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What’s new in this guide
Updated: Sunday, January 9, 2011

Version 2.0

1. This guide has been significantly updated to include setting up Mac OS X Server using Snow Leopard 10.6.5 and DeployStudio version rc124. This guide also includes information on deploying Windows 7 images.
2. Winclone, NetBoot Across Subnets and SCUBA are no longer being developed and have therefore been removed.
Overview

Please note: this guide is intended to be a resource for building and deploying images using DeployStudio. The author assumes no responsibility for lost time or lost data when using the tools described in this guide. **DeployStudio is intended to partition and re-image systems and, when configured as such, will erase all data on the drive.** It is important to understand this capability as it can cause automated, unrecoverable data erasure, depending on the chosen, configured deployment.

The author of this guide has no affiliation with the developers of DeployStudio. Third-party company and product names mentioned herein are trademarks of their respective companies. Mention of third-party products is for information purposes only and constitutes neither an endorsement nor a recommendation to use those products. The author assumes no responsibility with regard to the performance of these products.

When seeking support for DeployStudio Server, please consult the DeployStudio forums. It is recommended you first search for the issue you’re experiencing. If you cannot find the answer you’re looking for, post the question to the forum. The forum may be found here:

http://www.deploystudio.com/Forums/index.php

This guide was written and tested using Mac OS X v10.6.5 Snow Leopard Server. While current versions of DeployStudio support running either 10.5.x Leopard Server or 10.6.x Snow Leopard Server, this guide offers specific instructions on how to set up a Snow Leopard Server for use with DeployStudio imaging deployments. Some features in Snow Leopard Server are different when compared with Leopard Server. Differences in both interface and functionality between Leopard Server and Snow Leopard Server will **not** be pointed out.

DeployStudio has established itself as the premier, free tool for creating, customizing and deploying images. Initially, you may find all the features of DeployStudio a bit overwhelming. However, it is a comprehensive well-thought out solution for customizing and deploying images either locally or across the network. DeployStudio can assist in the creation of single, dual and triple boot Macintosh systems. DeployStudio can also be configured to run locally from a hard drive.

This guide will concentrate on setting up a private network based deployment of images to multiple machines simultaneously. However, many of the concepts discussed are relevant to utilizing existing DNS and DHCP servers at your deployment site. Other hard drive-based cloning alternatives for deploying Mac OS X include Carbon Copy Cloner, SuperDuper and others. DeployStudio documentation is sparse, which is the motivation for creating this guide.
Other resources, including some topics not covered in this guide, may be found here:

DeployStudio Documentation:

DeployStudio Quick Install Guide:

DeployStudio Architecture:

DeployStudio wiki:
http://deploystudio.wikispaces.com/

DeployStudio Video Tutorial:

DeployStudio Tips and Techniques:

Step-by-step reimaging guide:
http://www.wazmac.com/servers_network/desktop_maintenance/re-imaging_notes_mac.htm

As a side note, DeployStudio also has a PXE boot capability, which is a free alternative to other PC deployment tools for deploying Windows images to non-Mac PC systems. At this time, this guide will not discuss PXE booting.

This guide will step through setting up Mac OS X Server, installing and configuring DeployStudio, creating images for deployment and deploying and customizing images. It is important to first have a general understanding of the various components required. Basically, there are a number of Mac OS X Server services required. There are also a number of components in DeployStudio for building, managing and customizing deployment images. A summary of those services is as follows:

**Snow Leopard Server Components**

- File sharing - AFP (Apple File Protocol) Retains a central repository for all DeployStudio computer records, workflows, master images and scripts that are accessible from both the server and remotely from client systems for image creation and image deployment.
- DHCP - Allows dynamic network addresses for NetBooting. (Only necessary if isolated from a main network e.g. a standalone deployment server.)
- DNS - Required for server services including file sharing, user creation and basic server functionality.
NetBoot - Service for booting client systems from a network based image so that they can be completely erased and restored.

Open Directory - Directory services used for user and group creation for file sharing and access to the DeployStudio repository and the DeployStudio web server.

DeployStudio Components

DeployStudio Assistant - Used to set up the DeployStudio Server, create NetBoot sets and create external USB or FireWire drives for image creation and deployment. Also a tool for creating PXE boot images.

DeployStudio Admin - Central location for recent activities, managing computers and computer groups, creating workflows, managing master images for deployment, managing packages and for maintaining scripts.

Activity - Monitor systems while their workflow is running. Verify each step completed successfully and view logs for each session.

Computers - each computer can have custom scripts and workflows associated with it. It allows one to specify the hostname, new users, network settings, etc. Similarly it can create computer groups for automating complete workflows on multiple machines simultaneously.

Workflows - Create custom step-by-step workflows for image creation, image deployment, partitioning, running scripts, installing packages, connecting to directory services, setting up various specific network settings, setting the firmware password, binding to directory servers and more. Multiple workflows can be created for a variety of deployments all managed by individual computers or computer groups. Workflows may also be combined using the Meta Workflow task.

Masters - Manage the master images you have created for deployment so that they can easily be added to workflows.

Scripts - Customize scripts for further system customization before or after deployment occurs.

Packages - Install software packages including Mac OS X updates, Apple software or third party software that uses the .pkg or .mpkg installer(s). These may be added after the initial install for custom setups for different locations or to ease the creation process of the master image by supplementing new software releases or updates. These installers may even be run post restart in the event certain software must be installed from the running OS drive or verify installed software like the iLife suite, which verifies the version of QuickTime that is installed.

DeployStudio Runtime - Tool for running the various Workflows created in DeployStudio Admin including image creation, image deployment and running scripts for customization. This tool will present itself when the system NetBoots or can be run locally to create or deploy images from a local hard drive.
Chapter 1 - Introduction

This guide is very specific in what it covers. By following this guide you will be able to deploy a Mac OS X 10.6 image and a Windows XP (SP3) or Windows 7 image to Intel-based Macintosh systems across the network. While DeployStudio is a powerful and fairly intuitive tool, it does not offer full documentation or help files. Similarly it is reliant on several OS X Server technologies, which are not covered in the DeployStudio documentation. As of the writing of this version of the guide, DeployStudio Server rc20 is the last version to support Mac OS X Server v10.4.11 Tiger Server. Currently Future versions for the may only include support for 10.5.x and 10.6.x versions of Mac OS X Server. Please see the DeployStudio web site for more information regarding DeployStudio Server compatibility.

The following tools are necessary for a successful deployment:

1. Mac OS X Server 10.6.x Snow Leopard
   a. Server Admin - enabling various services.
      i. Apple File Protocol (AFP) - files sharing including hosting DeployStudio content
      ii. NetBoot - network based startup image hosting.
      iii. DHCP - dynamic IP addresses if deployment cannot rely on the network.
      iv. DNS - a properly configured dns is required for server connectivity and services.
      v. Open Directory - user database which stores user names, passwords and permissions to various resources
   b. Workgroup Manager - user creation for management and access.

2. DeployStudio Server
   a. DeployStudio Server repository - folder for storing various components, images, package installers and scripts.
   b. DeployStudio Server daemon - service running on the server running DeployStudio services.
   c. DeployStudio Assistant - tool for installing and configuring the DeployStudio Server daemon and for NetBoot system creation for the DeployStudio Assistant.
   d. DeployStudio Admin - configure and edit workflows, computers, scripts and disk images.
   e. DeployStudio Runtime - the engine that connects to the repository and runs the various, pre-configured workflows on the client system(s).

This guide discusses the following topics and/or gives instructions on how to:

1. Set up OS X Server 10.6.x and enable various services (not including installation)
2. Create users necessary for DeployStudio and image hosting
3. Set up share points for image creation and deployment
4. Configure NetBoot
5. Create a Mac OS X partition and install all necessary software
6. Create a Windows XP and/or Windows 7 partition and install all necessary software (including sysprep setup)
7. Build and customize the images for mass deployment
8. Build a basic NetBoot image for network based start up and deployment
9. Manage Workflows for system customization during deployment
10. Start the clients from a network volume to pull images down to the local drive
11. Enable and utilize multicast images

Note: Both NetBoot and file sharing via the Apple File Protocol (AFP) are very network intensive and hard drive spindle intensive tasks. For the best performance, the ideal DeployStudio set up would take advantage of a Snow Leopard Server running the NetBoot service(s) and another server that hosts the DeployStudio Server Repository via Apple File Protocol (AFP). This can result in up to 2X deployment performance. If only one server is available, separate drives for the NetBoot images and the AFP DeployStudio Repository share point will enhance performance compared with a single drive. While neither of these is required, deployment times can be reduced by implementing either of these methods. This guide will focus on a single server utilizing a single hard drive.
Chapter 2 - Configure Mac OS X Server

Using a fresh install of Mac OS X v10.6.x Snow Leopard Server, follow these steps:

1. If your server is going to be used on an organization’s managed network you will want to make sure you have a fully qualified domain name and a static IP address set up on the central DNS server prior to using the Mac OS X Server Setup Assistant.

   Verify that the parent DNS server has been configured correctly by running `nslookup` or another tool from a client system other than the server. For example, in Terminal.app, type `nslookup <ip address of your server>`, which should show the domain name. Then in Terminal.app, type `nslookup <domain name of your server>`. Replace the relevant information between the “<>” and remove the “< >” when typing the command as shown in the screen shot.

2. Set up the Server - setting up the server the first time is straightforward, however, selecting the right options for a standalone scenario is important.
   a. Welcome - select the Region and click Continue.
   b. Keyboard - select the keyboard layout and click Continue.
   c. Serial Number - enter your serial number for Mac OS X Server and click Continue.
   d. Transfer an Existing Server - select “Set up a new server” and click Continue.
   e. Register the server (if this is a reinstall and the Setup Assistant is running locally on the server as opposed to remotely you may bypass the registration with a Command-Q).
   f. Time Zone - select the proper time zone and click Continue.
   g. Administrator Account - enter the Name and Short Name for the server administrator and the password. **Note:** For security purposes it is recommended a different user be created for the server administrator, the directory administrator and the DeployStudio administrator.
   h. Internet Gateway - if prompted to configure an Internet Gateway, do not do so. Click Continue.
i. Network - configure the network information.
   i. Change the Configure IPv4: to “Manually”.
   ii. Enter private IP Address (ie 192.168.1.1).
   iii. Provide the Subnet Mask (ie 255.255.255.0).
   iv. Enter the Router address with the same address as the server (ie 192.168.1.1).
   v. Leave the DNS Server and Search domains blank (Snow Leopard Server will automatically configure these with minimal DNS information when a private IP address range is used.)
   vi. Click Continue and choose Ignore to the error message stating “The IP address and the router are the same.”

f. Network Names - set the Primary DNS Name (i.e., snowleopard.example.com) and Computer Name (ie snowleopard).

h. Users and Groups - configure Manually.

i. Connect to a Directory Server - do not connect and click Continue.

j. Directory Services - do not set up an Open Directory master and click Continue.


3. Run Software Update or download the Mac OS X Server Combo Updater to another computer and copy it to the server.

4. Configure Services - launch Server Admin (located in Applications/Server/Server Admin) and authenticate to the server using the user name and password you created during the set up assistant. Select the server in the left column (listed as either an IP address, the DNS name or the localhost name).
   a. Choose Settings from the top, then select the Services tab.
i. Enable AFP, NetBoot and Open Directory.
ii. If needed also enable DNS and/or DHCP. **IMPORTANT**: See DHCP and DNS warnings below.) **Note**: As mentioned earlier, Snow Leopard Server will automatically configure DNS if none is detected, as in the case of a private network. It is therefore not necessary to enable the service.
iii. Choose Save.

**Note**: Server Admin can be unresponsive if DNS is NOT set up properly, including forward and reverse lookup. A static IP address and proper DNS name supplied by a central DNS server, or on the server itself in a private network, will alleviate this problem. For more detailed DNS setup instructions visit: [http://images.apple.com/server/macosx/docs/Network_Services_Admin_v10.6.pdf](http://images.apple.com/server/macosx/docs/Network_Services_Admin_v10.6.pdf). Another tactic is to omit the DNS address in System Preferences for the network setup until the DNS service is properly configured which should allow you to overcome the temporary unresponsiveness of the server. You will note that if Snow Leopard Server sets up DNS automatically, System Preferences > Network will now show the DNS Server as 127.0.0.1 or the loopback address pointing at itself.

**IMPORTANT**: If the server will be run in a stand alone/private environment using self contained server settings (ie. 192.168.x.x), you will need to also enable DHCP. DHCP **MUST BE DISABLED** if you are not using a stand alone network environment as it can create network-wide problems.

**Note**: Occasionally, network server admins do not like additional DNS servers on their network for security and conflict reasons. Check with the network administrator before enabling DNS, unless, of course, you’re managing a private network with NO network uplink connection.
b. Turn the triangle in the left hand column of Server Admin to see the enabled services.

c. DNS - verify the “minimal DNS” settings are correct by choosing DNS and selecting Zones in Server Admin. If using the examples in this guide, 192.168.1.1 should resolve to snowleopard.example.com and vice versa.
d. **DHCP - IMPORTANT**: See the note earlier in this section regarding DHCP. **DO NOT** enable DHCP if the server is connected to a main network. DHCP is typically **ONLY REQUIRED** when configuring a private setup. (These instructions assume the server IP address is 192.168.1.1 with a server name snowleopard.example.com and that a range of IP addresses is available from 192.168.1.10 to 192.168.1.250)

i. In Server Admin in the left hand column, select DHCP for your server

ii. Select Subnets

iii. If a subnet already exists, select it

iv. Under Subnet Name: name it Private Network

v. Starting IP Address: 192.168.1.10

vi. Ending IP Address: 192.168.1.250

vii. Subnet Mask: 255.255.255.0

viii. Network Interface: Typically, en0 depending on which ethernet port is used by the server

ix. Router: 192.168.1.1

x. Lease Time: 1 hours
xi. Select the DNS tab in DHCP subnets
xii. DNS Servers: 192.168.1.1
xiii. Default Search Domain: example.com
xiv. Select the checkbox to enable the subnet
xv. Choose Save
xvi. Select Start DHCP

**WARNING**: Make absolutely sure you’re not connected to a network that already provides DHCP. You will bring the network down by enabling DHCP on a network that already has DHCP running.

**Note**: If you don’t add the DNS Servers address correctly for DHCP the client, systems may not be able to connect to the server on a private network. This includes clients starting up using NetBoot.

**Note**: When connecting more than 240 clients simultaneously, one should broaden the range of private addresses available to clients and change the subnet mask to reflect the changes. The scope of this information is beyond what is covered in this guide.
e. Open Directory - Open Directory will allow you to create users on your network for deployment purposes including the DeployStudio administrator, share point/repository access and other service administration. Configuring Open Directory is not required but is recommended.
   i. In Server Admin, select Open Directory
   ii. Select Settings
   iii. Choose Change

   iv. Select “Set up an Open Directory Master” and choose Continue
v. Enter a user name and password. It is required that this user name be something other than the server admin user name and password (i.e., diradmin).

![Directory Administrator](image1)

vi. Click Continue

vii. The default Kerberos Realm should be sufficient as long as DNS is set up properly

![Domain](image2)

viii. Click Continue

ix. Confirm the settings are correct

x. Click Continue. Creation of the Open Directory Master should take about a minute, depending on DNS and the speed of the machine.

xi. Click Done
f. **AFP (Apple File Protocol)** - AFP will allow you to share images, scripts and customization across the network  
   i. Select the AFP service from the left  
   ii. Choose Settings -> Access and verify that Enable Guest access is disabled (disabled is the default setting)  

![AFP Service Configuration](image)

iii. Select “Start AFP” from the bottom of the Window  

**g. NetBoot** - NetBoot cannot be enabled until a NetBoot image resides in /Library/NetBoot/NetBootSP0. This will be enabled in a later step after a NetBoot image has been created using the DeployStudio Assistant.
5. **Workgroup Manager - Configure the users you will use for DeployStudio access.**
   a. Launch Workgroup Manager and authenticate with the Directory Administrator credentials created in the Open Directory step previously discussed (not the Server Administrator credentials, which may be the default behavior).
   b. Verify you are viewing directory: /LDAPv3/127.0.0.1 (if this is not selected, choose it from the drop down visible below Server Admin - Accounts - Preferences etc.)
   c. Click the “+” New User button and create a new user named “DS Admin” with a short name of “dsadmin” and set a password. Disregard the message “New users may not have access to services,” if presented.
   
   ![Workgroup Manager](image.png)

   d. Choose Save

   **Note:** A useful guide to get the most out of Mac OS X Server with a focus on Workgroup Manager for managing users, groups and computers may be found here:

6. File Sharing - allow the “DS Admin” user just created to read and write to the Public directory
   a. In Server Admin, select the server in the left column.
   b. Choose File Sharing from the top.
   c. Select Share Points (to the right of “Volumes”).
   d. Select Public, which is a default share point in Mac OS X Server.
   e. Choose the “+” button below the User or Group section in Permissions.
   f. Drag the DS Admin (dsadmin) user created in step 4 in to the ACL section for
   the permissions on Public.
   g. Change the Permission for DS Admin to “Read & Write”.
   h. Click Save.
i. With Public still selected, choose Browse then select New Folder.
j. Type in DeployStudio.
k. Select Create.

Note: It is recommended that server administrators lock down the Service Access Control Lists (SACLs) for various services to ensure better security. This topic is beyond the steps covered by this guide. For more information, refer to the guides published on this page: http://www.apple.com/support/security/guides/

Note: To verify the server is set up correctly, run sudo changeip -checkhostname
Chapter 3 - Install DeployStudio

The DeployStudio installer and set up assistants make installing and setting up DeployStudio easy. Typically, installing DeployStudio is only necessary on Mac OS X Server. Mac OS X Server is required for network booting client systems and relies on the Mac OS X Server NetBoot functionality. An instance when Installing DeployStudio on a system other than Mac OS X Server, which will be covered in more detail later, include brand new systems utilizing a newer version of Mac OS X.

2. Launch the installer and follow the steps to install the software.
3. Introduction

4. Read Me - verify you have the latest, stable, release of DeployStudio.

5. License Agreement - agree to the license agreement to continue. Note: This software is provided for free and takes no responsibility for the loss of data by either being misconfigured or bugs in the software.
6. Select a Destination - choose the hard drive you will be running DeployStudio from.
7. Select Continue.
8. Select Install.
9. Enter the Administrator user name and password for the system.
10. Select Close, when finished.
Chapter 4 - DeployStudio Assistant - Set up a DeployStudio Server

1. Launch the DeployStudio Assistant in /Applications/Utilities. Upon first launch you will be prompted with a warning “DeployStudioServer is not running on this computer.” Choose Start, then OK, if you want this system to be the DeployStudio Server.

2. Select “Set up a DeployStudio Server” and click Continue.
3. Server connection - if the “Server Address:” DNS name is not pre-populated, enter the dns name of the server followed by :60080 (ie. http://snowleopard.example.com:60080). Then enter the user name created earlier in Workgroup Manager as dsadmin and the password associated with that user. Then click Continue.

4. Server role - DeployStudio supports the ability to have multiple DeployStudio Servers on the same network for load balancing. This is an advanced feature and typically only necessary when server administrators have a lot of systems to deploy simultaneously and want to centrally manage those systems across multiple departments, schools, or organizational units. Replicas require multiple Mac OS X Server setups throughout a network. Most administrators will not use replicas. Leave the setting as “a master” and click Continue.
5. Repository settings - choose “a network sharepoint.” **IMPORTANT:** Make sure you select “a network sharepoint” because “a local folder” will not operate properly across the network. Click Continue.

6. Create the path to the share point, which is most likely afp://<dns name>/Public. (i.e., afp://snowleopard.example.com/Public). Enter the user name dsadmin (created earlier), the password for that user and under “Use sub-folder:” enter DeployStudio. Then click Continue.
7. Select Enable email notifications ONLY if you have a mail server set up to send status emails. **WARNING:** Enabling a mail server without the highest level of security can potentially allow hackers to use your server as a spam server. Click Continue.

8. Network Security - select “com.deploystudio.server” from the drop down menu. Selecting the Interface is dependent on the server hardware being used. Mac Pros and Xserves have multiple Ethernet Ports. Leave the port set to 60443. Do not select “Reject unknown computers,” unless you plan to import lists of computers including the MAC address of every system. Click Continue.
9. User Groups - if you want to restrict access to various users within groups created in Workgroup Manager for restricting the setup, creation, management and deployment of the DeployStudio Assistant, Admin and Runtime applications add the groups here. These groups will need to have been created in Workgroup Manager with their respective users in each group. Users in these groups may be changed at any time after setting up the group. This is recommended for tighter control and security. Configuring the groups is not a requirement. Click Continue.

10. Enable Multicast - enabling multicast is discussed in a later chapter. Note: Changing any settings in this window will not enable multicast on your network. Note: If Multicast is desired, it is possible to run the DeployStudio Assistant to set up a DeployStudio Server at a later time, without effecting the server settings.

11. Click Continue to update the server settings.
12. When the process is complete click OK.

Note: When using DeployStudio Admin, you may receive an error stating “failed to mount or access the repository” while attempting to connect to the server. This may be caused by not choosing “a network sharepoint” during the DeployStudio Assistant
Server set up process. Be sure NOT to choose “a local folder” and select “a network sharepoint” when running the assistant.
Chapter 5 - DeployStudio Assistant - Create a NetBoot Set

NetBooting a client system requires utilizing the correct OS for the platform that is NetBooting. If, for example, a new system ships between 10.6.4 and 10.6.5, that OS will have a newer build of the OS with the proper ROM information and drivers for that specific system. That is to say, you cannot take an older OS like 10.6.0 and boot a Core i3 iMac, which shipped with 10.6.4 with a newer build than the 10.6.4 update available for download in a combo updater. Occasionally, depending on the timing of the OS update release, ROM information for a system that shipped with 10.6.5 will not necessarily be included in an update like 10.6.5. Later updates may be required.

If this is the case, a newer machine will fail to boot. This will be exhibited either by a kernel panic (experienced by lines across the screen or an incomplete boot process). Some OS releases will not boot other systems until subsequent releases have been provided by Apple in the form of OS updates. If you have a problem with a system not NetBooting or a Master Image does not allow the system to boot, the OS release for that system is not capable of booting it. You must either update the NetBoot or Master Image or use the default OS that shipped with that system to build the NetBoot set and/or the Master Image set. Apple does not guarantee an OS release will boot all systems.

To put it simply, every Mac has a minimum OS that it can boot from:
http://support.apple.com/kb/HT2186

With that said, use the latest OS to build your NetBoot sets. Note: You can create a NetBoot set for a client system from the latest OS X Server server OS because, technically, (although not supported on all systems), the Mac OS X Server kernel will work on all Mac systems (given the proper build version). The current build statement above still applies. IMPORTANT: Newer versions of DeployStudio will update the NetBoot set so that it has all the proper updated components and bug fixes inside. It is a good idea, however, to build a new NetBoot set (often accomplished in less than 10 minutes). This will ensure the latest drivers, scripts and fixes are included in the NetBoot image. Simply run the DeployStudio Assistant again to build a new NetBoot set. Be sure to delete any existing NetBoot sets located in /Library/NetBoot/NetBootSP0 on the server if desired. Note: When using older DeployStudio Assistant NetBoot sets, the
components may not be able to be updated. NetBoot sets as of rc124 should be able to be updated with any new installs of DeployStudio.

**Note:** DeployStudio supports the ability to NetBoot and deploy multiple OS versions, not limited to 10.6.x clients or servers. Administrators may use a 10.6.x Server to host 10.4.x, 10.5.x and/or 10.6.x NetBoot images. Similarly, DeployStudio can deploy 10.4.x, 10.5.x and 10.6.x master images from a 10.6.x Server to a system that supports that OS. Don’t confuse this with the fact that, as of 1.0rc121, DeployStudio only runs on a 10.5.x or a 10.6.x Server.

1. Welcome - select “Create a DeployStudio NetBoot set.” Click Continue.

![DeployStudio Assistant Welcome Screen](image1.png)

2. Service Information - **Note:** Mac OS X Leopard client 10.5.x was the only release of Mac OS X that was a Universal Binary. A Universal Binary is a version of the operating system that will boot both PowerPC and Intel-based systems from a single OS. Click Continue. **Note:** 10.6.x will only boot Intel-based Mac systems.

![DeployStudio Assistant Service Information Screen](image2.png)
3. General Settings - be sure to create a name for the NetBoot set that will help you recognize when it was created for future reference. Note: If you have multiple NetBoot sets, make sure you are not using the same “Unique identifier” for more than one image. You can verify the numbers currently in use by accessing Server Admin -> NetBoot -> Settings -> Images, unless you have no images built yet. **WARNING:** If DeployStudio is set up to automate the erasure and deployment of the OS, this could potentially erase unsuspecting users systems as well. NetBoot images will appear on client systems in System Preferences > Startup Disk. Including a name that warns users not to choose this startup disk is also recommended. Click Continue.

4. Service Discovery - choose Connect to a specific server and enter the secure server address. For example, https://snowleopard.example.com:60443. Be sure to add the “https” and the port “60443,” if not already entered. Note: The Alternative server could be the DeployStudio replica. Click Continue.
5. Authentication - specify the default log in user (i.e., dsadmin) and the correct password. **WARNING:** Setting a Default login can allow other users to boot their system from this NetBoot set and reimage their computers to the configured default image. This may have license implications for the software included in the master image. If you don’t wish to automate the process, do not include default login information. This will require that every NetBooted system be touched by an administrator entering a user name and password. An alternative security measure could be to disable NetBoot when deployments are not occurring. You can use the same or different password for the VNC password. The purpose of VNC is so that you can remotely monitor the status of a client system, while the client is NetBooted, running the DeployStudio Runtime. **Note:** Administrators may choose to not use VNC for security reasons. Typically, choosing the “Display Runtime log window by default” is a good troubleshooting technique. The “Quit Runtime automatically after 30 seconds of inactivity” should be chosen for the purpose of assisting with automating the deployment process. Click Continue.
6. Options - certain applications require Python (i.e., Microsoft Office 2008) or Ruby to run their installers. When using a package deployment workflow, one or both of these tools may be required. Simply check them to add them to the NetBoot image. If you’re experiencing slow network throughput when deploying the images, it may also be helpful to enable Custom TCP stack settings. Simply build a new NetBoot image with that item checked. In most cases wireless, is not necessary on the NetBoot image.

7. Destination - if you are running this from the server, leave the default path /Library/NetBoot/NetBootSP0. Note: The default location for NetBoot images is this location; the “0” on the end is a zero, NOT a capital “O” (oh). If the NetBootSP0 directory doesn’t exist yet, it will automatically be created. Click Continue.

8. Authenticate using the local Administrator user name and password. Click OK.
9. The NetBoot creation process will take several minutes. In the meantime, you will see a pinwheel informing you it’s working.

10. DeployStudio NetBoot set created! Click OK.

11. When the process is complete, the NetBoot service must be enabled in Server Admin to take advantage of the new NetBoot image.
   a. Launch Server Admin and authenticate, if necessary.
   b. Select NetBoot.
   c. Choose Settings -> General.
   d. Check Ethernet.
   e. Choose the Images and Client Data locations (depending on how many systems you will be imaging at a time, make sure you have plenty of free hard drive space on the volume you choose. Often this is a minimum of 2GB per system NetBooting.)
   f. Select Save. Note: Be sure to Save this step, otherwise the image will not appear in the next step.
g. Choose the Images tab - verify the image you created is visible and choose Default.
h. Select Save.

i. Select Start NetBoot.
Chapter 6 - Mac OS X Master Image Creation

Creating the master Mac and Windows images is probably the most important step(s) that require the most preparation and customization. Because you will be deploying these images to multiple systems, it is important that everything is set up correctly and/or can easily be changed after the fact. Customization can be as simple as creating an updated OS and software installations for deployment. It can also be as complex as customizing the image to authenticate to directory services, include multiple users and a customized user environment, replacing items, hiding users, etc., etc. There are a few things that are very important. Several of those steps are covered in this section.

1. Make sure that all Macintosh hardware firmware and SMC is up to date. This process can not be completely automated due to the requirement of holding down the power button on each machine to activate the firmware or SMC updates. [http://support.apple.com/kb/HT1237](http://support.apple.com/kb/HT1237)

2. Install Mac OS X (unless you are installing from a machine just out of the box, in which case you may want to use that default OS, as described earlier). **Note:** Depending on the system you are creating, your master image from it may have software included that is only offered, and therefore licensed, for that particular model. Make sure you have a license for all software you are deploying.
   a. Install all updates to the OS and any installed software.
   b. Enable Apple Remote Desktop, if desired.
   c. Create any users (i.e., an admin account for remote administration and an Apple Remote Desktop user account).
   d. Install and run all software once to verify serial numbers and build font lists.
   e. Run Disk Utility -> Repair Permissions.
   g. The following applications may be useful, depending on the type of deployment:
      i. [Flip4Mac](http://www.flip4mac.com) - allows users to play Windows Media Files
      ii. [Apple Remote Desktop](http://support.apple.com/kb/HT1229) - update to the current client version
      iii. [Boot Picker](http://www.bootpicker.com) - install the latest version
      iv. [Deep Freeze](http://www.deepfreeze.com) - obtain a license, install and configure. **Note:** Deep Freeze systems must be deployed thawed and can be set up from Apple Remote Desktop.
      v. Any Virus software deployed in the off setting
   h. Enabling and disabling various functions may also be helpful or necessary:
      i. Disable the Apple Remote functionality to avoid intentional or inadvertent IR signals effecting the systems - System Preferences -> General -> check. Disable remote control infrared receiver.
iii. If you bound the system for testing Active Directory or Open Directory testing, you must unbind the system prior to creating the image. DeployStudio includes Workflow Tasks for rebinding the systems to both Active Directory and/or Open Directory.

There are several additional Mac OS X customization options you may want to take advantage of. A short list of additional items are covered in Appendix C - Mac OS X Customization Options.

**Note:** DeployStudio manages the creation of the Local Kerberos Distribution Center (LKDC) on first boot. As of Mac OS X Leopard (including Snow Leopard clients), every Mac is now running a LKDC. The LKDC is used for features like Back to my Mac for security and authentication. Using tools other than DeployStudio to build and deploy images may sidestep the removal and recreation of the LKDC. In a scenario where DeployStudio is not used, each imaged machine is using the same security certificate and hash. Deploying a single image will deploy the same LKDC to every system. This can cause problems later when binding to Active Directory and/or Open Directory. It is for this reason that images should be built and deployed using DeployStudio Workflows. Disk Utility is one example of a tool that will not properly build an image to successfully manage the LKDC deletion and re-creation.
Chapter 7 - Windows Image Creation

Creating the Windows XP or Windows 7 master image partition using a DeployStudio Admin Workflow is straightforward but has a couple limitations. Note: DeployStudio is reliant on Apple Software Restore (ASR), which can only broadcast or multicast Mac based .dmg images. NTFS images created using DeployStudio may not be broadcast. Note: DeployStudio can create a compressed Windows image in the Image Task Workflow by selecting the “Try to shrink the size of NTFS volumes before imaging.” Similarly, “Expand restored NTFS volume” is an option in the Restore task Workflow item. The method for creating a master Windows XP partition compared with a Windows 7 master image in regards to SysPrep is different. This chapter will address each separately.

Windows XP Master Image Creation

If you are deploying Windows 7, see the note at the end of this section.

1. Install Windows XP (Service Pack 3 Home or Professional is required).
   a. Run the Boot Camp Assistant (located in Applications/Utilities) and partition the drive to the desired size for deployment. Then start the Windows XP installation process.
   b. Format the BOOTCAMP partition as NTFS (not FAT32) and install Windows XP SP3.
   c. Install the Boot Camp Drivers for Windows, which is included with the 10.6 Snow Leopard DVDs that shipped with the system or on the Mac OS X 10.6 Snow Leopard install DVD. If necessary, download the latest Boot Camp drivers that may be newer than the version included on the install disk. (As of this writing, the latest version for Snow Leopard systems is version 3.1. Leopard systems is 2.2.) Note: The Boot Camp drivers license is included with the host Mac OS. Note: There are several other drivers, some for specific systems and others for various Apple peripherals. Make sure the system is running the latest Apple Windows driver components for all hardware and connected peripherals. IMPORTANT: When the Boot Camp Drivers for Windows are installed they install only the components for that particular system including video drivers, bluetooth drivers, ethernet and wireless drivers, keyboard, trackpad and mouse drivers, etc. When trying to use the same Windows XP, Windows Vista or Windows 7 image on another non-similar system, certain video anomalies, keyboard issues or networking problems may occur. Often, simply installing the Boot Camp Drivers on that new system will resolve the issue.
   d. Install all relevant Windows updates from Microsoft. Note: Boot Camp 2.1 or later on Leopard systems is required for SP3 and is recommended before any other updates.
   e. Install any software including licenses.
f. To rename the Windows volume name, go to My Computer, right-click on drive “C:” (BOOTCAMP), choose rename and rename the volume.

g. Set the boot volume to Mac OS X by going to Control Panel -> Boot Camp -> Startup Disk and selecting Macintosh HD. Then click OK.

h. Run SysPrep and Reseal the OS for mass deployment. Microsoft offers detailed instructions on using SysPrep and Setupmgr here:

http://support.microsoft.com/default.aspx?scid=kb;en-us;302577

The most common steps are as follows:

i. Insert your Windows XP Service Pack 2 or 3 CD/DVD.

ii. Open My Computer, Right-click Local Disk (C:) and choose Explore. Go to File -> New Folder and create a new folder named “Sysprep” (without the quotes) at the root level of the C: volume.

iii. Open a new window and Right-click your Windows XP SP3 CD and choose Explore. Navigate to SUPPORT -> TOOLS -> DEPLOY.CAB and copy setupcl.exe, setupmgr.exe and sysprep.exe to the “Sysprep” folder you created in step ii. When using multiple languages, the i386 directory must also be copied over. Note: This is a ~550MB file.

iv. Eject your Windows XP SP3 CD (right-click and choose Eject).

v. Open the Sysprep folder (C:) -> Sysprep and launch setupmgr.exe.

vi. Step through the setup assistant clicking Next after each setting. Some of your specific settings may vary.

1) Choose Create New.

2) Choose Sysprep setup.

3) Choose the version of Windows XP SP3 (either Home or Professional).

4) Choose Yes, fully automate the installation.

5) Type Name and Organization.

6) Choose Color schemes or leave as default(s).

7) Select Time zone.

8) Enter your site license product key.

9) Select Automatically generate... or Use the following...

10) Choose Use the following Administrator password and Encrypt Administrator password in the answer file.

11) Choose the appropriate Network Components based on your environment.

12) Select your Workgroup or Domain based on your environment.

13) Enter the appropriate Telephony info, if desired.

14) Set the appropriate Regional Settings.

15) Select the Language(s) Note: You must include the i386 directory mentioned in step ii.

16) Install Printers, if desired.
17) Run any commands once at startup.
18) Run any additional commands.
19) Add an ID string, if appropriate.
20) Select Finish.
21) Save sysprep.inf to the default location (C:\Sysprep\sysprep.inf) and click Ok.
22) Close the Setup Manager window.
23) Run Sysprep.exe.
24) Select OK.
25) Select Use Mini-Setup.
26) Select Reseal.
27) Click OK.

Windows 7 Master Image Creation

1. Install Windows 7.
   a. Run the Boot Camp Assistant (located in Applications/Utilities) and partition the drive to the desired size for deployment. Then start the Windows 7 installation process from the Windows 7 DVD.
   b. Format the BOOTCAMP partition as NTFS and install Windows 7.
   c. Install the Boot Camp Drivers for Windows (version 3.1 or later), which is either included with the 10.6 Snow Leopard DVDs that shipped with the system or on the Mac OS X 10.6 Snow Leopard install DVD. Early versions of Snow Leopard included Boot Camp Drivers for Windows version 3.0.x. Version 3.1 is the first version to provide support for Windows 7. Simply download the 3.1 update(s) relevant to the hardware Windows 7 is being installed on. Note: The Boot Camp drivers license is included with the host Mac OS. Note: There are several other drivers, some for specific systems and others for various Apple peripherals. Make sure the system is running the latest Apple Windows driver components for all hardware and connected peripherals. As of this writing version 3.2 is the latest version.
   IMPORTANT: When the Boot Camp Drivers for Windows are installed, they install only the components for that particular system including video drivers, bluetooth drivers, ethernet and wireless drivers, keyboard, trackpad and mouse drivers, etc. When trying to use the same Windows XP, Windows Vista or Windows 7 image on another non-similar system, certain video anomalies, keyboard issues or networking problems can occur. Often, simply installing the Boot Camp Drivers on that new system will resolve the issue.
   d. Install all relevant Windows 7 updates from Microsoft.
   e. Install any software and include relevant licenses.
   f. To rename the Windows partition name, go to Computer, right-click on drive “C:” (BOOTCAMP), choose rename and rename the volume.
Configure Windows System Image Manager, a component of Windows Automated Install Kit (WAIK), and Sysprep to customize the Windows image. Refer to these articles for more information and to download WAIK:

- [http://www.trainsignaltraining.com/waik-windows-automated-installation-kit](http://www.trainsignaltraining.com/waik-windows-automated-installation-kit)
Chapter 8 - DeployStudio Admin - COMPUTERS

While setting up default computers may be helpful, it is an optional step. The Computers section of DeployStudio offers powerful features for automating the following tasks:

1. Incremental local hostname and computer name information
2. Licenses for Xsan or Mac OS X Server (primarily for server cluster deployments)
3. Network settings including:
   a. network location
   b. static IP addresses
   c. router configurations
   d. DNS servers
   e. search domains
   f. proxies
4. Adding additional user accounts including admin and non-admin users
5. Automating the process for all new computers

A step by step process and explanation for setting up the various COMPUTERS tasks is simple yet, at first, not obvious.

1. Start by launching DeployStudio Admin. If the “Server address:” is listed as “https://127.0.0.1:60443/” change it to “https://snowleopard.example.com:60443/” and authenticate using the “dsadmin” user created earlier.

2. Select COMPUTERS, then turn the triangle next to COMPUTERS.
3. Choose the “+” button in the lower left corner of the window. Note: there are 2 “+” buttons, be sure to choose the far left button.
4. Notice you now have a subcategory under COMPUTERS named “Group 0” - double-click on it to rename it (i.e., “Default” or “Lab Room 101,” etc.)

5. General - provide the Local hostname and choose the range depending on the number of systems being deployed, then select the Start index at:. Provide a Computer name: if desired. When deploying Boot Camp images, you can add a Windows computer name for Windows and determine what computer group(s) the Mac client is associated with in Workgroup Manager.
6. Licenses - the Mac OS X Server and Xsan (version 1 only) License keys are intended for server cluster environments utilizing one or both of these site licenses to deploy to other servers. Unless you are managing a server farm, most likely you are not using Volume License keys for your servers.

7. Network - it is possible to create additional network locations on the clients, set up static IP addresses and/or configure Proxy servers, although with DHCP this shouldn't be necessary. This step is primarily designed for a computer by computer set up, as opposed to applying this setting for all computers. The default AirPort network is an option and may be helpful.
8. Accounts - creating additional user accounts is simple with this step. It offers the ability to make the users administrators or non-administrators and to hide them from other users on the system. If you did not build users into your image, this is a helpful post image creation step.

9. Automation - default group setting is required to have all systems startup and image themselves given the workflow. This can easily be changed to the workflow desired for the default deployment. It’s important to check “Reset default workflow after a successful execution” so that inadvertent system re-images don’t happen. You may also wish to disable the computer where each individual computer must be re-enabled in the DeployStudio Admin to run the next time. Otherwise they will not automatically run a Workflow sequence.

10. Choose Save to save the settings.
Chapter 9 - DeployStudio Admin - WORKFLOWS

Managing and editing workflows are what is behind the real power of DeployStudio. Workflows can be managed for creating system images for both Mac and Windows partitions, deploying single, dual or triple boot systems, installing packages and/or scripts and more. Each workflow item can be set to full automation for minimal client interaction or can require user interaction for further customization and options. This section will cover the various options for creating custom workflows.

**IMPORTANT:** DeployStudio, NetBoot and the various workflows can, and in many cases are intended to, erase all data on remote systems. Until you fully understand each workflow item, it is important to use non-production systems with a known good backup.

The workflow tasks for creating sequenced workflows includes:

**Computer database update tasks**

- **Hostname** - allows the hostname to be set manually for each individual computer when the workflow is run. This can also be set by the default value found in the COMPUTERS list relevant to the computers MAC address in DeployStudio Admin.
- **New user** - a new user can be created manually when the workflow is run. This can also be set by the default value found in the COMPUTERS list relevant to the computers MAC address in DeployStudio Admin.
- **Network locations** - create additional network locations manually when the workflow is run. This can also be set by the default value found in the COMPUTERS list relevant to the computers MAC address in DeployStudio Admin.
- **License keys form** - input a site license number for either Mac OS X Server or Xsan. This feature only works for either of these licenses and is intended for license keys in cluster deployments. This can also be set by the default value found in the COMPUTERS list relevant to the computers MAC address in DeployStudio Admin.

**General Tasks**

- **Run a script** - from the scripts list within DeployStudio admin, you can specify a script to run before or after the image is deployed or during the systems first start up after the deployment is complete. This can be configured to provide an error message in the logs and specific parameters can be set. Scripts can only be applied to Mac OS X partitions.
- **Partition a disk** - partition a disk in to single, dual or triple boot partitions and is pre-configured with various options or can be custom configured. The size and partitioning scheme can be modified so that it is customized for the specific desired partition mappings.
- **Install a package** - various packages can be installed as a standalone deployment or as a pre or post install of Mac OS X. Packages work only with
Mac OS X partitions. Packages can be utilized by placing them in the DeployStudio/Packages directory or by manually dragging and dropping packages in to the Install a package workflow.

**Copy a file or folder** - any file can be copied with a variety of settings after a deployment. This could include new installers later prompted by a script or simply files set to a particular path on the drive. A full path could even be created if it does not exist. User names are limited, however.

**Shutdown** - by default when the workflow is done, a system will restart. If a shutdown is desired using this workflow task will force the system to shutdown after a deployment is completed. *Note:* This is dependent upon the utilization of “Quit Runtime automatically after <set time> seconds of inactivity”, which is created in the DeployStudio Assistant -> Create a DeployStudio NetBoot set.

### Imaging tasks

- **Image a volume** - this is for creating manual or automated workflows for the master image creation. This step creates a Mac OS X .dmg if a Mac volume is specified, or a NTFS volume if a Windows volume is specified. Each image created using the “Image a volume step” will be added to the Masters list automatically after it is built.

- **Restore a disk image** - will restore the various disk images as chosen from the Masters list in DeployStudio Admin. Several post restore actions may be configured for each Mac or Windows deployed image.

### Post-restoration tasks

- **Active Directory binding** - allows binding to Active Directory of the Mac OS X partition. It is required that the bind process happen after deployment and this step accomplishes that. Several Directory Utility parameters may be configured in this step.

- **Open Directory binding** - allows anonymous or trusted binding to Open Directory servers. This is also required for each individual system.

- **Time setup** - allows configuration of the Network Time Protocol (NTP) server. *Note:* This is important for Active Directory or Open Directory where the time must be within 5 minutes of the directory server, adjusted for the time zone.

- **Apple Software Update** - allows configuration of the Mac OS X Server Software Update Server (SUS) feature. Clients may be pointed to a unique SUS and prompted to check for updates on first boot. The SUS feature allows administrators to enable only the updates they have tested for compatibility and to avoid additional unique traffic between each client system and Apple’s software update servers. Updating to a local SUS hosted on a local network can limit bandwidth as well.

- **Reconfigure system with computers database content** - this step is used if all systems will be configured the same based on a particular COMPUTER group in DeployStudio Admin. This step only applies to Mac OS X installed systems. The database can rename the computer, set up computer information, including localhost name and computer name, configure network settings and more.
location(s), set software licenses (Mac OS X Server and Xsan only), create local users, run the setup assistant on first boot and enable the Apple Remote Desktop (ARD) agent. One or any of these configurations can be set. For Windows systems, use Sysprep for Windows XP clients and WAIK for Windows Vista or Windows 7 to customize these items.

**Periodic NetBoot setup** - this step can be utilized for several functions including set interval for running scripts, installing packages, reinstalling the OS or simply NetBooting the client on a regular basis to check for any of the above. Options include daily, weekly or monthly booting the systems, at a specified time, after optionally forcing the system to reboot to a NetBoot volume. This setting similarly can be set to a specific NetBoot server perhaps on another subnet. If the client is in a state where documents are unsaved the system can force a reboot to run the NetBoot process at the specified time.

**Security tasks**

**Firmware password** - the firmware password may be set on deployment for all systems for blocking malicious users from accessing various startup capabilities. Setting the firmware password is recommended on all open access computers.

**Meta tasks**

**Workflow** - the workflow task allows the use of other workflows within a workflow. Multiple workflows may be added to a workflow to simplify the use, repetition and creation of workflows.

Four sample workflows are included in the DeployStudio Admin including: Create a master from a volume, Install a package (pkg), Restore a master on a volume and Triple-OS restoration. Workflows can be customized in a variety of ways. This next section will cover more common workflow steps. It is broken down into master image creation and dual boot deployment and Mac OS X customization using NetBoot and DeployStudio.

DeployStudio Admin can be accessed by editing the database on the server itself or by running the workflows from a client system that has been authenticated to the DeployStudio Server. For this exercise, we will leave the default sample workflows intact and create new workflows for each step.

**Dual Boot Master Image Creation Workflow**

This step will focus on creating a Mac OS X master image and a Windows 7, both configured on the same client Mac to generate master images using an automated workflow.

1. Launch DeployStudio Admin.
2. Select WORKFLOWS.
3. Click the “+” button at the bottom of the window.
4. Select the newly created Workflow under Title.
5. Double click the newly created workflow and rename it “Create Master Images”. Notice you can also double click the Description column and add a description for the workflow. This will come in handy the more workflows you create. **Note:** The workflow will jump to an alphabetical spot in the list after you have renamed it. Be sure to select the workflow you just created before continuing.

6. Next to where it says “Drop tasks here”, select the “+” button.
A side window will appear with all the workflow items described previously for the various workflow tasks.
In this sample, the system used for creating the master images has a volume partition named “Macintosh HD” containing the Mac OS X system created earlier in this guide. It also has a partition named “BOOTCAMP,” which contains Windows 7, as created earlier in this guide. **IMPORTANT**: If the volumes do not mimic these names, they must be modified for their respective volumes in the instructions below.

7. Drag the “Image a volume” workflow object to the “Drop tasks here” location.
   a. Enter “Macintosh HD” as the source. **Note**: It is not required to enter /Volumes/Macintosh\ HD/ if the partition name has a space in it. Choosing the drop down menu will only see volumes on the local system. It cannot see remote drives.
   b. Choose the type. If you’re not using multicast (only supported on some networks as discussed in a later chapter), choose “Compressed - preserves storage capacity.” **Note**: Compressed may shrink the image by as much as 50% and will speed up the restore process. Compressed images take longer to create, however.
   c. Leave the Format set to “Auto-detect”.
   d. Enter any keywords you want. Keywords will appear in the DeployStudio Admin interface and may be helpful for understanding the version of the image. If nothing is entered version information will be included in the Keywords: field.
   e. Check “Cleanup Mac OS X machine dependent files and caches”.
   f. Uncheck “Try to shrink the size of NTFS volumes before imaging,” if desired. This will not effect a Mac image if it remains checked.
   g. Check automate if you wish this process to be automated. If automate is unchecked it will require manual interaction with the client once it is NetBooted.
8. Drag the “Image a Volume” workflow object on top of the Image task icon already in the Window.

   Note: Adding workflow objects can be tricky when dragging them to the workflow. Often you will need to move a workflow object either before or after another object. Simply drag that object to the right or left side of the object it needs to be before or after.

a. Enter “BOOTCAMP” as the source (if your Windows volume on the master system is named “BOOTCAMP”). It’s also possible the Windows volume is named something entirely different.
b. Select “Compressed - preserves storage capacity” as the Type. Note: NTFS or other non-Apple formatted partitions cannot be multicast using Apple Software Restore, which is used by DeployStudio to deploy the images. This will be discussed further in the Multicast chapter.
c. Leave the Format set to “Auto-detect”.
d. Enter any desired keywords as a reference. Keywords will appear in the DeployStudio Admin interface. If nothing is entered, version information will be included in the Keywords: field.
e. Leaving “Cleanup Mac OS X machine dependent files and caches” checked will not effect the Windows image.
f. Leave “Try to shrink the size of NTFS volumes before imaging” checked.
g. Check “Automate”.

h. Choose Save to save the workflow.
Test the Create Master Images Workflow

1. Assuming this system has never been started using NetBoot and DeployStudio Admin (see below if it has), select the Default group under COMPUTERS, which was created in the previous chapter.
   a. Choose the Automation tab at the bottom of the screen.
   b. Make sure “Default group” is still checked.
   c. Select “Create Master Images” from the “Start automatically workflow” drop down menu.
   d. Check “Reset default workflow after a successful execution”, if desired.
   e. Check “Disable computer after a successful execution”, if desired.

Note: “Reset default workflow after a successful execution” and “Disable computer after a successful execution” are options to avoid inadvertently re-imaging systems. Choosing none, one or both of these is up to each specific environment and desired operation determined by the administrator.

g. Select Save to save the settings.
If the system has been NetBooted and successfully connected to the DeployStudio Server previously and is listed as a computer in the DeployStudio repository, you can do one of two things:

1. Select it in the Default group under COMPUTERS. Then select the computer from the list and hit the “-” button to delete the computer from the list. It will reappear the next time it NetBoots.

2. Uncheck “Default group” under COMPUTERS -> Default -> Automation. Then choose COMPUTERS, select the master computer from the list, choose Automation and then choose “Start automatically workflow:” “Create Master Images”. Leave both “Reset default workflow after successful execution” and “Disable computer after successful execution” checked, if desired.

To complete the test, start up the test system holding down the “N” key. The workflow should start and complete automatically, as long as Automation was chosen for every step of the workflow and other parameters were set correctly.
Note: DeployStudio will complete the creation of both the Mac partition and the Windows partition and then reboot the system. Compressing the images will add significantly more time to the image creation process, but will speed up the deployment process later. Creating compressed images may take several hours or even days for extremely large images. Deploying systems with both Final Cut Studio and Logic Studio will result in images larger than 120GB and therefore take a long time to complete when compressing them. Utilizing faster hardware for the master image creation systems will accelerate this process.

Dual Boot Restoration and Customization Workflow

This step will concentrate on deploying a dual boot system with the Mac OS X image and Windows image created using the previous workflow. It will include a description of many of the relevant workflow objects including: partition the disk, restore images, bind to Active Directory, bind to Open Directory, install packages, run scripts, reconfigure the system, set the firmware password and shutdown the system when finished. The many steps to create this workflow are as follows:

1. Launch DeployStudio Admin.
2. Select WORKFLOWS.
3. Click the “+” button at the bottom of the window.
4. Double click the newly created workflow and rename it “Dual Boot Restoration and Customization”.
5. Next to where it says “Drop tasks here”, select the “+” button.
Please select a step to edit.
6. Before imaging a volume it must be partitioned. There are a number of partition options, some of which are important to understand with multi-boot deployments. Drag the “Partition a disk” icon to the “Drop tasks here” location and customize the settings as follows:

a. Specify the “Target disk:” volume name (i.e., “Macintosh HD”). Note: “Partition the first disk available” may be chosen but this could be problematic on Mac Pros with multiple internal drives or external USB or FireWire drives connected to the system. The first drive available is the drive that spins up the fastest. Note: Choosing the available drives from the drop down “Target disk:” menu will only show drives visible to the running DeployStudio Admin system and may not reflect the drives that will be deployed to, when an actual deployment occurs.

b. From the “Apply layout template” drop down, choose “Mac OS X + Windows” Note: When adding more than three partitions, because of the BIOS EFI plug-in used on Mac hardware, the Windows partition must always be the last partition created. It is important to note that Macs use a hidden EFI partition, which will be visible using the “diskutil list” command in Terminal. In an example where the machine will be set up using a Mac partition, a FAT32 partition and a Windows partition, the Windows partition will technically be the fourth partition.

In an example where Linux, Mac OS X, Windows and a shared partition are deployed, DeployStudio recognizes the first EFI partition and properly places Windows as the third partition when partitioning the drive.

Mac OS X will be the fourth (technically fifth) partition, as DeployStudio does not actually display the EFI partition in the list.

c. Rename the volumes accordingly (i.e., Macintosh HD and BOOTCAMP). To do this, mouse over the partition name and click the pencil icon (✏️) in the upper right corner. To complete the partition rename click the check mark icon (✔️), which now appears after clicking on the pencil icon. Note: These partitions will be renamed when the image is deployed, based on the name of the master image (s). The name will be important and used in the next step where the “Restore a disk image” task must have the correct name of the partition to restore to.
d. Adjust the size of the partitions by adjusting the slider bar(s) to the desired partition size or click the pencil icon (when mousing over the partition). Then set the percentage accordingly. Linux partitions must be set to a GB value manually.

e. Leave “Write random data to the disk before partitioning (takes lot of time)” unchecked. Use this function only if you need the existing data on the drive to be overwritten in a secure manner. This process could take several hours depending on the size of the drive and speed of the machine.

f. Check Automate.

**IMPORTANT:** As noted earlier in the Windows Master Image Creation section, you must set the correct size for the MS-DOS/NTFS partition based on the size of the partition that the original Windows XP image was created on. This is unless you select “Try to shrink NTFS volume’s size before imaging” during the master image creation process for the Windows partition. If this is unchecked, the Windows partition can be the same size or larger. Any space larger than the original partition will be lost, unallocated space on the drive. If the same size or larger is not chosen, the deployment will **FAIL**. Simply making sure to select that option during the creation process should help avoid this issue.

7. Restoring a Mac image is straightforward but does offer a number of useful options. Drag the “Restore a disk image” to the right of the “Partition task” and customize the settings as follows:

a. Specify the “Target volume:” as “Macintosh HD” or whatever name the partition was given in the Partition task step.

b. Choose “HFS” from the “Image:” drop down menu.
c. From the drop down, select the Mac .dmg created by the previous Dual Boot Master Image Creation Workflow exercise.
d. Uncheck “Restore image on the first drive available”.
e. Leave “Rename volume to:” blank unless another name is required.
f. Check “Don’t check restoration (faster)”.
g. Check “Erase target for block copy restoration (faster)”.
h. Check “Rename ByHost prefs”.
i. Check “Cleanup machine dependent files and caches”.
j. Uncheck “Enable multicast restoration”.
k. Uncheck “Expand restored NTFS volume”.
l. Check “Set as default startup volume”.
m. Check “Automate”.
8. Deploying a second Restore task for the Windows image is similar to deploying the Mac image, albeit with a few settings differences. Drag the “Restore a disk image” again to the right of the “Restore task” and customize the settings as follows:
   a. Specify the “Target volume:” as “BOOTCAMP” or whatever name the partition was given in the Partition task step.
   b. Choose “NTFS” from the “Image:” drop down menu.
   c. From the drop down, select the Windows ntfs.gz created by the previous Dual Boot Master Image Creation Workflow exercise.
   d. Leave “Rename volume to:” blank unless another name is required.
   e. Check “Don’t check restoration (faster)”.
   f. Check “Erase target for block copy restoration (faster)”.
   g. Uncheck “Rename ByHost prefs”. Note: This setting is irrelevant to Windows images, but will not effect the deployed image if checked.
   h. Uncheck “Cleanup machine dependent files and caches”. Note: This setting is irrelevant to Windows images, but will not effect the deployed image if checked.
   i. Uncheck “Enable multicast restoration”. Note: Multicast deployments are not possible for Windows images.
   j. Check “Expand restored NTFS volume”. IMPORTANT: Be sure to check this option so the Windows image will utilize the full Windows partition. Unchecking this option can result in unusable space on the Windows partition.
   k. Uncheck “Set as default startup volume”. IMPORTANT: When using Windows Automated Install Kit (WAIK) discussed in a previous chapter, Windows will need to run multiple reboots in order to complete the specified tasks. Mac OS X has several tasks to run at start up, as well to finalize the deployment of the image. Note: Whichever volume is “Set as the default startup volume” last in the Workflow will be the default start up volume.
I. Check “Automate”.

9. Active Directory binding will be site specific and is obviously not required. **Note:** Several of the options described in this section are very environment specific and will vary depending on the Active Directory server configuration and the specific settings for most of the tasks below. Setting up Active Directory is beyond the scope of this guide. **Note:** Active Directory binding occurs on the first boot up of Mac OS X after the client image(s) are deployed. If Active Directory binding is desired, drag the “Active Directory binding” task to the right of the second “Restore task” and customize the settings according to your Active Directory environment. Below are some sample settings:

a. Specify the “Target volume:” by typing “Macintosh HD”.
b. Uncheck “Bind the last restored volume”.
c. If COMPUTERS in DeployStudio Admin is set up with the computer names for each computer, DeployStudio can use those settings for the “Computer ID:” to bind to the Active Directory Computers object when each machine is bound. Alternately, the computers “Host name” or a script may be run to determine the binding name for the “Computer ID:” in Active Directory for each client system. Select the desired setting from the “Computer ID” drop down menu.
d. Specify the Active Directory “Domain:” DNS name in your environment. This is required.
e. Values are separated by a “,” but no space is necessary. The information used to determine these values will depend on the environment and the container in Active Directory where computer records are to be written.
f. Enter the “Active Directory computers’ administrator login:” Active Directory administrator with write privileges to the computers object(s) field(s).
g. Enter the Active Directory administrator “Password”.

h. Set the “Security:” for “sign packets”. If you’re not certain of the setting, set it to “Allow”. Set the “encrypt packets” setting. If you’re not certain of the setting, set it to “Allow”. Finally, set the “password change interval days”. Note: Many environments need to be set to 0 days. The Mac OS X and Active Directory defaults are 14 days. Note: When using Deep Freeze, 0 is recommended.

i. If desired, check “Enable mobile accounts” and “Require user confirmation”.

j. If desired, check “Force local home directories”.

k. If desired, check “Use UNC path from Active Directory with network protocol:” and set the protocol to either CIFS: or AFP: depending on the server(s) capability.

l. If desired, check and set the “Authenticate to domain:” for the specific domain or OU.

m. If desired, “Allow administration by” any Active Directory administrators allowing them administrator privileges to Mac OS X. Note: Be sure you know who is in the Active Directory Administrator group(s) before setting this to any group.

n. If desired, set the “UID attribute:” and/or the “GID attribute:”. Note: In most cases, simply letting the Active Directory plug-in set the UID and GID is the desired method.

o. Check “Automate”.

![DeployStudio Admin connected to snowleap.example.com](image)
10. Open Directory binding will be site specific as well, and is obviously not required. **Note:** Several of the options described in this section are very environment specific and will vary depending on the Open Directory server configuration and the specific settings for most of the tasks below. Setting up Open Directory beyond simple settings for deployment(s) is beyond the scope of this guide. **Note:** Open Directory binding occurs on the first boot up of Mac OS X after the client image(s) are deployed. If Open Directory binding is desired, drag the “Open Directory binding to the right of the “Active Directory binding task” (if used) and customize the settings according to your Open Directory set up in your environment. Below are some sample settings:

a. Specify the target by typing “Macintosh HD”.
b. Uncheck “Bind the last restored volume”.
c. Specify the Open Directory “Server:” fully qualified DNS name.
d. If desired, “Enable trusted binding” and choose the preferred “Computer ID:” from the drop down list. Alternately, the computers “Host name” or a script may be run to determine the binding name for the “Computer ID:” in Active Directory for each client system. Select the desired setting from the “Computer ID” drop down menu. **Note:** Computer names be unique for each system. This may be configured for each system in the COMPUTERS list in DeployStudio Admin.

**IMPORTANT:** If more than 100 Mac clients will be connecting to an Open Directory server, DO NOT bind the clients. Open Directory will be bogged down if more than 100 clients are bound to the server. This is not to say that Open Directory cannot be used, simply that binding is not the recommended method. In a given 100+ Mac client environment, specify the Open Directory server and avoid “Enable trusted binding”.

e. If desired, “Apply the computer’s Client Management settings,” select the “Computer ID:,” enter the “Directory admin:” and supply the “Password:.”
f. Enter the Open Directory “Directory admin:” and “Password:” if binding is desired
g. If desired, check “Enable SSL” if this is set up properly on the server.
h. Check “Automate”.

11. The Reconfigure system with computers database content task is great for configuring the computer name, local hostname, Apple Remote Desktop client specific information, network settings information, local user(s) creation, setting software licenses (OS X Server and/or Xsan only) and running Apple Setup/Server Assistant. This task assumes specific information will be entered in COMPUTERS -> Default or for each individual computer in the COMPUTERS list, so that each computer will have unique information, if desired. Drag the “Reconfigure system with computers database content” task to the right of the “Open Directory task”:
   a. Specify the target by typing “Macintosh HD”.
   b. Uncheck “Configure last restored volume”.
   c. If desired, check “Rename computer”.
   d. Uncheck “Set software licenses”.
   e. If desired, check “Enable ARD agent” for Apple Remote Desktop (ARD).
   f. If desired, check “Set computer information”.
   g. If desired, check “Create local users”.
   h. Uncheck “Configure network,” unless desired.
   i. Check “Skip Apple Setup/Server Assistant” if desired. Note: When deploying systems to multiple users, this feature is useful. It will prompt users on first boot to step through the Mac OS X Setup assistant, as though the machine is fresh out of the box. They will be forced to create a unique administrator user name and password. This new user will be in addition to any admin users that already exist on the system. This typically is not used in a lab or kiosk environment.
j. Check “Automate”.
12. Installing packages (.pkg or .mpkg) as a post restore action can be useful for unique configuration setup, software update releases without the need to create a new image. Similarly, installing any of a variety of other software packages that use Apple’s package installer to install software can be helpful. If post install package installation is desired, follow these steps:
   a. A package (.pkg) or master package (.mpkg) must first be copied to the Packages directory inside the DeployStudio repository directory (i.e., Shared\Items/Public/DeployStudio/Packages/). It will then appear in DeployStudio Admin under PACKAGES.
   b. In DeployStudio Admin, switch to WORKFLOWS and choose the Dual Boot Restoration and Customization workflow. Click the “+” to the right of the tasks and drag the “Install a package” task to the right of “Configure task”.
   c. Specify the “Target volume:” by typing in “Macintosh HD”.
   d. Uncheck “Install on the last restored volume”.
   e. From the “Package:” drop down menu select the .pkg installer.
   f. If required by the installer, check “Postponed installation (packages will be installed on first boot)”.
   g. Check “Ignore install failures” as long as you have verified this installation can occur successfully.

**Note:** Some installers use pre or post install scripts that may cause installation errors but may not prevent the software from running after a reboot. Ignoring these errors could allow the installation to complete successfully.
h. Check “Automate”.

13. Pre and post scripts may be run to gather information used in other workflow tasks, change settings, back up data and restore data as needed and an almost infinite number of other tasks. Most command line tools are available while the system is NetBooted, however, some may need to be run after the system has restarted. If running a script is desired, follow these steps:
a. Scripts may be created in DeployStudio Admin by hand-writing them or copying the contents of the shell script into the interface. To do this, simply choose “SCRIPTS” in the DeployStudio Admin interface and click the “+” button. Alternately, administrators can place any desired shell scripts (.sh) in the Scripts directory inside the DeployStudio repository.

b. In DeployStudio Admin > WORKFLOWS, select the workflow “Dual Boot Restoration and Customization” and drag the “Run a script” task to the right of the “Install task”.

c. If desired, enter a “Description:”.

d. If desired, enter an “Error message:”. This is for troubleshooting script problems from log entries containing text entered here.

e. Select the desired script from the “Command” drop down menu.

f. Specify any “Parameters,” if needed.

g. To run the script at first boot, set “Postponed execution (command will be launched on first boot).” Set the “Target volume:” to the correct volume or specify “Install on the last restored volume”. Ignore failures if the script doesn’t complete successfully, as desired.
h. Check “Automate”.

14. Copying a file to just about anywhere on the restored system can be helpful as a post restore task. If “Copy a file or folder” to the system is desired, follow these steps:
   a. A file or folder must first exist in the DeployStudio repository in the file system. If the repository is in Public directory move any file(s) or folder(s) in to that directory (ie /Shared\ Items/Public/DeployStudio/Files).
   b. In DeployStudio Admin > WORKFLOWS select the workflow “Dual Boot Restoration and Customization” and drag “Copy a file or folder” to the right of the “Generic task” “Run a script” task.
   c. Set the “Target volume:” to the volume name you wish to have the file or folder on.
   d. Uncheck “Copy file to the last restored volume”.
   e. Select the file or folder from the “File:” drop down menu. Note: If the file or folder does not appear in the drop down, quit DeployStudio Admin and relaunch it.
   f. Specify the “Path:” the file or folder needs to reside in.
   g. Check “Create path if needed”.
   h. Set the “Owner:,” “Group:” and “Others:” access settings. Note: Only the root and primary administrative user (501) may have permissions to the files. A chown (change owner) command script may be needed if the file is to be used by any other users on the system.
15. Apple Software Update can be run to check for any available updates based on information from a Mac OS X Server Software Update Server (SUS) or by directly accessing Apple’s Software Update service. Note: As stated previously, any Firmware or SMC Firmware updates will download, but may not run without physical access and intervention with the system. To set up “Apple Software Update”, follow these steps:
   a. Drag the “Apple Software Update” task to the workflow.
   b. Specify the “Target volume:” to the name of the partition to be updated (i.e., “Macintosh HD”).
   c. If desired, set the “Software Update Server base URL:” to the site software update server URL.
   d. Check “Run Apple Software Update client at first boot”.

i. Check “Automate”.

![Image of DeployStudio interface showing workflow setup for Apple Software Update](image-url)
e. Check “Automate”.

16. Setting the time correctly will help a variety of tasks including binding the system to Active Directory, Open Directory or any other time dependent service. To set up “Time setup”, follow these steps:
   a. Drag the “Time setup” task to the workflow.
   b. Specify the “Target volume:” to the name of the Mac partition (i.e., “Macintosh HD”).
   c. Choose one of the Apple time servers from the drop down menu or enter a location specific time server.
   d. Set the “Time zone:” from the drop down menu.
e. Check “Automate”.

17. Setting the firmware password on open access Mac systems is recommended for several reasons - primarily for OS security. More information about this capability may be found by visiting http://support.apple.com/kb/HT1352. To set the “Firmware password”, follow these steps:
   a. Drag the “Firmware password” task to the workflow.
   b. Set “Firmware security:” to “Enable”.
   c. Enter the desired “Password:”. Note: On certain systems, the password must be numbers and letters - no characters.
d. Check “Automate”.

18. DeployStudio allows for a Meta task Workflow, where you can combine other workflows into a workflow. This may be useful if all you want to do is specify a workflow and add a script on the end, or install some additional software, without creating a complete workflow. This function only allows flat-workflows, meaning workflows that don’t have meta-workflows in them, to avoid loops. To add meta “Workflow”, drag the “Workflow” task to the right of the “Firmware Security Task” and follow this step:

a. Drag the “Workflow” task to the workflow.
b. Select the desired meta-workflow task from the “Embed workflow:” drop down.
19. Following a deployment, it may be desirable to shutdown the system as opposed to the default configuration, which is to reboot the system. Rebooting is actually preferred in most workflows. IMPORTANT: DeployStudio implements a number of tasks during the first boot of a system including:

- Create a unique local Kerberos Distribution Center (LKDC).
- Reset ByHost preferences if setting selected.
- Bind to Active Directory and/or Open Directory.
- Run Apple Software Update if workflow action is set.
- Install any post restore packages if “Postponed installation” is set.
- Run any scripts if workflow action is set to “Postponed execution.”

These actions will be run at first boot, possibly delaying access to the system while these post start-up tasks run. IMPORTANT: In order for both restart and shutdown to work, when the DeployStudio Assistant was used to “Create a DeployStudio NetBoot set”, “Quit Runtime automatically after <enter seconds value> seconds of inactivity” must have been chosen. Otherwise no restart or shutdown will be exercised. Note: The default setting is enabled at 30 seconds. To configure shutdown, as opposed to restart, follow these steps:

a. Drag the “Shutdown” task to the end of the workflow.
b. Check “Automate”.
20. Be sure to choose “Save” to save the workflow.

**IMPORTANT**: For the workflow to run completely automated, every step of the workflow must have “Automated” checked.

**Test the Dual Boot Restoration and Customization Workflow**

As in the previous test, “Test the Create Master Images Workflow”, earlier in this chapter, if this workflow is being tested on a single system or run on a system that has been NetBooted before, it will need to be removed from the COMPUTERS -> Defaults list or set up for the particular system MAC address. To finalize the steps to utilize this workflow, follow these steps:

1. Enter the relevant information for each computer under “General” information for the “Local hostname:,” “Computer name:,” “Windows computer name:,” Computer Information,” “Client Management: and any other desired fields.

2. In the Automation tab, choose the “Dual Boot Restoration and Customization” from the drop down menu. Verify that “Default group,” is checked. “Reset default workflow...” and “Disable computer after...” may be selected or not if desired.

3. Choose “Save”.

4. If there are any computers in the list, a message states, “Applying changes to members. The group settings have been changed. Click on the ‘Apply to members’ button if you want to apply the new settings to actual members of this group”. The ‘members’ are the computers which have either already successfully connected to the DeployStudio server or were imported with information including the MAC.
addresses, various name information, any users, etc. Choosing “Apply to members” will change the settings, based on any changes made to any of the tabs to all computers. Similarly, individual computers can be selected to make changes to them specifically.

To complete the test, start up the test system holding down the “N" key. The workflow should start and complete automatically, as long as “Automation” was chosen for every step of the workflow and other parameters were set correctly. If any failure occurred, check the screen of the client system or check the logs in DeployStudio Admin for the computer(s) experiencing a problem.

**Mac OS X First Startup Scripts**

Upon first boot Mac OS X will run any delayed scripts or packages. This will be exhibited by a DeployStudio Finalize screen prior to the Mac OS X log in screen. Depending on the complexity of the scripts or the size of the packages being installed this could take some time. It is important to plan for this first boot process prior to allowing first time access to the systems for end-users.
Chapter 10 - DeployStudio Admin - MASTERS

When a master image is completed two things happen:
1. The image is moved to the repository, which was created earlier in /Shared\ Items/ Public/DeployStudio/Masters, into the respective subdirectories (including HFS, NTFS, FAT, DEV, etc.). Mac images are automatically placed in the HFS directory. Windows images are placed in the NTFS directory.
2. The images appear in the DeployStudio Admin under MASTERS. Once created, they can easily be chosen from the “Restore image” task workflow drop down menu, depending on the partition format chosen. Note: There may be a long delay for the images to appear in the directory or the DeployStudio Admin MASTERS list, due to any compression taking place.

Master images may be moved to the repository directory if they were created in a method other than using DeployStudio. Simply move or copy the image to the proper directory within the repository and DeployStudio will recognize it. It must have all the components necessary for deployment in order to work. Note: Mac images are .dmg files where Windows images have four components: “.bootstrap,” “.id,” “.bcd” and “.ntfs.gz.” Note: Using tools other than DeployStudio to create the images may create issues where various scripts or other software will not run successfully during first boot. An example where copying an image to the server may be useful is an image created on the client itself and later copied to the server.

If a particular master image is no longer needed, simply delete it from the repository directory it resides in. You must change the view in the DeployStudio Admin for it to
recognize any deletions or additions from outside the application. An easier approach is to open Deploy Studio Admin, select MASTERS and hit the “-” button. A dialog will verify you are sure you want to delete the master image, then completely remove the image from the drive.
Chapter 11 - DeployStudio Admin - ACTIVITY

DeployStudio offers a powerful activity monitoring tool. Administrators can monitor a number of different items including:

- Workflow status including each individual step of multiple object workflows
- MAC addresses of the machines conducting the work (i.e., the server compressing images) or a system running a workflow
- Log information for verifying successful and failed workflows

To access these workflows, simply launch DeployStudio Admin, select “ACTIVITY” and review the various activity items.

By double-clicking on the activity, a more detail window will be presented.
A multiple task workflow will show all the steps and their completed statuses in the ACTIVITY viewer. An 🚨 notifies you if the workflow is working or has failed. Notice all the steps to the right of the workflow showing the 10 steps of that particular workflow.

A successful workflow will show green icons under the status column.
If you double-click on any of the green icons, activity details and statuses will appear in a new window.

While it is outside the ACTIVITY section within DeployStudio Server, another valuable tool is to view the logs of each system in the event of a failure. Select COMPUTERS and choose the 📋 icon for the computer you would like to see the log for.
Once the 📈 is selected the log file will open.

Note: Log files will be slightly delayed compared with the current state of the system. Viewing the log files in the background of the DeployStudio Runtime may offer more up to date log information and machine status. Eventually, the complete log file will be updated in the DeployStudio Repository.

VNC is another useful tool for troubleshooting a system or simply monitoring the status remotely. If VNC was enabled in the NetBoot image creation using the DeployStudio Assistant any client may be connected to using VNC. Mac OS X uses Bonjour (zeroconf) to automatically discover client systems. If the system is on the same subnet as the server the system will show up in the Finder Sidebar. Simply select the system, click the “Share Screen...” button and type in the password. An error message stating an insecure protocol will be displayed. Choose Connect Anyway.
Chapter 12 - Deployment

Deployment to systems can be accomplished in a number of different ways. As discussed earlier, most networks, by default, do not route BootP across subnets. This can either be changed by the network administrator or tools may be used to specify a BootP server on another subnet. Assuming the NetBoot server is turned on and that the NetBoot image is set to “Default” in Server Admin -> NetBoot -> Images, there are four main ways a system can be NetBooted:

1. Simply holding down the “N” key on the keyboard of the client to be imaged or restored will allow it to start up and run the specified workflow. **Note:** When attempting to deploy multiple systems simultaneously, a bolt heavy enough to hold down the “N” key might be used. **Note:** This will not work if the firmware password has been set.

2. Launch System Preferences -> Startup Disk and choose the Network Startup volume.
3. Using Apple Remote Desktop, select the system(s) you want to NetBoot. From the “Manage” menu, choose “Set Startup Disk...” and specify the NetBoot volume. Then from the “Manage” menu, choose “Restart...”

![Set Startup Disk](image)

4. From the command line on the target system or using the Apple Remote Desktop “Send UNIX Command...” type:

   ```sh
sudo bless --netboot --server bsdp://leopard.example.com
   ```

   Replace the server dns name with the NetBoot server DNS name in your environment. **Note:** This will work to specify the NetBoot server on another subnet.

   To learn more about NetBoot across subnets, see [http://support.apple.com/kb/HT4187](http://support.apple.com/kb/HT4187).

   Troubleshooting NetBoot can be tricky and is often related to subnet issues. For more information, see [http://support.apple.com/kb/TA21155](http://support.apple.com/kb/TA21155). Another resource is [http://www.afp548.com/netboot/mactips/nbas.html](http://www.afp548.com/netboot/mactips/nbas.html).
Chapter 13 - Create a Bootable External Drive

An external drive can be useful for several reasons, including:

1. If you do not have access to a Mac OS X Server
2. If your network is slow and local drive-to-drive copies would be faster. Later plugging the drive in to the server and copying the necessary files is usually faster than a network transfer.
3. If you are in a part of the network that does not have access to the server and you need to create a NetBoot image or a master image and NetBoot Across Subnets is not an option.
4. If you need to build a NetBoot image from a brand new system, which is newer than the DeployStudio Server system

There are two main ways to accomplish this:

1. The DeployStudio Assistant can build a minimum image, very similar to the NetBoot image, which starts up using the DeployStudio Runtime, based on the OS of the system you have run the Assistant on.
2. Install the OS on an external drive, using the software that came with the system (or a newer OS release). Then install DeployStudio so that it can be run locally including any additional tools (i.e., Data Rescue or Disk Warrior) on that external drive.

 NOTE: You can start up an Intel-based Mac from either a USB or FireWire drive (if the system has a built-in FireWire port). Any PowerPC system can only be started from an external drive that is FireWire.

 NOTE: To boot an Intel-based Mac you must format the drive using the GUID Partition Table partition scheme. To boot a PowerPC-based Mac, you must format the drive using the Apple Partition Map partition scheme.

The steps required to build an external DeployStudio USB or FireWire drive are:

1. Using the DeployStudio Assistant option “Create a DeployStudio bootable external drive (USB & Firewire)”:  
   a. Start with the most current operating system.  
   b. Install DeployStudio as described in Chapter 3.  
   c. Launch DeployStudio Assistant (found in /Applications/Utilities/).
d. Select “Create a DeployStudio bootable external drive (USB & Firewire)”. Click Continue.

e. Read through the steps described and click Continue.
f. Choose the external drive (example is “External HD”), choose whether or not to Partition the disk with a single partition and select the language. **Note:** This drive or partition (depending on the options chosen) will be completely erased and all data on the drive will be lost. Click Continue.

g. Enter the specific server information so that any workflows can be managed from the server. In the examples outlined in this guide, the server would be https://snowleopard.example.com:60443. Bonjour may be used if .local is routed or if you will be running this from the same subnet as the DeployStudio Server. Click Continue.
h. Enter the specific information for your server environment and desired setup. Use the DeployStudio Server admin user name and password. Set up VNC if desired. The default settings for “Display Runtime log window...,” “Put display to sleep...” and “Quit Runtime automatically after...” are usually optimal. Click Continue.

i. Include Python and/or Ruby when using package workflows that require either of these tools (i.e., Microsoft Office 2008). Rebuild the image with the Custom TCP stack settings if network problems/throughput issue persist.
j. Note the time estimate. Faster drives will be shorter. Click Continue.

k. Click “OK” once the drive has been created.

The drive will now allow systems to start up using the DeployStudio Runtime, very similar to NetBoot images discussed earlier in this guide.
2. The alternate external drive solution is to erase a drive, partition it with the correct partition scheme (discussed earlier in this chapter) and install the latest OS on it. If, for example, you wish to use a new MacBook Pro, simply plug the USB or FireWire drive in to it, format it with the GUID partition scheme and install the minimum OS using the DVDs that came with the system. This OS can be updated, drive utilities or scripts added, etc. Then of course install DeployStudio. If you choose to, you can enable the DeployStudio Server and utilize the DeployStudio Assistant to create a local instance of the DeployStudio Repository. It can utilize all the WORKFLOWS, SCRIPTS, COMPUTER settings, PACKAGES and MASTER images discussed in this guide.

**IMPORTANT:** To set the server up, follow the instructions found in Chapter 4. In step 4, choose “Do you want to setup: a local folder”, NOT “a network sharepoint.” Make sure the drive is large enough to house the Master images you may create. Typically this requires double the size of the drive(s) the masters are created from.

You can now run the DeployStudio Runtime to utilize the various WORKFLOWS.
Chapter 14 - Multicast

Multicast is a valuable function when deploying system images. When deployment is done without using multicast - unicast is used. Unicast requires an individual conversation between the server and every client receiving the image. With a 40GB image deploying to 20 machines, 800GB must be distributed across the network. With a switched 100 Megabit (Mb) network, machines could theoretically, without any other network traffic, image themselves in about an hour. On a Gigabit (Gb) network, those same images could theoretically, without any other network traffic, deploy in about 6 minutes. Neither of these scenarios account for typical overhead and collisions associated with every network, nor do they account for normal network traffic. When using a single Gb ethernet port on an Xserve or Mac Pro, 20 machines would quickly saturate the port on either network causing the unicast deployment to go much slower. It is for this reason multicast, which broadcasts the signal to all machines, is ideal.

Apple Software Restore (ASR), which is part of Mac OS X Server and Mac OS X client, is a key component used by DeployStudio to deploy images. ASR offers the capability to start a multicast image, where client systems initiate the start of a multicast broadcast, and only finish when the last machine is no longer requesting data. With multicast, a single machine can request a multicast broadcast, two minutes later a second machine requests data and starts two minutes in to the broadcast only to wrap around to capture the first two minutes it missed. ASR is also capable of having up to 20% packet loss where the deployment will continue requesting additional data until the image is complete. Packet loss can occur if the data is being broadcast too quickly and/or perhaps other network traffic spikes during a broadcast. If the packet loss exceeds 20% the image deployment will fail. It is therefore important to understand and test the network to see what it is capable of. In DeployStudio Server, it is possible to require a set number of systems to start up before the broadcast will start. This allows all clients to start imaging at the same time and avoids network bottlenecks caused by the bandwidth required by the systems to NetBoot. NetBooting 20 systems can significantly constrain the network; however, once the systems are up and running, bandwidth is freed up for network traffic to the systems.

**VERY IMPORTANT:** Most network administrators do not allow multicast broadcasts on their network. Multicast can slow down other network functions and can be used maliciously to broadcast viruses or other unnecessary data. Verify that multicast is allowed on your network before attempting to deploy images. Some network administrators will allow multicast broadcasts during certain hours for the purpose of deployment tools like Symantec Ghost for deploying Windows PCs. Alternately, some network appliances will automatically shut down a port if a multicast broadcast is detected. Obviously, when setting up DeployStudio on a private network, even with simple switches, multicast is optimal.

**Note:** Windows NTFS images cannot be broadcast using multicast.
To take advantage of multicast within DeployStudio, a couple settings are required. First, it is important that when using the DeployStudio Assistant > Set up a DeployStudio Server > Multicast settings is set to the proper broadcast speed. Then you must build the Mac images to be multicast enabled. Finally, you must enable the image(s) as multicast images within the DeployStudio Admin - MASTERS.

Regarding data rate, prior to setting the maximum data rate per stream, it is important to verify what the server and the network is capable of. It is also necessary to understand peak usage times when images may be deployed and gauge network throughput. Another factor may be the slowest machine an image may be deployed to (including network speed and hard drive-write speed). One way to test this is to deploy an image using a unicast (or typical non-broadcast) deployment.

You must also verify with the network administrator what Multicast IP Address to use, as multicast broadcasts may be used by other services (i.e., Ghost, video streaming, etc.), which are using IP addresses in the range 224-239.254.254.254. Similarly, you must choose the desired First stream port.

You **MUST** verify that multicast is supported on your network or verify that you are disconnected from a network uplink when setting up a private network deployment. The steps required to utilize multicast are as follows:
1. Determine the network throughput capability by deploying an image using a unicast deployment. Then verify the graphs in Server Admin -> AFP -> Graphs -> Throughput.
   a. Set a computer to run a unicast deployment workflow and NetBoot that computer.
   b. Launch Server Admin.
   c. Select AFP.
   d. Choose Graphs.
   e. Select the “Average Connected Users” drop down and choose “Throughput” in the past hour. Notice it peaks around 22MB/s, but doesn’t start out that fast. 12 - 14 is probably a better number in this scenario, which utilized a simple Gb switch.
2. Configure the DeployStudio Server for multicast:
   a. Follow the steps in Chapter 4 up to step 9 where the Multicast settings come in to play.
   b. Select the Interface. Typically en0 is ethernet port 1 and en1 is ethernet port 2 on a Mac Pro or Xserve with 2 Ethernet ports.
   c. Select a multicast address. As discussed previously, set this port based on the network administrator’s recommendation. For a private network set up, leave the address at the default.
   d. Leave the First stream port set to 7800 unless it is absolutely necessary to change.
   e. Set the Supported simultaneous streams to the number of images you will be broadcasting at any given time. This number is only for the images, not the number of clients that will be requesting the broadcast.
   f. Adjust the Maximum data rate per stream based on the data acquired from the AFP graph in the previous step.
   g. Specify the Multicast TTL (Time To Live), which is basically the number of hops the broadcast can make across VLANs or subnets, given the routers are set up to support this. **IMPORTANT:** The Multicast TTL: cannot be set to 0 and it is highly discouraged that it be set to 1. The default is 3.
   h. Complete the Server setup as described in Chapter 4.
3. Create the Mac .dmg images using a DeployStudio Workflow:
   a. Launch DeployStudio Admin.
   b. Select and customize a WORKFLOW Image task.
   c. Specify the Source drive name.
   d. Select Type: “Read only - suitable for Multicast”. Note: “Compressed - faster restoration, small footprint” creates smaller images, but by default is not scanned by ASR for multicast deployments. Using Disk Utility > Images > Scan Image for Restore should allow these images to be broadcast. Test before trying this.
   e. Set “Format:” to “Auto-detect”.
   f. Enter any desired “Keywords:”.
   g. Leave “Temp volume:” blank.
   h. Check “Cleanup machine dependent files and caches”.
   i. Uncheck “Try to shrink the size of NTFS volumes before imaging.”
   j. Select “Automate”.

   k. Choose Save.
   l. Set the master computer to run this workflow as a default workflow and NetBoot the client so that it can create the master image.
4. Enable multicast for the image you wish to multicast.
   a. Launch DeployStudio Admin.
   b. Select MASTERS.
   c. Choose the master image you wish to multicast.
   d. Choose the AirPort looking icon at the bottom of the screen (as shown in the red circle).

   e. A message stating “Multicasting a master” “You are about to multicast...” will be displayed. Select Multicast.

   ![DeployStudio Admin connected to leopard.example.com](image)

   ![Multicasting a master](image)

   **Note:** You will NOT see any symbol in the MASTERS section indicating that this image is being multicast. This is indicated within ACTIVITY in DeployStudio Admin.
f. To disable an image from multicasting, select ACTIVITY and choose the square stop button at the bottom of the screen (as shown in the red circle).

g. A message stating “Stopping multicast stream” “You are about to stop a multicast stream...” will appear. Select Stop.

Note: A multicast stream will only run when a client has requested it. After a short period of inactivity, the stream will stop until another client requests the broadcast.
5. Next, create a workflow to re-image the systems. **Note:** DeployStudio Server allows multiple settings for Multicast restores. They include:
   - The “Stream data rate:” which is how much data can be sent across the network
   - The “Client disk speed:” which is how fast data can be written to the clients.
   - The “Startup trigger:” where the system waits for a specified number of clients to start up and request an image before it begins broadcasting the image. This is a valuable setting in a Multicast broadcast. (When all the systems NetBoot across the network, they’re using valuable network bandwidth to start up thereby constraining the amount of data that can successfully be broadcast. By setting the “Startup trigger:” to a certain number of clients, the server will wait until all clients have started to begin the broadcast.)
   - The “Timeout:” period is the amount of time after the last system has completed imaging that the server automatically stops broadcasting. When a new request is made the server will again begin broadcasting the multicast image.

Create a new Workflow by selecting WORKFLOWS, click the “+” button and follow these steps:

a. Add a “Partition task” and configure according to the deployment.
b. Add a “Restore a disk image” to the right of the “Partition task”.
c. Set “Image:” to “HFS”.
d. Choose the image you will be multicasting from the drop down.
e. Specify the “Target:” (i.e., Macintosh HD set in the previous “Partition task”).
f. Uncheck “Restore image on the first drive available”.
g. Leave “Rename volume to:” blank.
h. Check “Enable multicast restoration”.
i. Adjust the “Stream data rate:” to the bandwidth capable (discussed earlier).
j. Adjust the “Client disk speed:” to the proper setting based on the maximum speed of the client hard drives the image will be deployed to.
k. Set the “Startup trigger:” to the proper settings (see note above).
l. Check “Don’t check restoration (faster)”.
m. Check “Erase target for block copy restoration (faster)”.
n. Check “Set as default startup volume”.
o. Check “Cleanup machine dependent files and caches”.
p. Check “Automate”.
q. Check “Rename ByHost prefs”.
r. Add any additional workflow tasks desired to the particular workflow.
s. Click “Save”.

6. Verify the image configured for multicast is in fact enabled (as described earlier).

7. Set the default workflow in COMPUTERS to this workflow.

8. NetBoot the client to test the deployment. Note: The image process will not start if the “Startup trigger:” is set to anything higher than “0” or “1”, if the number of clients hasn’t started up yet. Note: The multicast image will automatically disable itself after a period of inactivity.
Appendix A - Additional Resources

DeployStudio Quick Install Guide:

DeployStudio Architecture:

DeployStudio wiki:
http://deploystudio.wikispaces.com/

Apple Training Series Mac OS X Deployment v10.6:

Ongoing system maintenance and tools can be found here:
http://web.mac.com/driley/web/home/home.html

If the server and client systems exist on separate network subnets, NetBoot Across Subnets can be used. More information can be found here:
http://www.afp548.com/netboot/mactips/nbas.html
http://support.apple.com/kb/HT4187
http://support.apple.com/kb/TA21155

To better understand and troubleshoot the NetBoot process reference these resources:
http://www.afp548.com/netboot/mactips/netboot.html

For configuring and getting the most out of Mac OS X Servers Open Directory directory services capabilities, see this guide:

Boot Picker is a great tool for allowing users to choose their Operating system of choice:
http://www.apple.com/education/it-professionals/bootpicker/

rEFIt is a firmware-based tool for choosing the preferred OS (loads earlier than Boot Picker):
http://refit.sourceforge.net/

Useful Apple Resources include:
Appendix B - Troubleshooting

The best resource for troubleshooting DeployStudio is the DeployStudio Forums. The forums offer a wealth of information, feedback and the most up to date information. Support for DeployStudio is handled through the forums, which is monitored by the DeployStudio Engineering Team. The forums may be found here: http://deploystudio.com/Forums/index.php

<table>
<thead>
<tr>
<th>Problem:</th>
<th>Possible Solution:</th>
</tr>
</thead>
<tbody>
<tr>
<td>System will not NetBoot</td>
<td>Make sure the NetBoot image is created on a known good system. Do not upgrade from a major OS and then deploy the image (i.e., 10.4.x -&gt; 10.5.x). Also, make sure you have the latest OS. Choose About This Mac from the (\text{Apple}) menu and mouse-click on the version to find the build number. Compare this to the default image that ships with the machine being NetBooted or deployed to. Each new machine released has specific ROM information and drivers not typically included in previous builds.</td>
</tr>
<tr>
<td>System will not NetBoot</td>
<td>NetBoot is designed to be able to traverse subnets but this is often blocked by the routers in a given environment. Network administrators can route bootp or a NetBoot Server on another subnet can be specified using the bless command. This is discussed in the Deployment Chapter.</td>
</tr>
<tr>
<td>System will not NetBoot</td>
<td>Make sure bootp is enabled and allowed on the network from the NetBoot Server. In certain network security scenarios BootP may not be allowed other than from the primary DHCP server.</td>
</tr>
<tr>
<td>DeployStudio “Repository Access Error”</td>
<td>Most likely when running the DeployStudio Assistant - Set up a DeployStudio Server you selected “a local folder,” when “a network sharepoint” is the desired configuration. Try running the DeployStudio Assistant again from the server. If this is unsuccessful try running it from another system pointed at the primary server (i.e., <a href="http://snowleopard.example.com:60443">http://snowleopard.example.com:60443</a>) This will often happen after rebooting the server. If this does not work, try checking for the latest Release Candidate (rc) on the DeployStudio web site or, if using the latest version try the latest nightly build. Note that you may need to create a new NetBoot image for DeployStudio Runtime compatibility.</td>
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<tr>
<td>Problem:</td>
<td>Possible Solution:</td>
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<tr>
<td>“Repository Access Error”</td>
<td>Another possible problem may be permissions issues on the DeployStudio Repository share point. Verify that the share point has been configured with the correct permissions for the user(s) requiring access. When configuring the DeployStudio Server for the first time using the DeployStudio Assistant, the <strong>admin user</strong> currently logged in to the system and running the DeployStudio Assistant must have access to the share point, as well.</td>
</tr>
<tr>
<td>System will not start the workflow automatically</td>
<td>The COMPUTER groups are designed to run automatically only for <strong>NEW</strong> computers. A computer must be removed from the group or a default workflow run by specifically choosing the system from the list and then selecting the desired automated workflow.</td>
</tr>
<tr>
<td>Image creation takes an extremely long time</td>
<td>When choosing the compress option creating the Mac and Windows Master, images may take several hours, depending on the size of the master image. Occasionally the Windows image creation will pause indefinitely. Simply stop the process, delete the files created in the repository and start the process again. Also, make sure the master image was verified using various included or commercial disk tools. A corrupt master image can cause the creation process to fail.</td>
</tr>
<tr>
<td>Workflow will not complete successfully</td>
<td>DeployStudio Runtime offers excellent logging information and error messages. If a task in a workflow is misconfigured or if “Automate” is not chosen for every task in the workflow, the process will not be able to complete. Click on the computer from the COMPUTERS list and choose the log icon as described in the ACTIVITY chapter.</td>
</tr>
<tr>
<td>Workflow does not complete successfully when deploying a dual boot or Windows only image (Logs show ERROR: Output device is too small...)</td>
<td>DeployStudio has the option to expand the NTFS image on deployment. The image must first be compressed, then later expanded, to take advantage of the space. Be sure to first “Try to shrink NTFS volume's size before imaging”. Then be sure to check “Expand restored NTFS volume” in the NTFS Restore task.</td>
</tr>
<tr>
<td>System will not start a workflow with stating it is Disabled</td>
<td>The specific computer or COMPUTER groups may be disabled. This can be prompted by selecting “Disable Computer after a successful execution”. To turn this feature back on, select the computer from the list, choose General, and uncheck “Disable”.</td>
</tr>
<tr>
<td>After reboot Windows repairs the volume</td>
<td>This is normal behavior. Windows will repair the Windows partition on each deployed system.</td>
</tr>
<tr>
<td>Windows will not boot (ie “Error loading operating system)</td>
<td>Verify Boot Picker is configured for the correct Windows partition. Boot Picker sets the Master Boot Record and will fail with an error if not configured for the correct partition.</td>
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<tr>
<td>Problem:</td>
<td>Possible Solution:</td>
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<tr>
<td>After rebooting Windows USB devices don’t work</td>
<td>Try rebooting Windows again. If the problem persists, reinstall the latest Boot Camp Drivers for Windows included on the Mac OS X 10.5 Leopard or Mac OS X 10.6 Snow Leopard DVDs. Verify the latest Boot Camp drivers from Apple’s support downloads web site have been installed.</td>
</tr>
<tr>
<td>Windows driver errors persist after deployment</td>
<td>The Windows drivers on the master Windows image are machine specific. Different video cards can create anomalies in functionality. Often, simply running the Boot Camp Drivers for Windows again will resolve the problem. Occasionally removing the drivers and reinstalling will address the issue. Also, make sure the latest drivers are being used by checking Apple’s support downloads site.</td>
</tr>
<tr>
<td>After choosing Windows using Boot Picker nothing happens</td>
<td>Verify you have set the correct path to the Windows volume in the Boot Picker preferences. Depending on how this was configured, the Master Boot Record may not be set properly and may not reboot in to Windows. Simply setting it again or remotely editing the Boot Picker plist file will set it properly. <strong>Note:</strong> At this time, first generation unibody MacBook 13” and unibody MacBook Pro 15” do not support the use of the bless -nextonly command, which is utilized by Boot Picker. rEFIt is a good alternative. The MacBook Pro 13” and 15” models with the integrated battery do not experience this limitation.</td>
</tr>
<tr>
<td>After reboot, Windows clock is off and/or won’t authenticate</td>
<td>Make sure you use a central network time server. The Boot Camp drivers should make it so that as long as you are connected to a network where the system can see the configured time server, it should automatically update.</td>
</tr>
<tr>
<td>After reboot Mac OS X is not set to the correct time and/or will not authenticate</td>
<td>During the startup of Mac OS X, the OS does not check the network time server as it is set in the Date and Time System Preference. This can cause Active Directory and/or Open Directory to fail because it must be within 5 minutes of the server clock, adjusted for the time zone. A Mac OS X startup script will solve this problem. More information may be found here: <a href="http://web.me.com/driely/driely/iWeb/Tools.html">http://web.me.com/driely/driely/iWeb/Tools.html</a></td>
</tr>
<tr>
<td>Connecting to Active Directory or Open Directory Servers fails or after several days/weeks becomes stale</td>
<td>As described in the Mac OS X Master Image Creation, you must remove the LKDC. DeployStudio should automatically recreate this on first boot. Not removing this from your master image will cause duplicate computer names and problems with authenticating. In certain circumstances, it also helps to run the command <code>sudo dsconfigad passinterval 0</code></td>
</tr>
<tr>
<td>Problem:</td>
<td>Possible Solution:</td>
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<tr>
<td>Image creation fails with error “Sorry, the image file cannot fit into the destination”</td>
<td>This may be due to improper permissions for the share point and the user. Try increasing the permissions to allow the user to have Full Control to the folder and any/all subfolders. You may need to choose Propagate Permissions...” to accomplish this using the gear at the bottom of the Server Admin &gt; FileSharing window.</td>
</tr>
<tr>
<td>Image may fail to deploy when using multicast</td>
<td>Make sure the master image was created using “Read-only...” Compressed images must be manually compressed outside of DeployStudio for multicast.</td>
</tr>
<tr>
<td>Multicast images will not start</td>
<td>If the multicast broadcast has timed out, i.e., is no longer running in DeployStudio Admin &gt; ACTIVITY, it must be re-enabled by selecting the image in MASTERS, then choosing the multicast button at the bottom of the window.</td>
</tr>
<tr>
<td>Multicast deployments never start</td>
<td>The “Startup trigger;” in the “Restore task” within the workflow may be set to a number higher than the number of clients NetBooting and requesting the image.</td>
</tr>
<tr>
<td>Multicast images start but eventually fail</td>
<td>The “Stream data rate;” may be set higher than the network is capable of. Try lowering the “Stream data rate;” to a number lower than the current setting and rerun the deployment.</td>
</tr>
<tr>
<td>NetBooted system cannot communicate with the DeployStudio Server</td>
<td>If configured to use a private DHCP network hosted from Mac OS X Server, it is important to verify the DNS information including the IP address of the DHCP server is entered in the DHCP &gt; DNS settings. Otherwise the client machines cannot communicate with the repository.</td>
</tr>
<tr>
<td>System image creation finishes copying to the server but does not complete the conversion on the server</td>
<td>In rare cases problems can arise from kernel extension issues with the server hosting the DeployStudio Repository. Always check the system.log for errors. A possible problem can be the kernel extension for the server is misconfigured and must be reset. The DeployStudio Forums include a detailed description on how to address this issue by resetting the ethernet kernel extensions for Yukon sourced Ethernet hardware.</td>
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</table>
**Appendix C - Mac OS X Customization Options**

<table>
<thead>
<tr>
<th>Customization</th>
<th>Steps</th>
<th>Explanation:</th>
</tr>
</thead>
</table>
| Customize the dock for all new users created on the system                   | Edit the file System/Library/CoreServices/Dock.app/Contents/Resources/English.lproj/default.plist  
  
  *ie change to /Applications/Microsoft\Office\2008/Microsoft\Word.app/*        | All default dock settings are in this file. If you choose not to have Time Machine in the dock by default, for example, simply delete it from the file. Using Property List Editor (part of the Xcode install) open the default.plist file and select “Dump.” |
| Set the default desktop background to something other than Aurora.jpg        | /Library/Desktop\Pictures/Nature/Aurora.jpg                          | An alternate default desktop can be used for use policies, instructions or specific organization pictures                                                                                                   |
| Provide a custom image background behind the login screen                   | Change the desktop background to display specific images. The default desktop image at the login screen and the desktop image are stored in different default locations. Replace /System/Library/Core\Services/DefaultDesktop.jpg for the the image behind the login screen | An alternate background behind the login screen can be used to include text for usage policies, instructions or to provide additional information to users in an open lab environment. |
| Customize the default home directory file structure and preferences for all newly created users | Edit the file /System/Library/UserTemplate/English.lproj  
  
  adding preferences to /Library/Preferences can create the same preference for all users. Other changes could include the removal of the Music, Movies and/or Pictures folders for all newly created users | Every new user created on the system will inherit a home directory based on this template. If certain preferences are desired, particular items on the desktop or a custom home directory structure is needed adding or removing items from this template will replicate for any new users. Certain ByHost Settings will be copied but replaced with their defaults. Google ByHost for more information regarding that feature in OS X. |
Appendix D - Worksheet Outline

1. Set up a Mac OS X Snow Leopard Leopard Server
2. Set up DNS (if running a standalone environment)
3. Set up DHCP (only if running a standalone environment)
4. Configure Open Directory
5. Enable Apple File Protocol
6. Create DeployStudio user
7. Create the DeployStudio share point
8. Install DeployStudio
9. Run the DeployStudio Assistant - Set up a DeployStudio Server
10. Install Mac OS X, updates, software and configurations on the client
11. Install Windows XP, updates, Boot Camp drivers and software on the client, then run Sysprep
12. Create the NetBoot image using the latest system OS
13. Move the NetBoot image to /Library/NetBoot/NetBootSP0, if necessary
14. Enable NetBoot and set the default image
15. Create the master Mac image for deployment
16. Create the master Windows image for deployment
17. Customize workflows in DeployStudio for image creation
18. Customize workflows in DeployStudio for deployment
19. Test or run the image deployment
20. Disable default workflows and/or NetBoot when not in use