



Glossary

In this glossary, multi-work terms that start with “VMware,” “vSphere,” or “vCenter” are listed alphabetically using the word that follows in the term. “VMware vCenter term” identifies technologies that are integrated with VMware vCenter, some of which are considered add-on products requiring additional licensing. “VMware term” identifies technologies that are stand-alone products. Where applicable, definitions are taken from the formal VMware glossary guide.

A

VMware ACE—Virtualization product for enterprise desktop deployments providing a highly configurable, secure, and portable PC environment.

ACE instances—The virtual machines that ACE administrators create, associate to virtual rights management (VRM) policies, and package for deployment to users. An ACE instance is an ACE.

VMware vCenter AppSpeed—An application performance monitoring tool engineered specifically for multi-tiered applications. AppSpeed passively listens to traffic flowing over a vSwitch (including the Nexus 1000V), which allows for discovery of transactions, application mapping, performance monitoring against SLAs, and root-cause analysis. Provides a method to evaluate performance of an application before and after virtualization to ensure that performance remains consistent. This tool provides *breadth* in latency analysis for an application.

C

VMware vCenter CapacityIQ—Identifies server resource inventories including used and unused capacity. This can be used for capacity planning, budgeting, and lifecycle management of resources. VMware vCenter Capacity IQ is used for cost avoidance and justification, availability and risk mitigation, and project planning and decision-making.

VMware Capacity Planner—An agentless data collection and “what if” scenario building tool that identifies server inventories and resource utilization to determine virtual machine candidates, server consolidation ratios, and resource requirements for migrating to a VMware Infrastructure based on target ESX host platform resources.

VMware vCenter Chargeback—Provides cost measurement, analysis, and reporting to provide cost transparency and accountability for the virtual machines and the supporting virtual infrastructure. IT costs may be mapped to business units, cost centers, or external customers to provide a better understanding of resource costs. This can further be used to determine optimization for cost reduction.

VMware vCenter Chargeback API—Provides an interface for vCenter Chargeback functionality. This includes management of the hierarchy, cost configurations, and reporting.

CIM Interfaces—Software interfaces designed for hardware management tool development. This includes **Server Management API**—CIM SMASH interface to monitor and manage virtualization server platforms and **Storage Management API**—CIM SIMI-S interface to monitor and manage virtual storage.

Cluster—A server group in the virtual environment that enables a high-availability solution.

vCLI (vSphere Command Line Interface)—Allows you to manage your Virtual Infrastructure using Windows PowerShell. This allows you to script and automate actions you would normally do in vCenter. There are approximately 200 cmdlets (PowerShell exposed procedures) to manage vSphere and ESX/ESXi functionality. There are many pre-built scripts available online that can provide functionality such as finding all VM snapshots, finding orphaned VMs, or even creating reports. Previously known as the VI Toolkit.

VCB (VMware Consolidated Backup)—Provides the capability to perform SAN-based backup and recovery of virtual machines using a backup proxy server without any network or virtual machine overhead.

VMware Converter—Used for physical-to-virtual machine (P2V) migrations, as well as importing virtual machines from other virtualization vendors (V2V). VMware Converter can import multiple machines concurrently and non-disruptively. Designed for large-scale consolidation, VMware Converter can be used with or without VMware vCenter Server.

D

Datacenter—In the context of vCenter usage, an optional inventory grouping structure contained within the datacenter structure. A vCenter Server supports multiple datacenter folders. Datacenter folders can contain only datacenters and other datacenter folders.

vDR (VMware Data Recovery)—Provides data protection for virtual machines. VMware Data Recovery is fully integrated with vCenter Server and includes data de-duplication to save on disk storage for full virtual machine backups. Includes file-level restore or entire images as needed.

Data Source Name (DSN)—An ODBC (Open Database Connectivity) object that you must configure to enable vCenter Server to access a database.

DPM (Distributed Power Management)—Dynamically starts up and shuts down ESX host hardware to reduce power consumption.

DRS (Distributed Resource Scheduler)—Dynamically allocates and balances workloads across hosts in a cluster.

DV Port Group—A port group associated with a Distributed Virtual Switch (DVS). It specifies port configuration options for each member port. It defines how connections are made through the DVS to the network.

DV Uplink (DV Uplinks)—Physical uplinks attached to a vDS to enable VMs and virtual network adapters connected to vNetwork Distributed Switch to connect to networks outside the hosts on which they reside.

DV Uplink Groups—Defines uplink policies for the associated DV Uplinks.

DV Port (Distributed Virtual Port)—A port on a DVS that connects to a host's Service Console or VMkernel or to a virtual machine's network adapter.

DVS (Distributed Virtual Switch)—An abstract representation of multiple hosts defining the same vSwitch (same name and network policy) and port group. These representations are needed to explain the concept of a virtual machine being connected to the same network as it migrates among multiple hosts.

E

Elastic Sky—The acronym ESX was created from the term Elastic Sky, a marketing label that was created but not used by VMware. The initials plus the letter X became the official product name. Elastic Sky was used as the name for a VMware band that was founded by Jeff Hanson, John Arrasjid, Melinda Marks, David Haberman, Doug Clark, Drew Kramer, and Ken Watson. Additional band members have participated with Elastic Sky, including Tim Mann, Linda Pak, Norman Malonzo, Arisa Amano, Vittorio Viarengo, and Robert Noth.

Emulation—In which a virtual machine simulates the hardware needed in a way that allows it to run on a platform with a different CPU than it was originally designed to work with.

VMware ESX/ESXi Server—ESX and ESXi are both hypervisors which install directly on the server hardware. Although the deployment and management methods are slightly different, both solutions provide better performance and availability than other methods. VMware ESX Server was initially released in 2002.

VMware ESX Server (VMware ESX Classic)—Classic ESX installs with a Linux-based Service Console to assist with management functions.

VMware ESXi Server—A version of VMware ESX Server that may be installed like VMware ESX Classic, on USB flash storage, or on an internal device. ESXi removes the Service Console, reducing the attach surface due to a smaller footprint and allowing the functionality to be embedded within the server hardware.

F

VMware Fault Tolerance or VMware FT—Provides clustering support of single vCPU VMs without requiring the embedded application to be cluster aware. FT utilizes VMware vLockstep technology. This technology uses an active secondary VM that runs in virtual lockstep with the primary VM. VMware vLockstep establishes and maintains this secondary VM. The secondary VM runs on a different host and executes the same set of instructions, in the same sequence, as the primary VM.

Full Virtualization (Native Virtualization)—The guest OS is presented with a virtual hardware abstraction that represents a physical machine. The virtual machine is recognized and accessible to the operating system or applications software just as if it were a physical machine, so no modification to the software is necessary. With full virtualiza-

tion, a standard operating system such as Windows or Linux, without modifications, will run in a virtual machine.

VMware Fusion—A virtualization product for Intel-based Mac OS X systems.

G

GSX Server—Original name for VMware Server. GSX existed as a commercial product from 2001 to 2006. The acronym is created from the term Ground Storm, a marketing label that was created but not used by VMware. The initials were used and the letter X was added to create the official product name.

GOS (Guest Operating System)—An operating system that runs within a virtual machine.

vSphere Guest SDK—Enables development of applications that will run within a virtual machine using C or Java libraries. Enables customers to write smart applications that respond to changes at the virtualization environment layer. Included with VMware Tools.

VMware Guided Consolidation—Used for planning physical-to-virtual machine migrations by utilizing VMware Capacity Planner Converter technology. VMware Guided Consolidation is an optional vCenter component and is designed for small-scale consolidation.

H

Hardware-assisted Virtualization—CPUs from Intel (Intel VT) and AMD (AMD-V) implement hardware assistance for CPU virtualization; the first generation of these CPUs was released in 2005 and 2006.

vCenter Heartbeat—Protects the vCenter Server, License Server and Database against hardware, OS, application, and network downtime. Failover and failback are provided for each. Protection is important especially when using VMware View, vCenter Lab Manager, and vCenter SRM, which require vCenter to be running at all times.

VMware High Availability (VMware HA)—Provides automated restart of failed virtual machines, regardless of the guest OS technology. Provides fault tolerance in the event of an ESX host failure. VMware HA enables the automated restart of virtual machines on other hosts in a cluster upon host failure, minimizing downtime without the cost of application clustering.

Host—A compute platform supporting the execution of virtual machines. Includes standard physical servers as well as platforms specifically designed to support virtual infrastructure such as Cisco UCS.

VMware Host Profiles—Enables the definition and application of standardized host configurations. Also supports compliance checks against the defined standards.

Hosted Virtualization—Relies on having a standard operating system between the physical computer and the virtualization layer. This requires installation of an operating system such as Microsoft Windows or Red Hat Linux, and then installation of virtualization software such as VMware Workstation on top of it. Finally, a guest operating system such as Windows or Linux is installed in one or more virtual machines running within VMware Workstation.

VMware Hyperic HQ—Provides complete discovery, monitoring, and analysis and control of all application, system, and network assets both inside and outside the virtual machines. Hyperic HQ includes full VMware ESX and VMware Server support, analysis of utilization and performance within a VM, correlation of events between hosts and guest OSes, and control of VMs. This tool provides detailed analysis of how the virtual machine is performing. This tool provides *depth* in latency analysis for an application.

Hypervisor—Hypervisor virtualization platforms have a partitioning layer, which runs directly on top of the hardware and below higher-level virtualization services, that provide a virtual machine abstraction. The hypervisor is installed on the computer, just as though it is an operating system. It provides the capability to create virtual machine partitions, with a virtual machine monitor running within each partition.

The Hypervisors—A VMware band.

L

VMware vCenter Lab Manager—Provides a self-service portal for real-time provisioning, managing, and collaboration of virtualized development and testing environments. VMware vCenter Lab Manager allows developers and testers to create and share libraries of virtualized application environments used in software development and testing. Applications can be moved through lifecycle stages until they reach production state.

VMware vCenter Lab Manager SDK—Enables development of applications that use Lab Manager Web service data, automate tasks, or integrate VMware Lab Manager with software testing tools.

VMware Lifecycle Manager or **VMware LCM**—Manages the lifecycle of virtual machines from request through provisioning and eventual archiving or destruction. VMware vCenter Lifecycle Manager provides a self-service portal for virtual machine requests, routed through a predefined workflow—streamlining provisioning, reducing overhead, and providing consistent management of the virtual machine lifecycle.

Logical Partitioning (LPAR)—Found in mainframe computers such as IBM System z (and, less commonly, on other IBM systems), as well as on computer systems from other vendors. In logical partitioning the resources of a physical computer are partitioned so that the computer's memory may be split, allocating a specific range to each partition. Hardware assistance is often used to partition a system but is not necessary for operating system virtualization in general.

M

vSphere Management Assistant (vMA)—A Linux appliance with pre-built management tools and the vCLI Interface. Allows scripting and agents to manage ESX, ESXi, and vCenter Server systems. vMA is a virtual appliance that includes the vSphere SDK and the vSphere CLI, logging capabilities, and an authentication mechanism.

Multipathing Policy—When connecting an ESX host to a Fibre Channel SAN, the multipathing policy enables multipathing support to maintain a constant connection between the ESX host and the storage device in the event that a critical connecting component (e.g., host bus adapter, storage controller, storage processor, or Fibre Channel cable) fails.

N

Network virtualization—VLANs (Virtual LANs) are used to segment networks on physical networks. This is different from the virtualized network devices available in VMware, although these two technologies can coexist.

O

VMware vCenter Orchestrator (vCO)—Provides out-of-the-box workflows to help automate existing manual tasks. Workflows can be created, modified and extended to meet custom needs.

VMware vCenter Orchestrator API—Allows for the programming of workflows for execution by VMware vCenter Orchestrator.

P

Para-virtualization (OS-assisted virtualization)—The guest OS is presented with a modified hardware abstraction. This requires operating systems to be modified and ported to this particular virtualization platform. This reduces operating system compatibility, but that is a trade-off against potential increases in performance of certain CPU-bound applications that run on systems without virtualization hardware. This performance increase is achieved by hypercalls, a communication method that occurs between the guest OS and the hypervisor, but the performance advantage can vary greatly, depending on the workload. However, each guest operating system, such as Linux, needs to be modified. VMware has traditionally offered full virtualization, but aspects of para-virtualization have been offered as an option for enhanced device drivers that increase the efficiency of guest operating systems.

PC-over-IP (PCoIP)—PCoIP was a purpose-built protocol designed by Teradici to deliver a rich desktop experience consisting of content such as application windows, Web pages, graphics, text, and streaming video and audio over both the LAN and the WAN. PCoIP recognizes the different types of content and uses different compression algorithms based on content type. PCoIP delivers multi-monitor support with up to 1920 x 1200 resolution, clear-type fonts, and 32-bit color per monitor for up to four monitors. It includes Auto Display scaling, dynamic resizing, and support of monitor pivoting. It enables multimedia redirection, USB support, support for host-based rendering of Flash, and bi-directional audio.

VMware Player—Enables creating virtual machines and running virtual appliances.

Port Group—Specifies port configuration options, including VLAN tagging policies and bandwidth limitations for each member port. Network services connect to vSwitches through port groups. Port groups define how a connection is made through the vSwitch to the network. In typical use, one or more port groups is associated with a single vSwitch.

Port Groups—A construct for configuring virtual network options such as bandwidth limitations and VLAN tagging policies for each member port. Virtual networks that are connected to the same port group share network policy configuration.

vSphere PowerCLI—Allows you to manage your Virtual Infrastructure using Windows PowerShell. This allows you to script and automate actions you would normally do in vCenter. There are approximately 200 cmdlets (PowerShell exposed procedures) to manage vSphere and ESX/ESXi functionality. There are many pre-built scripts available on-

line that can provide functionality such as finding all VM snapshots, finding orphaned VMs, or even creating reports. Previously known as the VI ToolKit.

S

vCenter Server (VMware Server)—Free entry-level server virtualization product for creating and running multiple virtual machines on existing physical Windows or Linux servers. Formerly titled GSX Server.

Service Console—The command-line interface for an ESX server system that enables administrators to configure the system. The Service Console is installed as the first component and is used to bootstrap the ESX server installation and configuration. The Service Console also boots the system and initiates execution of the virtualization layer and resource manager. You can open the Service Console directly on an ESX server system. If the ESX server system's configuration allows Telnet or SSH connections, you can also connect remotely to the Service Console.

VMware vCenter Site Recovery Manager (vCenter SRM)—Provides disaster recovery workflow automation through a centralized management interface. SRM automates the setup, testing, failover, and failback of virtual infrastructures between protected and recovery sites.

VMware vCenter Site Recovery Manager API—Provides an interface to SRM which allows external management systems to initiate tests or failovers and record results.

Storage Virtualization—The process of abstracting a logical storage device from a physical device. These are found in many areas, from virtual disks in VMware products to Fibre Channel or IP network storage devices such as IBM's SAN Volume Controller (SVC), EMC InVista, or LeftHand Networks Virtual SAN Appliance (VSA). The physical location of the storage can be on a SAN, but the representation might be iSCSI. The software handles the mapping between the physical storage and the logical storage.

Storage VMotion—Storage VMotion enables live migration of virtual machine disk files across storage locations while maintaining service availability. Storage VMotion utilizes VMotion technology to optionally move the VM to an alternate ESX host which has access to both the source and target storage locations. Storage VMotion can move the storage location of a virtual disk as long as the target is visible to the source and destination ESX host(s). The processes of the corresponding VM can stay on the same host, or the VM can be simultaneously VMotioned to a new host.

T

VMware ThinApp—Enables application virtualization, encapsulating the applications from both the OS and each other. This eliminates conflicts from badly behaving applications as well as the requirement for regression testing.

V

vApp—Provides a logical entity, or object, comprising one or more virtual machines using the OVF (Open Virtualization Format) to specify and encapsulate all components of a multi-tier application. In addition, policies and SLAs can be associated with the object as an attribute. The vApp construct is designed for interoperability of a multi-tiered application on the virtual datacenter as well as for the ability to move the application between internal or external clouds while maintaining the same SLAs.

Virtual Machine (VM)—This book focuses on “system virtual machines,” a form of virtualization whereby the underlying physical computer resources are mapped into one or more different virtual machines (tightly isolated software containers that behave exactly like a physical computer).

VMDirectPath—Offloads I/O processing from the hypervisor by allowing virtual machines to directly access the underlying hardware devices.

VMware Certified Professional or **VCP**—A certification designed for individuals wishing to demonstrate expertise in virtual infrastructure and increase potential for career advancement.

VMware Certified Design Expert or **VCDX**—The highest level of VMware certification, evidencing an exceptional proficiency in designing and implementing successful VMware infrastructures. John Arrasjid, lead author of this booklet, is VCDX #1 and Duncan Epping is VCDX #7.

vCLI—The vSphere Command-Line Interface command set enables running common system administration commands against ESX/ESXi systems from any machine with network access to those systems. vSphere CLI commands are especially useful for ESXi hosts that do not include a Service Console.

vCloud—The VMware vCloud initiative consists of technology from VMware as well as the ecosystem of technology and cloud service providers to enable application delivery on a common VMware vSphere platform. Nearly 1,000 validated applications are easily deployed to an on-premise environment or to a cloud without requiring recoding or rebuilding.

vCloud API—Provides an interface for providing and consuming virtual resources within a VMware-based cloud by enabling deployment and management of virtualized workloads by working with vApps. This API is based on OVF standards providing platform independence and multi-tenancy in a purely virtual infrastructure. Includes functions for Inventory Listing, Catalog Management, Upload/Download/Provisioning Operations, vApp Configuration Operations, Resource Entities Operations, vApp State Operations, and other operations. Also includes administrative functions including Cloud, Org, vDC, Catalog, User, Group, and Role Administration.

vCloud Express—An Infrastructure as a Service (IaaS) offering providing pay-as-you-go infrastructure that ensures compatibility with internal VMware environments.

vCPU—A virtual central processing unit is similar to the CPU in a traditional physical machine. A virtual processor is assigned (either one or in multiples) to a virtual machine.

VMware View—A system for managing connectivity, security, and administration of centralized virtual desktop computers hosted on ESX clusters. VMware View Manager supports the connection brokering for the Virtual Desktop Infrastructure (VDI), while View Composer provides advanced desktop image management.

VMware View Composer—Provides advanced desktop image management for the Virtual Desktop Infrastructure (VDI).

VMware View Manager—Supports the connection brokering for the virtual desktop infrastructure (VDI).

VIX—Allows development of programs and scripts to automate virtual machine and guest OS operations. VIX runs on Windows or Linux platforms. It manages VMware vSphere, ESX, ESXi, VMware Server, and VMware Workstation through the use of C, Perl, and COM bindings, including Visual Basic, VBScript, and C#.

VIX API—Provides a programming interface to manage and automate functionality of OS guests. Allows a script to be executing through vCenter using VMware Tools rather than being sent across the VM networks.

Virtual Desktop Infrastructure (VDI)—Virtual Desktop Infrastructure is the term coined by VMware to describe the process of running desktop operating systems and applications as virtual machines on an ESX host.

Virtual Disk—A virtual disk simulates a physical disk in memory and is usable although not physically present in the computer.

Virtual Disk Development Kit (VDDK)—Interface to allow ISVs to use VMDK as a native format when developing virtual disk tools through the use of the VMware Virtual Disk Libraries (VixDiskLib and ViMntapi).

Virtual Machine Monitor (VMM)—The VMM is a layer of software that runs between the hypervisor or host operating system and a virtual machine. It manages the resources and their allocation to the virtual machines running on the system. The VMM decouples the software from the hardware underneath. As computer scientist Butler Lampson famously said, “All problems in computer science can be solved by another level of indirection.” VMM’s decoupling capability provides substantial control over how the guest operating system accesses the hardware.

Virtual Operating System—A small, lightweight component embedded with ThinApp compiled applications.

Virtual SMP—Virtual SMP allows a single virtual machine to use multiple physical processors simultaneously. It enables virtualization of even very resource-intensive applications such as databases, large Web servers, and ERP.

Virtual Switch—A software program emulating a physical switch to enable one virtual machine to communicate with another. See *vNetwork Standard Switch* and *vNetwork Distributed Switch*.

vLockstep—Virtual Lockstep technology is utilized as part of vSphere Fault Tolerance. It facilitates zero downtime and zero data loss for a virtual machine by keeping a second instance of the FT-enabled virtual machine in lockstep with the primary instance.

VMDK—The Virtual Machine Disk Format is a file format used to store a virtual machine image and the contents of a virtual machine hard drive.

VMFS—Virtual Machine File System is a cluster file system enabling storage of virtual machine disk images, including snapshots.

VMkernel—The VMkernel is a microkernel handling CPU and memory directly as part of CPU instructions. It provides a hardware simulation interface to guest systems.

VMmark—A benchmark tool specifically designed for measuring scalability of virtualization host systems. Provides an accurate measurement of application performance in virtualized environments. Measures virtual machine performance, determines how dif-

ferent hardware and virtualization platforms will affect performance, and enables “best fit” choices for hardware. VMware is working with the Standard Performance Evaluation Corporation (SPEC®) and members of the SPEC Virtualization subcommittee to develop standard methods of comparing virtualization performance for virtualized applications running on hypervisors.

VMotion—VMware VMotion enables the live migration of running virtual machines from one physical host to the other with zero downtime, continuous service availability, and complete transaction integrity. VMotion migration requires either the same processor family on both the source and target ESX hosts, or “Enhanced VMotion Compatibility” (EVC) on a cluster of hosts with technologies enabling VMotion compatibility with older servers. Hosts need to be grouped within the same vCenter datacenter. The shared storage holding the VM virtual disk is presented to both the source and target hosts.

VMware VMsafe—Provides an open approach to security through an application program interface (API). This enables selected partners to develop security products for VMware environments. VMsafe gives fine-grained visibility over virtual machine resources, making it possible to monitor every aspect of the execution of the system and stop previously undetectable viruses, root kits, and malware before they can infect a system. VMsafe provides inspection of virtual machine memory pages and CPU states, filtering of network packets inside hypervisors as well as within the virtual machine itself, and in-guest, in-process APIs that enable complete monitoring and control of process execution. Guest virtual machine disk files can be mounted, manipulated, and modified as they persist on storage devices.

VMsafe API—Allows vendors to develop advanced security products.

vNetwork—vNetwork refers to the collection of networking technologies enabling optimal integration of networking and I/O functionality into vSphere. The vNetwork enhancements include the vNetwork Distributed Switch, VMXNET3 (third-generation para-virtualized NIC), IPv6 support extended to VMkernel and Service Console ports, bi-directional traffic shaping, network VMotion, and VMDirectPath.

vNetwork API—Provides integration with the virtual networking capabilities of vSphere to enable the development of advanced network tools.

vNetwork Distributed Switch (vDS)—Provides a switch that acts at a datacenter level across multiple ESX hosts, providing centralized provisioning, administration, and monitoring. Simplifies network management by moving the virtual network configuration and management from the host level to the datacenter level.

vNetwork Standard Switch (vSS)—A software program emulating a physical switch to enable one virtual machine to communicate with another. It is a basic Layer 2 switch without routing.

vmnicvNIC—A virtual network interface card is a virtual representation of a physical NIC and is configured on top of a system’s physical network adapter.

VMware vShield Zones—Enforces corporate security policies at the application level in a shared environment, while still maintaining trust and network segmentation of users and sensitive data. Provides a mechanism to monitor, log, and block inter-VM traffic with an ESX/ESXi host or between hosts in a cluster. This includes the ability to firewall,

bridge, or isolate virtual machines between multiple pre-defined zones. All activities, blocked as well as allowed, are logged and can be graphed.

VMware vSphere—A collection of software providing management of a dynamic environment, cost reduction, and significant improvement to the life-work balance of IT professionals. VMware vSphere is the next generation of the Virtual Infrastructure 3 product. Known also as the first cloud operating system, vSphere 4 was one of the most complex software development projects of all time, consisting of over 3,000,000 engineering hours by over 1,000 engineers over a three-year period.

vSphere SDK—A software development kit that acts as an interface ESX/ESXi, vCenter, and VMware Server to extend the management of the Virtual Datacenter. Programming languages supported include Perl, .NET, and Java.

vSphere SDK for Java—Supports simplified vSphere Management applications by defining client-side data models. These models provide utility functions to simplify data access to servers.

vStorage—Provides integration of advanced capabilities from storage vendors with the vSphere Cloud OS from VMware. This API enables customers to leverage array-based capabilities such as support for multipathing control, which enables advanced load balancing algorithms.

vStorage API—A collection of software providing management of a dynamic environment, cost reduction, and significant improvement to the life-work balance of IT professionals.

vswif#—The VMware vCenter Server Service Console NIC.

vSwitch—See Virtual Switch.

W

vSphere Web Services SDK—Provides a Web service accessible through the vSphere API to develop client applications.

VMware Workstation—Enables running multiple virtual machines on a PC, each with its own operating system. VMware Workstation resides on top of a host operating system and supports over 200 guest operating systems. It includes clones, multiple snapshots, and secured “virtual rights management” features. See also *VMware Player*.

