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# Oracle Solaris 11 System Software Management with Image Packaging System

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## Introduction

For most enterprise IT organizations, significant effort goes into upgrading operating system software to appropriate patch levels so as to benefit from bug fixes, security updates, or new hardware driver support when available. Proper management of system software can also help ensure a well-known, tested, and consistent system state across a variety of systems in the data center. With increasing trends towards consolidation using virtualization, system administrators are being asked to manage large volumes of software often with complex interdependencies, making it harder for them to keep systems running smoothly.

As the Oracle Solaris operating system evolved to include new technologies such as Oracle Solaris Zones, ZFS, and Service Management Facility, previously used processes for managing system updates and upgrades have become more complex. With thousands of operating system instances installed in some of today's large virtualized data centers, manual methods of tracking and installing patches can result in errors that negatively affect application service availability and data center security.

Oracle Solaris 11 takes a new approach to package management that greatly simplifies the process of managing patches and updates to help reduce the risk of operating system maintenance issues.

## Image Packaging System

Based on extensive customer feedback about patch and upgrade processes for Oracle Solaris 10, Oracle engineers completely redesigned the software packaging system in Oracle Solaris 11. Oracle Solaris 11 represents a significant change for system administrators because of its new software packaging model—the Image Packaging System (IPS). IPS is a comprehensive delivery framework that spans the complete software lifecycle, addressing software installation, updates, system upgrades, and the removal of software packages. In contrast to the SVR4 packaging model used in earlier Oracle Solaris releases, IPS eliminates the need for patching. Relying on the use of software repositories, IPS dramatically changes how an administrator updates system and application software, as shown in Figure 1.

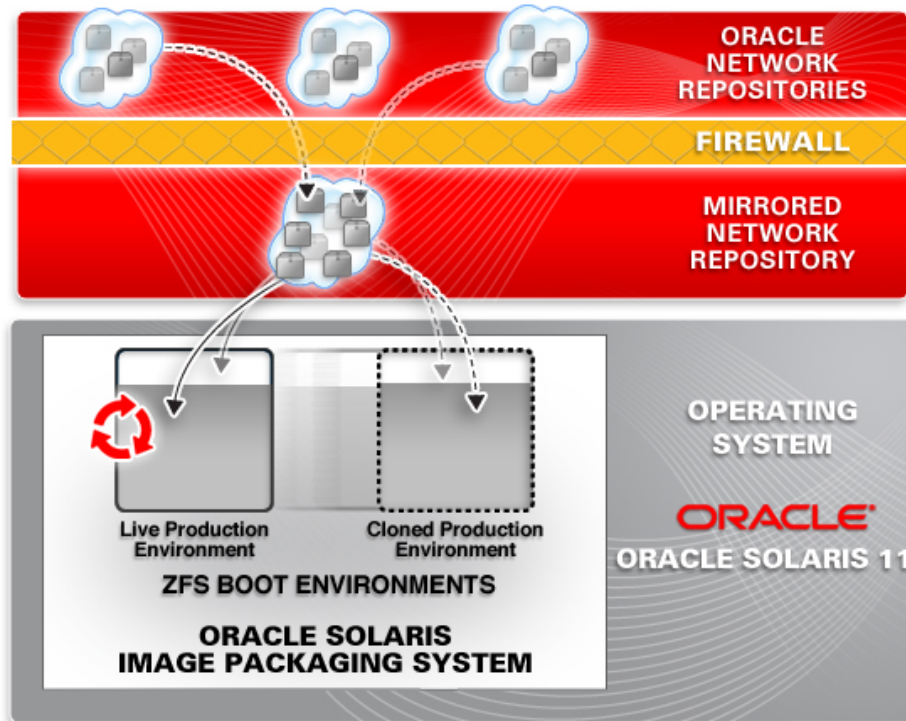


Figure 1. Oracle Solaris Image Packaging System

A design goal behind the development of this new model (in addition to simplifying software lifecycle maintenance and improving reliability) is compatibility with zones and other installation contexts. From the perspective of keeping system software up to date, the IPS framework greatly simplifies software maintenance. For Oracle Solaris 10 and earlier releases, patching is often a complex manual process requiring manual patch analysis to understand dependencies and to determine and apply appropriate patches. With the former patching process, administrators sometimes inadvertently introduced problems when appropriate patches were not applied or patch dependencies were not well understood. With Oracle Solaris 11, the IPS model reduces the risk of introducing incompatibilities or problems resulting from human error since all updated OS packages are fully integration-tested before download and installation.

## Network Based Repositories

IPS relies on network-accessible or locally available software repositories as a delivery mechanism, which is similar to how other operating systems (notably Oracle Linux) supply software updates. During a package install, IPS performs automatic dependency checking, adding additional packages, such as libraries, that might be required. Administrators can easily set up and manage local repositories to deploy both OS and application packages within network-restricted environments. Repositories are also easily mirrored, allowing an administrator to optimize for more efficient access.

Table 1 lists default network-accessible repositories for Oracle Solaris 11.

**TABLE 1. ORACLE SOLARIS 11 REPOSITORIES**

REPOSITORY	DESCRIPTION
<a href="http://pkg.oracle.com/solaris/release">http://pkg.oracle.com/solaris/release</a>	Default repository for Oracle Solaris 11. This repository contains updates for each new release of Oracle Solaris. Significant bug fixes, security updates, and new software may be provided at any time, at Oracle's discretion, for users to install.
<a href="https://pkg.oracle.com/solaris/support">https://pkg.oracle.com/solaris/support</a>	Support repository providing the latest bug fixes and updates. Access is restricted to users with current Oracle Solaris support contracts.

## Package Management

IPS provides these interfaces to manage software packages:

- A command-line interface, the `pkg(1)` command and associated subcommands.
- A graphical user interface to search and manage installed packages called the Package Manager, which can be initiated on the command line by `packagemanager(1)`. A related GUI, called the Update Manager, initiated on the command line by `updatemanager(1)`, can be used to oversee full system updates.

Table 2 shows IPS command-line equivalents for a few frequently used SVR4 packaging commands.

While IPS packaging is the default packaging technique for Oracle Solaris 11, SVR4 packaging tools, such as `pkgadd(1M)`, are still provided for compatibility to support installations of SVR4 packaged application software.

TABLE 2: IPS AND SVR4 PACKAGING COMMANDS

TASK	IPS COMMAND	SVR4 PACKAGING COMMAND
Install package	<code>pkg install</code>	<code>pkgadd</code>
Display package state and version information	<code>pkg list</code>	<code>pkginfo</code>
Verify package installation	<code>pkg verify</code>	<code>pkgchk -v</code>
Display package information, such as license	<code>pkg info</code>	<code>pkginfo -l</code>
Display contents of a package	<code>pkg contents</code>	<code>pkgchk -l</code>
Search for a package	<code>pkg search</code>	<code>pkgchk -l -p</code>
Uninstall a package	<code>pkg uninstall</code>	<code>pkgrm</code>

Figures 2 and 3 show the Package Manager and Update Manager interfaces, respectively. Update Manager reconciles all system software packages, bringing the base OS environment and any Oracle Solaris Zone virtual environments to a defined and integration-tested level. Package Manager, on the other hand, allows an administrator to add, remove, or update individual packages between full system update operations. Both interfaces provide descriptive details about each package (including a date and time stamp to identify versions), making software management a more intuitive process. Package Manager also groups packages by category to simplify locating a specific package.

Both Package Manager and Update Manager can check package versions against packages in a specified repository and identify when updates for installed packages are available. The “Update All” function in Package Manager updates all installed packages, as does “Update All” in Update Manager. The command-line equivalent for updating all packages is `pkg update`.

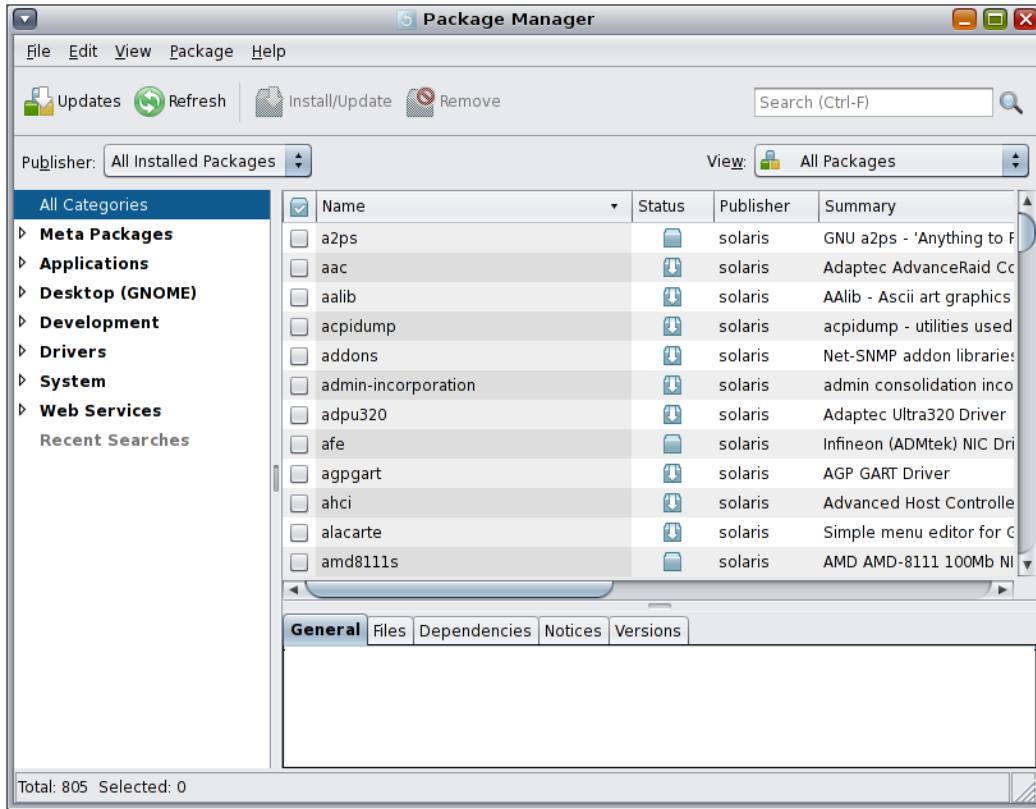


Figure 2. Package Manager in Oracle Solaris 11

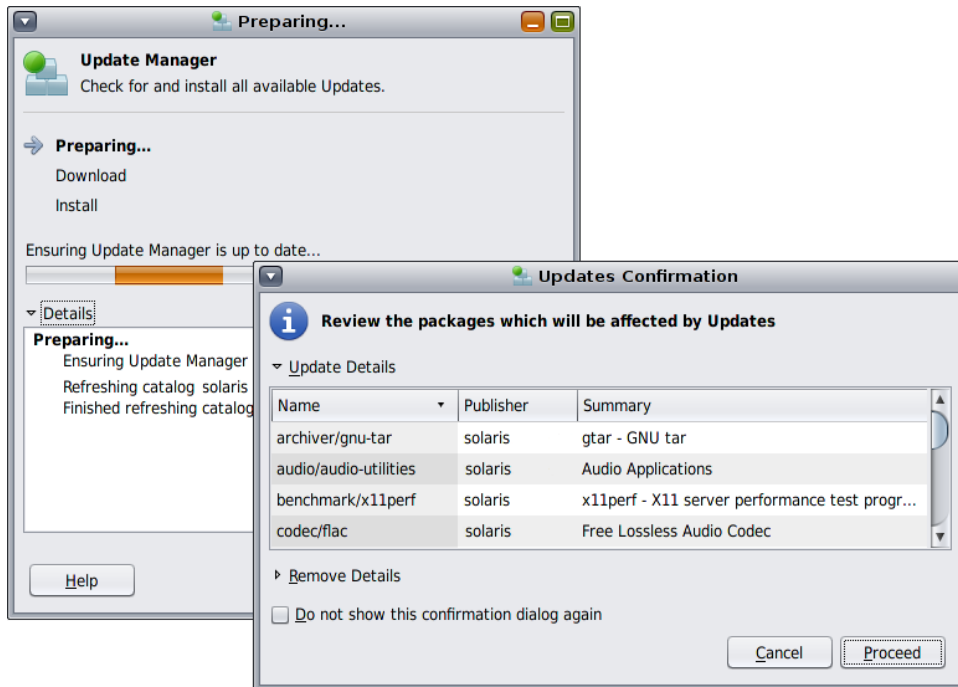


Figure 3. Update Manager in Oracle Solaris 11

## Upgrading Software in a System

In conjunction with the IPS packaging framework, Oracle Solaris 11 supplies a new methodology and tools to clone the active boot environment and subsequently use that image to upgrade the operating environment. Similar in concept to Live Upgrade in Oracle Solaris 10, upgrading in Oracle Solaris 11 takes advantage of the underlying ZFS file system technology, using its native fast snapshot and clone capabilities to replicate the active operating system image.

When an administrator updates system software (via an “Update All” in Package Manager or Update Manager, or via `pkg update`), Oracle Solaris 11 first clones the current boot environment and applies packaging changes to the clone. By default, the clone is automatically activated on reboot. If a problem occurs, the administrator can easily roll back to the previous boot environment image. In this way, Oracle Solaris 11 provides an administrative safety net for OS upgrades and software changes, which helps to improve system and application availability. A fast system reboot by default for x86 systems (and optionally enabled for SPARC systems) means that administrators can switch to a new boot environment quickly, often within seconds.

## Managing Boot Environments

In Oracle Solaris 11, the new `beadm(1M)` utility is used to manage boot environments and snapshots of system images (in this context a snapshot is a read-only, non-bootable image). Table 3 shows `beadm` commands for common management tasks.

**TABLE 3. BOOT ENVIRONMENT COMMANDS**

TASK	COMMAND
Create a boot environment	<code>beadm create</code>
Make the specified environment active on the next reboot	<code>beadm activate</code>
List information about boot environments	<code>beadm list</code>
Destroy a boot environment	<code>beadm destroy</code>
Mount or unmount a boot environment at a mount point	<code>beadm mount</code> or <code>beadm unmount</code>
Rename a boot environment	<code>beadm rename</code>

Note that it is possible to create and mount an inactive boot environment and then update it:

```
# beadm create Special
# beadm mount Special /mnt
# pkg -R /mnt install mpathadm
# beadm unmount Special
# beadm activate Special
# reboot
```

This series of commands creates and mounts an inactive boot environment `Special` and then updates it by adding a new package. The boot environment is then unmounted, activated, and booted. (Note that all these commands require special privilege, which can be gained by use of `sudo`, `pfexec`, or `su`.)

## Boot Environments and Zones

There are important implications to understand when managing systems that include Oracle Solaris Zones. When non-global zones are created within certain shared areas of the global zone (for example, `/rpool/export` or `/rpool/zones`), new child boot environments can be created for that zone that are attached to the parent boot environment of the global zone. Installing a new package within the global zone does not automatically install it in any non-global zones.

Likewise, when a new package is installed in a non-global zone, it is not automatically installed into the global zone or any other non-global zones. However, packages in these zones are automatically upgraded when the base environment image is upgraded. This ensures that software running in different zones is at the same package level. Since administrative privileges for zones can now be delegated, a zone administrator can independently use `beadm` to create and roll back image snapshots created within a zone.

## Summary

Image Packaging System (IPS) is a significant milestone in Oracle Solaris 11, providing a flexible and efficient software management solution that allows for safe system upgrades and better control over planned system downtime for administrators. IPS is fully integrated into existing Oracle Solaris technology, such as Oracle Solaris ZFS and Oracle Solaris Zones, providing a much-improved out-of-the-box experience for administrators and greater ability to manage software versions across multiple systems in the data center.

The Oracle Solaris 11 release forms a strong foundation for the entire Oracle software stack, allowing customers to deploy enterprise applications with confidence. Oracle Solaris 11 adds new functionality that helps to simplify administration, secure data and applications, improve system resource utilization, and promote business continuity. Oracle Solaris 11 is a production-capable release that administrators can download and deploy now, with full support available as an option from Oracle.

## For More Information

**TABLE 4. RESOURCES FOR ADDITIONAL INFORMATION**

REFERENCE	WEB SITE URL
Oracle Solaris 11 Image Packaging System Resources	<a href="http://www.oracle.com/technetwork/server-storage/solaris11/technologies/ips-323421.html">http://www.oracle.com/technetwork/server-storage/solaris11/technologies/ips-323421.html</a>
Oracle Solaris 11 Product Documentation	<a href="http://www.oracle.com/technetwork/server-storage/solaris11/documentation/index.html">http://www.oracle.com/technetwork/server-storage/solaris11/documentation/index.html</a>
All Oracle Solaris 11 How-To Guides	<a href="http://www.oracle.com/technetwork/server-storage/solaris11/documentation/how-to-517481.html">http://www.oracle.com/technetwork/server-storage/solaris11/documentation/how-to-517481.html</a>
IPS Developer Site	<a href="http://hub.opensolaris.org/bin/view/Project+pkg/WebHome">http://hub.opensolaris.org/bin/view/Project+pkg/WebHome</a>
Oracle Solaris 11 Technical Resources	<a href="http://www.oracle.com/technetwork/server-storage/solaris11/overview/index.html">http://www.oracle.com/technetwork/server-storage/solaris11/overview/index.html</a>
Oracle Solaris 11 Download	<a href="http://www.oracle.com/technetwork/server-storage/solaris11/downloads/index.html">http://www.oracle.com/technetwork/server-storage/solaris11/downloads/index.html</a>
Oracle Premier Support for Operating Systems	<a href="http://www.oracle.com/us/support/systems/operating-systems/index.html">http://www.oracle.com/us/support/systems/operating-systems/index.html</a>
Oracle Solaris 11 Training and Support	<a href="http://www.oracle.com/technetwork/server-storage/solaris11/training/index.html">http://www.oracle.com/technetwork/server-storage/solaris11/training/index.html</a>



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