

Managing change with the HP and VMware Change and Configuration pack



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Complexity is the business we are in, and complexity is what limits us.
–Frederick P. Brooks,
Author of “The Mythical man-Month”, on creating large-scale software systems

Introduction

The inherent complexity of designing, building and evolving large software systems has been well known for decades. With rapid growth and incorporation of dynamic technologies such as Virtualization and Service Oriented Architecture (SOA), new challenges are now being faced by IT organizations in managing and changing IT infrastructures consisting of physical and virtual networks, servers, desktops, storage systems and the business applications running on them. How do you dynamically manage your IT organization while meeting increased customer demands?

As part of their predictions for 2007, IDC analysts summarized their forecasts regarding the management of infrastructure that is increasingly becoming virtualized as follows:

“The management of virtual infrastructure will take center stage for large enterprise IT organizations, extending the adoption of virtualization technologies across test, development, and production environments. In 2007, heterogeneity will become an increasingly important requirement for large enterprises as they consider broader use of virtualization technologies. As more enterprise IT organizations deploy production workloads into virtual infrastructure environments, the opportunity will arise for IT to deliver more efficient processes and more efficient task execution to a wider range of infrastructure layers. Management of virtual infrastructure provides a strong opportunity for improving process and resource efficiency, notably across application, desktop, server, and storage environments. Users are looking for leadership on key investment areas such as performance monitoring, provisioning, compliance reporting, cluster visibility, change and configuration management, and APIs that enable management console integration.”

HP’s Business Technology Optimization (BTO) strategy takes this challenge head on by helping you make sure that every dollar invested in IT is working to meet your business goals and includes best of breed products to address automation in the area of strategic planning, application delivery and operations. The area of operations is further divided into business service management (BSM) and IT Service Management (ITSM). HP Change and Configuration Center software, a collection of logically related software products and solutions within ITSM area, addresses planning and deployment of new systems and changes to the existing systems.

This paper presents the change and configuration management considerations and processes an IT organization will face in order to support VMware virtualization and outlines how HP Change and Configuration Center address these. This is followed by a more detailed discussion of HP Configuration Management software; the components and solutions around provisioning of Operating Systems, application software, patches and configuration settings to IT datacenter servers and desktops. These servers and desktops could be physical or virtual. Keep in mind that provisioning VMware ESX Server to a bare-metal machine is just a special case of provisioning Operating System to a physical machine. The paper is concluded by demonstrating provisioning of Windows Operating System to a VMware virtual machine.

Virtualization is a rapidly evolving area that poses a number of operational challenges. One of the largest challenges is managing change and keeping track of existing configuration. This paper serves as an introduction to the field and available solutions.

Change and configuration management

Per ITIL, the goal of the change management process is to ensure that standardized methods and procedures are used for efficient and prompt handling of all changes, in order to minimize the impact of change-related incidents upon service quality, and consequently improve the day-to-day operations of the organization. A change could be as simple as adding a new machine, physical or virtual, to the IT infrastructure and provisioning it with appropriate software; or it could be as complex as upgrading all desktops, physical and virtual, within the organization to a new operating system, like Windows Vista. Example changes of intermediate complexity include applying a patch, security related or otherwise, to a subset of machines, migrating the software, settings and data from one machine to another, or consolidating applications running on a large number of physical machines to a handful of servers running virtualization software.

Change management is closely related to configuration management, another ITIL process responsible for tracking individual configuration items (CIs) and their relationships within an IT system. A CI typically has many attributes that describe its technical capabilities, such as data storage capacity and operating system identification and ownership characteristics, such as purchase date, warranty etc. Application of a change usually results into addition, removal or update of CIs and their relationships.

With ITIL v3, both change and configuration management are now part of service transition, a service management activity that includes the management and coordination of processes, systems and functions to package, build, test and deploy a release into production and establish the services offered to the customers. Notice the focus around the concept of service. The end goal of an IT organization is provide its customers the benefits of IT without worrying about acquisition, deployment and ongoing operation of specific components, hardware and software, that enable the service.

In absence of virtualization, services have to be delivered by underlying physical infrastructure of servers, machines, storage, networks and business applications. These infrastructure elements tend to be tightly coupled, making it difficult to automate introduction of changes such as adding or removing CPU, memory, networking or storage resources, deploying new business applications or changes to existing ones and so on. Adding a virtualization layer on top of physical components simplifies these operations.

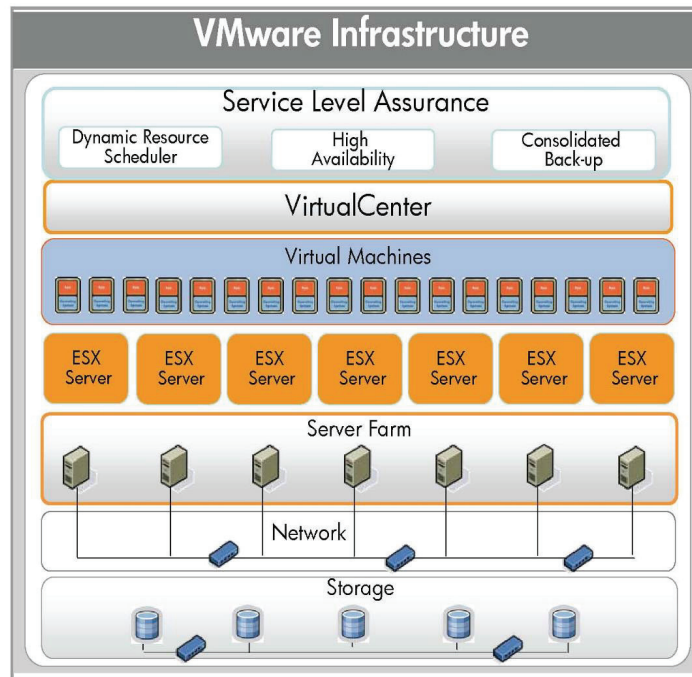
VMware virtualization

VMware virtualization software provides an abstraction layer that decouples the physical resources such as CPUs, memory, networks and storage from the operating system to deliver greater IT resource utilization and flexibility by supporting multiple virtual machines and virtual networks. Multiple virtual machines, or VMs, with different operating systems and applications run in isolation, side-by-side on the same physical machine.

VMware Infrastructure 3

VMware Infrastructure 3, or VI3, is a full infrastructure virtualization suite for comprehensive virtualization of servers, network and storage and offers integrated management, resource optimization, application availability and operational automation capabilities.

Figure 1. VMware Infrastructure 3



As shown in the above diagram, VI3 includes following main components and capabilities:

VMware ESX Server—Virtualization hypervisor software that runs on a single physical machine and abstracts processor, memory, storage and network resources to support multiple virtual machines. The symmetric multi-processing capability of this software allows multiple CPUs to be effectively utilized.

VirtualCenter Management Server—The central point for configuring, provisioning and managing IT infrastructure of multiple ESX servers and the VMs that these servers support. Multiple VI clients can connect to this server, or individual ESX servers, remotely.

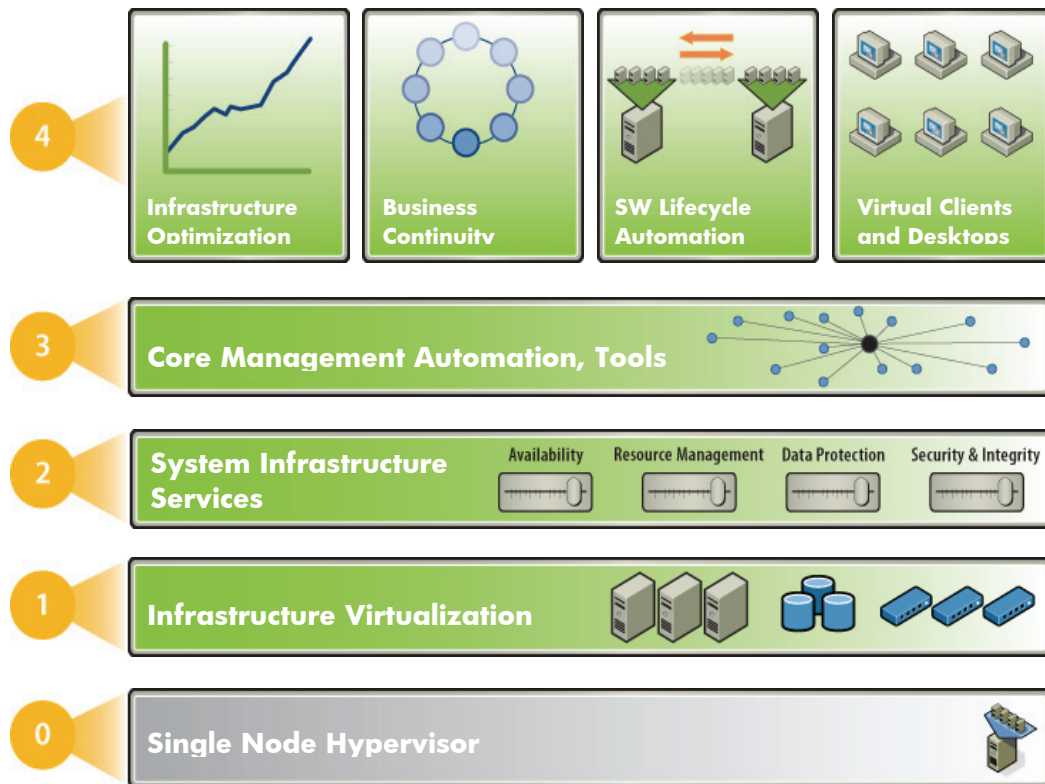
VMware VMotion, High Availability (HA) and Distributed Resource Scheduling (DRS)—VMware VMotion supports live migration of VMs from one physical machine to another. The HA feature makes it possible for VMs to be started on a different machine in event of a server failure and the DRS capability intelligently allocates and balances computing capacity across the collection of hardware resources.

VMware virtualization solutions

VI3 and other VMware products can be used to create a number of virtualized solutions. These include:

Infrastructure optimization—Resource utilization in traditional datacenters is fairly low due to the need to dedicate physical infrastructure to individual applications and over-provisioning of hardware for handling peak load. Use of virtualization allows multiple applications to be deployed on the same hardware and dynamically move physical resources from one application to another on need basis.

Figure 2. VMware virtualization solutions



Business continuity—VMware VMotion and HA capabilities allows planning for disaster recovery with minimal downtime.

Software lifecycle automation—The ability to quickly create VMs with desired configuration, store them on disk, and destroy makes virtualization very attractive for test and development purposes. Virtualization even allows automation of transitioning the tested system to production infrastructure.

Virtual clients and desktops—This solution replaces individual desktops and laptops running their own OS and applications by a central pool of VMs within a datacenter and access through diskless thin clients or terminal services client programs. It is much more cost effective to manage and secure the central pool of VMs than the individual desktops and laptops.

Change and configuration considerations

The need to track IT resources, both physical and virtual, and manage the changes doesn't go away with virtualization. In fact the addition of virtual resources requires an organization to pay close attention to its existing change and configuration practices and make sure that they are appropriately modified to handle both physical and virtual resources.

As an IT organization rolls out virtualized infrastructure on top of its physical infrastructure, it needs to pay attention to the following considerations:

1. How to provision Operating Systems to newly created VMs. Just as it is on a physical server, the manual process of installing the OS from installation media, either a CD/DVD or ISO image, to each VM is very time consuming and laborious. Using virtualization technology that supports

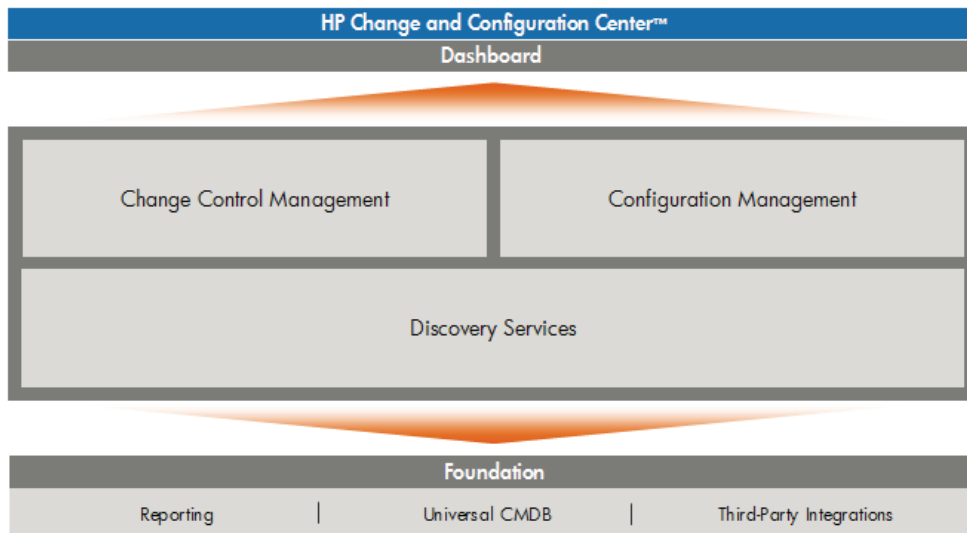
- cloning existing VMs or using a template addresses this issue to some extent but does not completely handle the issue when the VMs are significantly different.
2. How to deploy application software to VMs. The application software may have settings that are different for different VMs.
 3. How to deploy patches to operating systems and applications running on VMs. The special nature of VMs allows scanning for vulnerabilities in the offline state. How to patch such a VM without bringing it online and giving it a chance to get infected or attack others on the network has attracted a lot of attention.
 4. How to carry out the tasks of OS and application provisioning and deployment of patches to both physical and virtual machines across the whole IT infrastructure in a uniform way.
 5. How to keep track of physical infrastructure components such as servers, storage elements, network elements, VMs, operating systems, application software, patches, and their relationships.
 6. How to deploy ESX server software on bare-metal machines and keep it updated with latest patches. In this respect ESX server is no different than a server operating system.
 7. How to keep track of software licenses and their usage. Creating VMs may be much cheaper and faster than buying and commissioning physical servers, but the rules and regulations around legal use of software still applies and needs to be tracked.

Most of these, though not all, are addressed by HP Change and Configuration Center.

HP Change and Configuration Center

HP Change and Configuration Center software helps in automating IT processes in the area identified as service transition by ITIL v3, a service management activity that includes the management and coordination of processes, systems and functions to package, build, test and deploy a release into production and establish the services offered to the customers.

Figure 3. The HP Change and Configuration Center



Discovery services, consisting of enterprise discovery (ED) from former Peregrine software products and application mapping from former Mercury software products, support discovering the resources such as physical and virtual machines, applications, and services within the enterprise and storing

them in the HP Universal CMDB (configuration management database). The Universal CMDB plays a crucial role in problem resolution, change management and a number of other activities.

HP Change Control Management software automates the change management process and workings of a Change Advisory Board (CAB).

HP Configuration Management software carries out OS and application provisioning, patch management, settings migration and such release related operations.

These products integrate well with other products within HP BTO portfolio.

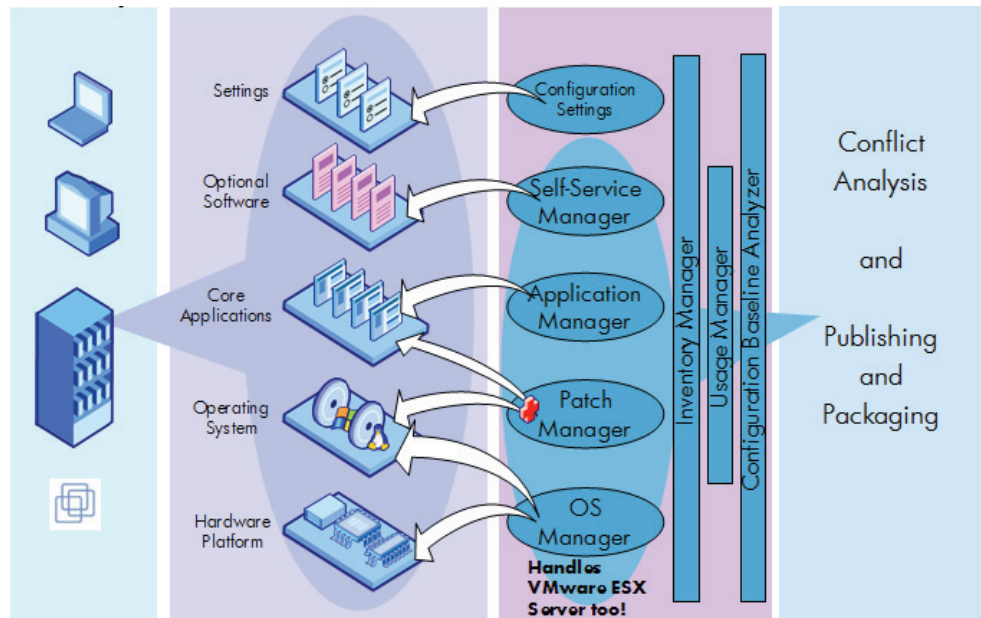
HP Configuration Management software

HP Configuration Management (HP CM) is a suite of products to automate provisioning and continuous update of software, including operating systems, applications, patches, and content and configuration settings, to a wide variety of target devices based on desired state policies. A target device could be a server machine running virtualization software or even a virtual machine itself.

HP Configuration Management products

HP CM consists of a number of products, each focusing on specific configuration management functionality.

Figure 4. The HP Configuration Management suite



HP Configuration Management OS Manager software: Provisions operating systems to “bare-metal” target devices. As far as OS provisioning is concerned, virtual machines are treated the same way as bare-metal physical machines. It also provisions ESX Server software to bare-metal machines.

HP Configuration Management Patch Manager software: Manages repository of OS vendor supplied patches and applies them to target devices in a continuous manner. Note: Patch management to ESX server will be coming in a future release.

HP Configuration Management Application Manager software: Provisions application software to target machines, physical as well as virtual. Maintains machine specific configuration data for the application in application management profiles (AMPs) and deploys them to the target machines.

HP Configuration Management Application Self-Service software: Allows a user to initiate installation of applications from a repository based on entitlement. Again, this works on both physical and virtual machines.

HP Configuration Management Settings Migration Manager software: Helps in migrating machine and user specific settings from one machine, physical or virtual, to another and allows migration of the settings from a physical machine to a virtual machine and vice-versa.

The noteworthy aspect of these components and their capabilities is that they all work uniformly for both physical and virtual machines, making it easier to manage the heterogeneous infrastructure in a consistent way.

These products depend on a number of infrastructural components for packaging, publishing, storing and transmitting to-be-deployed software and content. These infrastructure components also take care of managing policies, inventory of managed devices, deployment of HP CM agents, internal communication, and reporting.

Selected HP CM products and infrastructural components can be deployed and configured to meet specific needs of a particular customer. One such generic solution is Client Configuration Management solution geared towards automated delivery of patches to a large number of machines used by individuals as their desktops/laptops. Such a solution could optionally include HP CM OS Manager, HP CM Application Self-Service, and HP CM Settings Migration Manager as well.

When to use HP CM

While selecting a configuration management solution, it would be helpful to remember following characteristics of HP CM.

- HP CM has been proven to scale quite well from small deployments (less than 100 machines) to very large deployments (more than 10,000 machines). There is a fixed overhead in setting up HP CM and its ongoing maintenance, so a very small deployment (less than 10 machines) may not benefit much.
- HP CM handles both physical machines and virtual machines. So the same setup can be used to deploy software and patches to both physical and virtual infrastructure in a uniform way. This is a benefit for organizations looking at heterogeneous infrastructure, which includes most large organizations.
- HP CM has its origin in provisioning patches and applications to desktops and laptops and its capability in client markets are much more mature. The underlying architectural principle of desired state management works quite well for this market segment and has been shown to reduce the error rate significantly.
- HP CM is well integrated with other HP management products such as HP Enterprise Discovery software, HP Change Control Management software, HP Service Management Center software, and offers additional benefits to organizations that have deployed these products.

Based on these characteristics it is easy to see that the HP Configuration Management solution is well suited for mixed deployments of PC based desktops/laptops and VMware Virtual Desktop Infrastructure (VDI).

HP CM was recognized as a leader by Forrester Research in the category of client management suites. "As a top vendor in the IT management market, HP understands what enterprises need from their management solutions," wrote Natalie Lambert, senior analyst, Forrester Research, and author of the report. "HP Configuration Management offers a comprehensive client management suite,

including full capabilities in the areas of software, OS, and systems management. ... Most important is HP's ability to maintain the desired state of managed machines through its identity-based policy management capabilities. These capabilities assure that users have the necessary applications and settings when logging into their machine."

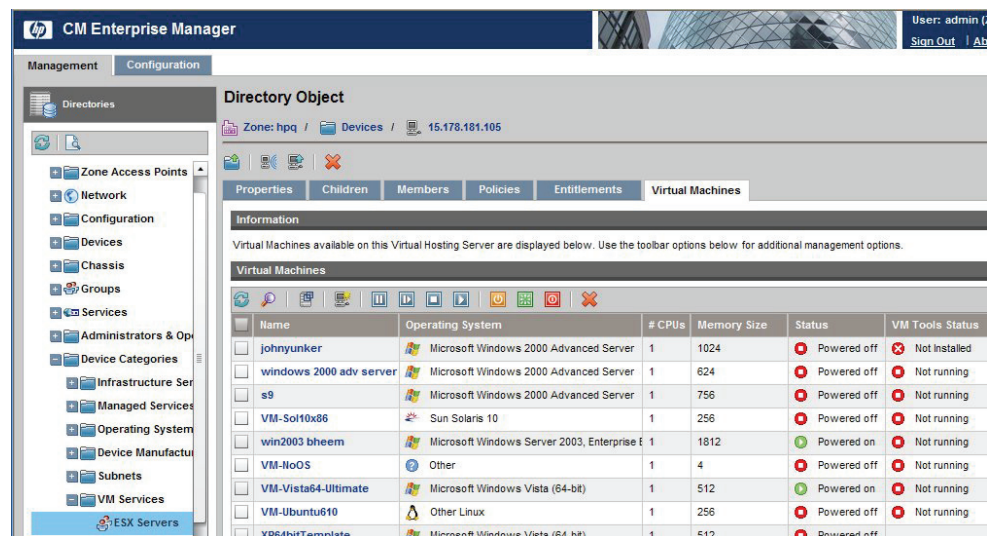
Although the report recognizes HP CM as leader in the client management space, the same strengths play well in the server market as well. Also, integration with other Change and Configuration center products such as Change and Control Manager software, Enterprise Discovery software and Universal CMDB makes it well equipped to handle change and configuration needs in the server management space.

Automation with the HP and VMware Change and Configuration pack

As mentioned earlier, HP CM OS Manager can provision ESX Server to bare-metal machines.

A soon-to-be released version of HP CM automates creation of VMs, provisioning OS to them and managing the whole lifecycle of VMs in an integrated manner through CM Enterprise Manager, GUI to HP CM.

Figure 5. HP CM Enterprise Manager



With these capabilities within HP CM, other products within the pack and integration with ITSM products HP Service Management Center and HP AssetCenter software, the whole lifecycle of a change within IT infrastructure is easily automated:

1. Change request is raised in HP ServiceCenter software by the customer and approved.
2. Discovery services discover the existing infrastructure.
3. HP AssetCenter helps in analyzing the existing infrastructure and determining whether new existing infrastructure with virtualization can satisfy the request, and in purchasing the necessary software.
4. HP Change Control Management analyses the impact and risk.
5. HP Configuration Management deploys virtualization software (if hardware had to be purchased), creates VMs and deploys software.

Example—provisioning OS to a VM

This section describes how HP CM provisions Windows® operating system software to a Virtual Machine. The specific component used for this purpose, besides HP CM infrastructure, is HP CM OS Manager. The VM to be provisioned with OS is created on an ESX Server, a component of VMware VI3.

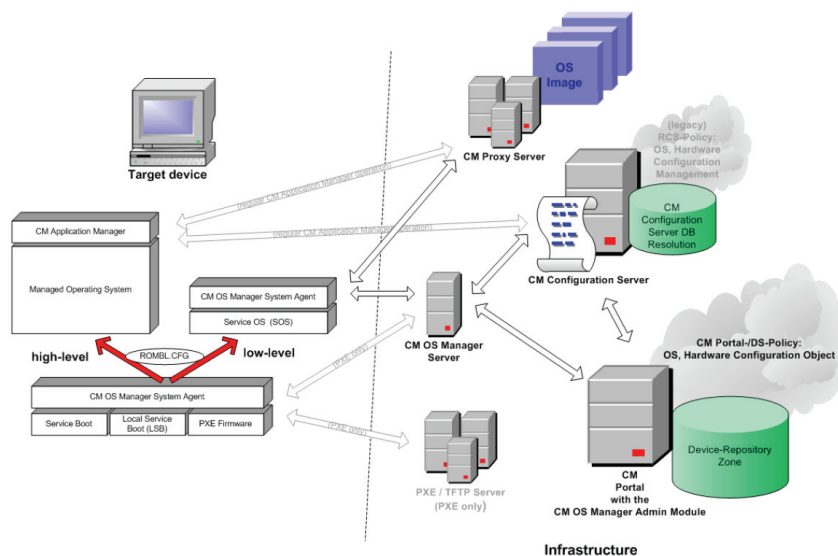
HP CM OS Manager

HP CM OS Manager has a number of components that install and configure OS software on a machine, physical or virtual, as prescribed by the policy. The policy selects the correct OS image based on one or more of the following criteria: network location (e.g. LAN segment), physical device characteristics (e.g. CPU type, RAM size, disk space etc.), electronically inscribed identification (e.g. asset tag, MAC address, computer identification etc.), user supplied parameters (e.g. machine role, user ID).

HP CM OS Manager components provide specific functionality and can be deployed in a distributed fashion for better performance and scalability, as shown in the following diagram. HP CM proxy servers store OS images and are responsible for streaming the bits to the target machines. As the OS images tend to be big in size, these servers should be deployed closer to the target machines to optimize network traffic.

HP CM configuration server stores the policies and helps determine the desired state of a machine based on machine characteristics. PXE boot server transmits the HP CM OS Manager system agent during network boot of the bare-metal target machine and kick-starts the OS provisioning process. The system agent is a low-level agent that initiates policy resolution on the HP CM configuration server through the HP CM OS Manager server, and determines which operating systems qualify for installation on the target machine.

Figure 6. Provisioning the Windows operating system using HP Configuration Management software.



HP CM OS Manager supports the full life cycle of an OS covering image creation, machine discovery, targeting, analysis, deployment, updating, repair and removal. However for this white

paper, we will assume that an OS image has already been created and necessary policies have been setup and only focus on the steps involved in deploying the OS bits to the VM as it boots after creation.

OS provisioning steps

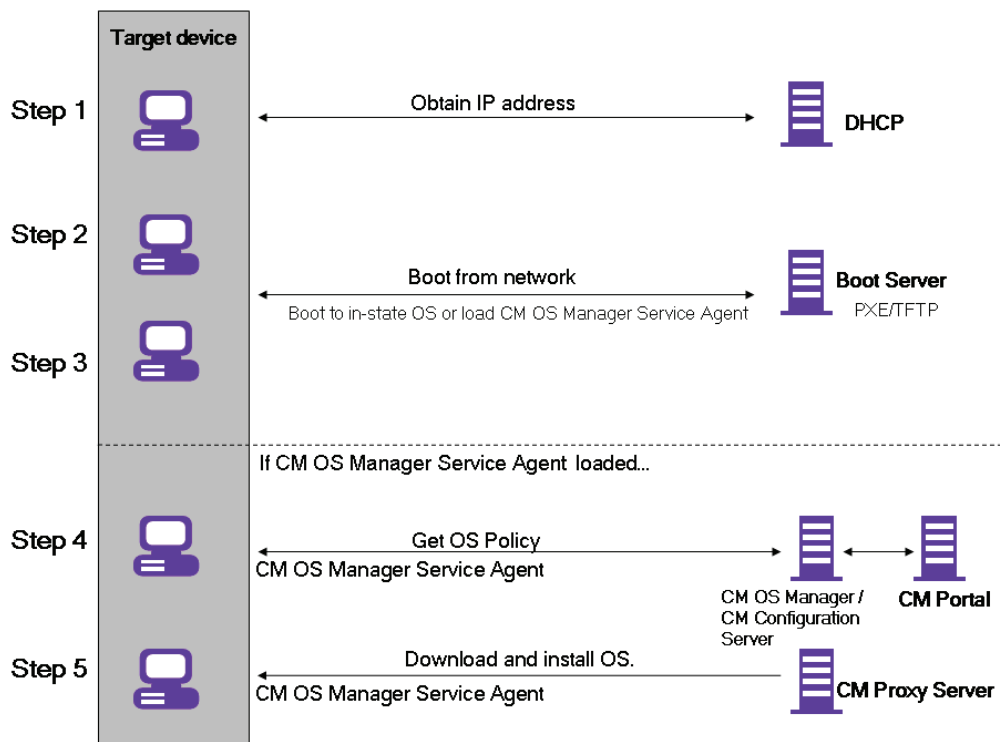
By default a vanilla VMware VM is configured for preboot execution environment (PXE), a technology that permits the VM BIOS and network interface card (NIC) to bootstrap from the network. BIOS typically loads the boot program from the local hard drive but using PXE it gets the boot program over the network. Here are the steps:

Step 1: The VM BIOS uses DHCP to obtain an IP address from a specially configured DHCP server, which need not be the one packaged with HPCM, and locates the PXE server that stores the network bootstrap program. Again, this PXE Server need not be the one packaged with HPCM.

Step 2: The VM BIOS downloads the HP CM OS Manager boot loader from the PXE Server.

Step 3: HP CM OS Manager boot loader runs within the VM and checks with HP CM portal for existence of a ROM object corresponding to this VM. If such an object does not exist then it is created within the portal. The boot loader also checks for existence of a valid OS on the device's system drive. If there is a valid OS on the machine, it boots to the existing OS.

Figure 7. HP and VMware provisioning steps



Step 4: If there is no valid OS on the device, the boot process continues by loading the HP CM OS Manager system agent from the PXE server to the VM. This agent and the HP CM configuration server communicate through the HP CM OS Manager server to handle policy resolution of the correct OSs for the target device.

Step 5: The HP CM OS Manager system agent downloads the appropriate images from the HP CM proxy server and installs that on the VM.

Now, let's take a look at a few screen shots of the entire OS provisioning process.

Figure 8. The main screen of HP CM portal shows the high level entry points into various parts of HP CM OS Manager.

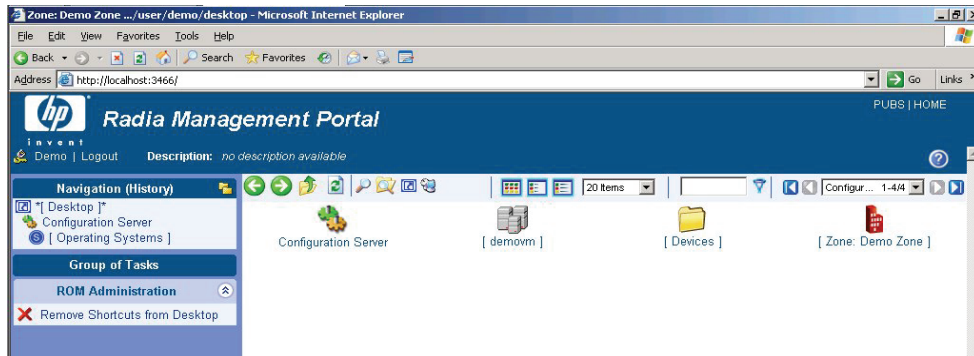


Figure 9. Clicking on the “devices” icon shows all the ROM objects. Notice that a ROM object is typically identified by the name of the corresponding machine.

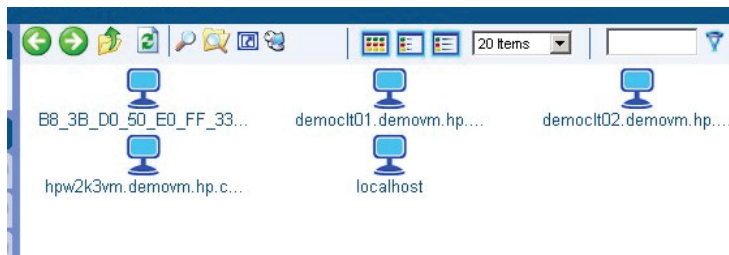


Figure 10. Clicking on “configuration server” in the main page shows various policy objects.

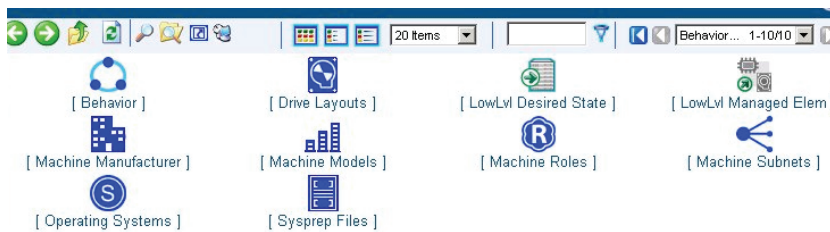


Figure 11. A newly created VM gets its IP address from DHCP server during PXE boot, downloads and runs the HP CM OS Manager boot loader and then HP CM OS Manager service agent.

```
Network boot from AMD AM79C970A
Copyright (C) 2003-2005 VMware, Inc.
Copyright (C) 1997-2000 Intel Corporation

CLIENT MAC ADDR: 00 50 56 BE 5F 97  GUID: 503E0017-855E-8BB1-2B4D-673282F6EF0E
CLIENT IP: 192.168.5.210  MASK: 255.255.255.0  DHCP IP: 192.168.5.11
GATEWAY IP: 192.168.5.2

Auto-select:
  Remote Boot Linux

BOOT SERVER IP: 192.168.5.11

Radia OS Manager Boot Loader (ROMBL) v1.28/1.27/1.09, (C) 2004 Novadigm, Inc.
-----
No valid partition layout found on local drive.
Checking machine status ... received.
BS1 determined (_SUC_LINUX_). Starting Linux service OS.
Loading X86PC/UNDI/linux-boot/bzImage from the Network: done.
Loading X86PC/UNDI/linux-boot/rootfs.gz from the Network: 7% ..._
```

It also downloads the OS image (Windows 2003) and allows the VM to boot into this OS. Patches and pre-configured applications are installed and inventory is taken after booting the OS. All this is completely automated and happens without any user interaction.

Figure 12. A message window from HP CM

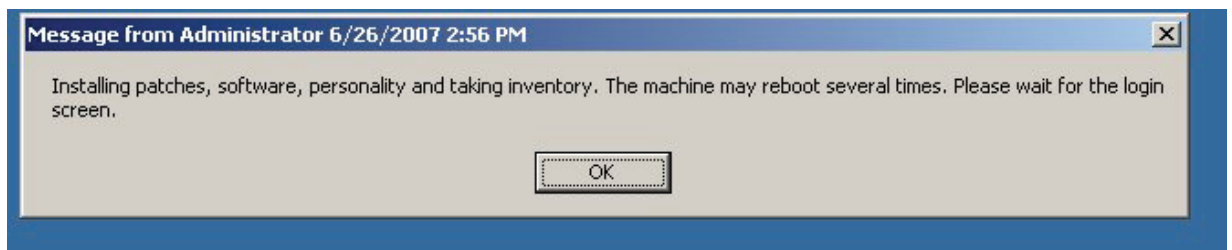
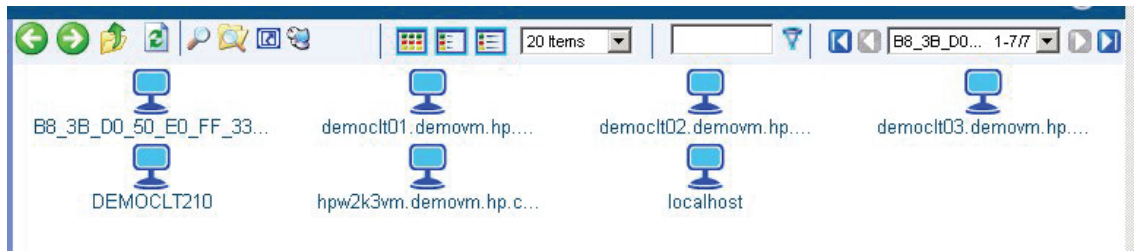


Figure 13. In the “devices” screen, you can see the ROM object corresponding to the VM (DEMOCLT210).



HP and VMware Change and Configuration pack

HP and VMware Change and Configuration pack is a bundle of HP and VMware products and services that together provide a ready integration solution for enterprises. This bundle includes:

- HP Change and Configuration Center products
- VMware Infrastructure 3 software
- Implementation services from leading service providers

Refer to the HP and VMware Change and Configuration pack brochure for details. The brochure is available at www.hp.com/go/vmware/management.

Summary

HP and VMware Change and Configuration pack provides an integrated solution for managing change within the IT infrastructure of an organization. The value of this solution includes:

- Pre-validated collection of products from HP and VMware
- Seamless integration of virtualization into the overall IT infrastructure and uniform treatment of virtual and physical machines
- Leveraging of virtualization to simplify and speedup a category of change requests
- Scalable solution to meet needs of large environments
- Integration with other products managing the IT infrastructure

The pack can be purchased as independent component products from HP, VMware and other channel partners. Implementation services for the pack are available from leading system integrators such as BearingPoint and HP Consulting and Integration.

For more information

For more on HP virtualization solutions visit:

www.hp.com/go/vmware/management

www.hp.com/go/virtualization

For more on HP Software solutions and products visit:

www.hp.com/go/managementsoftware

For more on VMware visit:

www.vmware.com

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