Securing Virtualised Environments

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PulseANZ 2010

Meet the people who can help advance your infrastructure

Agenda

- Introduction to Virtualization
- Security and Risk Implications
- Operational and Organizational Implications
- Common Mistakes
- What Can I Do?
  - Current technologies and solutions
  - The future of virtualization and enterprise security

Introduction to Virtualisation

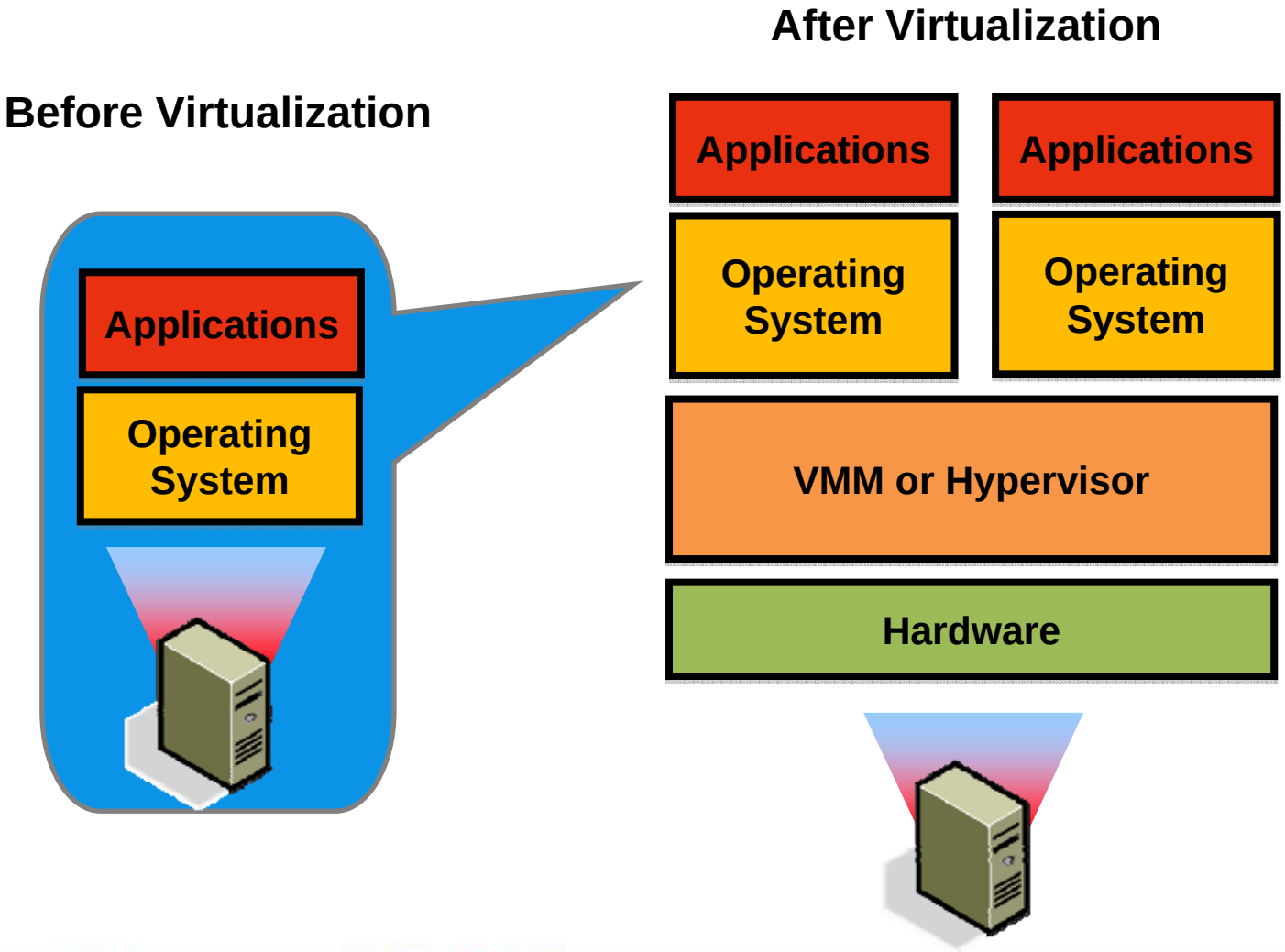
Basics: Disruptive Innovation

Virtualization is a Disruptive Innovation

Virtualization:

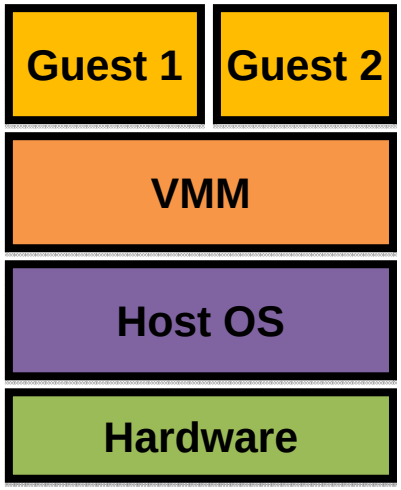
The logical abstraction of physical computing resources (OS, application, switches, storage, networks) designed to create computing environments that are not restricted by physical configuration or implementation.

Basics: Virtualization Architecture



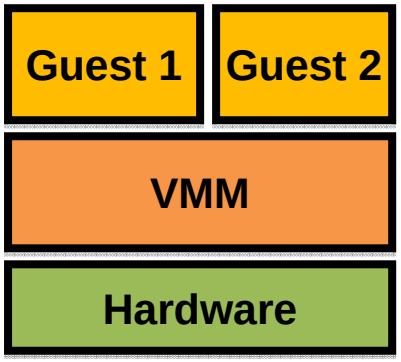
Basics: Virtualization Types

type-2 VMM



Examples:
KVM (Linux)
VMware Workstation
VMware Server
Microsoft Virtual PC

type-1 VMM

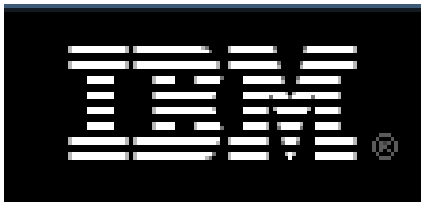


Examples:
Xen
VMware ESX
IBM pHype / LPARs
Microsoft Hyper-V

What does Virtualization Change?

- Everything
  - Dynamic, fluid data-center
  - Resource pools
  - Commoditization of everything
  - Increased efficiency
- Nothing
  - Virtual IT is still IT
    - Security, sprawl, management, complexity, h

Major Players



- Founded in 1998
- Division of EMC

- Acquired XenSource in 2007 for $500 million
- Based on open-source Xen hypervisor

- Virtual server, acquired VirtualPC in 2003 from Connectix
- Hyper-V

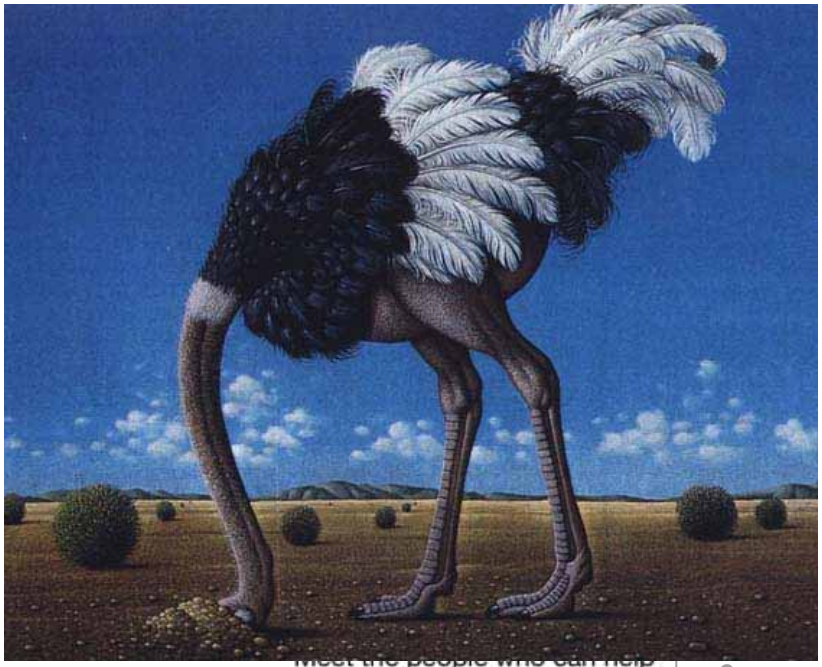
- Pioneered virtualization over 40 years ago
- LPAR, sHype, VSS

- Based on open-source Xen hypervisor

Security and Risk Implications

Virtualization and Enterprise Security

- Virtualization != Security
  - Standard servers are as secure as standard VMs
- Partitioning divides VMs, but does not secure them
- Same principles apply
  - Defense in depth
  - Network design and segmentation
  - Unified security management



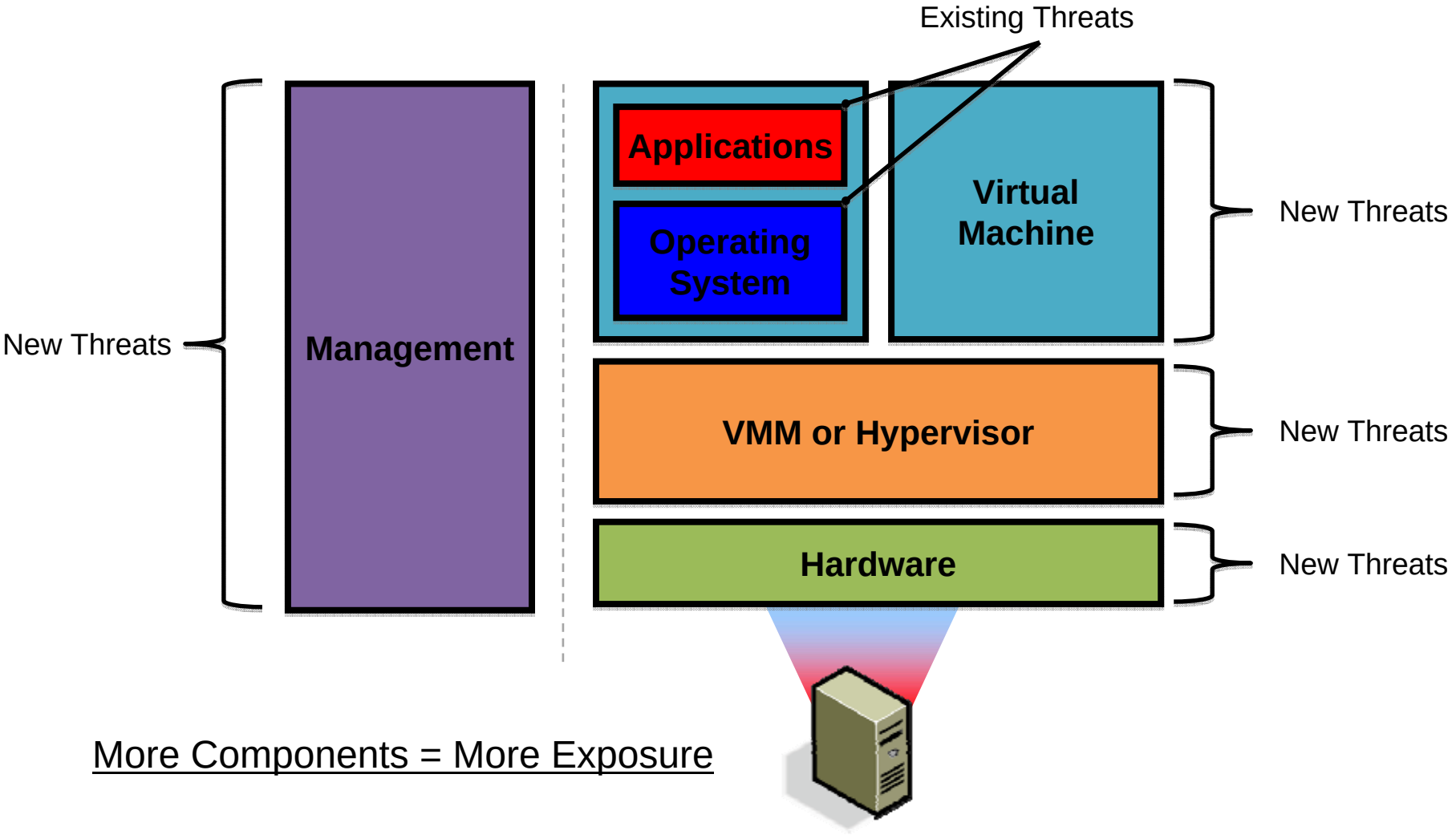
Threat Landscape

- New Swath of Availability Attacks
  - Owning a single guest
  - Breaking out of the guest
  - Guest theft
  - Compromise of Virtual Console/Management
    - Provision my own evil guest(s)
    - Adjust resource quotas
    - Shut OFF guest(s)
  - Compromise of the VMM/Hypervisor
    - IsGameOver()

Threat Landscape (cont.)

- Other Threats…
  - Regulatory
  - Auditors
  - Org-Charts...
    - Separation of Duties
    - Politics

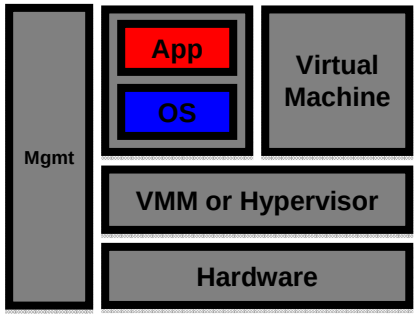
Points of Exposure



More Components = More Exposure

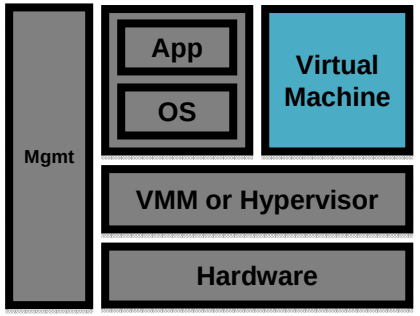
Operating Systems and Applications

- Traditional threats remain:
  - Malware: Viruses, Worms, Trojans, Rootkits
  - DoS/DDoS attacks
  - Buffer Overflows, SQL Injection, XSS
  - Data Leakage
  - Access Control, Compliance, Integrity
- Virtualized OSes and Apps threats remain:
  - Disaster Recovery and Sandboxing are notable arguments
  - However, they do not increase native resistance to OS/Application threats



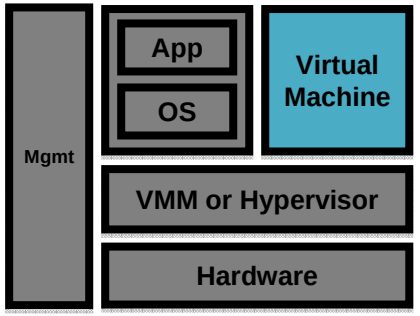
Virtual Machines

- Compliance and Patching
  - Ability to “Suspend” / “Activate” VMs alters update lifecycle.
- Virtual Sprawl and Identification
  - Difficult to keep track of VMs. Unmanaged, rogue VMs.
- Dynamic Relocation (Live Migration)
  - Are VMs moving to less secure machines, networks, datacenters, etc?
  - Static security policies no longer apply.

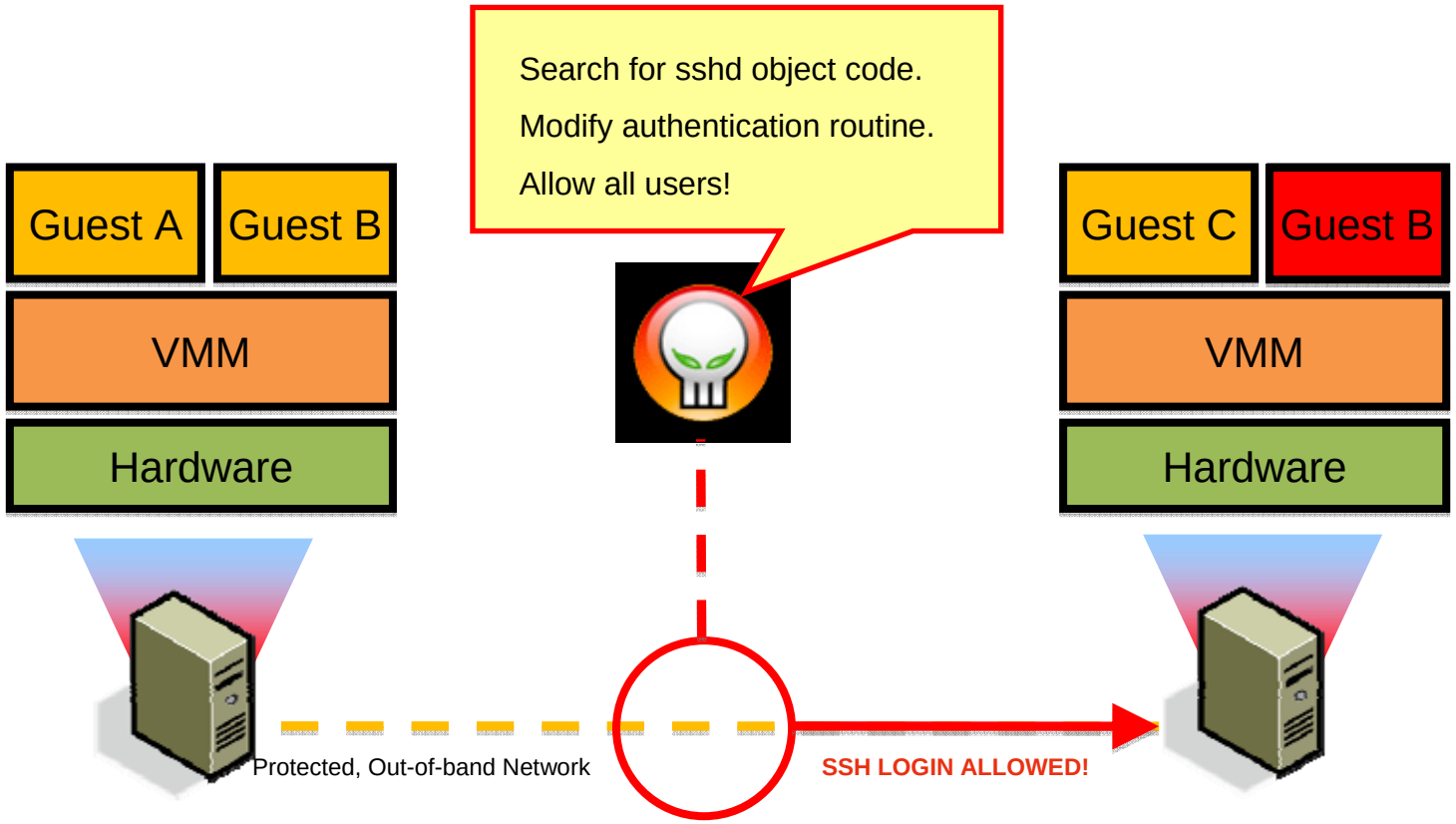


Virtual Machines (cont.)

- Replay Attacks and Data Retention
  - VM replay may foster advanced cryptographic attacks.
  - Is sensitive data being cached in unknown areas for replay purposes?
- Virtual Machine Stealing
  - VMs are just files, its trivial to steal a full system or groups of systems.

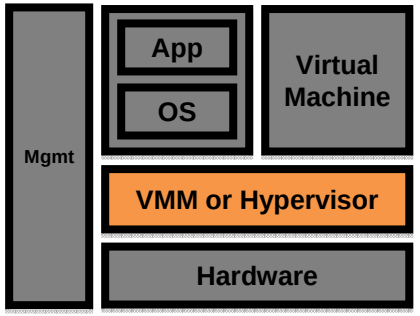


Exploiting Live Migration: Xensploit

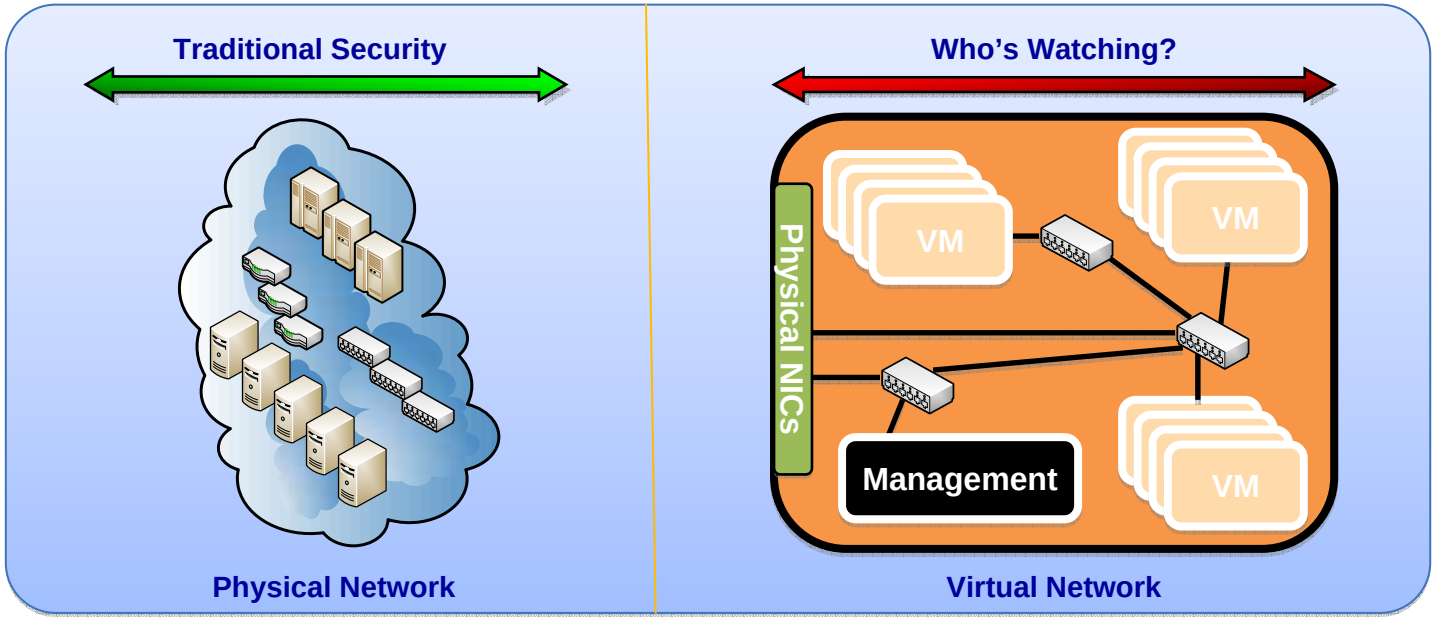


By default, live migration traffic is sent in plain text across the network.
A man-in-the-middle attack can be used to own endpoints in limitless ways.

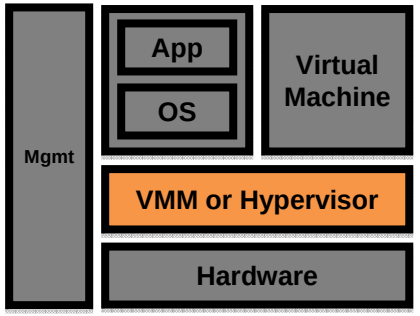
Virtual Machine Manager / Hypervisor



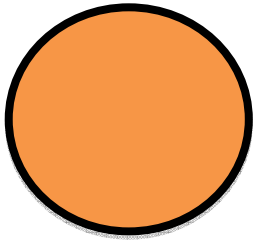
- Single Point-of-Failure/Attack
- Mandatory Access Control / Resource Sharing
  - Can we guarantee isolation, sharing and communication?
- Inter-VM Traffic Analysis:



VMM / Hypervisor (cont.)



- Attacks against the VMM / Hypervisor.
  - There are going to be bugs that lead to security risks.
  - Shrinking size of VMMs is good for security, but does not make them immune to risk. Features demand complex code.



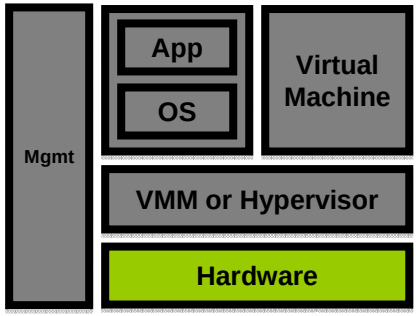
VMware ESX 3
~2GB Surface Area
Lines of Code: Millions

VMware ESX 3i
~32MB Surface Area
Lines of Code: ~200,000

- Hypervisor Services
  - Network – DHCP, vSwitching, general packet processing
  - Communication – Inter-domain communication APIs (VMCI, XenSocket)
  - Other Services – Security (VMsafe), Disaster Recovery (vMotion), etc.

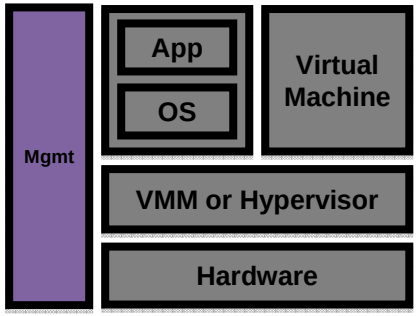
Virtualization-Aware Hardware

- Hardware Assist (Intel-VT, AMD-V)
  - Techniques (e.g. rootkits) with stealth capabilities.
  - Low-level makes detection more difficult.
  - Risk to non-virtualized deployments.
    - Blue Pill: Malicious hypervisor injection for AMD-V
    - Vitriol: Leverages Intel VT-x



- I/O Virtualization
  - VMs natively share virtualization-aware I/O devices.
    - Virtual Ethernet Cards (vNICs), Virtual FC HBAs (vHBAs), etc.
  - How do we secure a new class of on-demand, dynamic and virtualized allocation of resources?

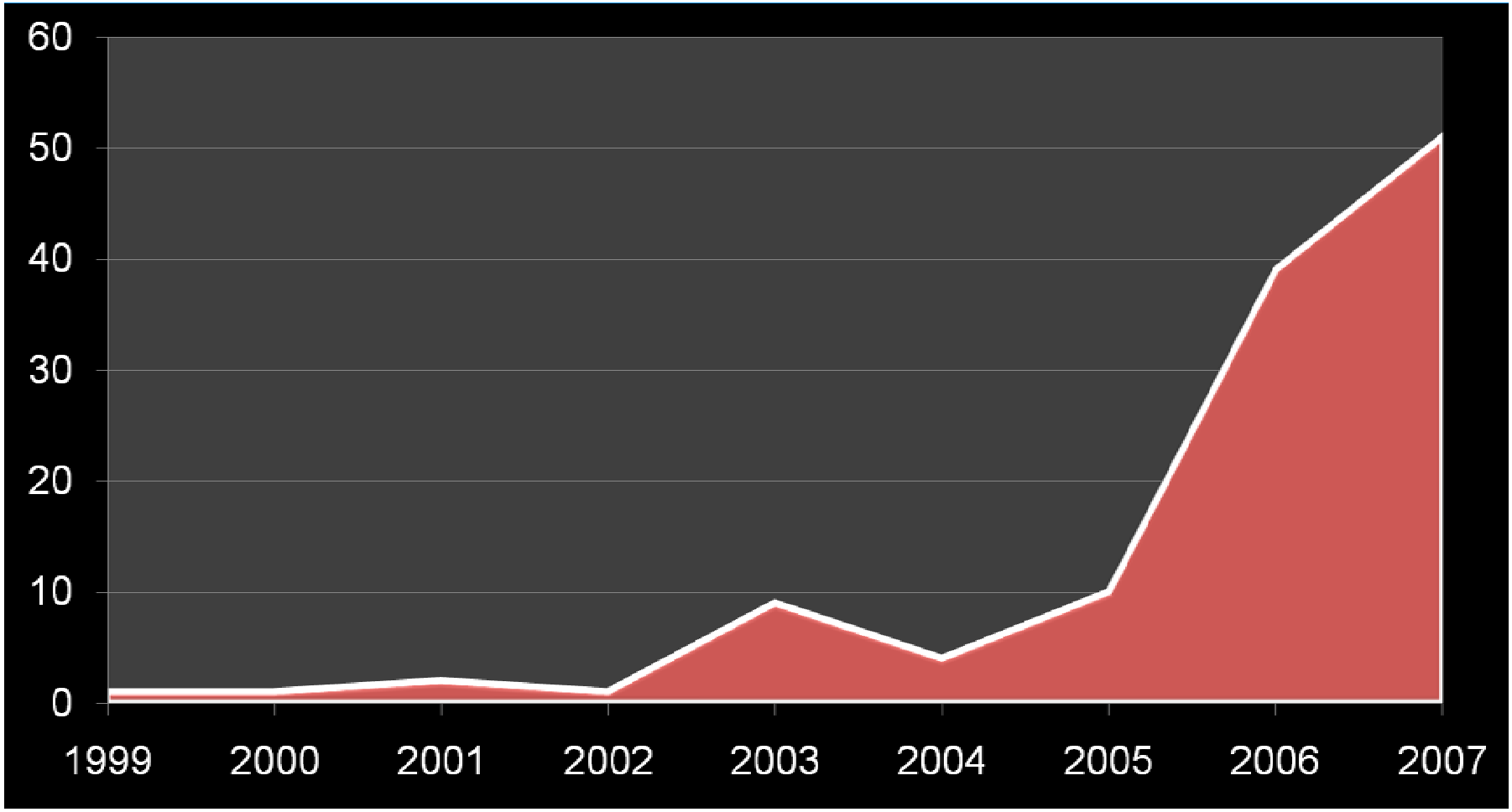
Management Infrastructure



- Software Threats:
  - Keys to the castle.
  - Vulnerabilities in management applications.
  - Secure storage of Virtual Machines and management data.
- Operational Threats:
  - Managing risk requires new technology, skills and expertise.
  - We now also factor the extremely dynamic nature of virtualization into our evaluation of overall risk.

Vulnerabilities by Year

XFDB Search: VMware, Xen, Virtual PC, QEMU, Parallels, etc.



Operational and Organizational Implications

Organizational Ownership?

- Who owns the Virtual [Fill in the Blank] ?

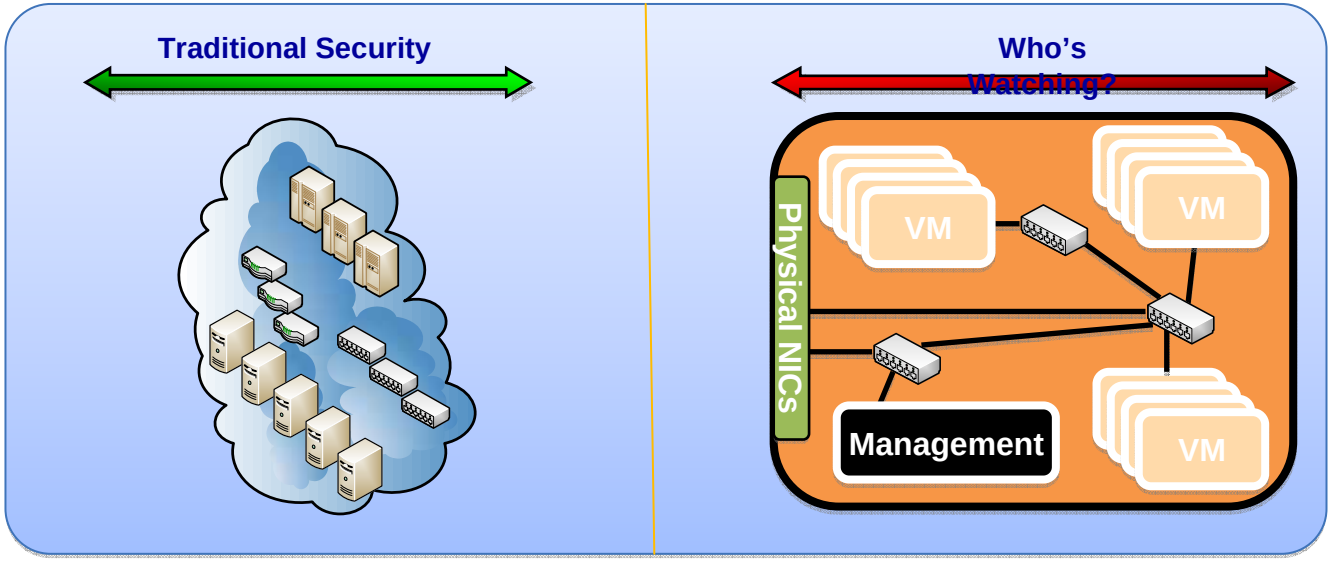
Network Admin

Server Admin

Application Owners

Data Custodians

?



Organizational Ownership?

- Traditional disciplines and functions still require competence
- Separation/Segregation of Duties remains critically important
- Care and Feeding of the Virtual Infrastructure will also be required
  - Are you likely to have a mix of Physical and Virtual Servers?
  - Are you likely to have a heterogeneous mix of Virtual platforms?

Politics of Ownership

- “Turf Wars” and “Land Grabs” are possible
- “Hot Potato” is also possible
- “Finger Pointing” is probable

New Operational Challenges

- Find the Server…
  - Live Migration makes servers harder to track
- Configuration/Patch Management
  - Pause/Offline features impact:
    - Audits
    - Scanning
    - Patching
  - Boot Prone?
- Image Management
  - Storage
  - Version Control

Operational Controls

- Discipline, Discipline, Discipline
- What are your policies for use of Virtualization?
  - Which Servers can be clustered?
  - Which Servers cannot be clustered?
- What are your controls for provisioning?
  - Easy to slip into Virtual Sprawl
  - Two Key System?

Common Mistakes

Elective Risk

- Understand the inherent differences in Type 2 vs Type 1 Virtualization for Production
- These “Free” versions of the platform are meant for Testing
- Type-2 VMM specific vulnerabilities

Failure to Establish Policy

Before it gets away from you…

- Establish Clear Use Guidelines
- Establish Clear Roles & Responsibilities
- Establish Controls for Provisioning
- Establish Intelligent Image Management
- Establish Security Guidelines
- Establish Compliance Requirements

Failure to Consider Compliance

- Anticipate Future Regulatory Granularity
  - Right now Virtualization is ahead of Compliance
- Will you still be PCI Compliant?
  - Consult your Auditors **Early and Often**
- PCI DSS 2.2.1 states: "Implement only one primary function per server"
  - How does your auditor interpret this?

Failure to Involve Security

- By default, Virtualization reduces your security posture
  - New attack surfaces
  - New operational risks
  - New availability risks
  - Increased complexity that comes with beneficial features
    - E.g. Live Migration
- Security Analysis/Design can inform smart compensating controls and best practices while countermeasures mature

Failure to Control Live Migration

- Cascading Failover Example
  - True Story…
- We often overlook the fluid realities of Live Migration
  - E.g VMotion

“Silver Bullet” Virtual Appliances

- Today’s Virtual Security Appliances are very nascent
  - Coverage is limited
  - There is NO Silver Bullet
  - Buzz Words and Snake Oil abound
  - Realistic expectations can help reduce over-confidence in these products
- Security will improve as Virtual Platforms release their Security APIs and as Security Vendors leverage them

What Can I Do?

Virtualization Security Evolution

Existing solutions certified for protection of virtual workloads

Virtual Environment Ready

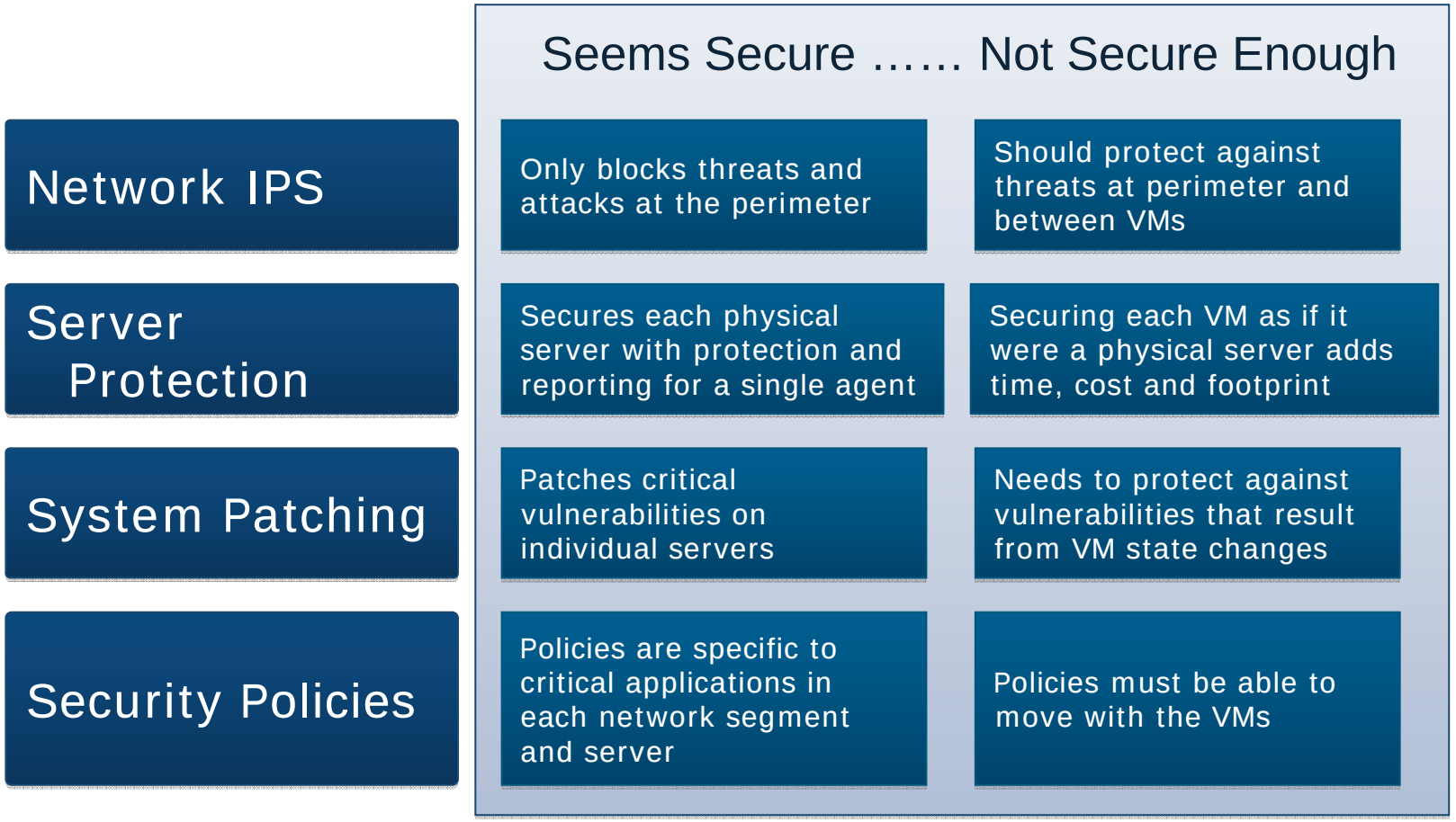
Threat protection delivered in a virtual form-factor

Virtual Appliances

Integrated virtual environment-aware threat protection

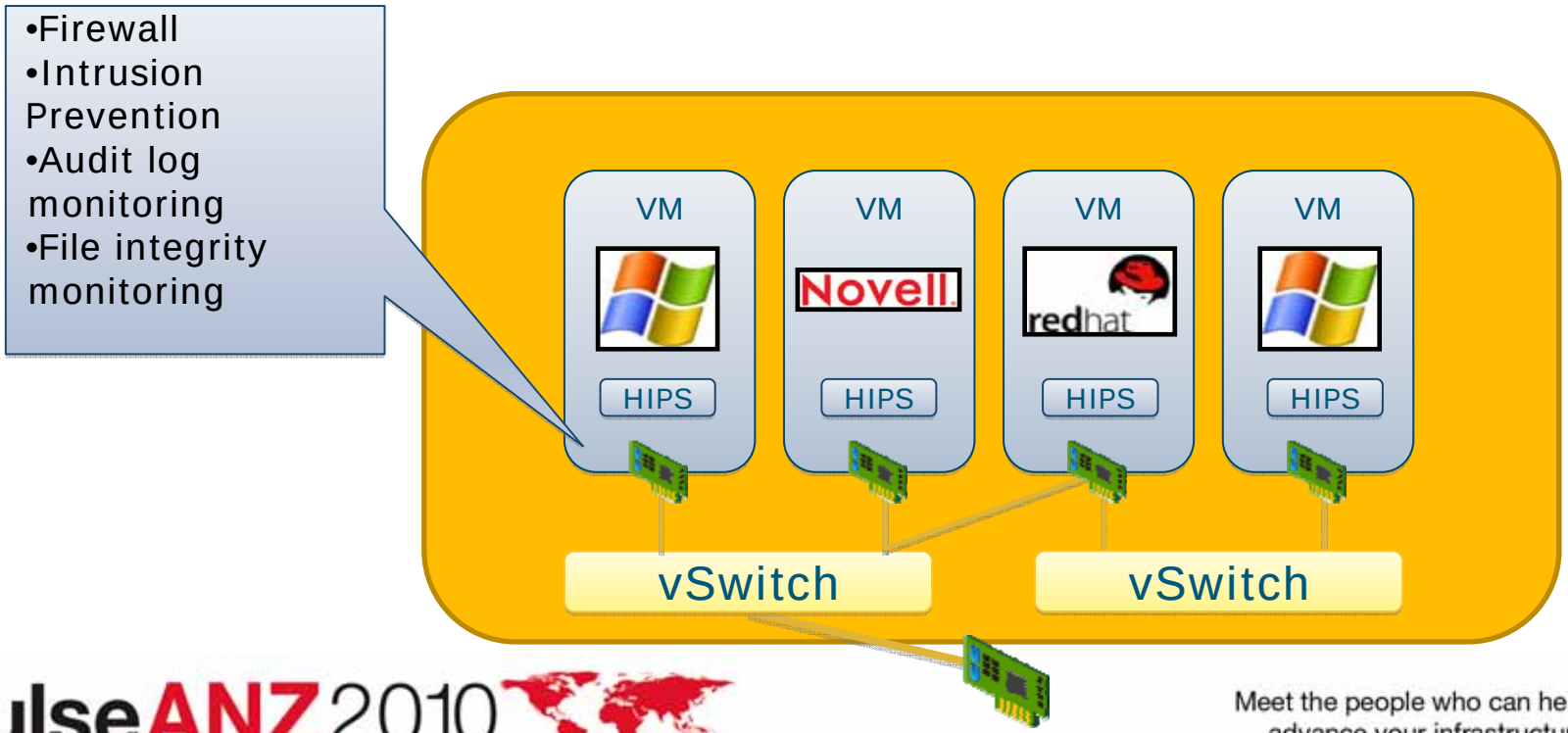
Virtual Infrastructure Protection

Traditional Security in the Virtual Environment

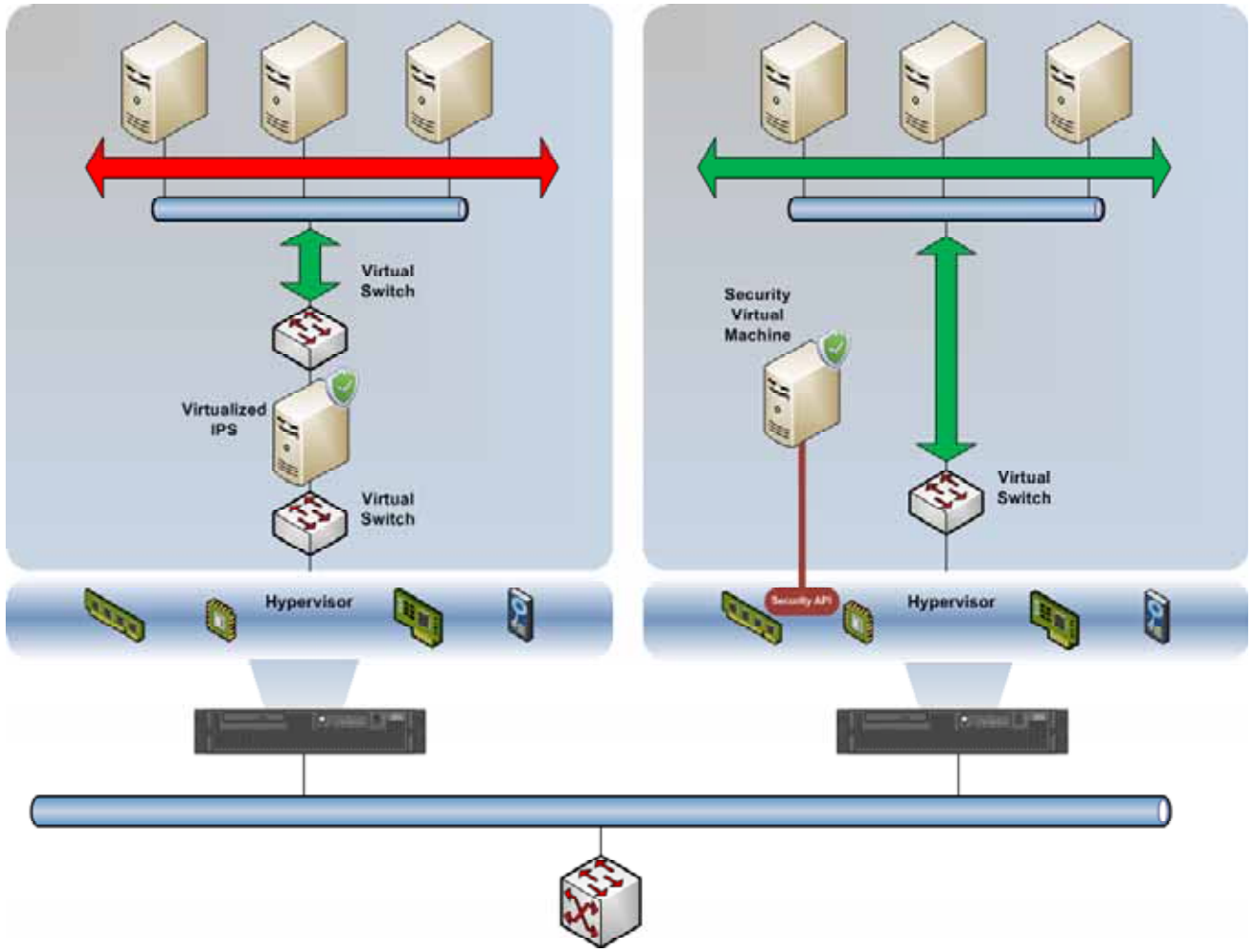


Host-Based IPS

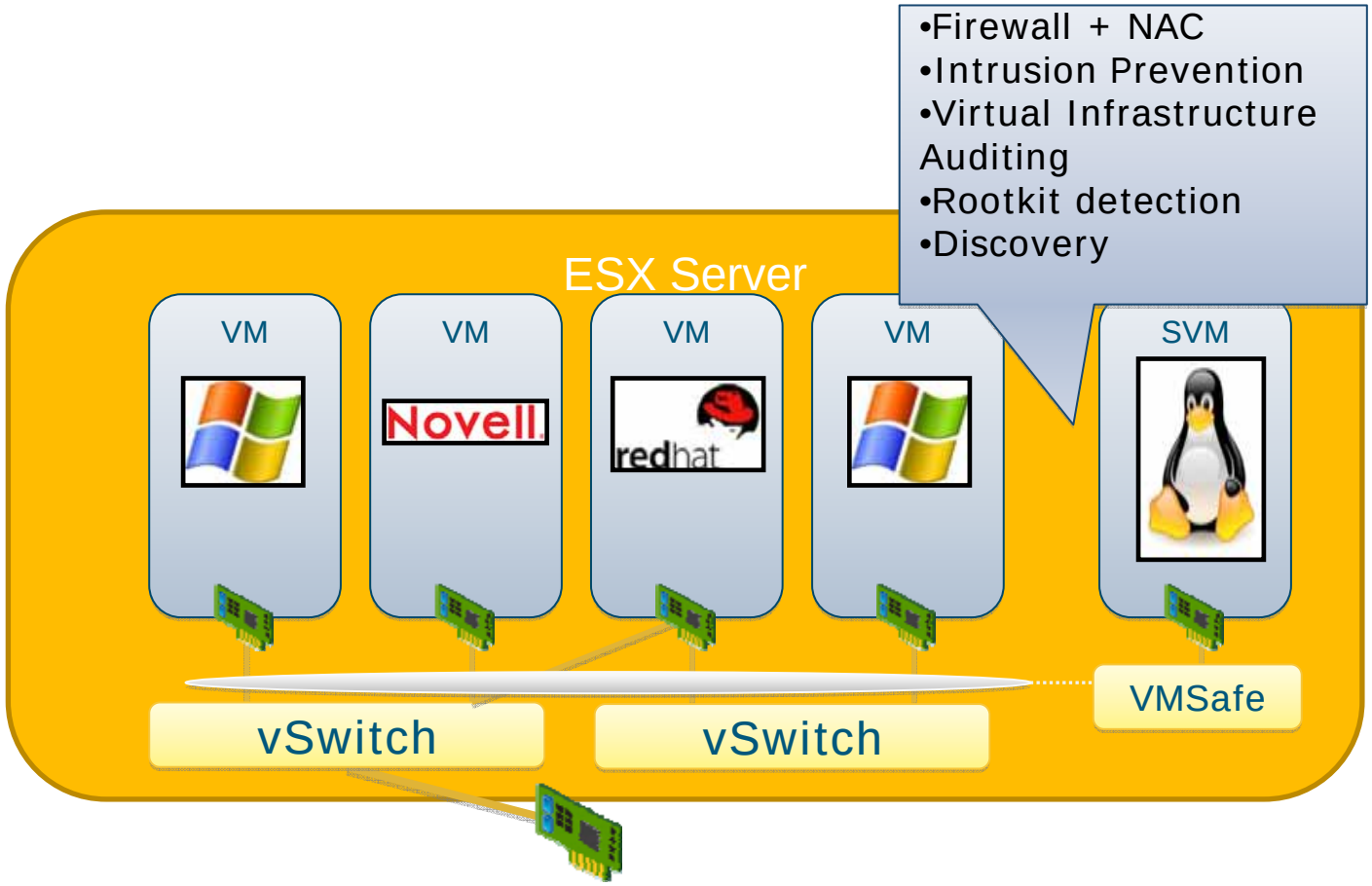
- Captures inter-VM communication…
  - IF host agent is installed
- Larger “total” footprint on a hypervisor



Virtual IPS vs. Security Virtual Machine



Integrated Virtual Infrastructure Protection



Integrated Security Benefits

- Simplified deployment
- Eliminates visibility gaps
  - Inter-VM communication
  - Discovery
  - VM whitelisting/vNAC
- Automated protection
- Advanced security techniques
  - Introspection-based malware detection
- Control of resources allocated to security

Host Security Footprint Reduction

- Security Virtual Machines take over host-level firewall and IPS/IDS functions from HIPS agent
  - Fewer resources (CPU, memory) consumed
  - Less intrusive (kernel drivers)
  - Guest OS-independent
- More to come…

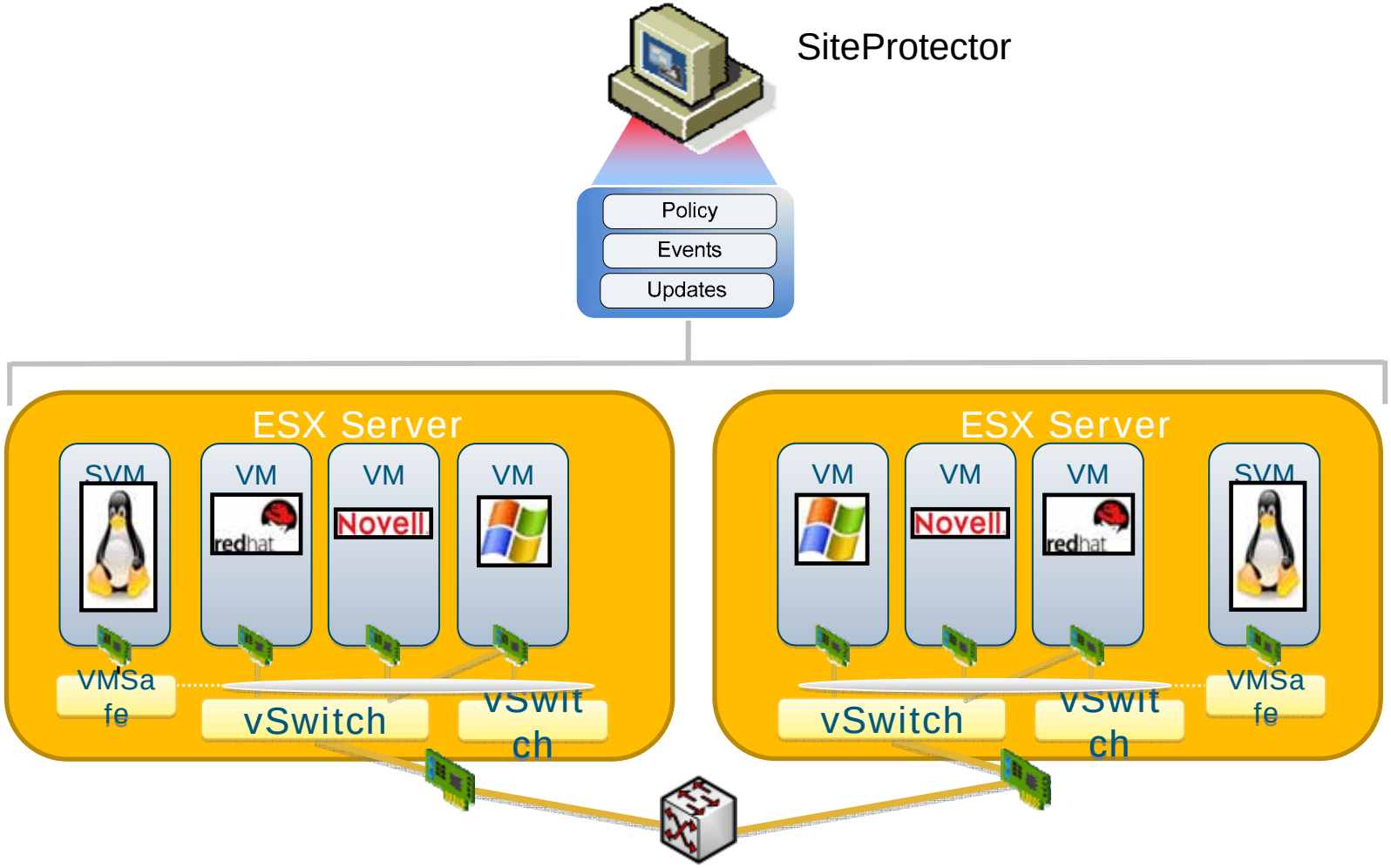
Simplified Deployment

- Virtual appliance form-factor
  - No reconfiguration of virtual network
    - Abstracts underlying network topology
  - Consolidated, locked-down VM dedicated to security
  - OVF format reduces configuration time
  - Compatible with automated image deployment solutions

Control VM Sprawl

- Identify VMs that are invisible to traditional discovery tools
- Control unauthorized crossing of trust zones
- Ensure VMs that come online do not introduce vulnerabilities
- Quarantine unauthorized VMs
  - VMs that are not considered trusted are given limited network access

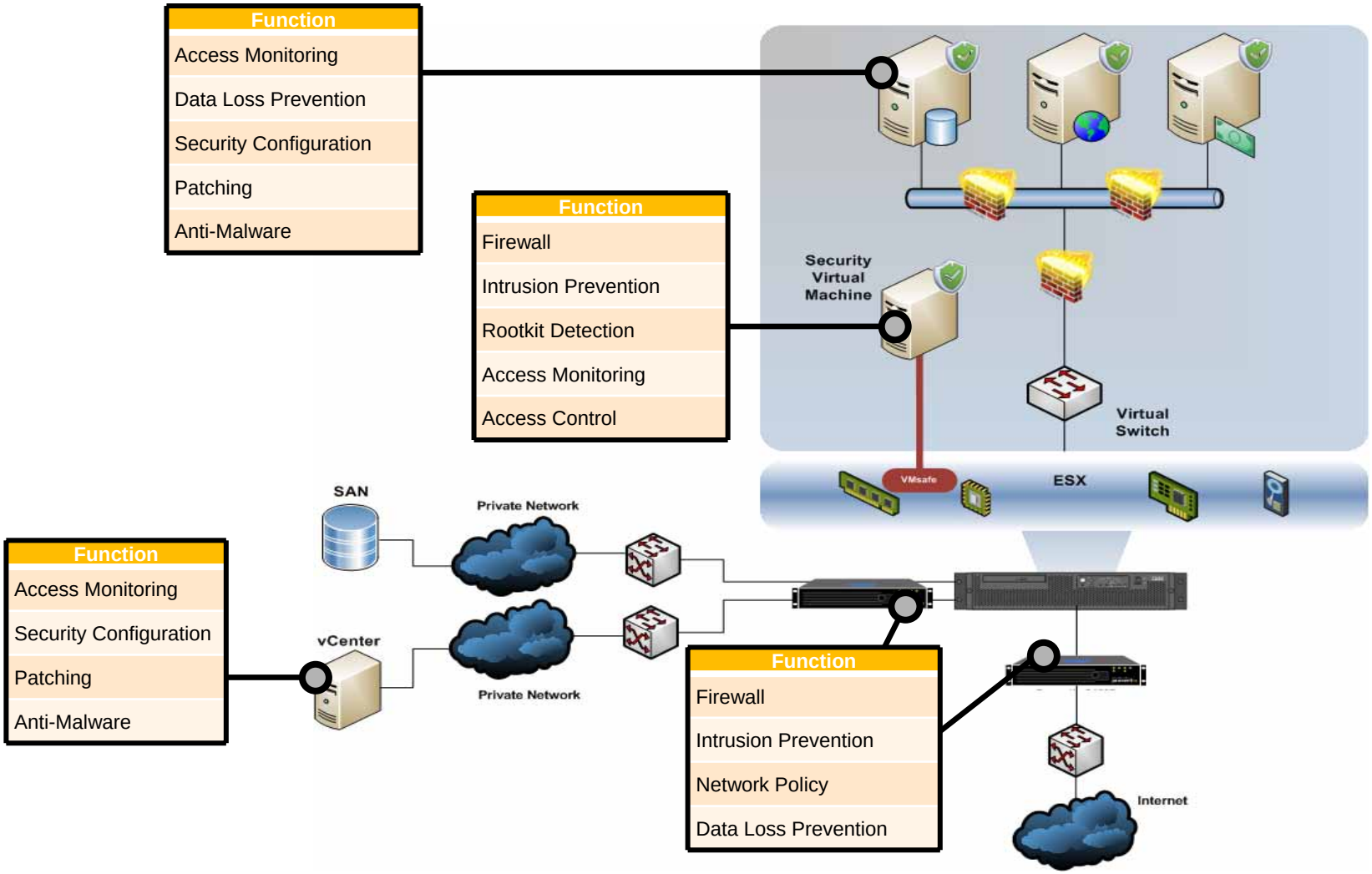
Dynamic Environment Protection



Is There a Need for Host-Based Agents

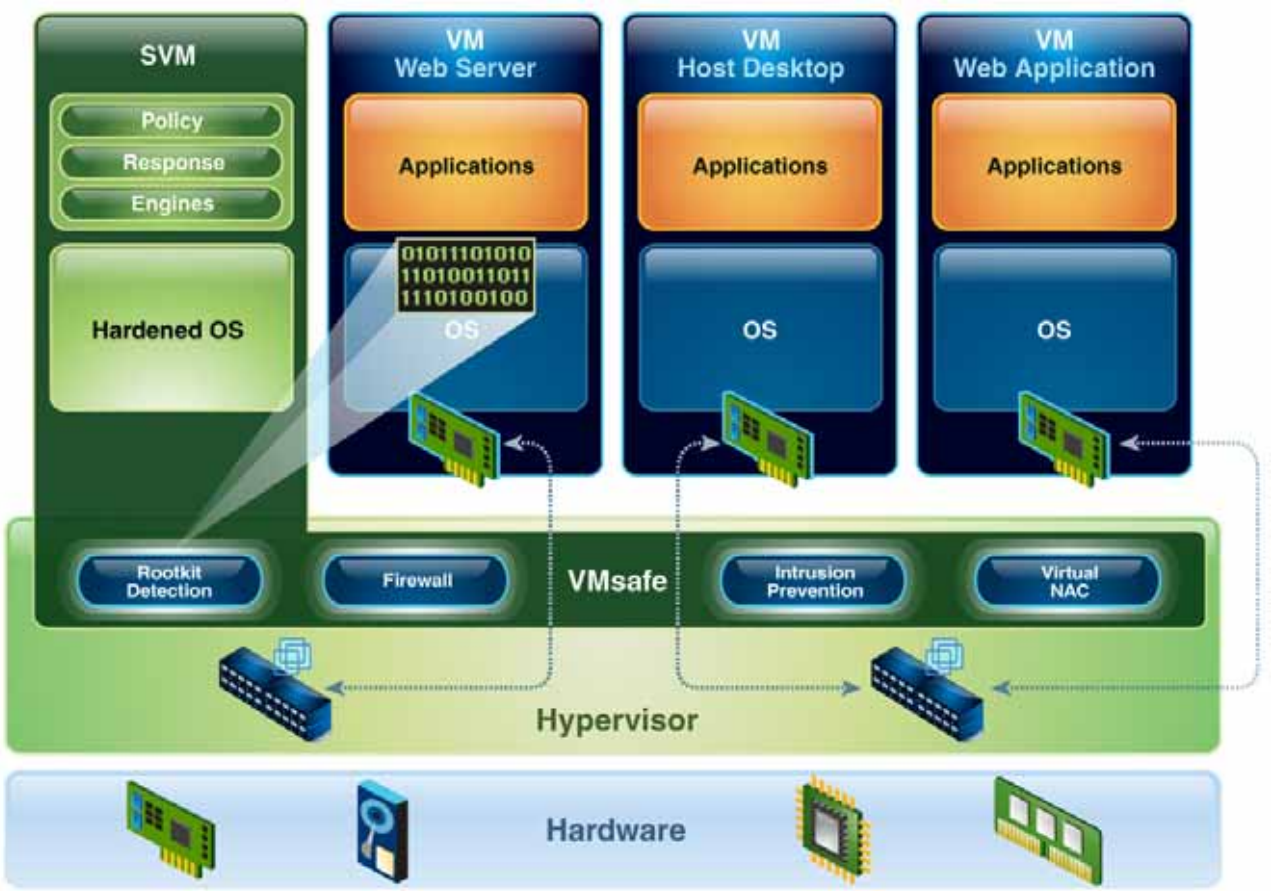
- YES!
- Host context required for many security functions
  - Privileged-access control/monitoring
  - File integrity monitoring
  - Encryption
  - Anti-malware
  - Patching
  - Security configuration management

Defense in Depth



IBM Virtual Server Protection for VMWare

Helps customers to be more secure, compliant and cost-effective by delivering integrated and optimized security for virtual data centers.



- VMsafe Integration that's transparent to guests
- Inter-VM Traffic Analysis
- Fail open
- Firewall and Virtual Network Access Control
- Network Intrusion Prevention
- Rootkit Detection/Prevention
- Automated Protection for Mobile VMs (VMotion)
- Virtual Network Segment Protection
- Virtual Network-Level Protection
- Virtual Infrastructure Auditing (Privileged User)

Summary

- Virtualization does impact security posture
- “Traditional” tools are still relevant
- New products adapted for virtual environments are available
- No single product provides adequate protection

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