Building Multi-platform Images for Deploying Operating Systems on Dell Business Client Systems

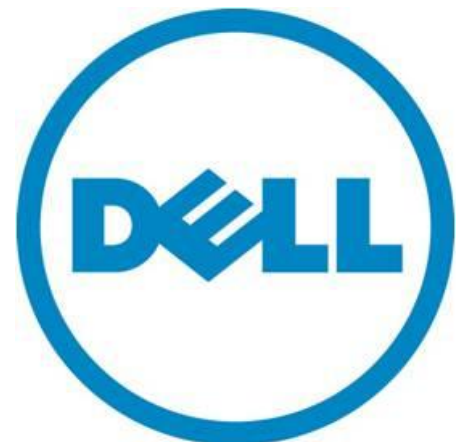A Dell Technical White Paper

Dell │ OpenManage™

Systems Management

By Sandeep Karandikar and Harsha Yalagach

August 2011

Table of Contents

Introduction

IT departments typically manage a heterogeneous mix of decentralized client hardware and various software applications. Administration of large scale enterprises requires the use of centralized systems management processes that use consistent methods for managing the diverse network clients. Some typical I/T administrator activities involve deploying standardized corporate operating system images to client hardware, and using a consistent mechanism to gather application software, hardware, and operating systems (OS) information across the network from a central management console.

These administrators often times are faced with the complex task of managing generations of client hardware systems and ensuring that their image management and deployment process continues to work across these changing hardware technologies. Enterprise administrator activities can be broadly categorized into four areas –

1. Planning activities
2. Building Images
3. Capture Process
4. Deployment across the wire

The intended audiences for this whitepaper are I/T and network administrators or managers who do not use Microsoft or 3rd party standardized deployment tools and processes for building and managing images but rather use home grown tools to build and manage their images. The intent of this paper is to outline considerations for building scalable infrastructure for image deployment spanning multiple generations of hardware.

Planning

Image creation activity requires planning to ensure that the image management strategy is sustainable and is scalable to handle future needs. Planning activities requires many upfront considerations in terms of long term desired goals. Some planning goals to be considered for example include but not limited to:-

1. Number of enterprise operating enterprise systems that will be supported (XP, Vista, Win7)
2. Architectures that will offered for Enterprise users (Win7-64bit, XP and Vista 32-bit)
3. Image refresh frequency (How frequently will drivers be updated)
4. On-going sustaining/update strategy
5. Hardware replacement /refresh cycle

Responses to above questions often help drive the planning strategy. Image creation activities typically start with selecting an operating system image to use. Planning also involves selection of hardware to build the image on. Installation process results can vary depending on the hardware chosen to build the image.

Base Image

One of the primary steps around planning involves selecting the appropriate starting operating system image to use for installation. Enterprise customers have a variety of options to choose from for their starting OS image. This section will outline the top 3 mechanisms that are available and the pros and cons for each approach. This section assumes that most of these administrators are supporting a variety of hardware in their network.

Reusing Existing Images

Large enterprises often have older captured images that are used to deploy Operating systems on their existing hardware pool. The image build process steps used for existing image creation can create challenges especially when the image is being used for deployment on newer hardware systems. The ability of the Image to work on newer hardware is also determined by the drivers that are included natively within the OS Image. As newer hardware devices and thereby hardware systems emerge, the drivers may not be included natively often times requiring manipulation of the image to make it functional.

For e.g. an XP image captured on a D630 system configured in AHCI Mode will not work with on an IRRT mode controller setup on E-Series systems. An attempt to deploy an image will result in 0x07B BSOD message.

Other factors that can contribute to a non-functional images are hot fixes commonly known as QFEs (Quick Fix Engineering) Released from Microsoft and/or Dell. Existing images do require a periodic refresh to be able to support newer generations of hardware. In general the more compact the imaging process, the more likeliness that it will require retrofitting.

Drivers packaged with the existing images can also sometime cause unexpected behavior when newer devices are detected.

Using Retail OS Media

Retail OS media refers to the original Microsoft Installation media provided with each system by the manufacturer or available from Microsoft. This refers to the original Microsoft RTM Disc as opposed to the media provided by Dell labeled as 'Reinstallation media'. Re-install media is customized snapshot of the hardware system that was purchased and is much tailored to the configuration ordered. Microsoft media on the other is the as-shipped media when the operating system or a corresponding integrated service pack was launched. Depending on the timing it may or may not contain the latest hot fixes of Microsoft QFEs that have been released since the particular OS was RTM'ed (Release to Manufacturing). Thus the deployment process in this case needs to layer in the QFE post OS installation to bring the OS up to the latest specification as defined by Microsoft.

Factory Shipped Image

Dell systems ship out with Factory Installed images sometimes referred to as 'on-the-box' image which are highly customized to the hardware at the time the system was shipped. The image can be reused as-is if the target hardware was an exact match for the initial hardware deployment when the system is purchased. Some other considerations with using the as-is factory image is the partition layout,

additional software dependencies, etc., that are ordered with the box and may have potential conflict when deploying on other systems. Customers choosing to use the factory install image option should try and match the hardware as closely as possible given the optimal operational efficiency that each image is customized to. A point to also consider is these images are node-locked at the BIOS level to the motherboards. So deploying an image from a machine to another machine without any kinds of sysprep generalize may cause un-foreseen issues.

Hardware Selection for Building Images

Once the choice of the base image to use for deployment has been made, the next step involves selecting the test hardware to deploy the image and capture an image on. Deployment system used for the image capture process can occasionally introduce variations. For e.g. once the system image has been deployed, using the syprep process without the proper switches specified can cause all unused drivers to get removed for image optimization. While this approach is beneficial to optimizing the size of the captured image, it causes the image to be locked down to a particular hardware configuration.

Installing on Mule Hardware

This process is commonly used when the actual hardware on which the image will eventually be deployed is unavailable on the build site for testing or is located at remote locations. An example would be a where a system or exact configuration match is unavailable. In this case, the drivers and/or applications are often staged based on the knowledge of the target system.

Installing on a VM

Virtual machines offer the most cost-effective way of building hardware image without relying on the physical configuration of the box. While this absolves of any issues during the build can capture process, this doesn't necessarily mirror the building of the image on an actual piece of hardware. Images built in a Virtual machine environment typically end up encompassing a larger driver set during the capture process. This implies the images may be less than optimal but is highly portable.

Removing Build Machine Hardware specific dependencies

After you are done with building the image, you should remove the machine specific information/content like Event Logs, Unique SID's and other unique information. You can do this by running the command "Sysprep /oobe /generalize". Please see the reference section for more information on Sysprep tool.

Build Images

When building an image, there are various schools of thoughts on how the Master Image should be built varying from the larger "One size fits all" image to the smaller "Stripped down" images. Also, we would be making an effort to understand the OS specific nuances, integrating QFE's and OS Service packs, integrating hardware specific drives into the image build process, considerations for the image capturing process.

You can find a comparison between the Larger Image and the Smaller Images approach.

Larger Images	Smaller Images
(+) Less Setup	(-) More setup
(+) Easy to design	(-) Difficult to design
(-) Difficult to maintain in the long run	(+) Easy to maintain in the long run
(-) Difficult to troubleshoot	(+) Easy to troubleshoot
(-) All software's are installed on all machines, hence high licensing cost.	(+) Software can be installed based on various inputs, and hence lower licensing cost.
(-) Consumes more Network Bandwidth during OS Deployment.	(+) Consumes less Network Bandwidth during OS Deployment.

Install QFEs from Microsoft and Dell

A QFE is a software package that is used to address a problem in a Software Product. Microsoft and Dell Inc., regularly release these QFE to address various problems. Also to install an older OS on a newer hardware, we need to install some software components like UMDF and KMDF which are released later, so that device installation happens without any issues during OS Deployment.

Installing Universal or Common applications

Every company has a set of Applications that it installs on every client like Antivirus Software, Email Client, Productivity Software's like Microsoft Office, etc. These applications can be pre-installed when we are building the image, or can be installed separately as part of OS Deployment. The advantage of putting it in the image itself is that, you don't have to maintain complex OS Deployment scripts. The downfall of having the software pre-installed on the image is that, every time there is a newer version of the software, the image has to be updated.

Laying down Drivers in Traditional way

In the traditional way of installing drivers, all the drivers for the systems to be supported are copied into the master image for unattended installation.

Advantages	Disadvantages
Single Image that supports multiple systems.	Bulky image, consumes more network bandwidth during deployment, takes more time to deploy.
	Unsupported/Incompatible Drivers may be picked up the OS, than what was recommended, yielding a poor experience.

Laying down drivers using new approach and tools.

In the new approach, we segregate drivers for different platforms into separate packages and conditionally consume these packages at runtime as part of a Deployment Task Sequence Item using WMI query.

Advantages	Disadvantages
Compact image that supports multiple systems..	Difficult to design.
Only Supported/Compatible drivers are installed, hence giving the best experience.	
Consumes less network bandwidth and takes less time to deploy.	
Easier to maintain and update the image in the long run.	

Below is a snapshot depicting the use of WMI queries to install Drivers Packages for different systems.
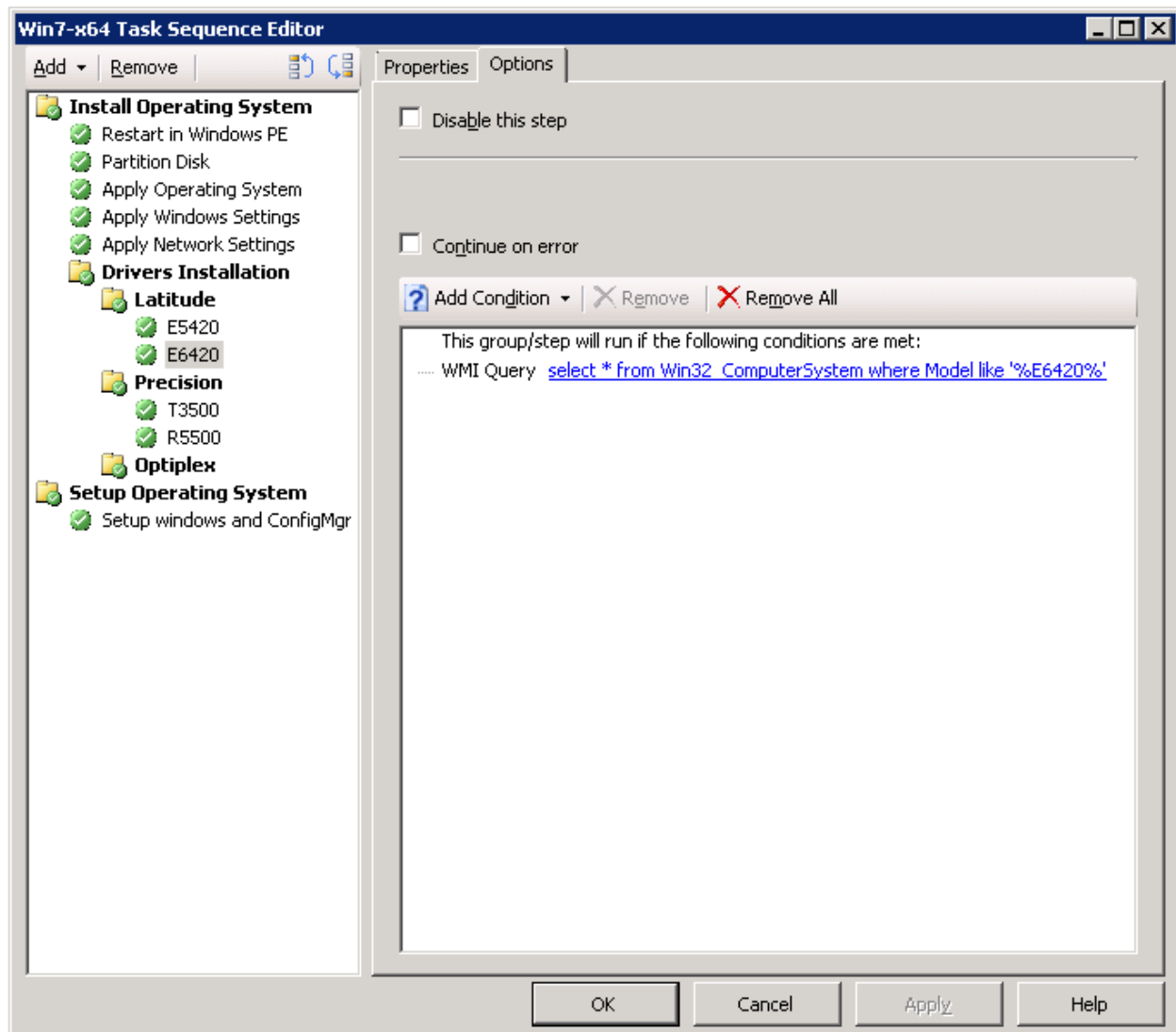
Install Hardware independent software

Hardware independent software's are those, which don't require a particular Hardware component for them to function. Examples include Microsoft Office, Adobe Reader, etc. These software's can be installed into the image, or they can be deployed during OSD separately.

Install Hardware dependent software

Hardware dependent software's are software's which are dependent on a particular hardware component to be present. Examples are DVD Burning Software, which is useful only if there is DVD R/W Drive, Bluetooth Stack for Bluetooth device. Installation of such software required prior knowledge of existence of such devices on the target system. Hardware dependent software's can be easily installed on the target machine by using conditional Deployment Task Sequence steps and WMI Queries.

The following are the Hardware dependent software that Dell Recommends when deploying an OS on Dell Machines.

1. Dell System Software (DSS). These may include private QFE's (not available through Windows Update) or QFE specific to Dell Systems.
2. Touchpad drivers and software's. Touchpad devices will still continue to function as a 'Mouse' device in absence of the complete Touchpad software stack. The additional software is needed to enable Touchpad specific functionality like Horizontal/Vertical scrolling, double tap functions, etc.
3. Camera Software. Standard out of the box drivers will work for most systems, but some systems might require additional software to enable full functionality.
4. Bluetooth software stack. Additional functionality like Profile enablement is controlled by Bluetooth software stack provided by Dell.

Microsoft Sysprep tool considerations

Sysprep is the System Preparation Utility for Microsoft Windows XP OS Deployment. Sysprep can be used to prepare an OS for Disk Capturing and later restoration via captured image. Please see the reference section for a link to Sysprep tool.

Offline Image Servicing:

The task of updating an image is a tedious task, as you need to deploy the image, install the required software components, and recapture the image again. Offline Image servicing eliminates this problem. Offline Image Servicing was introduced in Windows Vista and is available as part of the Windows Automated Installation Kit (WAIK).

With Offline Image Servicing tools like ImageX/DISM, you can

a. Add or Remove Drivers offline.
b. Add and Remove Window Features and Packages offline.
c. Add and Remove Language Packs offline.

For more information on this, please see the reference section for links.

Capture Images

Now that the image has been laid down with the mandatory or necessary components, let's look at the various image capturing tools and techniques. Image capturing tools to use, Using disk capture v/s partition capture process. The two predominant ways of capturing images are:-

1. Sector Based image capture
2. File based image capture

Sector based image capture involves capture either partitions or entire disks and duplicating them to the target system along with resizing if required. File system based image capture involves capture just the file and directory system layout along

Sector Based Disk Capture or Partition Capture considerations

- Requires that the destination computer use the same Hardware Abstraction Layer (HAL) as the master computer.
- Requires that the destination computer boot from the same mass-storage controller as the master computer.
- Destroys the existing contents of the destination computer's hard drive, complicating Windows deployment scenarios.
- Duplicates the hard drive exactly; therefore, the image can deploy only on partitions of the same type as the master computer, and are at least as large as the partition on the master computer.
- Does not enable direct modification of imaged files.
- Might require the purchase of third-party applications and services.

Reference Tools

Ghost

Ghost is one of the popular tools used for deploying images. The tool in its simplest form requires a system be setup with the desired configuration of disk layout, software, drivers and applications. Then using the tool customers can capture the disk or partition for deployment to 'n' systems. Supporting tools like ghostwalker also allow changing the Computer SID upon deployment to ensure that no two systems on the network have the same system name.

Imagex for partition based capture

ImageX is a command-line tool that enables the creation, the modification, and the deployment of images, by using a shared imaging format across operating system images, including applications. The following scenarios are particularly compatible with the ImageX process. ImageX tool provide the following advantages –

- Rapid extraction of images to decrease setup time.
- Reduced image size due to "single instancing," which means that the file data is stored separately from the path information. This enables files that exist in multiple paths or in multiple images to be stored once and shared across the images.
- Non-destructive image application. ImageX does not perform an all-inclusive overwrite of the contents of your drive. You can selectively add and remove information.
- The ability to work across any platform supported by Windows.
- Two different compression algorithms, Fast and Maximum, to reduce your image size further.
- The ability to treat image file like a directory. For example, you can add, copy, paste, and delete files from a file management tool, such as Windows Explorer.
- Offline Image Servicing.

Deployment & Distribution Tools

With the Image captured and ready for deployment, let's looks at the various tools available for distributing the built images to multiple systems. We will also look at identifying hardware specific deployment tasks and layering down applications to build an optimized manageable configuration

BIOS Configuration Tools (CCTK) or DCCU

Dell™ Client Configuration Toolkit (CCTK) is packaged software offering that provides configuration capability to Dell Business Client Platforms – OptiPlex™, Latitude™ and Precision™. This product consists of a command line utility (cctk.exe) to configure various BIOS features. CCTK can be used in a Microsoft® Windows® Pre-installation Environment (Windows PE), Windows (XP, Vista), and Red Hat Linux™ environment. For the client systems that do not have an operating system installed, you can create a bootable image that contains CCTK to run the CCTK commands on Windows Pre-installation Environment (Windows PE). Windows PE provides a standalone Pre-installation environment that is used to prepare a system for Windows installation. Use Microsoft Windows Automated Installation Kit (Windows AIK) to create a Windows PE image.

Enterprise Deployment Tools

There are several tools available to deploy and distribute the OS Image that has been built. In this document, we would be talking about MDT and SCCM.

Microsoft Deployment Tool Kit (MDT 2008, 2010)

Microsoft® Deployment Toolkit (MDT) 2008 provides unified processes and tools for desktop and server OS deployment using a common deployment console and a collection of best practices. The toolkit provides a single mechanism for image creation and an automated installation process to reduce deployment time.

MDT can be used in two different operational environments –

1. Lite Touch Installation (LTI) - Used primarily when software distribution tools like Microsoft Systems Center Configuration Manager (SCCM aka ConfigMgr) 2007 are not available
2. Zero Touch Installation (ZTI) – Used as an extension of the OS deployment capabilities available with ConfigMgr 2007

For additional details on using MDT 2008 with Dell provided deployment pack, please refer to the MDT whitepaper link listed in the references section of the document.

Microsoft provides native integration of Dell delivered Cabs with MDT 2010. See the references section below for Technical presentation on integration of Dell provided drivers cab with MDT.

Microsoft System Center Configuration Manager 2007

Microsoft System Center Configuration Manager 2007 (MS SCCM) provides centralized systems management capabilities for OS deployment, security patch management, application deployment and asset management using the Windows® Management Services Integration (MSI). This article will discuss

how to use the SCCM operating system deployment function to deploy your corporate image on Dell hardware.

The Dell Client System Deployment CAB files that are now available on the Dell support Website offer new levels of ease and flexibility for creating and deploying customized OS images on Dell Latitude E-Series systems. The key capabilities provided by the Dell Client Systems Deployment CAB are:

- All system applicable drivers in a single archive.
- The flexibility to manage and deploy corporate standard images on Dell client systems

With the Dell Client Systems Deployment CAB, IT Administrators can perform the following tasks:

1. Use Microsoft Windows OS-based PnP enumeration capabilities to install drivers for applicable devices.
2. Create a system-level optimized deployment sequence.
3. Setup an appropriate boot control sequence.
4. Optimize the deployment of targeted system-specific driver packages

Best Practices

1. Use the latest generation hardware to build your master image, if you are using physical hardware to build and capture image.
2. Keep the Master Image as small as possible, with only the required drivers and software applications in it. Install the H/W dependent drivers and software's during OS Deployment based on the need/rules.
3. Use WMI Queries to install components/drivers/software's conditionally.
4. Install software components referenced in Dell System Software (DSS). These may include private QFE's (not available through Windows Update) or QFE specific to Dell Systems.

References

1. Client Configuration Tool kit
   http://www.delltechcenter.com/page/Dell+Client+Configuration+Toolkit
2. Deploying Operating System Images on Dell Business Client Systems using Microsoft® Deployment Toolkit (MDT) 2008
   http://www.dell.com/downloads/global/power/Automating_Image_Deployements_with_MDT.pdf
3. MDT 2010 Integration with Dell Deployment Cabs – Michael Niehaus
   http://blogs.technet.com/mniehaus/archive/2009/05/26/piles-and-piles-of-dell-drivers.aspx
4. Deploying Operating System Images on Latitude™ and Precision™ E-Series Systems using Microsoft® System Center Configuration Manager 2007
5. ImageX Command Line Tool Reference
   http://technet.microsoft.com/en-us/library/cc722145(WS.10).aspx

6. Microsoft Sysprep Tool
   http://support.microsoft.com/kb/302577
7. Pre-install KMDF/UMDF.
   http://support.microsoft.com/kb/2494168
8. Offline Image Servicing
   http://technet.microsoft.com/en-us/library/dd799304(WS.10).aspx