Technical Documentation

Hewlett Packard Enterprise

HPE Synergy ImageStreamer Artifacts Development Best Practices

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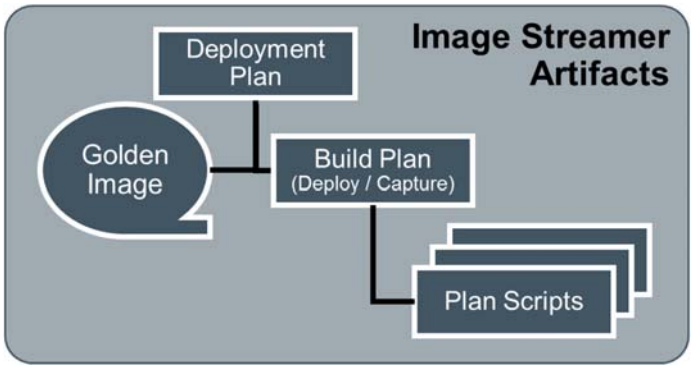
1 Image Streamer Artifacts

1.1 Introduction

The HPE Image Streamer product provides a general capability for deployment and capture of OS images. The appliance handles creation of OS volumes from Golden Images during deployment and creation of Golden Images from OS volumes during capture.

The Image Streamer user is responsible for modifications of OS volume content during deployment and capture using artifacts. This document provides suggested best practices for developing these artifacts.



1.2 Overview of Image Streamer Artifacts

Plan Scripts are the lowest level artifact type and provide the details of these deployment and capture modifications. During deployment the modifications are typically for inserting per-server configuration content which is called personalization. During capture these modifications are typically for removing per-server configuration content which is called generalization.

The Image Streamer build environment is the protected execution environment where these Plan Scripts run. The format of Plan Scripts is guestfish scripts which facilitates OS volume access and manipulation with minimal disruption to the Image Streamer appliance. The guestfish environment has a large and rich set of commands designed for simple OS Volume access and manipulation. Shell scripts can be imbedded in guestfish scripts to simplify complex OS Volume modifications.

Deploy type Plan Scripts may include attributes which provide values for personalization. The syntax of “@name@” or “@name:value@” is used. The optional value is a default for the attribute. During deployment these attributes in the script are replaced with the deployment-specific values.

NIC type attributes are used to configure network settings. In the Server Profile a NIC attribute is associated with a network connection. If the network has an associated subnet those details will be made available to the Plan Script. The Server Profile may also be edited to have user provided details for static configuration.

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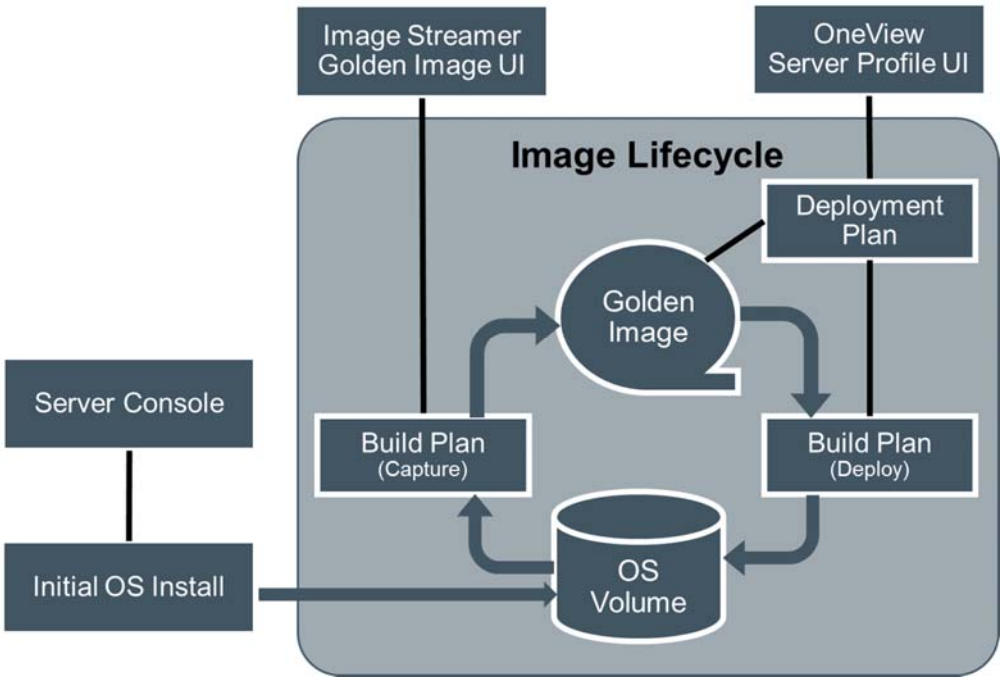
Build Plans provide the recipe to modify the contents of an OS Volume. Build Plans have a sequence of steps each of which is a Plan Script. During deployment these scripts are run in sequence. The current method to sequence Plan Scripts is to concatenate them into a single guestfish script. However, the Image Streamer appliance may use another method for step sequencing in the future. Artifact developers should not rely on script concatenation.

Build Plans may specify types, constraints, and default values for attributes. Default values in Plan Scripts provide the initial Build Plan defaults. Build Plan defaults override Plan Script defaults. Changing the Plan Script artifact defaults later will not change Build Plan defaults.

Golden Images provide the OS Volume content. The format of a Golden Image is a compressed file that holds the block-for-block copy of a previously installed OS Volume which has been generalized to remove server-specific content.

Golden Images are created by capturing the content of an OS Volume. A capture type Build Plan provides the recipe for generalization to remove server-specific content from the Golden Image. Capture type Build Plans and capture type Plan Scripts do not have attributes.

Golden Images may be uploaded to and downloaded from an Image Streamer. The file format is a gzip compressed archive file containing a single disk image file.



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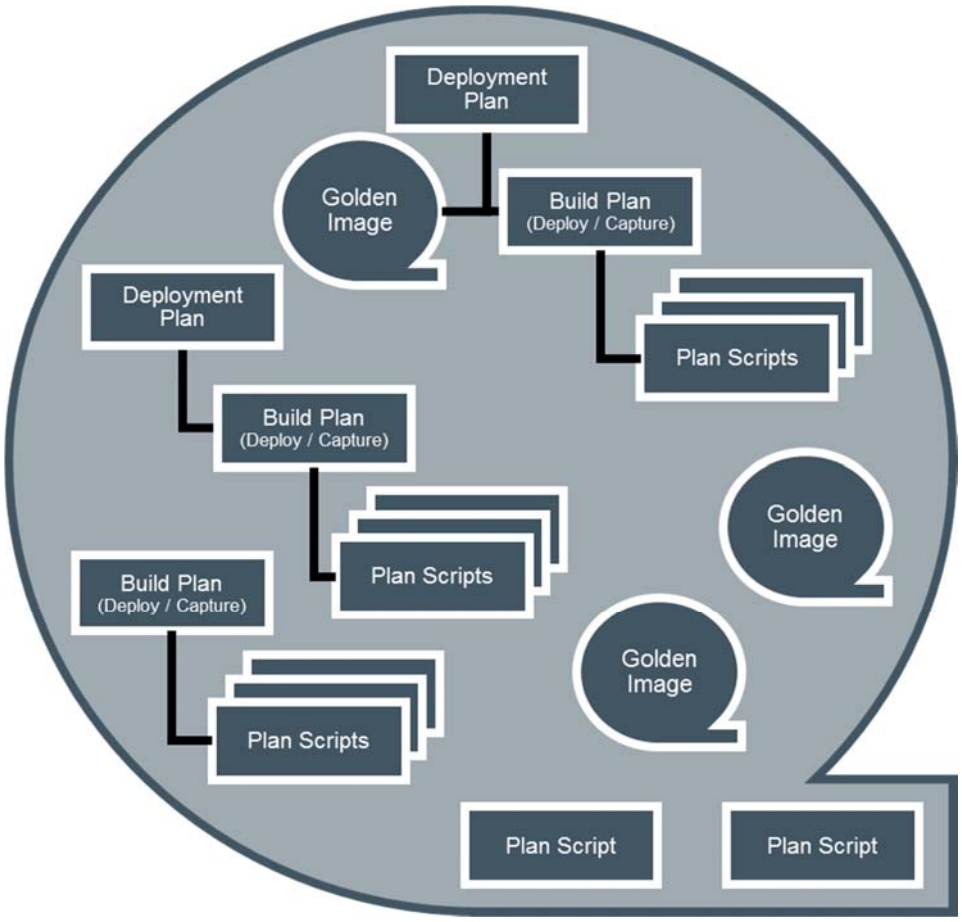
Plan Scripts implement the steps of the Build Plans but are not shown in this diagram. Plan Scripts may be of type deploy, capture, or general. General type Plan Scripts may be used in capture and deploy Build Plans.

Artifact Bundles provide a simple way to transfer artifacts between different Image Streamer Deployment Servers. An Artifact Bundle is a particular type of archive file. Archive Bundles may include any number of artifacts.

When an artifact depends on other artifacts those artifacts will be included in the Artifact Bundle. Any mix of stand-alone and dependent artifacts may be included in an Artifact Bundle.

At the time an Artifact Bundle is created artifacts may be marked as read-only. Read-only artifacts become immutable and remain read-only when the Artifact Bundle is uploaded and expanded on another Image Streamer.

Golden Images can be quite large. Deployment Plans may be edited to not refer to a Golden Image so that they may serve as example Deployment Plans included in Artifact Bundles. Thus, Golden Image artifacts may be stored and transferred separately from Artifact Bundles of other artifact types which are typically much smaller.



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2 Best Practices for Image Streamer Artifacts

Once the Image Streamer Deployment Server is setup in OneView, Artifact Bundles are typically uploaded and expanded. Then, users may wish to develop additional artifacts. Artifact developers can find very useful best practices which will aid collaboration and speed artifact development in this document.

2.1 Use HPE artifacts as templates

HPE provides a Foundation Artifact Bundle with artifacts not specific to any OS which help use of basic Image Streamer appliance features.

HPE provides a Developer Artifact Bundle with artifacts to aid artifact development and to serve as examples for custom artifact development. This document includes an overview of these HPE provided Artifact Bundles.

HPE provides OS-specific Artifact Bundles with example artifacts to help users learn to make use of Image Streamer to deploy and capture specific OSes. Refer https://github.com/HewlettPackard for details about these HPE-provided artifacts.

HPE provided artifacts are designed to be easily copied and modified as needed. Artifacts supplied by Image Streamer are read-only and may not be edited, but you can make an editable copy to modify.

2.2 Use HPE's naming convention for Artifacts

Good names are important for understanding what a Build Plan does and for helping you find the Build Plan you are looking for. HPE uses the following naming convention for the Build Plans supplied with Image Streamer. Users are encouraged to follow these conventions for their own artifacts.

The table below shows how to use HPE's naming convention for artifacts.

<Organization> - <OS & version> - <Action> <Modifiers> - <Version>

	Description	Examples	Notes
Organization	To avoid naming conflicts, names should begin with the company or organization name.	"HPE" for Hewlett Packard Enterprise artifacts	Avoid use of "HPE" for artifacts not provided by Hewlett Packard Enterprise

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	Description	Examples	Notes
		Based on company initials, stock symbol, Internet domain name, etc.	
OS & version & edition & layered SW	The operating system to be deployed, with major and minor version numbers, plus architecture. May also include information about layered application software.	“ESXi 5.5 U2” “RHEL6.2 Enterprise” “RHEL7.0 Docker-Enabled”	This indicates the software stack in a Golden Image or the expected software stack in Build Plans and Plan Scripts.
Actions	The functional propose or action performed by the artifact.	“create” “mount” “set”	This is especially useful for Plan Scripts. It is very useful to indicate the type of deployment personalization or capture generalization done by Plan Scripts.
Modifiers	Anything else that might assist in describing this artifact.	“full” “special”	Especially useful for plan scripts.
Version	Version numbers help developers and users keep track of the evolutionary development of artifacts.	2017-01-30	Including version numbers in attribute names avoids the need for renaming artifacts to resolve naming conflicts for different versions. Version history details may also be included in descriptions if desired.

Build Plan and Plan Script types, such as deploy and capture, are not normally included in artifact names.

2.3 Examples of HPE-provided artifacts

The following is a sample list of HPE-provided Build Plans. Access https://github.com/HewlettPackard for additional HPE provided artifacts.

Examples of HPE-provided Build Plan names:

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- HPE - Foundation 1.0 - create empty OS Volume-2017-03-24
- HPE - Foundation 1.0 - capture OS Volume as is-2017-03-24
- HPE - ESXi - deploy in single frame non-HA config- 2017-03-24
-

Examples of HPE-provided Plan Script names:

- HPE - ESXi - mount - 2017-03-15 (general)
- HPE - ESXi - configure management 1st NIC - 2017-03-16 (deploy)
- HPE - ESXi - generalize host configuration - 2017-03-15 (capture)
- HPE - ESXi - umount - 2017-03-15 (general)

Plan Script type is generally not included in the name since the type of the plan is specified on the artifact resource.

Examples of HPE-provided artifact bundle names:

- HPE-ESXi-2017-03-24
- HPE-RHEL-7.2-2017-03-24

2.4 Use HPE's naming and type convention for plan attributes

Consistent names are important for understanding what a Build Plan does and for simplifying automated deployment via API. HPE uses the following naming convention for the Build Plan attributes supplied with Image Streamer.

Name	Type	Description	Notes
Hostname	hostname	Server hostname.	Normally domain name is taken from the management NIC details.
DomainName	FQDN	Fully qualified server domain name.	Domain name may also be taken from the subnet details for networks having a subnet.
Password	password	Clear text password	Passwords may be set via default attribute values in Deployment Plans or Build Plans with the attribute being marked as not visible for deployment.

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Name	Type	Description	Notes
ManagementNIC	NIC	Networking configuration details for management network interface. The NIC type includes these details: • ipaddress • domain • dns1 • dns2 • dns3 • mac • netmask • gateway • vlanid • dhcp • networkuri • ipv4disable	Use of NIC attribute type is the preferred method for getting network configuration details to permit OneView to coordinate settings. Build Plans may specify that DHCP may be used to obtain NIC configuration. ManagementNIC attribute can have the following modes in ServerProfile • auto • user-specified • dhcp
<Purpose>NIC	NIC	Networking configuration details for additional network interface. This is specific for a single interface. Purpose has to come from OneView The <purpose> portion of the name should be used to describe the purpose of the network (e.g. “storage” “application”, “vmotion”, etc.).	Cluster management tools often expect to configure networks other than the management network needed to access the host. In that case OS deployment should not configure these networks.
VolumeSize	number	This is a special attribute name predefined in the appliance. If there is no Golden Image, this attribute defines the size of an empty OS Volume to be created (in MiB).	The appliance limits the maximum size of the OS Volume. Note that Image Streamer OS Volumes should not be used for large amounts of data or temporary storage.

2.5 Points to note before publishing artifact bundles

- Ensure that the functionality of the artifacts are verified in Synergy single frame as well as multi-frame environments

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- Description field of all artifacts should be set to explain the intent of artifacts
- Artifacts can contain a copyright/licence header if needed
- Artifact bundles should be accompanied by documentation containing a detailed explanation of its functionality
- Artifacts can be marked read-only where appropriate
- Golden images need not be bundled with artifact bundle. If golden images need to be included, ensure applicable licensing and re-distribution requirements of the OS images are met
- Refer HPE supplied Image Streamer artifact bundles and their documentation at https://github.com/HewlettPackard for more details

2.6 Running scripts in the Image Streamer build environment

Conventional OS deployment tools run on the target server using a small in-memory OS which typically matches the OS to be installed. This in-memory OS may be called a Live Media or Pre-Install Environment but it can generically be called a “service OS”.

In the conventional approach, the service OS is booted on the server to be installed. This service OS then sets up the storage layout, installs the OS SW, and configures OS settings. The server then reboots and starts running the deployed OS. Live DVD and WinPE are examples of service OSes. OS software install and configuration is then done by an installer or configuration tool running on the service OS. Anaconda is an example of an installer tool.

It is important to always remember that Image Streamer Plan Scripts run in a build environment on the Image Streamer appliance with no access to the actual server hardware where the OS will eventually run or use of commands in the OS to be deployed. The server will not be powered on or running while deployment is done. This appliance based approach requires plan script writers to carefully consider how customization of Golden Images for deployment and generalization of Golden Images for capture should be done.

The format of an Image Streamer Golden Image is a block-for-block copy of an already installed OS volume which has been generalized to have server-specific configuration content removed. The Image Streamer has the ability to capture existing OS volumes using SAN snapshot and clone. The generalization process is accomplished via running capture type plan scripts in the Image Streamer build environment.

The Image Streamer build environment is guestfish environment running on CentOS with tightened SELinux settings and additional constraints to avoid plan scripts from disrupting operation of the Image Streamer appliance. The build environment is entirely unrelated to the OS in the Golden Image being deployed.

The procedure for OS Volume deployment is:

1. A block for block (Linux dd) type of copy of the Golden Image is done to create the new OS storage volume. This copy is accomplished via SAN clone so the copy finishes in a few seconds regardless of the OS volume size.

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2. The build environment is used to run the Image Streamer deploy plan scripts which are responsible for making personalization changes to the newly created OS Volume. These OS Volume changes usually include adding configuration content specific to the data center or the individual server.

3. The created OS Volume is ready for server use (i.e. boot / run).

The procedure for Golden Image capture is:

1. A block for block (Linux dd) type of copy of an existing OS Volume is done to capture the content of the OS Volume and leave the original OS Volume unchanged. This copy is accomplished via SAN clone so the copy finishes in a few seconds regardless of OS Volume size.

2. The build environment is used to run the Image Streamer capture plan scripts which are responsible for making generalization changes to the cloned OS Volume. These OS Volume changes usually include removing configuration specific to the individual server.

3. A block for block (Linux dd) type of copy of the modified cloned OS Volume is done to create a Golden Image. The copy process includes processing to find and compress unallocated file system space to minimize the size of the resulting Golden Image. This process may require significant time and depends on the size of the OS Volume.

3 Developing Artifacts for New OS Types

Due to licensing constraints HPE cannot provide ready-to-use Golden Images of OSes. Instead, users will need to create these Golden Images by installing the OS to an Image Streamer OS Volume and performing a capture to create the Golden Image.

HPE has Artifact Bundles with example artifacts for some OS types. The HPE documentation specific to these OS types should be consulted for how to install and capture Golden Images for those OS types.

This section is focused on getting started with developing artifacts for new OS types. The high level steps are:

1. Install the OS into an empty Image Streamer OS Volume.
2. Capture OS Volume to a Golden Image “as is”
3. Deploy the Golden Image to OS Volume “as is” to test basic ability to redeploy
4. If the redeployed OS does not boot, the original install will need to be studied
5. If the redeployed OS boots, study the new deployment and compare to the original
6. Use “show OS Volume structure” to learn storage layout
7. Create prototype mount script to permit OS Volume content access
8. Create prototype deployment configuration artifacts
9. Design and create more complete deploy and capture artifacts

Whenever possible start from existing artifacts which provide an example for access of volume content and how to accomplish needed configuration within the OS. Even for a new OS type, artifacts for similar OS types may be very helpful. For that matter, artifacts for any other OS type may have useful ideas.

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3.1 Make sure you have an HPE Synergy distro of the OS

Use OS distributions specifically intended for HPE servers when possible. These distros may have drivers or other customizations which will help ensure correct operations on HPE Synergy servers.

For example, VMware ESXi requires HPE-supplied VMware ESXi distribution files that include the appropriate ProLiant drivers and certain firmware recipes. HPE provides links to these ProLiant-specific ESXi images at http://www8.hp.com/us/en/products/servers/solutions.html?compURI=1499005

For all OSes refer to the HPE Synergy support matrix.

3.2 Make sure firmware and driver levels agree

HPE designs its firmware, drivers, and agents to work together at specific revision levels. OneView Server Profiles may be used to coordinate firmware revisions with the OS Deployment Plan and its Golden Image being deployed; see the *HPE Insight Management Support Matrix* at http://www.HPE.com/go/insightmanagement/docs for details. For best results, you should keep your system firmware at this same revision. Failure to do so might cause problems. See Deploy a Support Pack for ProLiant (SPP) for instructions. Also consult the appropriate *Image Streamer Artifact Reference Guide* for the OS type for additional details.

3.3 First Redeployment of a new OS type

Typically the first thing to try with a new OS type is to install the OS, capture the OS volume to a Golden Image as is, and redeploy the Golden Image to an OS Volume exactly matching the original. That may be done as follows:

1. Provision server with an empty OS Volume. The HPE Image Steamer Foundation Artifact Bundle has an OS Deployment Plan for this.

2. Deploy OS from ISO image or network server to the empty OS Volume. Start with a simple minimal OS software stack.

3. Perform minimal OS configuration. It may be helpful to not allow the installed OS to reboot for first boot. However, in other cases this reboot performs install completion which is important.

4. Shut down and power off server.

5. Capture OS Volume to Golden Image as is with no generalization changes. The HPE Image Streamer Foundation Artifact Bundle has a capture Build Plan for this.

6. Create OS Deployment Plan to deploy the new Golden Image as is. The HPE Image Streamer Foundation Artifact Bundle has a Build Plan for use in this OS Deployment Plan.

7. Perform a test deployment using the Golden Image to create an OS Volume having exactly the same content as the original OS Volume.

   Ideally the initial OS deployment will result in a running server, even if not yet correctly configured. However, this initial OS deployment may result in a server which does not boot successfully. The first thing to look at is network and iSCSI boot settings. OSes should be able to get these details from the UEFI firmware at boot. But, some OSes hard code these settings into boot configuration content at the time of install. In that case some personalization will be needed before any deployment is possible.

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3.4 Creating a Golden Image from an OS Volume

The general process is:

1. Provision a Synergy server using the OS Deployment Plan for creating an empty OS Volume. The Image Streamer Foundation Artifact Bundle includes an OS Deployment Plan for creating an empty OS Volume of any size. The Synergy Server will be configured for access to this empty OS Volume.

2. Boot the provisioned server from install media or a network install server. For example, ProLiant iLO Virtual Media may be used to boot the server from an ISO image on the user's laptop. This may be configured via the iLO Integrated Remote Console with the ISO image file being the Virtual Drive CD-ROM/DVD Image File.

3. Install the OS using the Image Streamer empty OS Volume as the target for install. This OS Volume should appear as an iSCSI disk device in the OS installer. It may be necessary to add iSCSI device drivers to the OS or do special iSCSI configuration for this initial install.

4. During this install for creating a Golden Image, consider the software to be installed. The Image Streamer deployment process uses cloning of the OS Volume and there is not a simple way to add software during Image Streamer deployment.

5. During this install for creating a Golden Image, consider the server OS Volume storage configuration. The Image Streamer deployment process uses cloning of the OS Volume and each server will have the same storage configuration. There is not a simple way to make OS Volume storage configurations during Image Streamer deployment. Note that the Image Streamer appliance provides highly-available storage. Normally a very simple OS storage configuration should be used. Complex OS storage configuration will make Build Plan personalization and generalization much more difficult.

6. During this install for creating a Golden Image, consider what additional server configuration should be done.

    a. Configuration that would be exactly replicated for every future server is probably appropriate.

    b. Configuration that would be performed for every future server, but with different details. This requires some consideration (see section below).

        For example, it may simplify writing Plan Scripts to use example configuration values which scripts can later recognize. In some cases it is best to avoid configuring these details since the result is more server-specific configuration content that must be cleaned up in capture Plan Scripts.

    c. Configuration which would be significantly different for each server should normally be avoided.

        Significant differences may suggest that multiple Golden Image are needed, one for each major configuration variant. It's also possible that the Golden Image should serve as an OS base with these additional significant configuration changes being made after Image Streamer OS deployment.

        Finally, it is possible that Image Streamer is not a good fit for the OS deployment needs. HPE Insight Control server provisioning is designed to handle deployment of servers which require significant server-specific customization.

7. Optionally boot the OS and perform additional configuration or installation of software.

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8. Shut down the server at the end of the install process.

9. Create a new Golden Image using the Image Streamer Deployment Server UI. The Golden Image capture process will use this installed OS Volume and the capture Build Plan indicated by the user. The capture Build Plan will determine the generalization processing to be done. The user is responsible for selecting the appropriate capture Build Plan for the OS Volume content.

    a. The Image Streamer Foundation Artifact Bundle includes a Build Plan for capturing an OS Volume as is. That is, creating a Golden Image from an OS Volume with no generalization processing to remove any server-specific configuration details.

    b. Once developed, OS-specific capture Build Plans are used so that server-specific configuration details are removed from the OS Volume and a generalized Golden Image results.

3.5 Creating a Golden Image Independent of Image Streamer

An Image Streamer Golden Image is a zip archive file containing a single file which is the Golden Image clone of an OS Volume.

One way to create a Golden Image file is to independently capture an OS Volume into an image file (e.g. .img file), and use that file to create the needed zip file. For example:

Zip archive: my_golden_image.zip which contains:

Disk image file: my_previously_installed_disk.img

ProLiant iLO Virtual Media may be used to create this file as follows:

1. Create an empty disk image file on your laptop. For example, to create a 10 GiB disk image file:

```
C:> fsutil file createnew empty10GiB.img 10737418240
```

2. Use the created file as the Image File of the iLO Removable Media Virtual Drive. This may be configured via the iLO Integrated Remote Console.

3. Install OS from DVD image or network source and including considerations used for install to an empty Image Streamer OS Volume.

4. Shut down the server.

5. Create a zip archive file containing the disk image file.

While it is possible to create Golden Images outside of the built-in Image Streamer capture process, it is generally not advisable. The types of issues you may discover:

- OSes may configure the OS kernel differently if the target storage is iSCSI. For example, the kernel may not include iSCSI drivers as needed.

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- OSes may format or configure boot / root storage differently if the target storage is iSCSI. For example, boot from iSCSI OS Volumes may need different boot configuration or boot loader content in the OS Volume.

- Golden Image is very large due to temporary file system content needed during the install process. Even temporary files which are removed may leave traces in the disk image.

The very much recommended process for creating a Golden Image is to use the built-in Image Streamer capture process.

Capture outside of the built-in process may be helpful when the OS installer does not support iSCSI and cannot be extended to have iSCSI support added.

3.6 Strategies for Simplifying Personalization

Because the build environment is unrelated to the OS being deployed, personalization of the OS to set server-specific configuration changes can be difficult. Strategies to reduce the amount and complexity of per-sever customization are important and will save considerable effort.

1. Make the configuration simple. Choose OS defaults or configuration choices even more simple than OS defaults. Rely on Image Streamer storage and Synergy features which permit simple, but highly-available, server operation.

2. Perform as much standard configuration as possible before capture. The installed OS should be booted, additional software should be installed if needed, and configuration applying to all servers should be performed. Note that it may be necessary to consider if per-server personalization will matter to this general configuration in some way. That is, if the general configuration will inherit the per-server configuration details and create another setting to be generalized and personalized.

3. Control configuration from a few master configuration settings. Per-server settings may be used in several places in the OS configuration. Network MAC addresses and IP addresses are common examples. It can simplify deployment to insert personalization settings into a master location such as one configuration file and use that master copy to control secondary OS and application settings.

4. Staging content during personalization for use during server first boot. Some OS and application configuration tasks may be difficult to accomplish outside of the actual target OS environment. In this case personalization settings may be placed in a configuration file used by functionality running the first time the server boots, or the first boot script(s) might be constructed as part of the personalization process.

In summary, it's vital to remember that the Image Streamer build environment is independent of the server being provisioned and the OS being deployed. Hardware details cannot be meaningfully be queried in scripts from the hardware where the scripts are run, and OS-specific programs may not be used.

3.7 Configuring OSes for use with Image Streamer deployment

The first Golden Image is created by installing the OS and additional software into an empty Image Streamer OS volume. A special Deployment Plan is provided to create an empty OS volume in Image Streamer storage. Normal OS install processes from DVD or network repositories are used to install the OS and other software into this OS volume and make desired configuration changes.

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After install OS and other configuration changes may be performed. It is likely to be easier to make configuration changes in the OS than in the Image Streamer build environment. In general, configuration changes which are not server-specific should be done in the OS prior to shut down and Golden Image capture.

Configuration variants which apply to sets of servers may be handled by using separate Golden Images or by build plan personalization depending on the complexity required.

The OS file system storage layout should be kept simple. A simple partitioned layout holding boot partitions and file systems is recommended. Image Streamer provides availability via SAN technology. Since Image Streamer uses thin provisioning, resizable OS volumes may not be needed.

The OS volume should be kept small and used to hold the OS, other software, configuration, and a limited amount of other content which varies between server instances. Placing server log files in the OS volume is appropriate. Placing large amounts of active application data being crated or modified is not appropriate.

Hypervisors are a very good OS type for Image Streamer. Hypervisor software, host configuration, and logs are appropriate Image Streamer OS volume content. Virtual machine guests should not be placed in Image Streamer OS volume storage.

It's not recommended to place swap space on the OS volume. Some OSes require a swap partition to exist but will not actually need to use it for swapping and placing this partition in the OS volume is appropriate.

Image Streamer does not rely on any special content in the Golden Image such as agents to help with personalization or generalization. However, such agents may be included in the Golden Image for ongoing management of servers by installing them in the server's OS prior to capture.

3.8 Dealing with Golden Image volume structure details

Creating OS volume structure during deployment is complex and not generally recommended. OS volume layout variations may be handled by having different Golden Images.

Ideally plan scripts should be written to locate the appropriate partition and file system in the Golden Image volume where configuration based on attribute values should be done. If plan scripts cannot be written to find the correct partition it may be a good idea to use attribute(s) to indicate the correct partition(s). These attribute(s) may be hidden in the deployment plan to keep the server administrator's job simple and to avoid deployment mistakes. If the partition layout is very unlikely to vary, hard coding the partition numbers and other layout details in the plan may be preferred.

Often partitions and file systems include unique identifiers such as UUIDs. Since Image Streamer uses Golden Image cloning for deployment, these identifiers will be the same for each cloned volume. Normally this should not be an issue since Image Streamer OS volumes are only presented to one server. Plan scripts can use guestfish or gparted commands to modify UUIDs if required. However, it is likely that other OS configuration changes, such as file system mount tables, may be required for these UUID changes.

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4 Tips for Plan Script artifact development

4.1 Significant OS expertise is required

Development of Image Streamer artifacts requires significant OS expertise.

Ask an OS administrator how to configure boot, networking, or other OS setting and you are likely to be told to use the abc-adm or xyz-configure OS commands, or the configuration user interface. These commands and interfaces will not be available in the Image Streamer build environment.

Personalization and generalization of OS Volume contents requires knowing where configuration settings are stored in the OS file system.

In some cases it is not possible to directly modify configuration settings via file system content changes. In that cases it may be necessary to stage configuration content during Image Streamer deployment so that the OSes built-in configuration commands may be used during the server's first boot.

4.2 The OS deployment test cycle

The general approach for artifact development is a two part process.

The first part is to get the scripts nominally working:

1. Create or Plan Script artifacts.
2. Test OS deployment by creating or editing Server Profile.
3. Review deployment log to see Plan Script expansion and deployment script messages.
4. Delete or edit Server Profile so that artifacts are no longer in use and may be modified.
5. Repeat until scripts are running without error.

The second part is to add server boot into the test cycle to validate that the deployed OS Volume is correctly configured:

1. Create or modify Plan Script artifacts.
2. Test OS deployment by creating or editing Server Profile.
3. Power on and boot server.
4. Login to server and review configuration for correctness.
5. Power off server (generally controlled shutdown of the OS is not needed).

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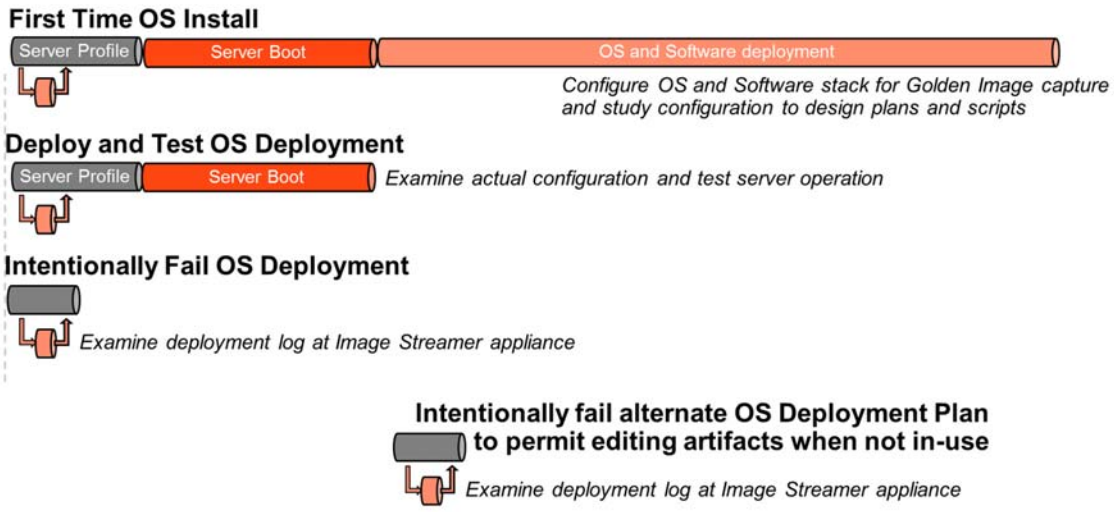
6. Delete or edit Server Profile so that artifacts are no longer in use and may be modified.

7. Repeat until scripts are deploying servers correctly.

4.3 Faster OS deployment test cycles

Image Streamer OS deployment is extremely fast, generally taking less than 15 seconds. However, applying a Server Profile to a server typically takes several minutes. Each cycle of testing deployment requires two Server Profile edits. One is needed to trigger the OS deployment and a second is needed to free the Image Streamer artifacts from use to permit editing to resolve issues or perform another experiment.

It's helpful to note that OS deployment is one of the first steps in creation or edit of a Server Profile and that failed OS deployment will prevent further Server Profile processing steps from being attempted.



One technique to speed initial development of Plan Scripts is to insert an invalid guestfish command at the end of a Plan Script to block the Server Profile from taking the time to apply the server configuration. The HPE Developer Artifact Bundle has a Plan Script for this purpose.

Artifacts which are in use by a Server Profile may not be edited. An OS Deployment Plan with a failing Plan Script is helpful to quickly switch between the OS Deployment Plans to permit Plan Script editing. The HPE Developer Artifact Bundle has a Deployment Plan for this purpose.

The following Plan Script development cycle may be used:

1. Edit Server Profile to use OS Deployment Plan being developed. An invalid guestfish is included at the end of the Plan Script(s).

2. Review deployment log to see Plan Script expansion and deployment script messages.

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3. Edit Server Profile to use alternate OS Deployment Plan having a Plan Script with an invalid guestfish command. Editing the Server Profile to not have an OS Deployment Plan would require applying the entire Server Profile configuration to the server. Selecting an OS Deployment Plan known to fail will cause the Server Profile edit to quickly fail.

4. The OS Deployment Plan, Build Plan, and Plan Scripts being developed may be modified since the Server Profile is no longer in use.

5. Repeat until scripts are running as wanted. At that point the invalid guestfish command may be removed from the Plan Script under development.

4.4 Server Profile identity values

There are alternatives for how Server Profile changes are used to trigger OS deployment. Each has certain advantages and disadvantages for testing OS deployment:

1. Delete Server Profile used to create the Golden Image and create a new Server Profile using the new OS Deployment Plan. This will allocate new identity values for the server such as server serial number, MAC addresses, iSCSI initiator IP address, iSCSI initiator IQN, etc. This approach is most like how deployment will finally be done for this new OS type.

2. Create a new Server Profile using the new OS Deployment Plan and keep the existing initial OS install to the empty OS Volume. This approach requires an additional Synergy server but allows simple exploration of the installed OS to find and understand OS configuration details which need to be personalized and generalized. The new Server Profile will of course have new identity values (MAC address, etc.). Note that without personalization this deployment will probably result in a duplicate server which may conflict with the initially installed server (e.g. duplicate IP addresses).

3. Edit the existing Server Profile to change from use of the empty OS Volume Deployment Plan used for initial OS install to the new OS Deployment Plan testing as is deployment. Some of the server identity values will remain unchanged using this approach. [Need to check on preservation / reallocation of iSCSI initiator IP value]. Each deployment will create a new iSCSI IQN for the target OS volume. A disadvantage of this approach is the original OS install is lost which may have aided understanding OS configuration details.

4. Install a second time to an empty OS Volume on a different server to permit one server to stay with the original OS install and have a second to be used with Server Profile edit. The original OS install may be used to help find and study OS configuration details. The second server may be used to edit the Server Profile and try redeployment with as little change of server identity values as possible.

4.5 Using Deployment Plan defaults for fast redeployment

Normally artifacts will not include server-specific values. However, if development is done by editing the Server Profile most server-specific values in the profile will remain the same. These values may be used as default values for the Deployment Plan so that redeployment may be quickly repeated for testing.

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5 Golden Image generalization

5.1 Choosing replacement generalization values

During OS Volume capture to create a new Golden Image is recommended to remove server-specific settings. Leaving the captured values can create a risk that later deployments will cause unwanted server duplication conflicts. These server-specific values may also include information that server administrators would rather not share with others.

Most identity address spaces include ranges of addresses reserved for special purposes. Often there are addresses reserved for local use and addresses reserved for documentation. When possible, it is recommended to use addresses reserved for documentation for Golden Image generalization. Using addresses reserved for local use is not optimal since deployment may be done in a data center actually using local addresses.

Configuration content may be modified to replace server-specific values with the addresses reserved for documentation.

Generalization MAC addresses:

- MAC Addresses Reserved for Documentation:
  - 10:00:00:00:00:01 - 10:00:00:00:00:FF
- MAC Addresses Reserved for Local Use:
  - x2-xx-xx-xx-xx-xx
  - x6-xx-xx-xx-xx-xx
  - xA-xx-xx-xx-xx-xx
  - xE-xx-xx-xx-xx-xx

Generalization IPv4 addresses:

- IPv4 Addresses Reserved for Documentation:
  - 192.0.2.0/24
  - 198.51.100.0/24
  - 203.0.113.0/24
- IPv4 Addresses Reserved for Local Use:
  - 10.0.0.0/8 - 10.0.0.0 - 10.255.255.255
  - 172.16.0./20 - 172.16.0.0 - 172.31.255.255
  - 192.168.0.0/16 - 192.168.0.0 - 192.168.255.255

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