WHITE PAPER

Virtualization Overview

vmware®

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Virtualization Overview

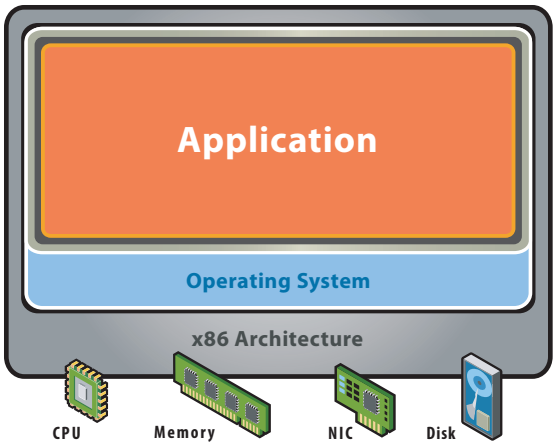
Introduction

Among the leading business challenges confronting CIOs and IT managers today are: cost-effective utilization of IT infrastructure; responsiveness in supporting new business initiatives; and flexibility in adapting to organizational changes. Driving an additional sense of urgency is the continued climate of IT budget constraints and more stringent regulatory requirements. Virtualization is a fundamental technological innovation that allows skilled IT managers to deploy creative solutions to such business challenges.

Virtualization in a Nutshell

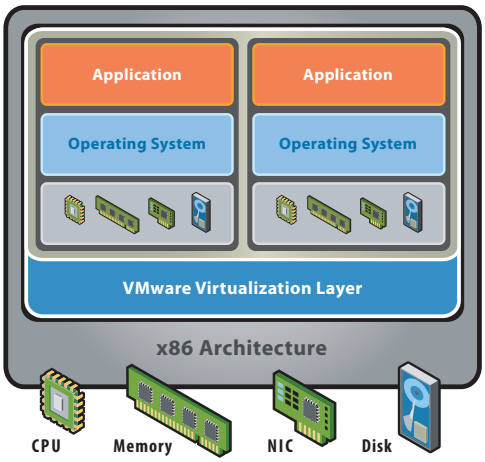
Simply put, virtualization is an idea whose time has come. The term ***virtualization*** broadly describes the separation of a resource or request for a service from the underlying physical delivery of that service. With virtual memory, for example, computer software gains access to more memory than is physically installed, via the background swapping of data to disk storage. Similarly, virtualization techniques can be applied to other IT infrastructure layers - including networks, storage, laptop or server hardware, operating systems and applications.

This blend of virtualization technologies - or ***virtual infrastructure*** - provides a layer of abstraction between computing, storage and networking hardware, and the applications running on it (see Figure 1). The deployment of virtual infrastructure is non-disruptive, since the user experiences are largely unchanged. However, virtual infrastructure gives administrators the advantage of managing pooled resources across the enterprise, allowing IT managers to be more responsive to dynamic organizational needs and to better leverage infrastructure investments.



Before Virtualization:

- Single OS image per machine
- Software and hardware tightly coupled
- Running multiple applications on same machine often creates conflict
- Underutilized resources
- Inflexible and costly infrastructure



After Virtualization:

- Hardware-independence of operating system and applications
- Virtual machines can be provisioned to any system
- Can manage OS and application as a single unit by encapsulating them into virtual machines

Figure 1: Virtualization

Using virtual infrastructure solutions such as those from VMware, enterprise IT managers can address challenges that include:

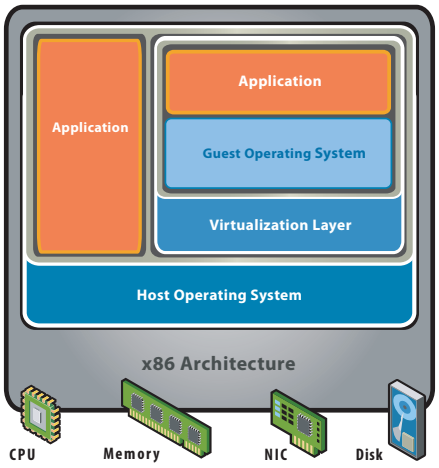
- ***Server Consolidation and Containment*** – Eliminating 'server sprawl' via deployment of systems as virtual machines (VMs) that can run safely and move transparently across shared hardware, and increase server utilization rates from 5-15% to 60-80%.
- ***Test and Development Optimization*** – Rapidly provisioning test and development servers by reusing pre-configured systems, enhancing developer collaboration and standardizing development environments.
- ***Business Continuity*** – Reducing the cost and complexity of business continuity (high availability and disaster recovery solutions) by encapsulating entire systems into single files that can be replicated and restored on any target server, thus minimizing downtime.
- ***Enterprise Desktop*** – Securing unmanaged PCs, workstations and laptops without compromising end user autonomy by layering a security policy in software around desktop virtual machines.

Virtualization Approaches

While virtualization has been a part of the IT landscape for decades, it is only recently (in 1998) that VMware delivered the benefits of virtualization to industry-standard x86-based platforms, which now form the majority of desktop, laptop and server shipments. A key benefit of virtualization is the ability to run multiple operating systems on a single physical system and share the underlying hardware resources – known as ***partitioning***.

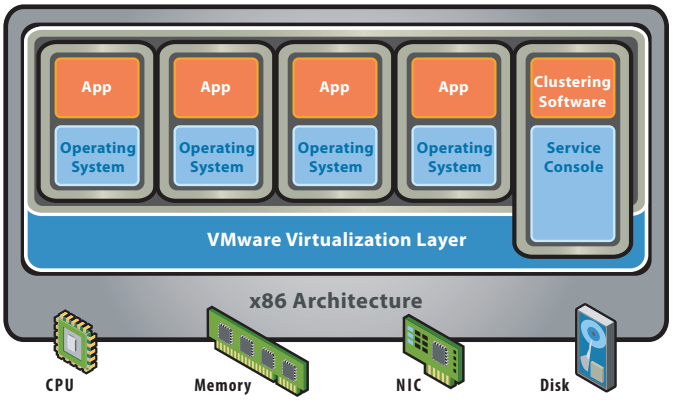
Today, virtualization can apply to a range of system layers, including hardware-level virtualization, operating system-level virtualization, and high-level language virtual machines. Hardware-level virtualization was pioneered on IBM mainframes in the 1970s, and then more recently Unix/RISC system vendors began with hardware-based partitioning capabilities before moving on to software-based partitioning.

For Unix/RISC and industry-standard x86 systems, the two approaches typically used with software-based partitioning are hosted and hypervisor architectures (See Figure 2). A ***hosted*** approach provides partitioning services on top of a standard operating system and supports the broadest range of hardware configurations. In contrast, a ***hypervisor*** architecture is the first layer of software installed on a clean x86-based system (hence it is often referred to as a "bare metal" approach). Since it has direct access to the hardware resources, a hypervisor is more efficient than hosted architectures, enabling greater scalability, robustness and performance.



Hosted Architecture

- Installs and runs as an application
- Relies on host OS for device support and physical resource management



Bare-Metal (Hypervisor) Architecture

- Lean virtualization-centric kernel
- Service Console for agents and helper applications

Figure 2: Virtualization Architectures

Hypervisors can be designed to be tightly coupled with operating systems or can be agnostic to operating systems. The latter approach provides customers with the capability to implement an OS-neutral management paradigm, thereby providing further rationalization of the data center.

Application-level partitioning is another approach, whereby many applications share a single operating system, but this offers less isolation (and higher risk) than hardware or software partitioning, and limited support for legacy applications or heterogeneous environments. However, various partitioning techniques can be combined, albeit with increased complexity.

Hence, virtualization is a broad IT initiative, of which partitioning is just one facet. Other benefits include the ***isolation*** of virtual machines and the ***hardware-independence*** that results from the virtualization process. Virtual machines are highly portable, and can be moved or copied to any industry-standard (x86-based) hardware platform, regardless of the make or model. Thus, virtualization facilitates adaptive IT resource management, and greater responsiveness to changing business conditions (see Figures 3-5).

To provide advantages beyond partitioning, several system resources must be virtualized and managed, including CPUs, main memory, and I/O, in addition to having an inter-partition resource management capability. While partitioning is a useful capability for IT organizations, true virtual infrastructure delivers business value well beyond that.

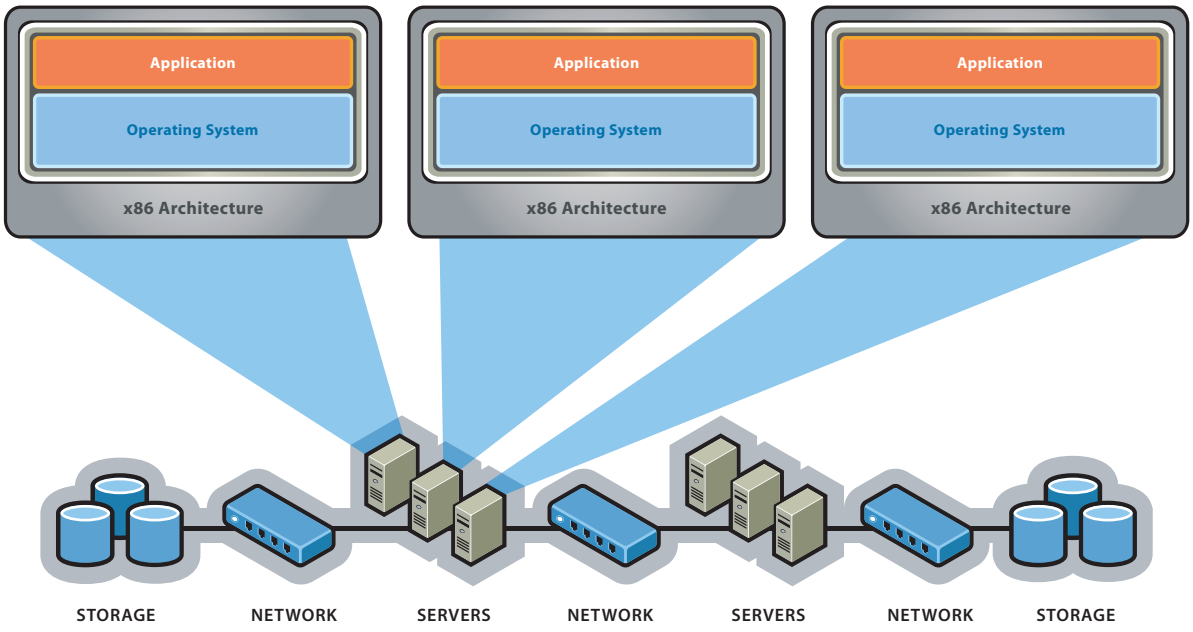


Figure 3: Traditional Infrastructure

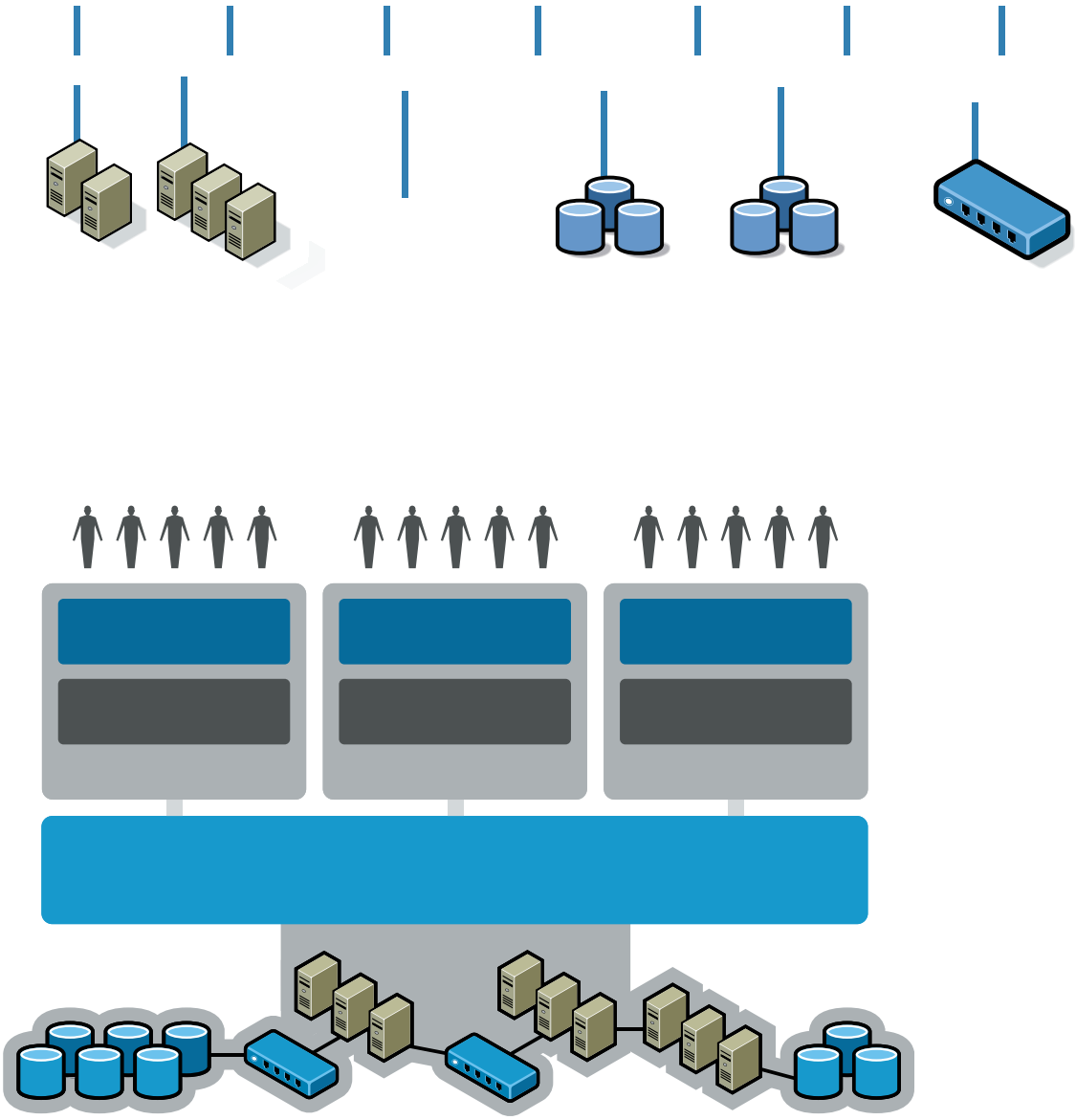


Figure 5: VMware Virtual Infrastructure