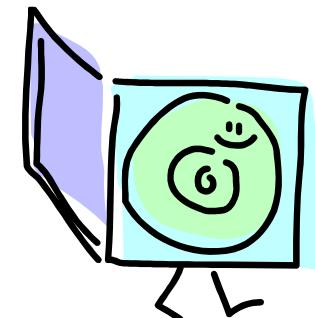
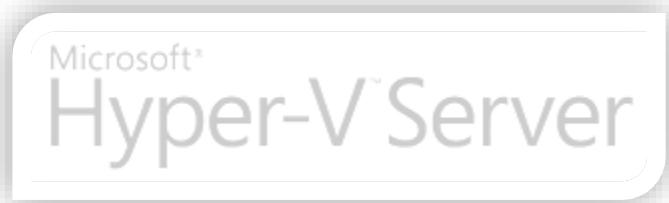


3. hardware

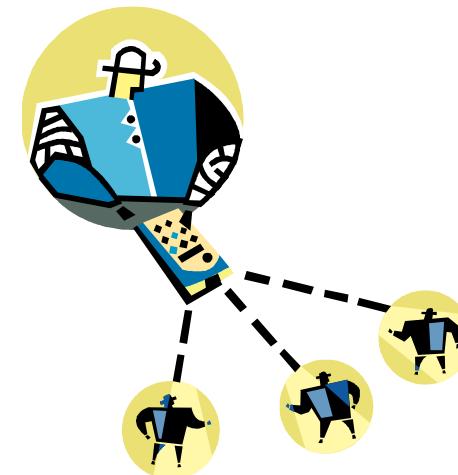
server (**MIPS/MOPS**), storage (**I/O-OPS**),
network (**1Gbps, 10Gbps, infiniband, fiber**)



4. virtualization layer



5. management / monitorizzare



6. procese interne

politici de securitate/incident-response,
ușurință de a detecta/repara problemele,
disaster recovery, high availability și timpul
necesar aducerii unui nod online



7. oameni

echipa tehnică, mentenanță post-implementare



Recapitulare – Private Cloud

1. Buget
2. Arhitectură
3. Hardware
4. Virtualizare
5. Management și monitorizare
6. Procese interne
7. Oameni

Recapitulare – Private Cloud

1. Buget
2. Arhitectură
3. Hardware
4. Virtualizare
5. Management și monitorizare
6. Procese interne
7. Oameni

ARHITECTURI DE VIRTUALIZARE

când lucrăm cu virtualizarea,
ajungem să auzim câțiva **termeni
uzuali...**





virtualizare
mașină virtuală
hypervisor
paravirtualizare
microkernelized hypervisor
monolithic hypervisor
synthetic device drivers
parent partition
binary translation

un pic de istorie

virtualizarea e veche

primul val, IBM CP-40

**CP-40 a intrat în producție în
ianuarie 1967**

**atunci, ca și acum, atracția o constituia reducerea
costurilor**

era bazat pe sistemul S/360



S/360 a introdus facilități de memorie virtuală și
adresare pe 32-bit

**CP-40 a extins S/360, oferind un
mediu complet virtualizat**

**astfel, CP-40 avea suport pentru
14 mașini virtuale**

a urmat CP-67, bazat pe S/360-67

**iar în 1972, IBM a finalizat
VM Facility 370, sau VM/370**

cu ocazia asta vin și termenii...

Virtual Machine (VM)

Control Program (hypervisor)

a apărut și o nouă mașină, **S/370**

iar **VM/370** a reușit să virtualizeze eficient SO destinate **S/360** și **S/370**

...și erau vreo câteva :)

**OS/360, DOS/360, OS/370, DOS/370, MVS, CMS,
CMS/370**

așa că virtualizarea și-a atins scopul: **reducerea costurilor**

...în final s-a ajuns la z/VM care rulează acum pe sistemele mainframe IBM z10 și IBM zEnterprise (z196/z114)

**chiar și cu VM/370,
costurile erau încă ridicate**

al doilea val, microprocesoarele

1977, Macintosh Apple II



1988, Connectix
Virtual PC (pentru Macintosh)



Virtual PC putea rula Windows, OS/2, Linux pe
hardware Macintosh

În 2003, Microsoft cumpără Connectix

Virtual PC e modificat, și astfel userii Windows pot să ruleze și alte SO

**MS-DOS 6.22, Windows 95, 98, NT 4.0,
Me, OS/2, 2000, 2003, XP, Vista, 2008**

al treilea val, VMware

**1999, VMware produce
VMWare Workstation**



**2001, VMware (GSX) Server
(virtualizzare server-level)**



trecem și la partea tehnică

**chiar dacă la bază, conceptele VMware și Virtual
PC erau similare cu CP-40**

totuși, atât din Virtual PC, cât și din VMware, lipsea
hypervisor-ul

ambele se bazau pe
existența unui SO "gazdă" (**host**)

**host-ul era astfel intermediar (ineficient) între VM
și hardware**

ulterior, au apărut îmbunătățiri

**posibilitatea de a rula VM pe hardware
nespecializat**

**migrare de la arhitecturi hosted la arhitecturi
bazate pe hypervisor**

**VMware ESX, Hyper-V, Xen
folosesc o forma de hypervisor**

**reintroducerea suportului hardware:
Intel VT, AMD-V**

tendințe

chiar dacă **micro-virtualizarea tinde să egaleze
soluția IBM de acum 50+ ani**

au apărut pe și elemente inovatoare, majoritatea
din partea **VMware**

live server migration (vMotion)

dynamic load balancing (Distributed Resource Scheduling)

real-time failover (HA Clustering)

sau din partea Intel

Virtualization for Directed I/O (VT-d)

pentru procesarea input-output

**și în același timp, virtualizarea a adus cu ea
probleme de securitate**

**la început, avantajele virtualizării, gen izolarea
aplicațiilor, au fost afectate**

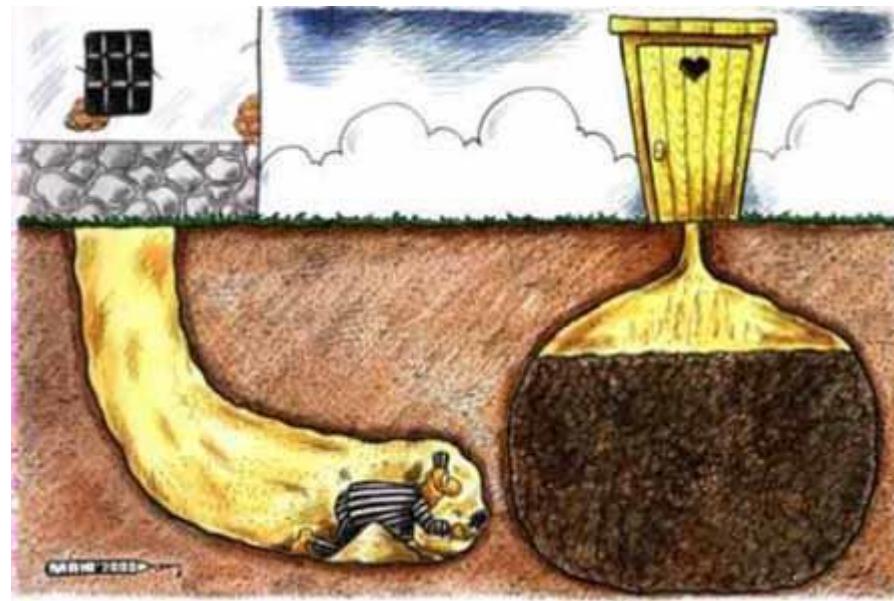
**procesoarele cu virtual-assist
sunt un bun exemplu**

un **guest** putea să acceseze direct alt **guest**,
ignorând **politicele de securitate**

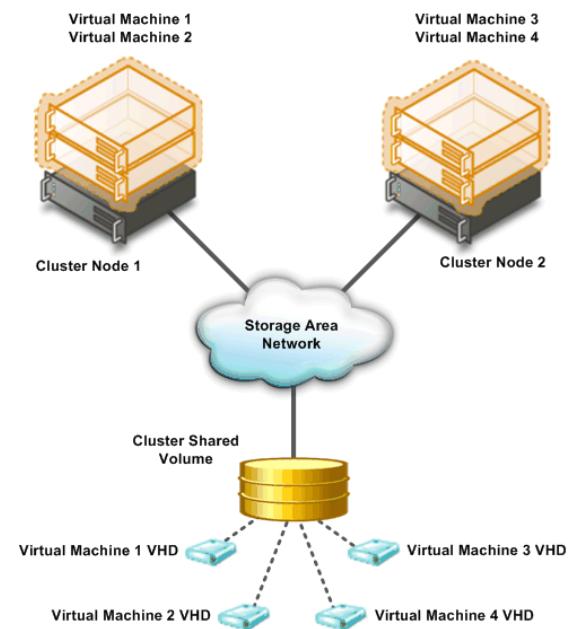
sau mai rău, exploit-ul Blue Pill

tipuri de atacuri

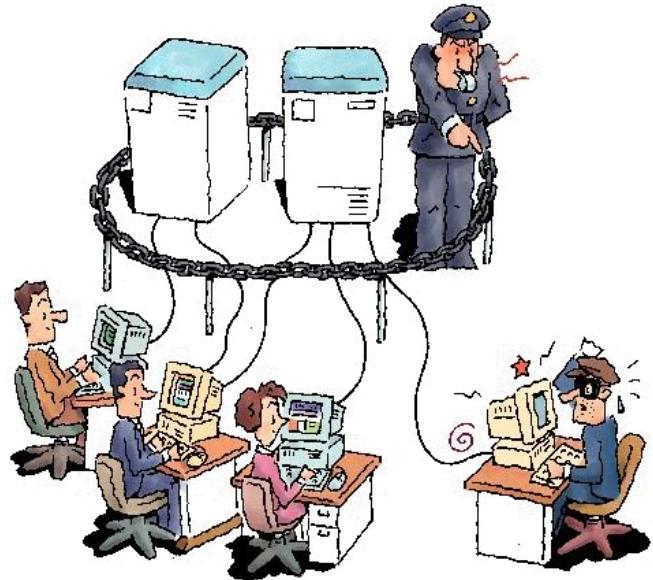
jailbreak attacks (escapes)



migration attacks



virtual / physical network service attacks



encryption attacks



**soluția? facilități de securitate adăugate la noul
hardware**

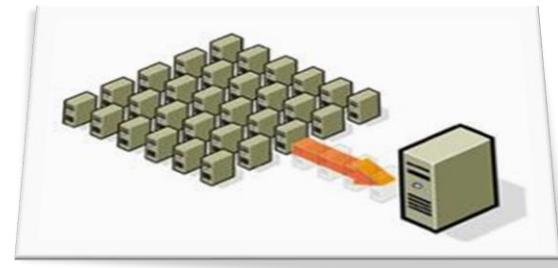
**chiar și aşa, virtualizarea va rămâne, atât timp cât
își îndeplinește scopul**

Începem cu câteva **explicații**

de la soluțiile de **virtualizare**,
toată lumea aşteaptă automat la:

**izolare eficientă
securitate
performanță
ușurință în administrare**

**tehnic, virtualizarea se poate
realiza în mai multe moduri**



full virtualization (Type 1)

**guest nemodificat, migrare ușoară
spre medii virtualizate**

paravirtualizare

guest modificat pentru a elimina
nevoia de "binary translation"

oferă avantaje de performanță în
anumite circumstanțe, însă e nevoie
de o versiune modificată de kernel
instalată pe guest

virtualizare asistată hardware

AMD-V, Intel VT

prima generație a inclus doar
virtualizare CPU, generațiile
următoare vin cu suport de
virtualizare pe memorie și I/O

hosted virtualization (Type 2)

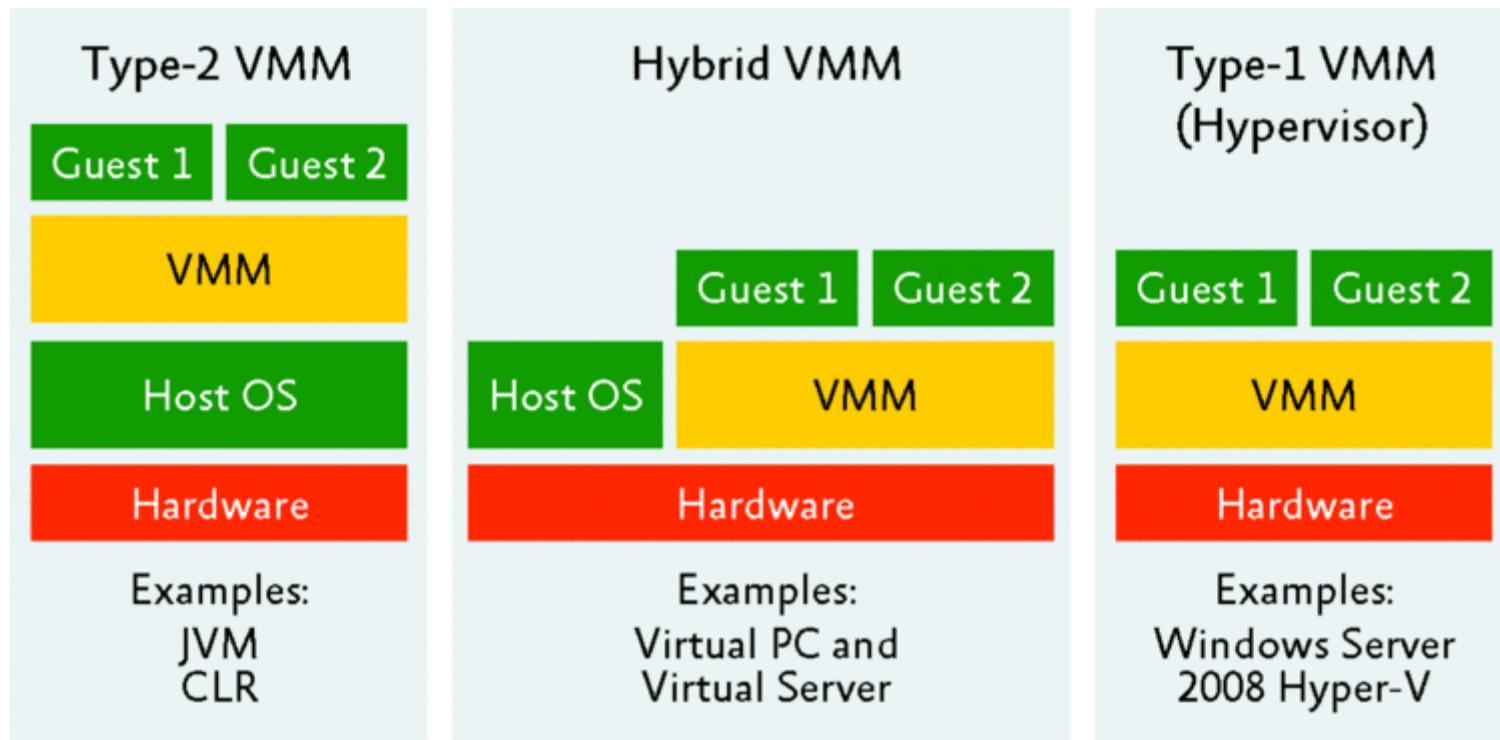
Microsoft Virtual Server / Virtual PC

VMWare Workstation

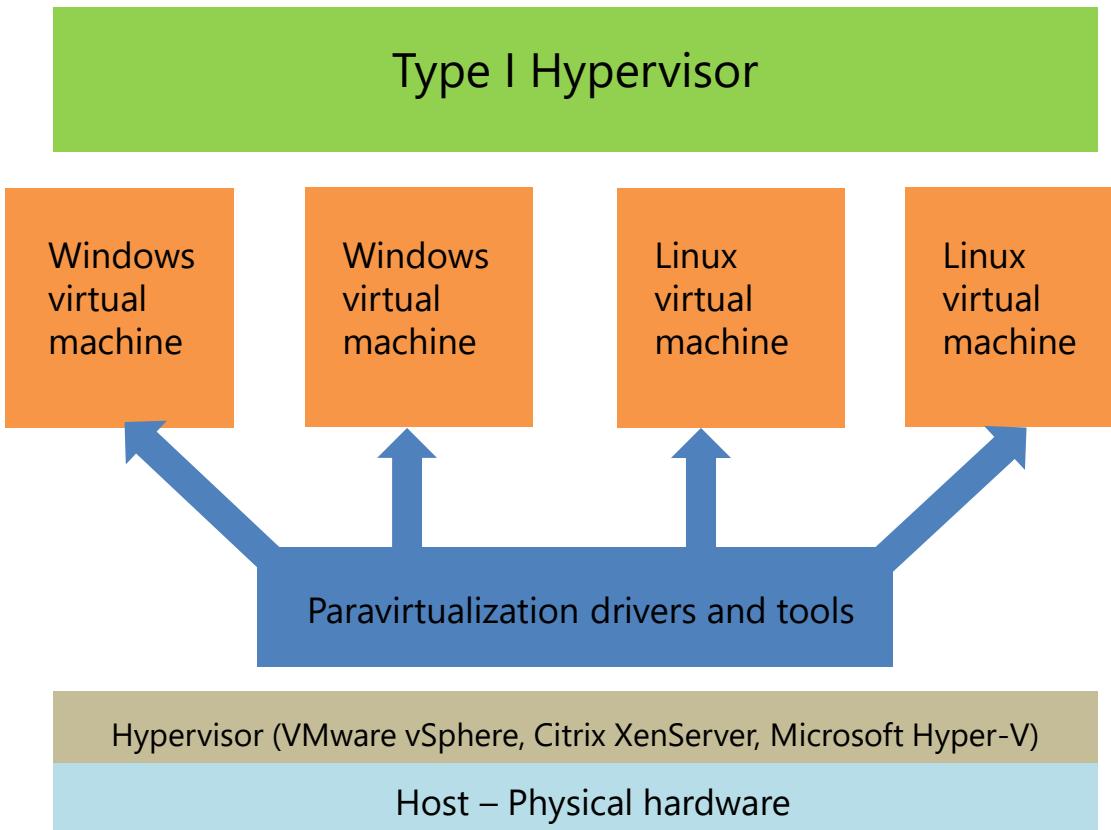
VirtualBox

Linux KVM

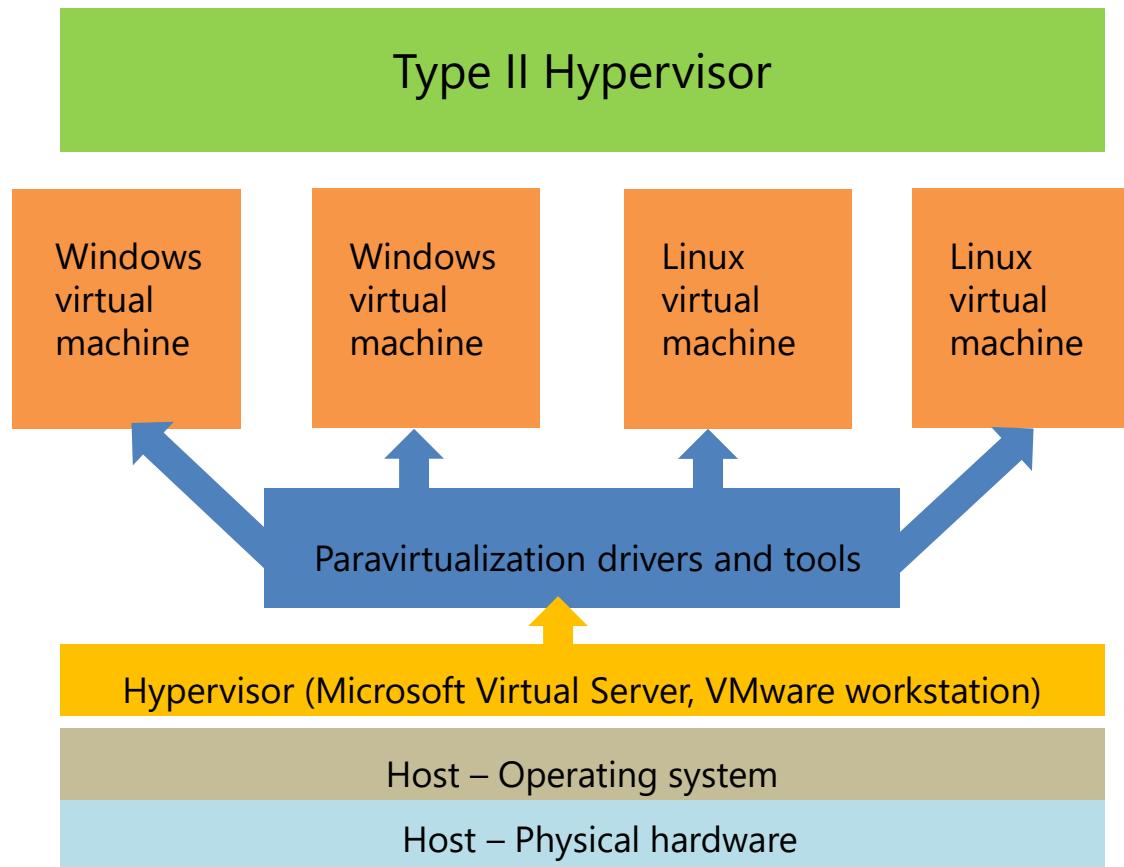
Tipuri de virtualizare



Type I Virtualization Overview



Type II Virtualization Overview



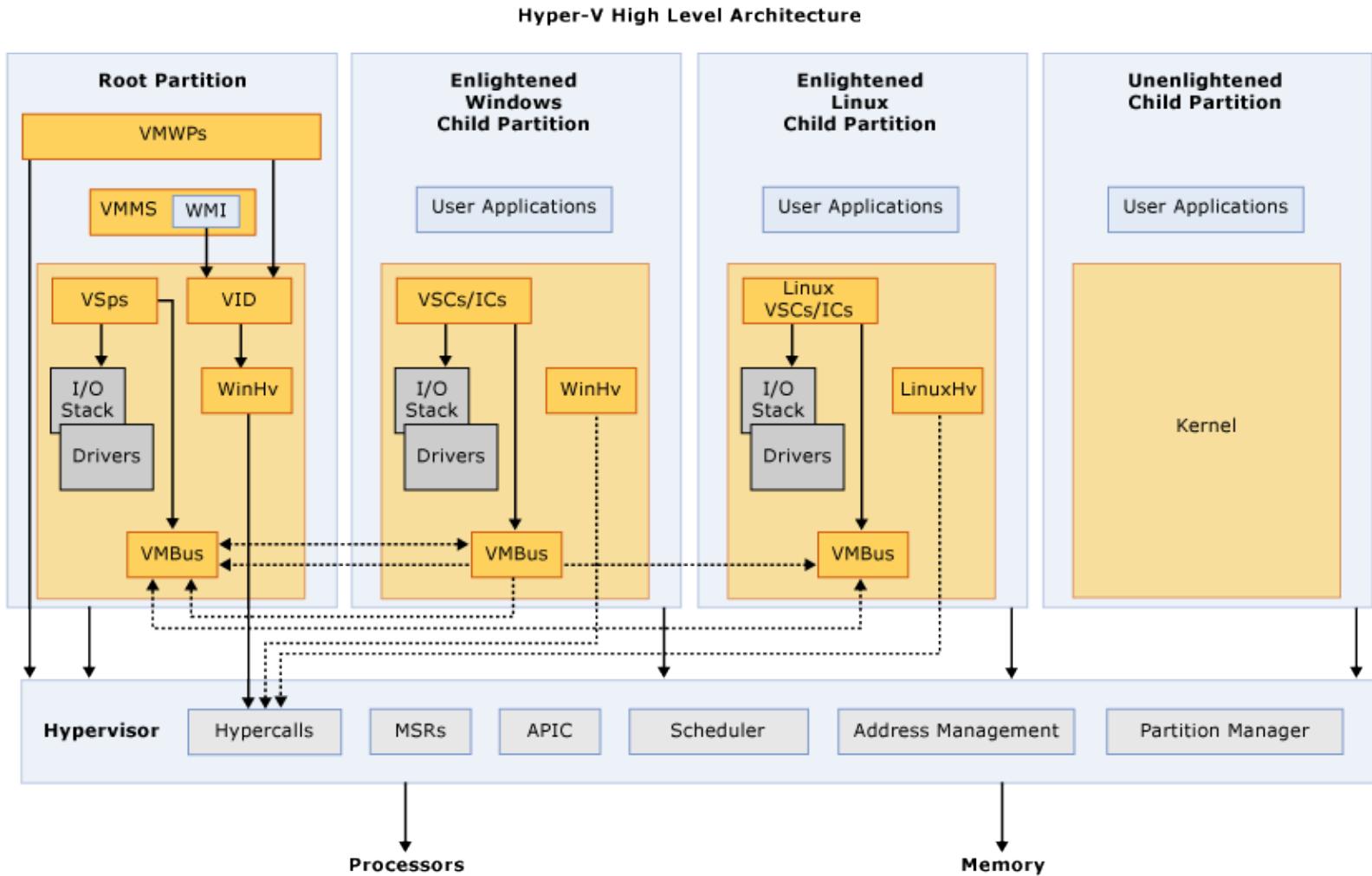
OS virtualization

Virtuozzo / OpenVZ

să discutăm puțin despre

**Hyper-V / Xen / VMWare
KVM / Virtuozzo / OpenVZ**

Arhitectura Hyper-V



iar **cerințele** nu sunt exagerate...

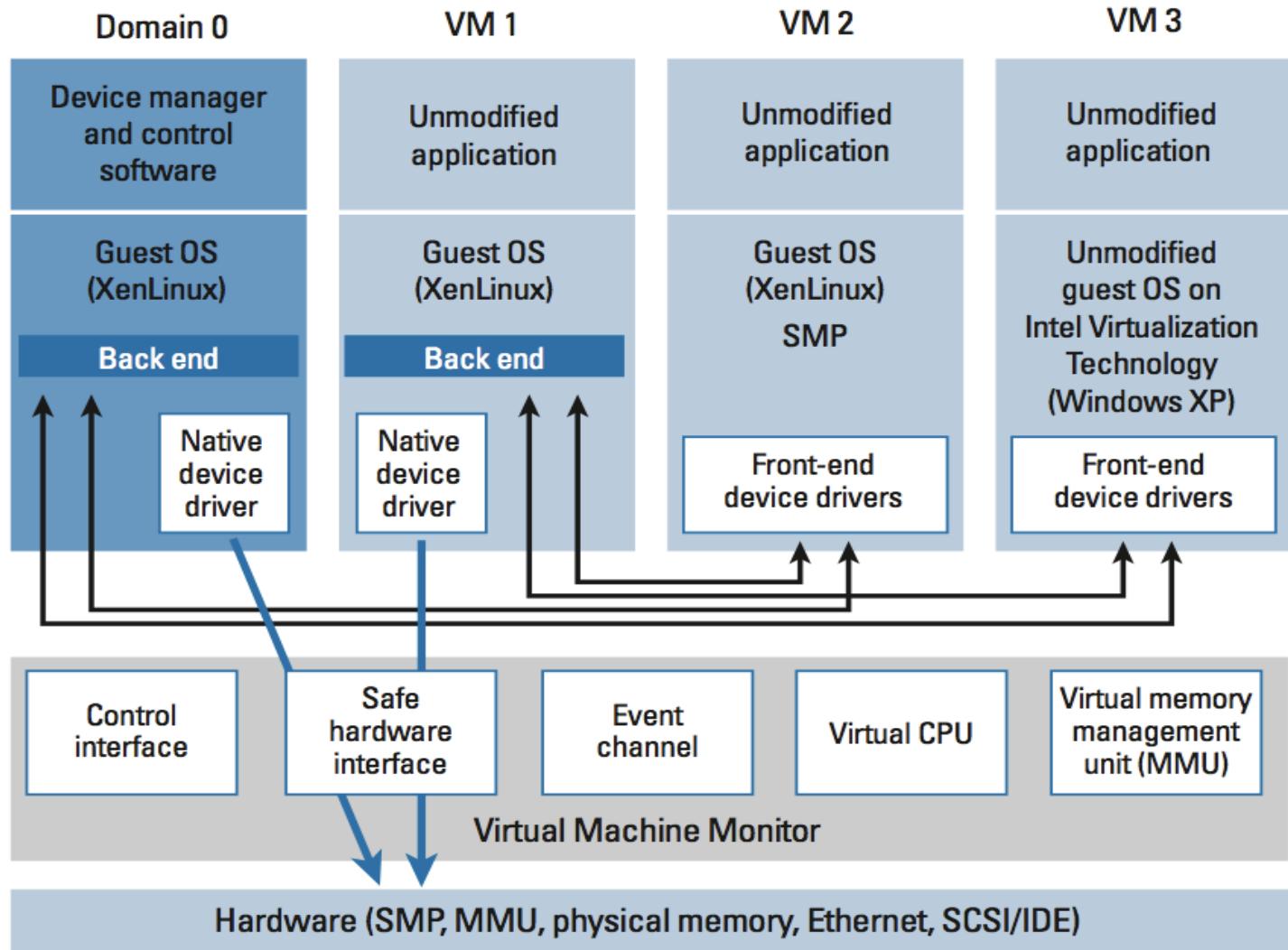
x64

DEP

Intel VT / AMD-V

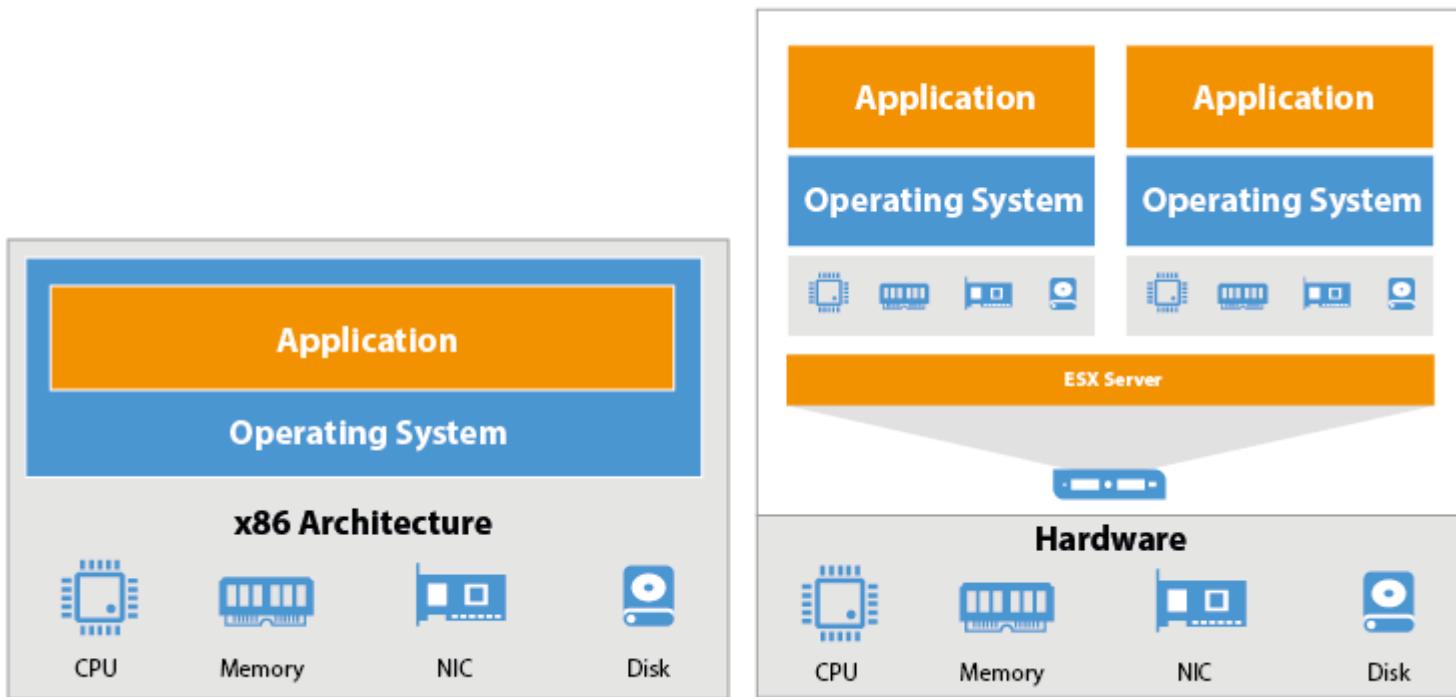
SLAT (w8 Client)

Xen



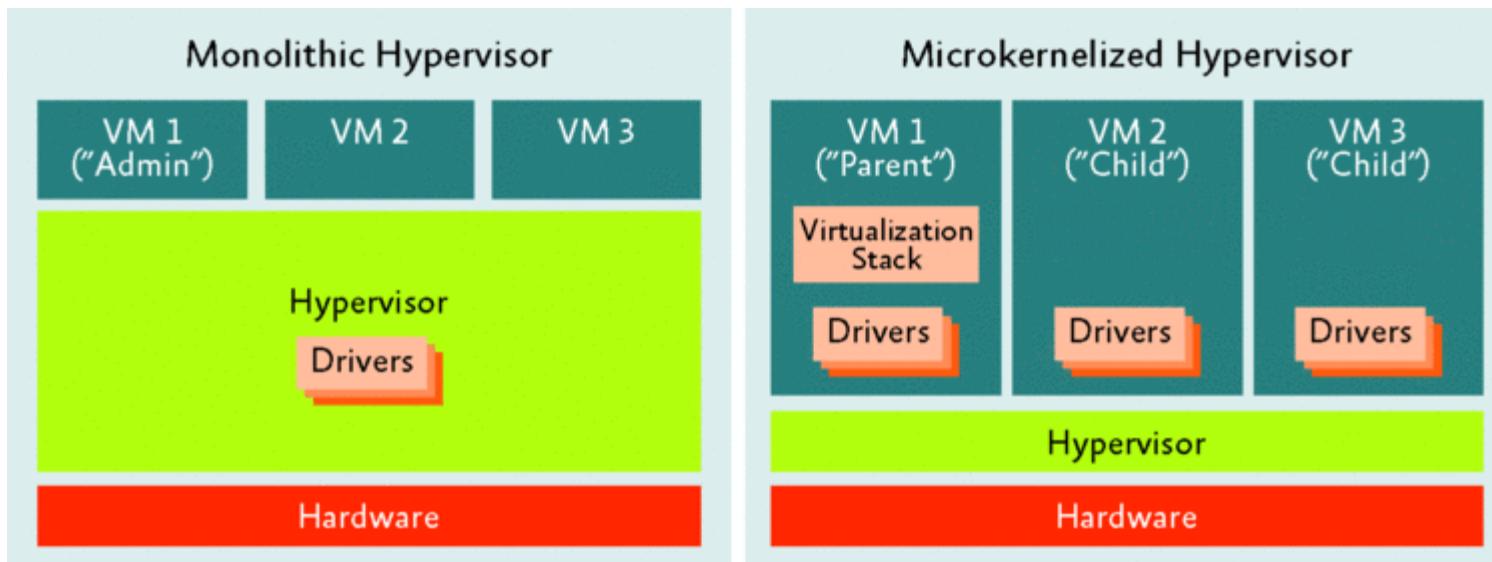
**la VMWare,
lucrurile stau puțin diferit**

VMWare ESX Server



Hyper-V – microkernelized hypervisor

VMWare – monolithic hypervisor



Hyper-V hypervisor (Windows 10)

hvax64.exe (AMD) – 1.02MB

hvix64.exe (Intel) – 1.33MB

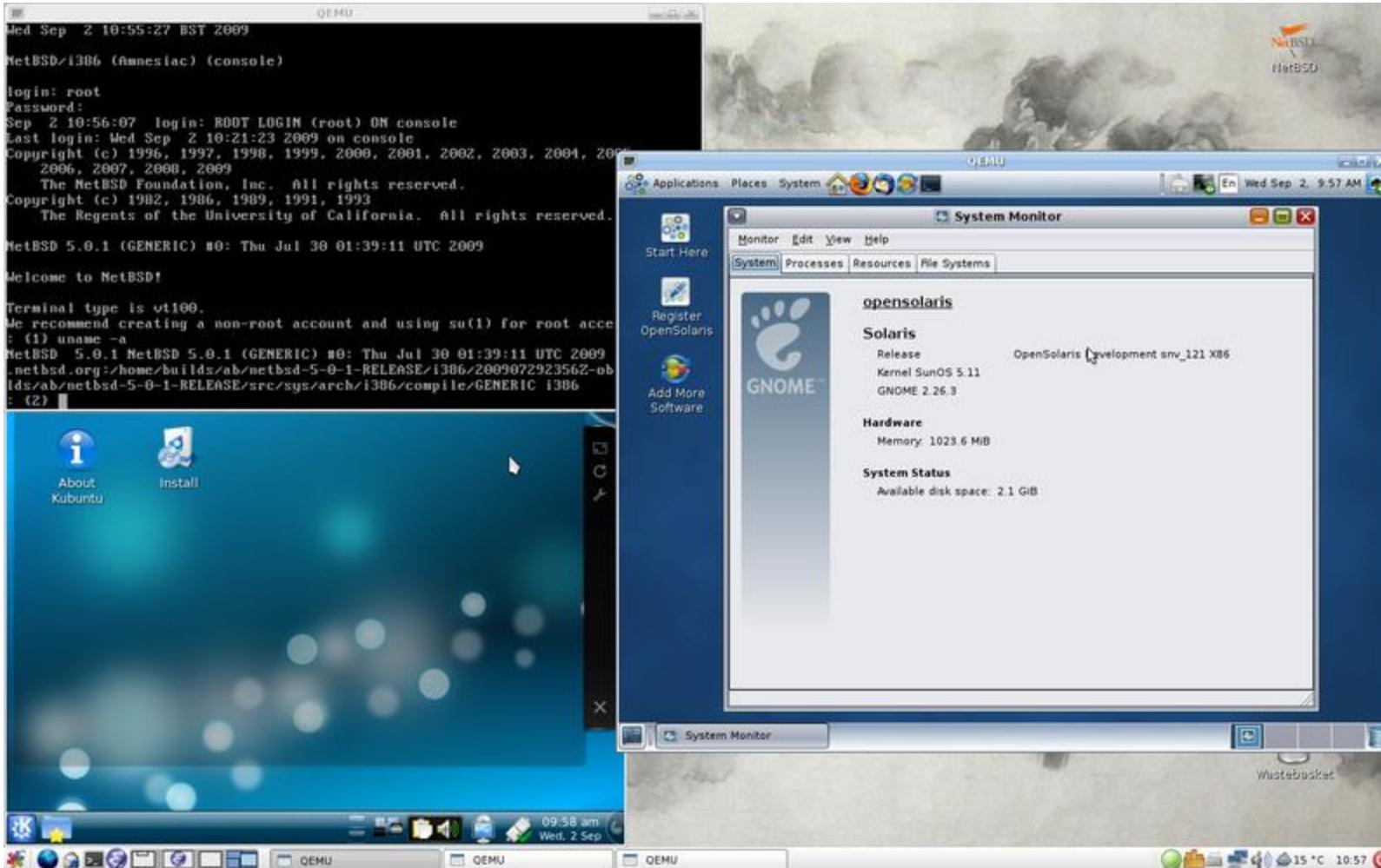
VMWare hypervisor – ~150-200MB

Hyper-V – “synthetic” drivers

VMWare – emulated drivers

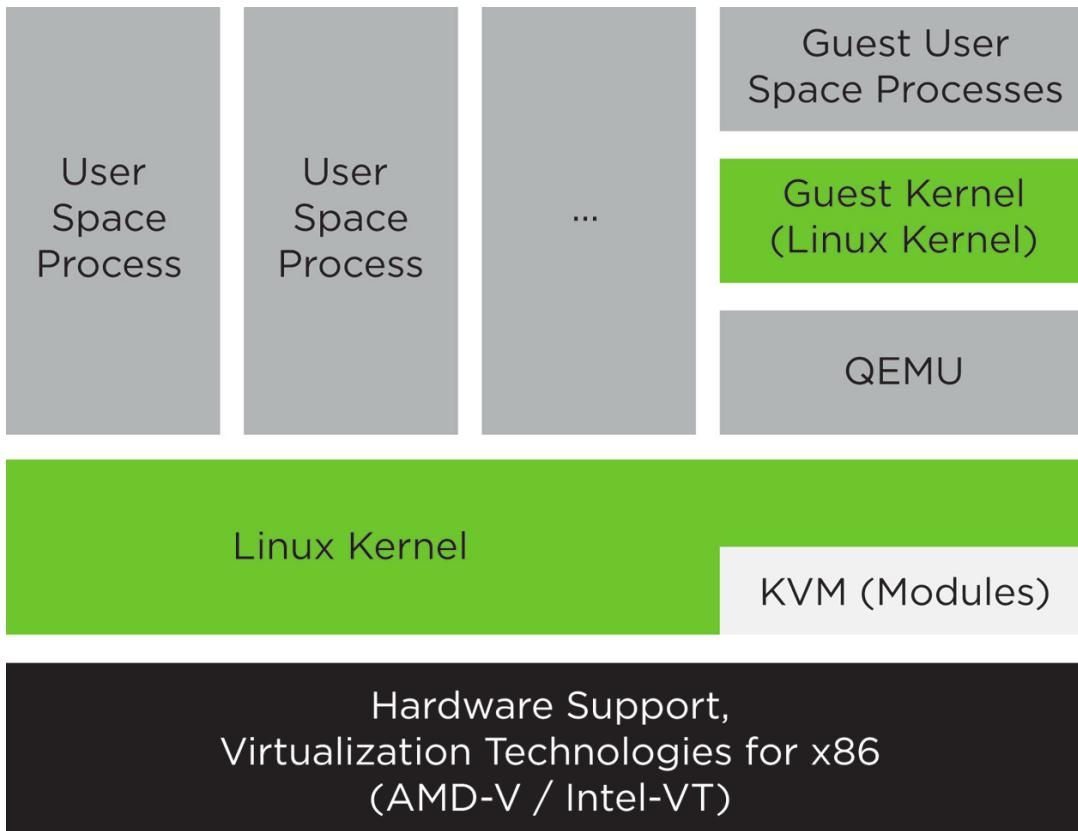
KVM / Qemu

KVM – no emulation, user-space program



VMM architecture: KVM

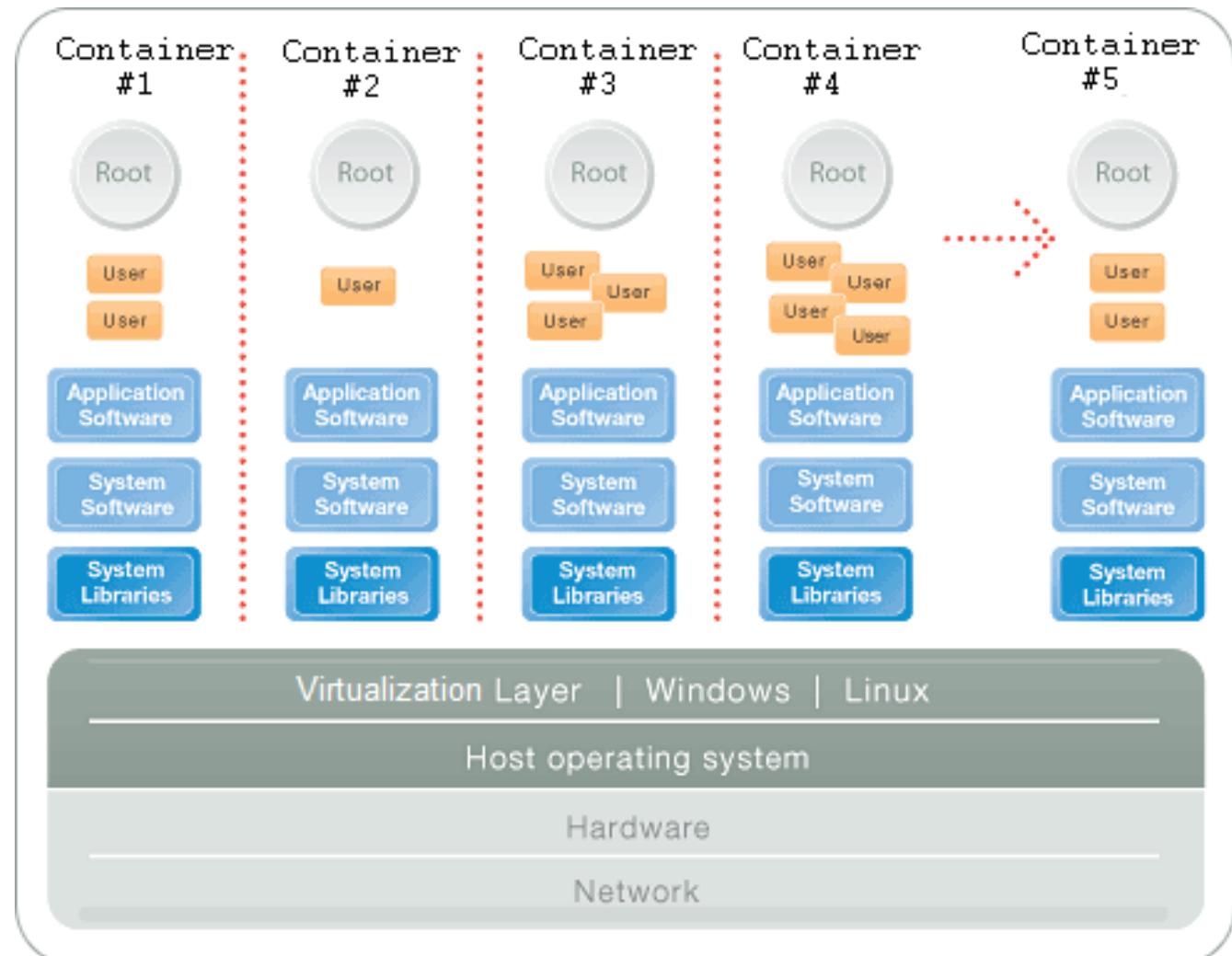
- Hypervisor integrat în Linux (code based)



- Hypervisor: Kernel module
- Guest OS: User space process (QEMU for x86 emulation)
- Are nevoie de HW virtualization extensions

Virtuozzo / OpenVZ Containers

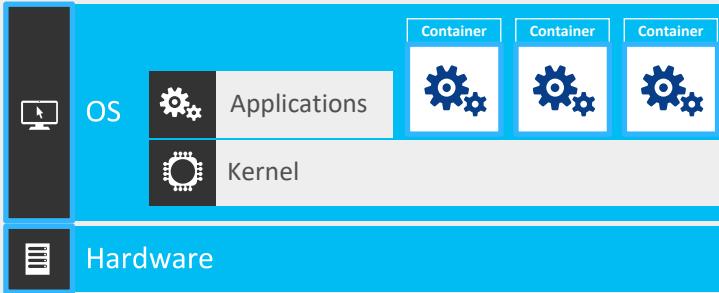
VZ / OpenVZ oferă container-based virtualization



Containers in Windows Server

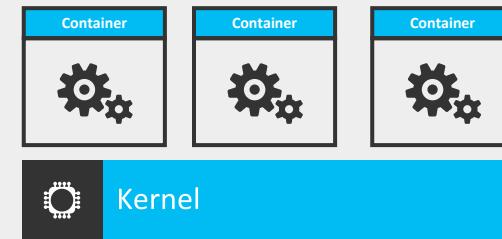
Containers

= Operating system virtualization



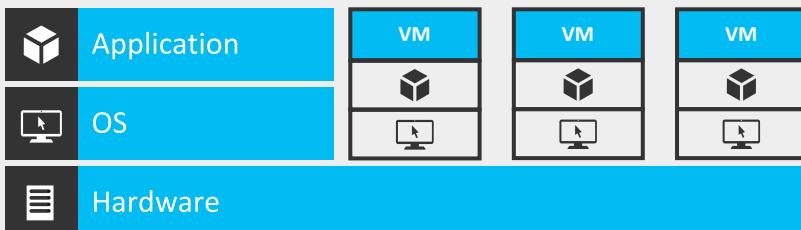
Windows Server containers

Maximum speed and density



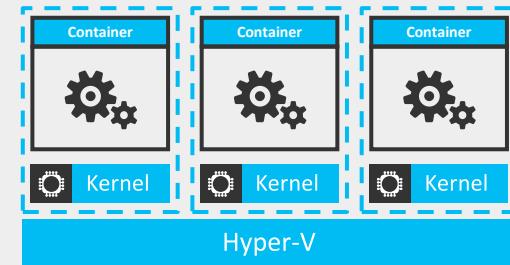
Traditional virtual machines

= hardware virtualization



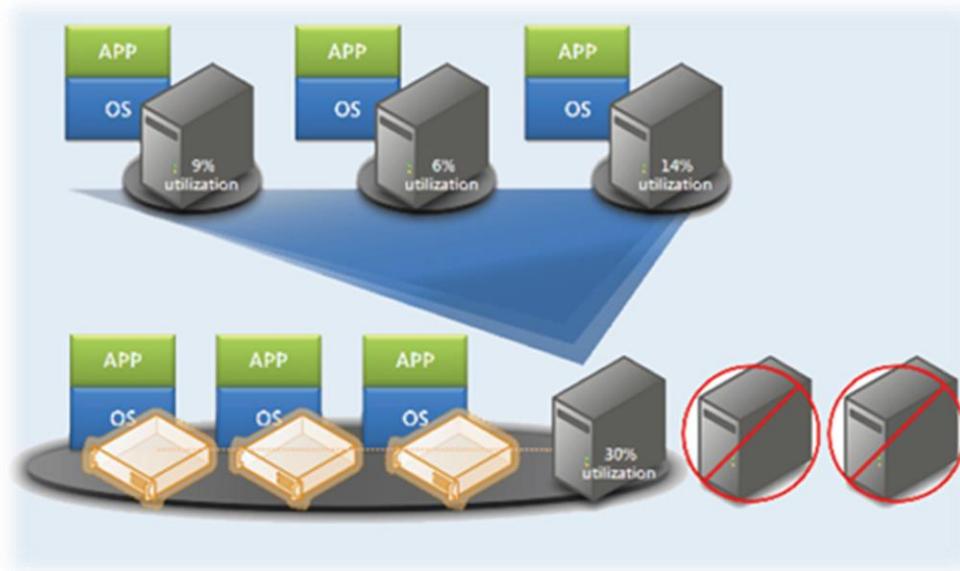
Hyper-V containers

Isolation plus performance



soluții bazate pe virtualizare

consolidare hardware



high availability



testing



disaster recovery



virtual private clouds

target
computing
private
cloud
virtual

ownership
solution
policy
power
network
hardware
funding
elasticity
monitoring
adaptability
cpu
storage
isolation
protection
redundancy
shared processes
people
management
change
technology
scalability
budget
messaging
memory
obsolescence
3rd-party
change
scalability
budget
messaging
memory

sandboxing

[http://en.wikipedia.org/wiki/Sandbox_\(computer_security\)](http://en.wikipedia.org/wiki/Sandbox_(computer_security))



forensic analysis



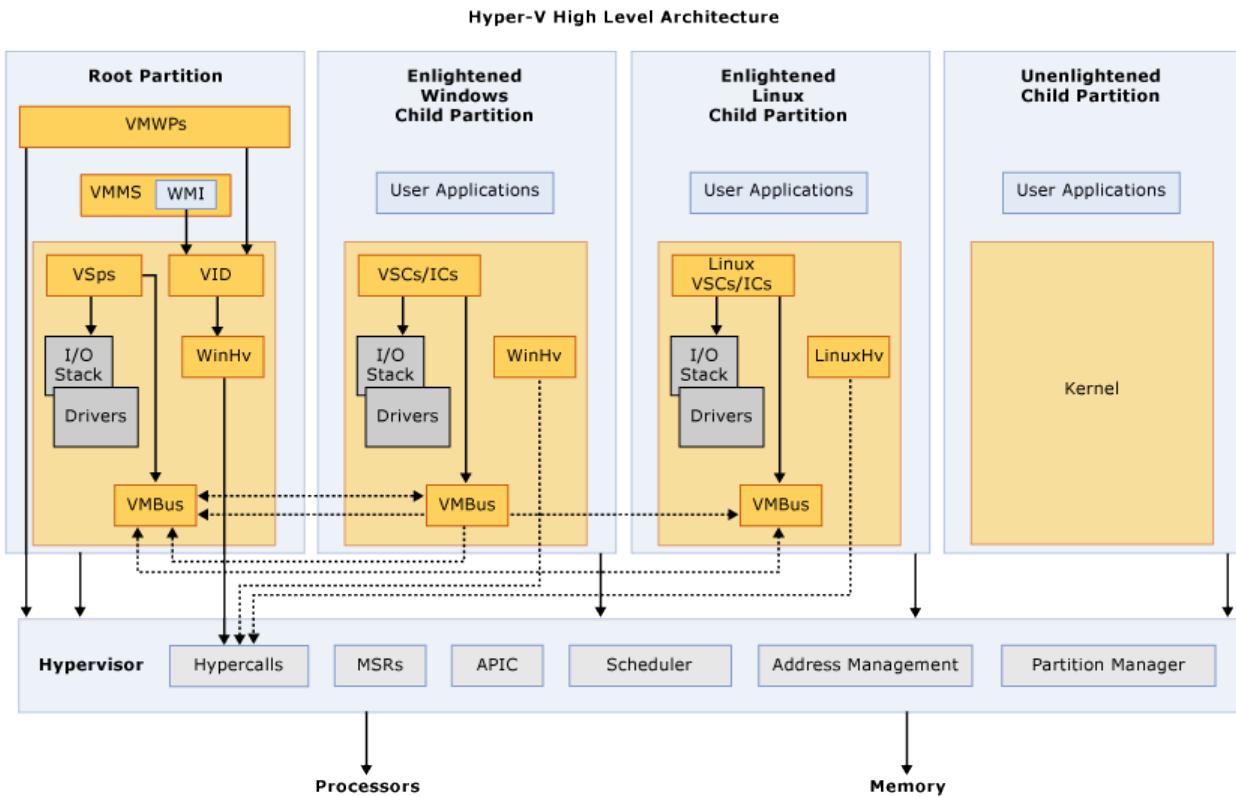
honeypots / honeynets

[http://en.wikipedia.org/wiki/Honeypot_\(computing\)](http://en.wikipedia.org/wiki/Honeypot_(computing))



HYPER-V OVERVIEW

Hyper-V architecture

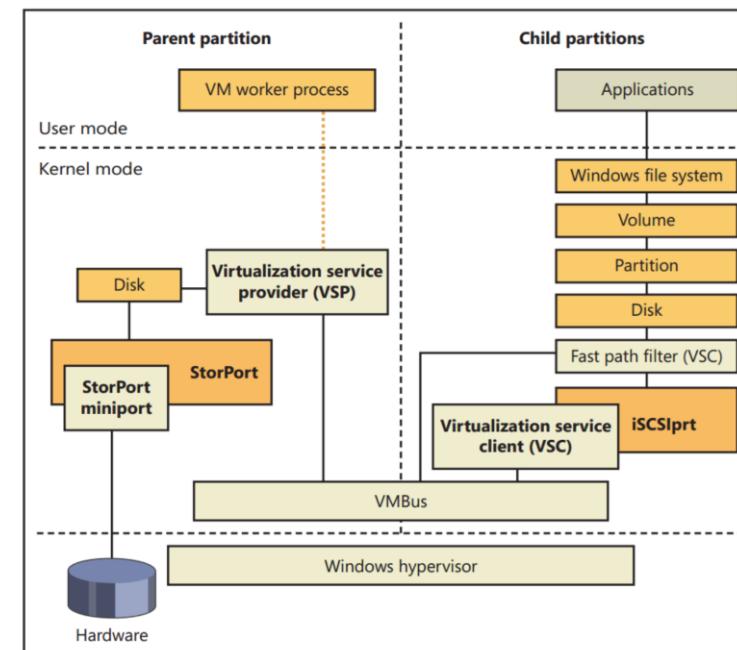


How does it work?

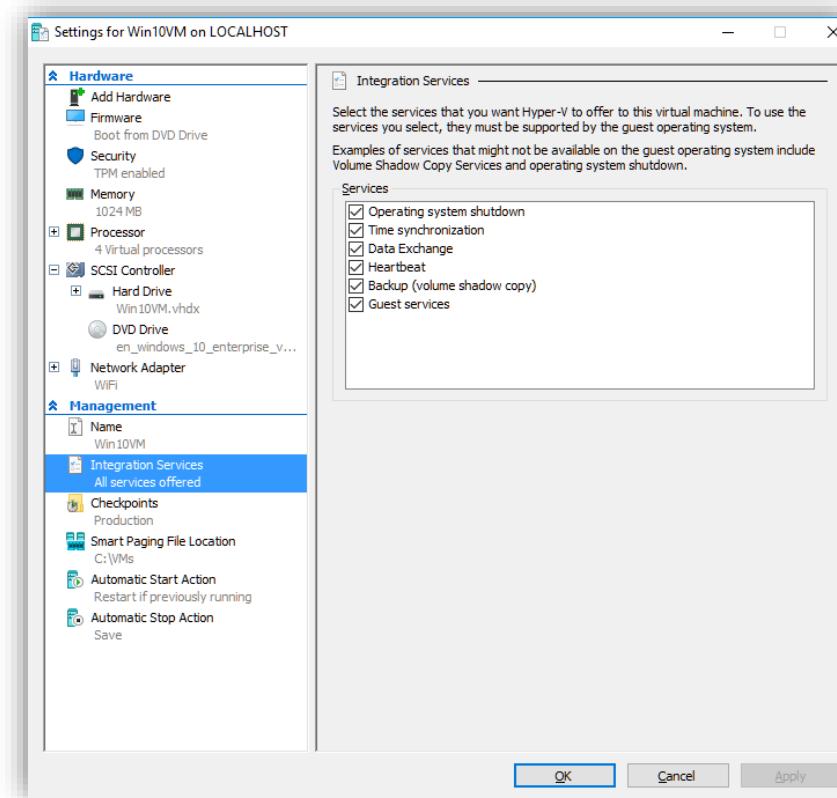
- VSP (virtualization service provider)
 - Hyper-V component in the “parent partition”
 - Communicates with the hardware drivers
 - Gives access to the host resources
- VSC (virtualization service client)
 - Drivers for “synthetic devices” installed in the enlightened guest OS
 - Exposes every virtual device and translates I/O requests
 - There’s always a VSP/VSC pair
- VMBus (virtual machine bus)
 - A high-speed point-to-point in-memory bus
 - Allows the communication between VSPs and VSCs through Hyper-V
- For Linux, every VSC has a DIM (Driver Interface Mapper)
 - DIMs interact with the Linux Kernel like any other driver
 - There’s also a “VSC core” based on each existing VSP

Emulated vs. enlightened

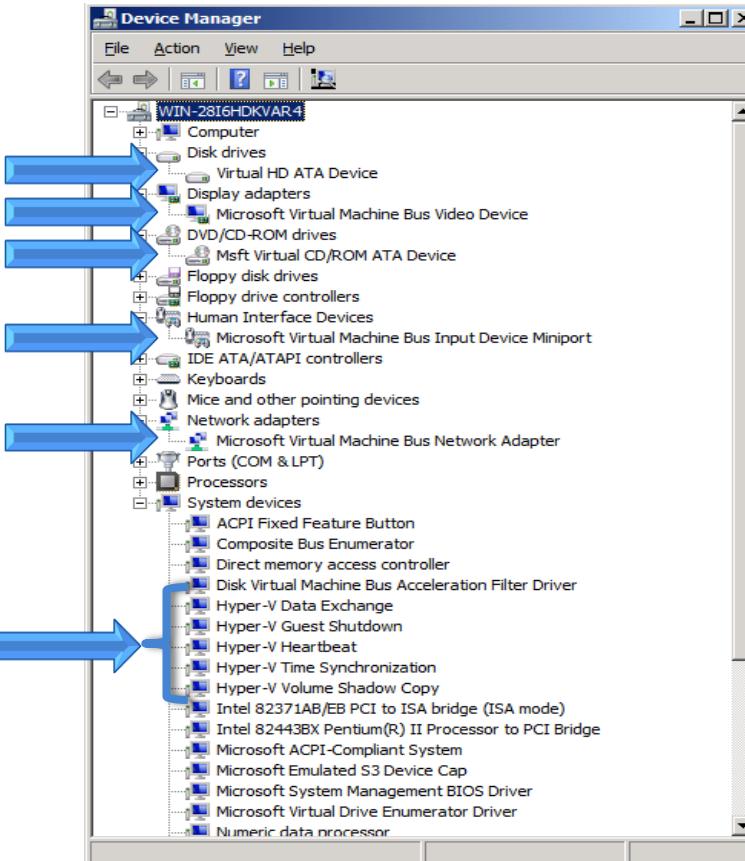
- Emulated drivers
 - Drivers are “emulated”
 - All requests targeting the hardware (HDD, network, etc) are not direct
 - “Translated” in both directions (VM-hw, hw-VM) by the hypervisor
 - They bring in a performance overhead
 - The emulated drivers are pretty similar to what we had in Virtual Server, with some enhancements:
 - Video = S3 Trio64+ SVGA (VESA)
 - Network = Intel/DEC “Tulip” 21x4x
 - IDE = Intel 440BX chipset MB
- “Enlightened” drivers
 - Also known as “synthetic drivers”
 - These make the VM “hypervisor aware”
 - Written especially for virtualized environments => paravirtualization
 - They’re basically just pointers to the drivers in the “parent partition”
 - Huge performance boost!



IS on Windows



IS on Windows



Hyper-V before WS 2012

- Hyper-V history
 - Introduced with Windows Server 2008
 - New version in Windows Server 2008 R2
 - Update with Windows Server 2008 R2 SP1
- Two manifestations of Hyper-V
 - Hypervisor-based virtualization feature of Windows Server 2008 R2
 - Microsoft Hyper-V Server (free download) containing only:
 - Windows Hypervisor
 - Windows Server driver model
 - Virtualization components
 - Failover Clustering
- Windows Server 2008 R2
 - VM mobility with live migration
 - VM high-availability improvements
 - Improved management of datacenters
 - Simplified method for physical and virtual computer deployments
 - Easier adding and removing VM storage
 - Improved virtual networking performance
 - Hyper-V processor compatibility mode
 - Improved memory management

Hyper-V in WS 2012/R2

- Performance & scalability improvements
- Disaster recovery
 - Hyper-V Replica
- Storage improvements
 - VHDX, Virtual Fiber Channel in the Guest (MPIO), NFS Storage with RDMA support, ODX, native deduplication, 4K native disk, iSCSI Target, NTFS online scan/repair
- New migration scenarios
 - Live Migration with no Clustering (via SMB share), LM with no shared storage, Live Storage Migration
- ~150 new PowerShell cmdlets
 - In-box metering
- Snapshots, backup and control
 - Online snapshot merge, Windows Server Backup Support, DM improvements, VM Priority
- Networking improvements
 - NIC Teaming
 - Extensible Virtual Switch
 - Bandwidth QoS
 - Dynamic Virtual Machine Queue (DVMQ)
 - Single Root I/O Virtualization (SR-IOV)
 - Receive Side Scaling (RSS)
 - Receive Side Coalescing (RSC)
 - IPSec Task Offload
 - Address Virtualization
 - Generic Routed Encapsulation (GRE)
 - Address Rewrite

WS 2016 - Hyper-V & Clustering

- Connected Standby support
- Discrete Device Assignment
- Host resource protection
- Hot add and remove for network adapters and memory
- Hyper-V Manager improvements
- Integration Services through WU
- Linux Secure Boot
- Nested virtualization
- Production Checkpoints
- Rolling Hyper-V Cluster Upgrade
- Clustered VM start order priority
- Storage quality of service (QoS)
- Shielded virtual machines
- VM configuration file format
- VM configuration version
- Windows Containers
- Windows PowerShell Direct
- Node Fairness
- Site Awareness
- VM Storage Resiliency
- Cluster Node Quarantine
- Workgroup & multi-domain clusters
- Cluster Cloud Witness

WS 2016 - Storage

- Storage Spaces Direct
- Storage Replica
- Storage Quality of Service
- Data Deduplication improvements
- SMB hardening improvements
- Work Folders
- ReFS

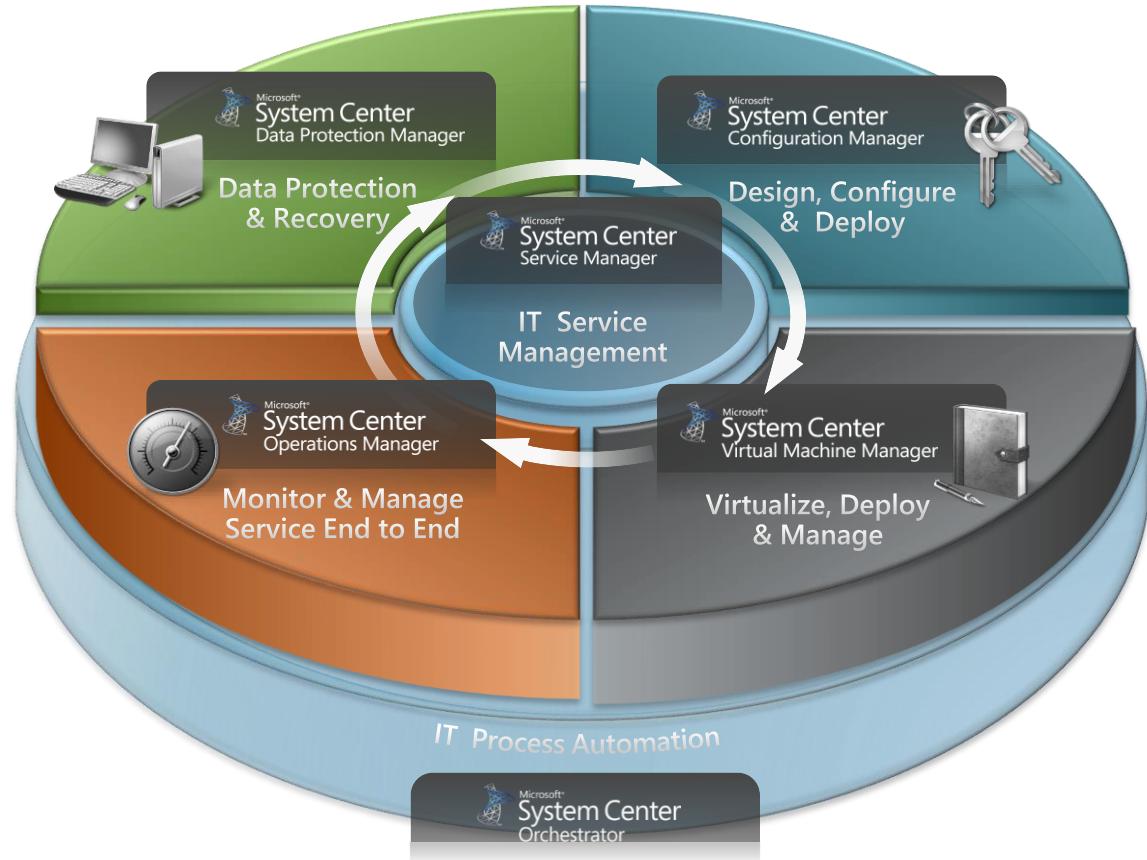
WS 2016 - Network

- Software Defined Networking (SDN) infrastructure
- Network Controller
- Network Function Virtualization (NFV)
- Datacenter Firewall
- RAS Gateway
- Software Load Balancer (SLB) and Network Address Translation (NAT)
- Standardized protocols (REST, JSON, WSMAN/OMI, SNMP)
- Flexible encapsulation technologies (VxLAN & NVGRE)

Instrumente de management

SUITA SYSTEM CENTER

System Center - overview



Hyper-V & System Center

- **Virtual Machine Manager** – Manage physical and virtualized infrastructure
- **Operations Manager** – Monitor physical and virtualized infrastructure
- **Data Protection Manager** – Backup VMs and hosts
- **Orchestrator** – Automate VMs in a workflow
- **Configuration Manager** – Secure and manage VM operating systems
- **Endpoint Protection** – Protect VMs from virus and malware
- **Service Manager** – Provide service offerings with VMs
- **Operations Management Suite** (formerly Azure Operational Insights) – Looks for best practices for virtual machines and hosts
- **Windows Azure Pack** – Offer an Azure-like experience to employees and customers, built on top of your own private cloud

LINUX ON HYPER-V

How does it work?

- VSP (virtualization service provider)
 - Hyper-V component in the “parent partition”
 - Communicates with the hardware drivers
 - Gives access to the host resources
- VSC (virtualization service client)
 - Drivers for “synthetic devices” installed in the enlightened guest OS
 - Exposes every virtual device and translates I/O requests
 - There’s always a VSP/VSC pair
- VMBus (virtual machine bus)
 - A high-speed point-to-point in-memory bus
 - Allows the communication between VSPs and VSCs through Hyper-V
- For Linux, every VSC has a DIM (Driver Interface Mapper)
 - DIMs interact with the Linux Kernel like any other driver
 - There’s also a “VSC core” based on each existing VSP

Emulated vs. enlightened

- **Emulated drivers**
 - Drivers are “emulated”
 - All requests targeting the hardware (HDD, network, etc) are not direct
 - “Translated” in both directions (VM-hw, hw-VM) by the hypervisor
 - They bring in a performance overhead
 - The emulated drivers are pretty similar to what we had in Virtual Server:
 - [Video](#) = S3 Trio64+ SVGA (VESA)
 - [Network](#) = Intel/DEC “Tulip” 21x4x
 - [IDE](#) = Intel 440BX chipset MB
- **“Enlightened” drivers**
 - Also known as “synthetic drivers”
 - These make the VM “hypervisor aware”
 - Written especially for virtualized environments => paravirtualization
 - They’re basically just pointers to the drivers in the “parent partition”
 - **Huge performance boost!**

The story so far

- **What's been done so far?**
 - July 2009 – Microsoft contributes with over 20.000 lines of code in the Linux kernel
 - December 2009 – The drivers (in staging) are included in the 2.6.32 Kernel
 - July 1st 2010 – Microsoft presents at the Red Hat Summit
 - Official support list:

[http://technet.microsoft.com/en-us/library/cc794868\(WS.10\).aspx](http://technet.microsoft.com/en-us/library/cc794868(WS.10).aspx)

- **Linux Integration Services 2.1 (July 2010)**
 - SUSE Linux Enterprise Server (10 SP1/SP2/SP3, 11)
 - Red Hat Enterprise Linux (5.2, 5.3, 5.4, 5.5)
- **Linux Integration Services 3.4 (September 2012)**
 - Red Hat Enterprise Linux 5.5-5.9 & 6.0-6.3 x86 and x64 (Up to 4 vCPU)
 - CentOS 5.5-5.8 & 6.0-6.3 x86 and x64 (Up to 4 vCPU)
 - SUSE Linux Enterprise Server 10 SP4 & 11 SP1/SP2
- **Linux Integration Services 3.5 (December 2013)**
 - Red Hat Enterprise Linux (RHEL) 5.5-5.8, 6.0-6.3 x86 and x64
 - CentOS 5.5-5.8, 6.0-6.3 x86 and x64

Pigs do fly: Microsoft unleashes 20,000 lines of Linux code

By Mary Jo Foley | July 20, 2009, 8:58am PDT

Summary

Nope, that's not a typo in the headline. Microsoft is releasing three Microsoft-developed

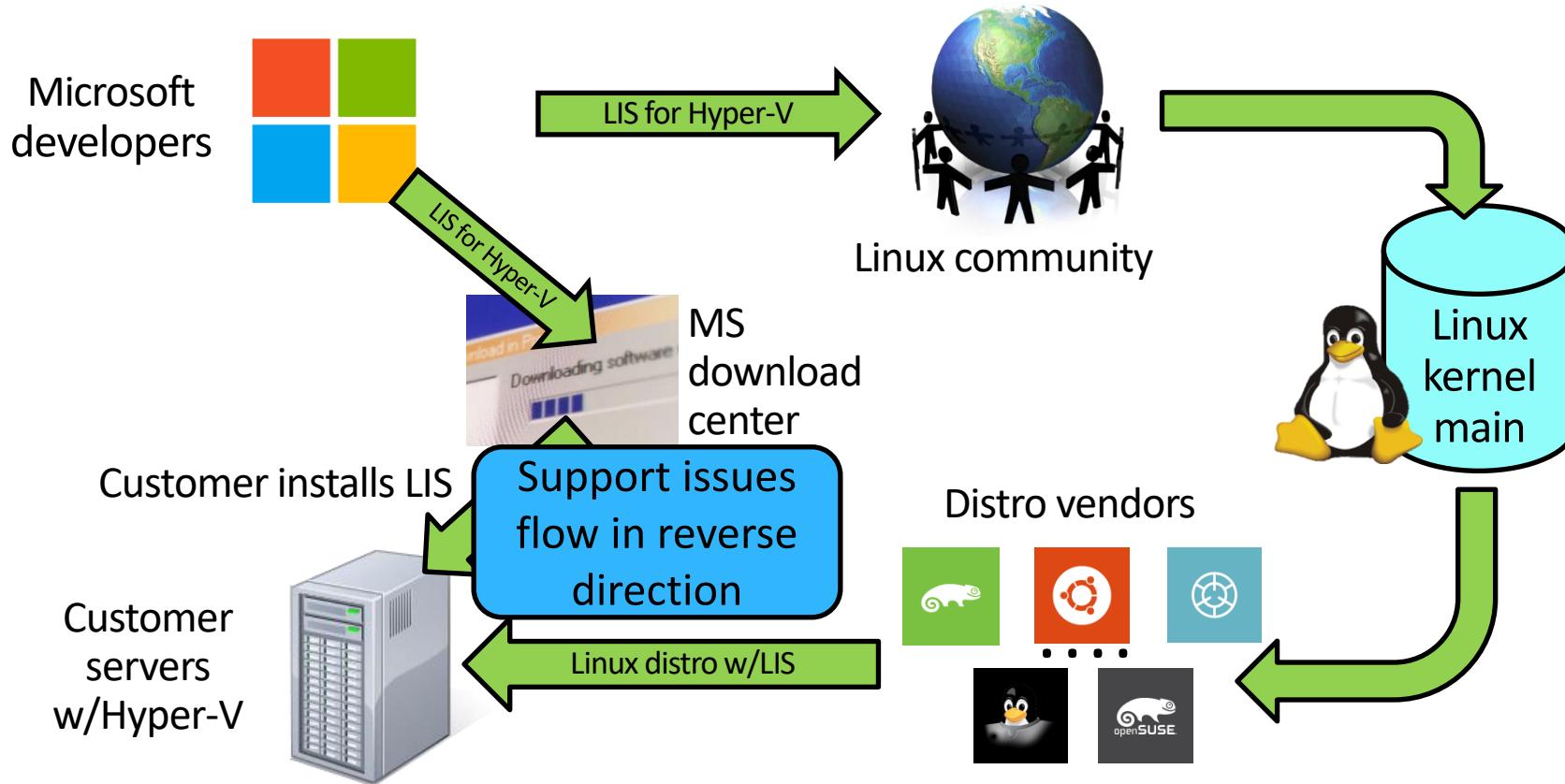
Microsoft is releasing three Microsoft-developed Linux drivers to the Linux community for possible inclusion in the Linux source tree.

This is the first time Microsoft has made Microsoft-developed code available directly to the Linux community. The Redmondians have released various pieces of code under different open-source licenses.

The road to “enlightment”

- Driver support for synthetic devices (**v1 – original distro code, created by Citrix**)
 - Synthetic network controller & Synthetic storage controller (IDE/SCSI)
- Fastpath Boot Support for Hyper-V (**v2.0 – December 2009**)
 - Block VSC – increased boot performance
- Timesync (**v2.1 – July 2010**)
 - The clock inside the virtual machine will remain synchronized with the clock on the host
- Integrated Shutdown (**v2.1 – July 2010**)
 - VMs can be cleanly shut down from Hyper-V
- Symmetric Multi-Processing (SMP) Support (**v2.1 – July 2010**)
 - Supported Linux distributions can use up to 4 virtual processors (VP) per virtual machine
- Heartbeat (**v2.1 – July 2010**)
 - Allows the host to detect whether the guest is running and responsive
- Pluggable Time Source (**v2.1 – July 2010**)
 - A pluggable clock source module is included to provide a more accurate time source to the guest.
- KVP (Key Value Pair) Exchange (**v3.1 – July 2011**)
 - Information about the running Linux VM can be obtained by using the Key Value Pair exchange functionality on the host (FQDN, Linux IS version, IP addresses, OS version/distro/kernel, CPU architecture x86/x64)
- Integrated Mouse Support (**v3.2 – January 2012**)
 - The cursor is no longer bound to the VMConnect window when used with the Linux Graphical User Interface
- SMP 32 vCPU support (**v3.3 – June 2012**)
 - Support for up to 32 vCPUs on certain distros
- Live Migration (**v3.4 – September 2012**)
 - Linux virtual machines can undergo live migration for load balancing purposes
- Jumbo Frames (**v3.4 – September 2012**)
 - Linux virtual machines can be configured to use Ethernet frames with more than 1500 bytes of payload

Linux Integration Services Development



Microsoft & Linux/Unix

	Linux						UNIX		
	Red Hat	SUSE	CentOS	Ubuntu	Debian	Oracle	AIX	HP-UX	Solaris
Operations Manager	✓	✓	✓	✓	✓	✓	✓	✓	✓
Configuration Manager	✓	✓	✓	✓	✓	✓	✓	✓	✓
Endpoint Protection	✓	✓	✓	✓	✓	✓	<i>No Plans</i>		
Data Protection Manager	✓	✓	✓	✓	✓	✓			
Virtual Machine Manager	✓	✓	✓	✓	✓	✓			
Hyper-V	✓	✓	✓	✓	✓	✓			
Azure IaaS	✓	✓	✓	✓	✓	✓			

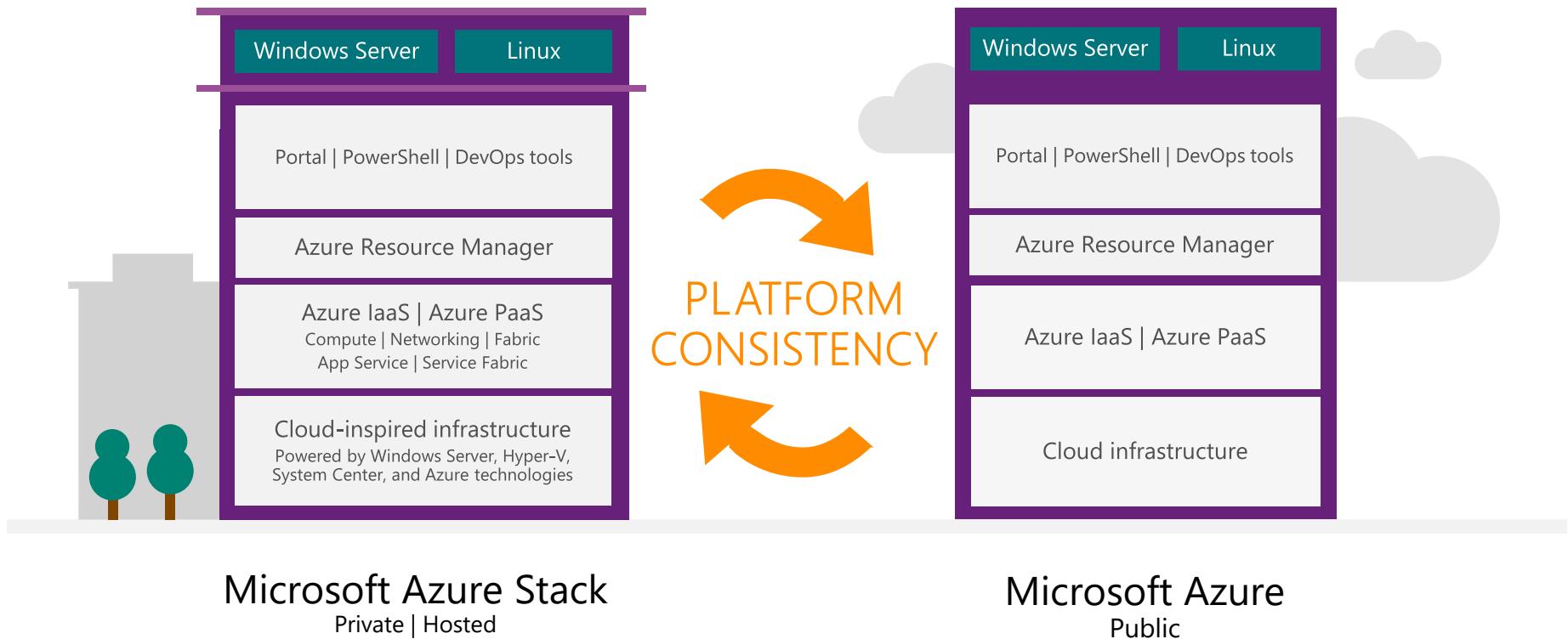
Linux IS components

- hv_vmbus – communication with the host
- hv_storvsc – storage VSC
- hv_netvsc – network VSC
- hv_timesource – pluggable time source
- hv_mouse – enlightened mouse
- hv_utils – graceful shutdown, timesync, heartbeat
- hv_balloon – dynamic memory
- hv_vss_daemon – live backups

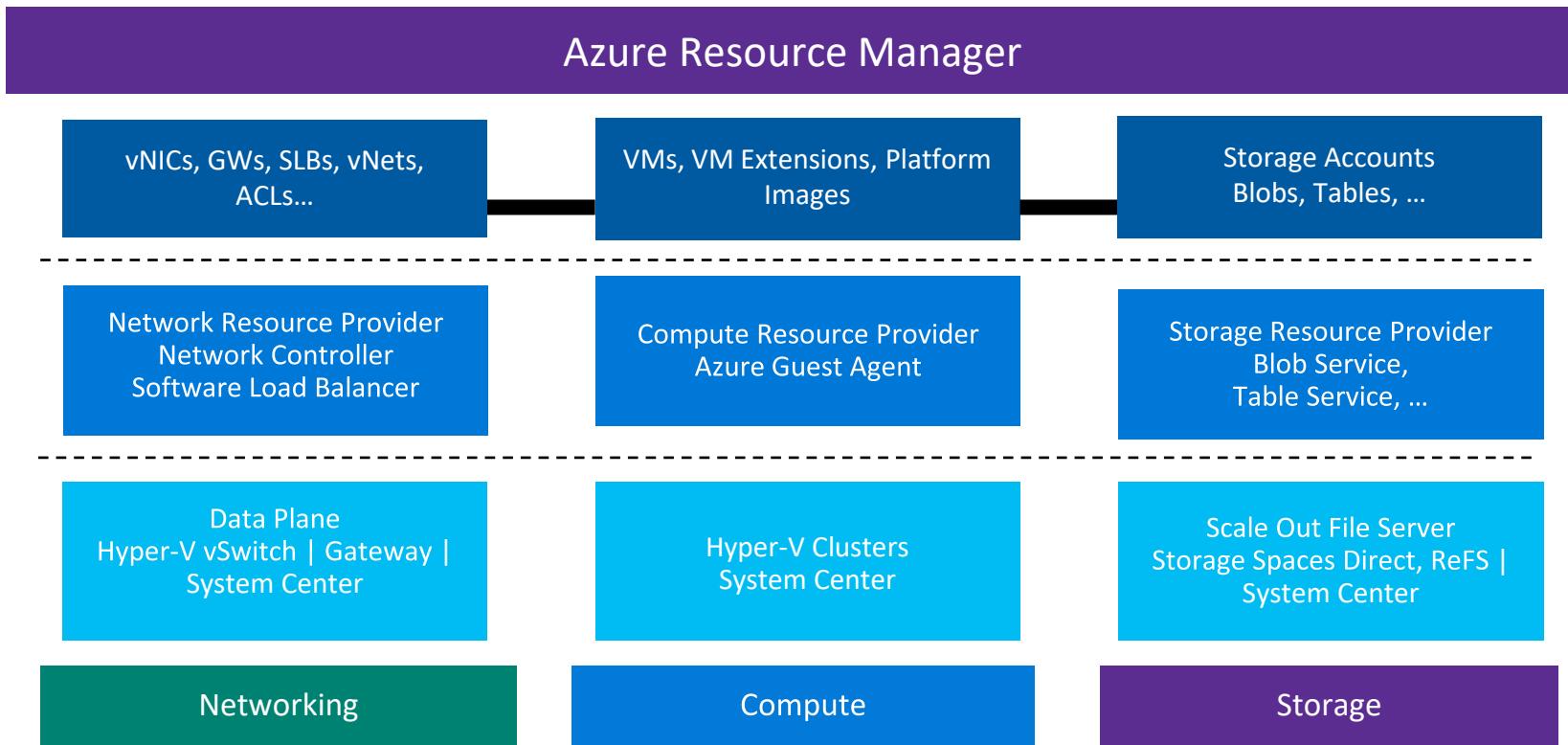
WINDOWS AZURE STACK

Azure Stack

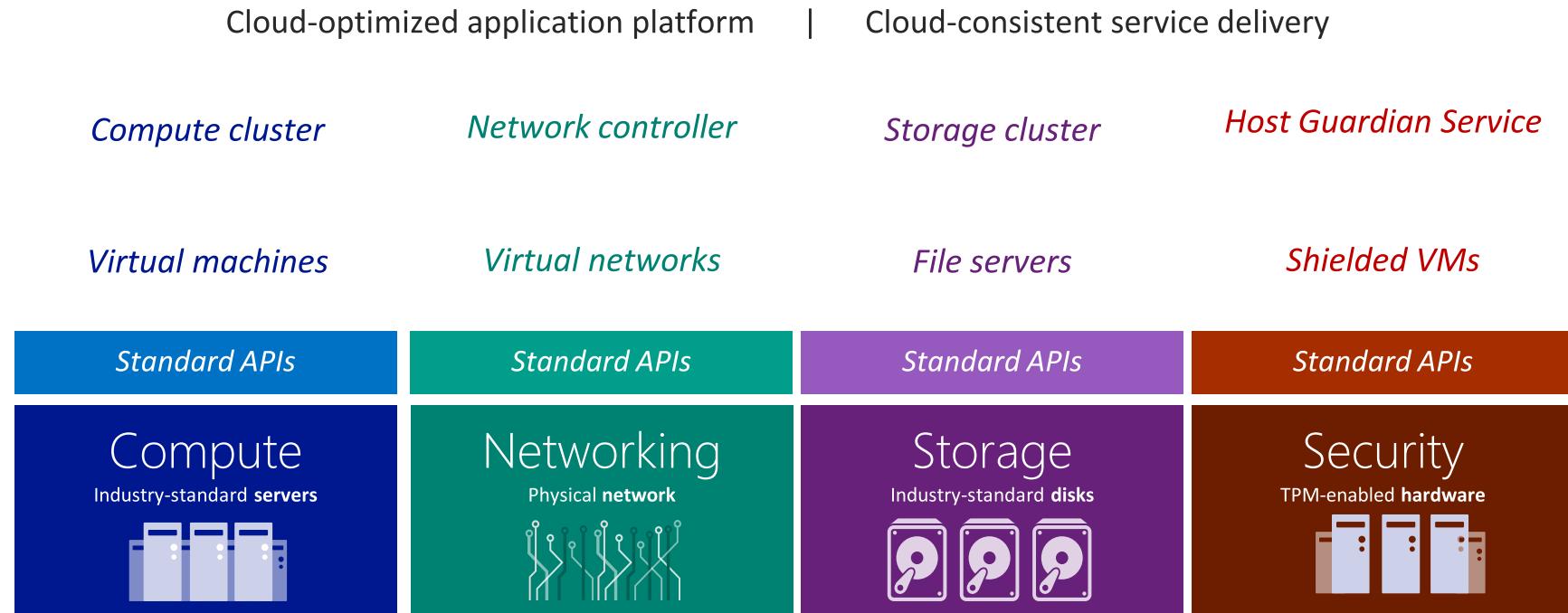
The power of Azure with the control of the datacenter



Azure Stack - Overview



Cloud-inspired infrastructure



Soluții de scripting

POWERSHELL

Powershell v1.0

- Command Line Interpreter – CLI
- Script Execution Engine
- Help online vast
- Comenzi build-in (cmdlets), extensibile
- Suportă WMI, COM, CMD, etc.
- Construit peste .NET Framework 2.0
- Suport pentru:
 - Windows Server, Exchange, SQL, SCOM, SCVMM, SCDPM, Compute Cluster, OpenXML, IBM WebSphere MQ, Active Directory, Lotus Domino, VMWare Infrastructure, Windows 7, WDK, NetApp Data ONTAP

PowerShell – before & after

	INAINTE	ACUM
GUI	MMC	GUI-uri bazate pe PowerShell
Shell interactiv	CMD	PowerShell
Scripting	BAT în CMD	PowerShell
COM	WMI (VBScript)	PowerShell

Securitate în PowerShell

- Secure by design & by default
- Fisierile script sunt asociate cu Notepad
 - Scripturile nu vor rula
- CLI cere permisiunea de executare pentru scripturi neverificate
- Execuția PS se face:
 - Prin 'cmdlets', (programe .NET, scrise de un developer, compilate într-un DLL și încărcate de un script PowerShell)
 - Script-uri PowerShell ('.ps1')
 - Funcții PowerShell
 - Programe executabile

PowerShell v2.0

- Control Remote (PowerShell Remoting)
- Îmbunătățiri ale engine-ului (cmdlets, operators, debugging)
- Try-Catch-Finally
- GUI pentru PowerShell (PowerShell ISE)
- Hosting
 - - Run-space restrictionat
 - - Delegare drepturi
- Background Jobs
- Operații tranzacționale
- Eventing
- Network File Transfer
- API-uri noi

PowerShell v3.0

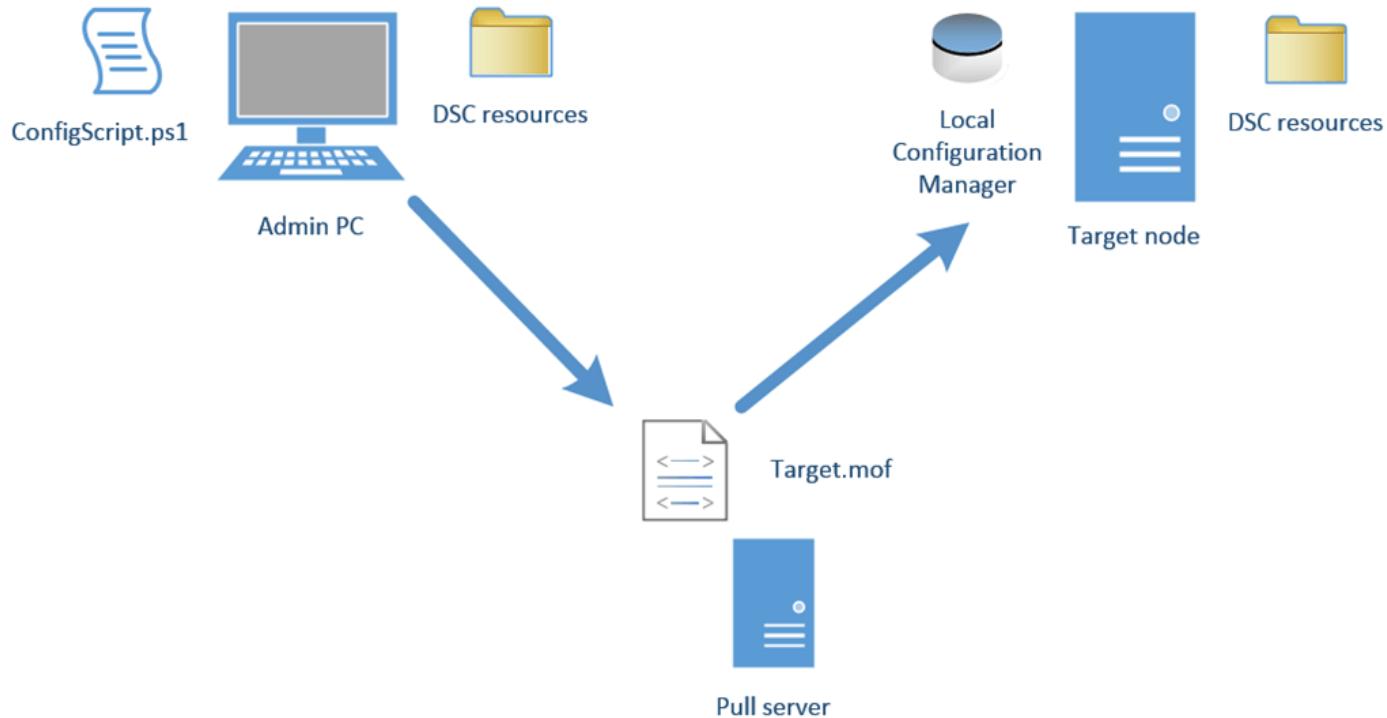
- New commandlets
 - \$Pv3 = Get-Command *
 - \$Pv3.count
- PowerShell ISE
 - Single Command Pane
 - IntelliSense
 - Snippets
 - Collapsible regions
- Updatable Help
 - Update-Help
- Windows PowerShell Workflows
 - Parallel, Sequence & InlineScript keywords
- Remote Get-Module
 - Get-Module implicit remoting

PowerShell v4.0 and v5.0

- PowerShell Desired State Configuration (DSC)
 - Enables deployment and management of configuration data for software services and their environments
- Improvements in job scheduling
- Development using classes
 - Using formal syntax and semantics similar to OOP languages (Class, Enum and other keywords have been added)
- ConvertFrom-String cmdlet
- Archiving (zip) native support
- Script tracing feature
 - Enables detailed tracking and analysis of PowerShell scripting usage on a system
 - All script blocks are logged to ETW (Event Tracing for Windows) event log, under Microsoft-Windows-PowerShell/Operational
- And a lot more:
 - <https://technet.microsoft.com/en-us/library/hh857339.aspx>

PowerShell DSC

<https://msdn.microsoft.com/en-us/powershell/dsc/overview>



Windows PowerShell – resurse/comunități

- Team blog: <http://blogs.msdn.com/PowerShell>
- PowerShell Community: <http://www.powershellcommunity.org>
- PowerShell Forum: <http://social.technet.microsoft.com/Forums/en-US/winserverpowershell/threads>
- Channel 9: <http://channel9.msdn.com/tags/PowerShell>
- Wiki:
<http://channel9.msdn.com/wiki/default.aspx/Channel9.WindowsPowerShellWiki>
- Script Center: <http://www.microsoft.com/technet/scriptcenter/hubs/msh.mspx>
- CodePlex: <http://codeplex.com/Project/ProjectDirectory.aspx?TagName=powershell>
- Cărți
 - PowerShell in Action by Bruce Payette
<http://manning.com/powershell>
 - Windows PowerShell Cookbook by Lee Holmes
<http://www.oreilly.com/catalog/9780596528492/index.html>
 - Professional Windows PowerShell Programming
<http://www.wrox.com/WileyCDA/WroxTitle/productCd-0470173939.html>

THANKS ☺