Transitioning From Oracle® Solaris 10 to Oracle Solaris 11.1
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Preface

Transitioning From Oracle Solaris 10 to Oracle Solaris 11.1 covers topics for transitioning from Oracle Solaris 10 to Oracle Solaris 11.1, as well cumulative feature changes that were introduced in Oracle Solaris 11 11/11.

Note – This Oracle Solaris release supports systems that use the SPARC and x86 families of processor architectures. The supported systems appear in the Oracle Solaris OS: Hardware Compatibility Lists. This document cites any implementation differences between the platform types.

For supported systems, see the Oracle Solaris OS: Hardware Compatibility Lists.

Who Should Use This Book

This book is intended for anyone responsible for administering one or more systems running the Oracle Solaris 11 release. To use this book, you should have 1–2 years of UNIX system administration experience. Attending UNIX system administration training courses might be helpful.

Access to Oracle Support

Oracle customers have access to electronic support through My Oracle Support. For information, visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=info or visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=trs if you are hearing impaired.

Typographic Conventions

The following table describes the typographic conventions that are used in this book.
TABLE P–1  Typographic Conventions

<table>
<thead>
<tr>
<th>Typeface</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>AaBbCc123</td>
<td>The names of commands, files, and directories, and onscreen computer output</td>
<td>Edit your .login file.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use ls -a to list all files.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>machine_name% you have mail.</td>
</tr>
<tr>
<td>AaBbCc123</td>
<td>What you type, contrasted with onscreen computer output</td>
<td>machine_name% su</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Password:</td>
</tr>
<tr>
<td>aabbcc123</td>
<td>Placeholder: replace with a real name or value</td>
<td>The command to remove a file is rm filename.</td>
</tr>
<tr>
<td>AaBbCc123</td>
<td>Book titles, new terms, and terms to be emphasized</td>
<td>Read Chapter 6 in the User's Guide.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A cache is a copy that is stored locally.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do not save the file.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note: Some emphasized items appear bold online.</td>
</tr>
</tbody>
</table>

Shell Prompts in Command Examples

The following table shows UNIX system prompts and superuser prompts for shells that are included in the Oracle Solaris OS. In command examples, the shell prompt indicates whether the command should be executed by a regular user or a user with privileges.

TABLE P–2  Shell Prompts

<table>
<thead>
<tr>
<th>Shell</th>
<th>Prompt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bash shell, Korn shell, and Bourne shell</td>
<td>$</td>
</tr>
<tr>
<td>Bash shell, Korn shell, and Bourne shell for superuser</td>
<td>#</td>
</tr>
<tr>
<td>C shell</td>
<td>machine_name%</td>
</tr>
<tr>
<td>C shell for superuser</td>
<td>machine_name#</td>
</tr>
</tbody>
</table>
General Conventions

Be aware of the following conventions used in this book.

- When following steps or using examples, be sure to type double-quotes ("), left single-quotes (‘), and right single-quotes (‘) exactly as shown.
- The key referred to as Return is labeled Enter on some keyboards.
- The root path usually includes the /usr/sbin, /usr/bin, and /etc directories, so the steps in this book show the commands in these directories without absolute path names. Steps that use commands in other, less common, directories show the absolute paths in the examples.
This chapter provides overview information about transitioning from Oracle Solaris 10 to an Oracle Solaris 11 release.

The following topics are covered:

- “Welcome to Oracle Solaris 11.1” on page 13
- “Oracle Solaris 10 Features Compared to Oracle Solaris 11 Features” on page 15
- “Transitioning Your Oracle Solaris 10 System to an Oracle Solaris 11 Release” on page 23
- “Installation Features” on page 24
- “Software and Boot Environment Management Features” on page 25
- “Network Administration Features” on page 26
- “System Configuration and SMF Features” on page 27
- “Storage and File Systems Features” on page 28
- “Security Features” on page 29
- “Virtualization Features” on page 29
- “User Account Management and User Environment Features” on page 30
- “Desktop Features” on page 30

Welcome to Oracle Solaris 11.1

The Oracle Solaris 11.1 operating system (OS) is the first update of the latest major Oracle Solaris release, Oracle Solaris 11 11/11. An operating system for the enterprise environment, Oracle Solaris 11.1 is an integral part of Oracle’s combined hardware and software portfolio. If you are moving from Oracle Solaris 10 to an Oracle Solaris 11 release, you might have some questions. The purpose of this guide is to provide answers to some of those questions.
Welcome to Oracle Solaris 11.1

**Note** – This book contains cumulative information for anyone who is transitioning from Oracle Solaris 10 to an Oracle Solaris 11 release. Important information about feature differences between Oracle Solaris 11 and Oracle Solaris 11.1 is also provided, when appropriate. For specific details about transitioning from Oracle Solaris 10 to the Oracle Solaris 11 11/11 release, see *Transitions From Oracle Solaris 10 to Oracle Solaris 11*. For more information about a particular feature, refer to the product documentation.

Most Oracle Solaris 10 applications are known to work on Oracle Solaris 11. You can run supported applications *as is*. Or, you can run applications that rely on features that are excluded from Oracle Solaris 11 in an Oracle Solaris 10 virtual environment. See *Chapter 10, “Managing Oracle Solaris Releases in a Virtual Environment.”* To determine the readiness of Oracle Solaris 10 applications to run on an Oracle Solaris 11 release, use the Oracle Solaris 11 compatibility checking tool, which is available at:


See also the following documentation:


Note that this guide does not provide information about every new feature in Oracle Solaris 11, nor does it mention every feature that is excluded from Oracle Solaris 11.

- For information about upgrading from Oracle Solaris 11 to Oracle Solaris 11.1, see *Updating to Oracle Solaris 11.2*.
- For information about Oracle’s Sun hardware platforms and the corresponding Oracle Solaris operating system requirements, go to http://www.oracle.com/technetwork/systems/software-stacks/stacks/index.html.
Oracle Solaris 10 Features Compared to Oracle Solaris 11 Features

The following table compares Oracle Solaris 10 features to Oracle Solaris 11 features.

**Note** – Features are listed in alphabetical order.

<table>
<thead>
<tr>
<th>Feature or Command</th>
<th>Oracle Solaris 10</th>
<th>Oracle Solaris 11</th>
<th>Oracle Solaris 11.1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>x86: boot loader</strong> (GRUB)</td>
<td>GRUB Legacy (0.97)</td>
<td>GRUB Legacy (0.97)</td>
<td>GRUB 2</td>
</tr>
<tr>
<td>boot loader (administration)</td>
<td>SPARC: installboot x86: installgrub</td>
<td>SPARC: installboot x86: installgrub</td>
<td>bootadm install-bootloader (SPARC and x86)</td>
</tr>
<tr>
<td><strong>Booting (from a root device)</strong></td>
<td>From a ZFS, UFS, or Solaris Volume Manager root device</td>
<td>From an Oracle Solaris ZFS root file system</td>
<td>From an Oracle Solaris ZFS root file system</td>
</tr>
<tr>
<td><strong>Booting (from the network)</strong></td>
<td>SPARC: From the ok PROM prompt: boot net[:dhcp] or boot net[:rarp] x86: Requires a DHCP server that supports a Preboot Execution Environment (PXE) boot from the network</td>
<td>SPARC: boot net:dhcp x86: Requires a DHCP server that supports a PXE boot from the network</td>
<td>SPARC: boot net:dhcp x86: UEFI firmware and BIOS firmware types are supported. The PXE boot process has changed for UEFI firmware.</td>
</tr>
</tbody>
</table>

"GRUB, Firmware, and Disk Labeling Changes" on page 122
"System Boot, Recovery, and Platform Changes" on page 121
"Booting Systems With UEFI and BIOS Firmware From the Network" in Booting and Shutting Down Oracle Solaris 11.1 Systems
<table>
<thead>
<tr>
<th>Feature or Command</th>
<th>Oracle Solaris 10</th>
<th>Oracle Solaris 11</th>
<th>Oracle Solaris 11.1</th>
</tr>
</thead>
</table>
| **Booting (recovery)** | SPARC: ok boot -F failsafe  
x86: Select the failsafe boot entry in the GRUB menu at boot time | Failsafe mode no longer supported (SPARC and x86)  
- Boot from an alternate boot environment (BE) or backup BE  
- Boot in single-user mode or perform system recovery steps | Failsafe mode is not supported on SPARC or x86 platforms.  
- Boot from an alternate BE or a backup BE.  
- Boot in single-user mode or perform system recovery steps.  
“System Boot, Recovery, and Platform Changes” on page 121 |
| **Desktop environment** | Common Desktop Environment (CDE) (default) and GNOME 2.6 (optional) | Oracle Solaris Desktop (GNOME 2.30) | Oracle Solaris Desktop (GNOME 2.30)  
Chapter 12, “Managing Desktop Features” |
| **Disk labeling** | UFS root disk is SMI (VTOC); UFS non-root disk is SMI or EFI  
ZFS root disk is SMI (VTOC); ZFS non-root disk is SMI or EFI (recommended) | ZFS root disk is SMI (VTOC); ZFS non-root disk is SMI or EFI (recommended) | SPARC with GPT-aware firmware and x86: ZFS root disk is EFI (GPT)  
SPARC: ZFS root disk is SMI (VTOC)  
SPARC and x86: ZFS non-root disk is SMI or EFI (recommended) |
| **File systems (default)** | ZFS, UFS, or Solaris Volume Manager root file systems | ZFS root file system (default) | ZFS root file system (default)  
Chapter 5, “Managing File Systems” |
| **x86: Firmware support** | BIOS | BIOS | UEFI and BIOS  
Chapter 3, “Managing Devices” |
| **GRUB configuration file (default)** | menu.lst | menu.lst | grub.cfg (Do not edit)  
“GRUB, Firmware, and Disk Labeling Changes” on page 122 |
<p>| <strong>GRUB configuration file (custom)</strong> | menu.lst | menu.lst | custom.cfg |</p>
<table>
<thead>
<tr>
<th>Feature or Command</th>
<th>Oracle Solaris 10</th>
<th>Oracle Solaris 11</th>
<th>Oracle Solaris 11.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation (graphical user interface (GUI))</td>
<td>GUI installation program on DVD or CD</td>
<td>Live Media (x86 only)</td>
<td>Live Media (x86 only)</td>
</tr>
<tr>
<td>Installation (interactive text)</td>
<td>Interactive text installation and interactive text installer for ZFS root pools</td>
<td>Text installer (stand-alone and network installation)</td>
<td>Text installer (stand-alone and network installation)</td>
</tr>
<tr>
<td>Installation (automated)</td>
<td>JumpStart feature of Oracle Solaris 10</td>
<td>Automated Installer (AI) feature of Oracle Solaris 11</td>
<td>Automated Installer (AI) feature of Oracle Solaris 11 Oracle VM Manager Ops Center</td>
</tr>
<tr>
<td>Installation (automated client configuration)</td>
<td>JumpStart profile files</td>
<td>AI manifests</td>
<td>AI manifests</td>
</tr>
<tr>
<td>Installation (other)</td>
<td>Oracle Solaris Flash Archive installation</td>
<td>See “System Boot, Recovery, and Platform Changes” on page 121.</td>
<td>See “System Boot, Recovery, and Platform Changes” on page 121.</td>
</tr>
<tr>
<td>Java (default version)</td>
<td>Java 6</td>
<td>Java 6</td>
<td>Java 7</td>
</tr>
<tr>
<td>Network configuration (fixed and reactive)</td>
<td>ifconfig</td>
<td>Fixed: dladm for datalinks and ipadm for IP configuration</td>
<td>Fixed: dladm for datalinks, ipadm for IP configuration, and netadm for viewing information about NCPs, including the Default Fixed NCP</td>
</tr>
<tr>
<td></td>
<td>Edit /etc/hostname.*</td>
<td>Reactive: netcfg and netadm</td>
<td>Reactive (active and non-active NCPs): netcfg and netadm</td>
</tr>
<tr>
<td></td>
<td>nadd for configuring protocols</td>
<td>Reactive (applies to currently active NCP only): dladm and ipadm for datalink and IP configuration</td>
<td>Reactive (applies to currently active NCP only): dladm and ipadm for datalink and IP configuration</td>
</tr>
</tbody>
</table>

Chapter 1 • Transitioning From Oracle Solaris 10 to an Oracle Solaris 11 Release (Overview) 17
<table>
<thead>
<tr>
<th>Feature or Command</th>
<th>Oracle Solaris 10</th>
<th>Oracle Solaris 11</th>
<th>Oracle Solaris 11.1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Network configuration (DHCP)</strong></td>
<td>Oracle Solaris DHCP and other naming services</td>
<td>Internet Systems Consortium (ISC) DHCP and legacy Sun DHCP</td>
<td>Internet Systems Consortium (ISC) DHCP and legacy Sun DHCP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Working With DHCP in Oracle Solaris 11.1</em></td>
</tr>
<tr>
<td><strong>Network configuration (IPMP)</strong></td>
<td>Miscellaneous commands, for example: <code>ifconfig</code> and <code>plumb/unplumb</code></td>
<td><code>dladm</code> and <code>ipadm</code></td>
<td><code>dladm</code> and <code>ipadm</code></td>
</tr>
<tr>
<td><strong>Network configuration (TCP/IP properties or tunables)</strong></td>
<td><code>ndd</code></td>
<td><code>ipadm</code></td>
<td><code>ipadm</code></td>
</tr>
<tr>
<td><strong>Network configuration (wireless)</strong></td>
<td><code>wificonfig</code></td>
<td><strong>Fixed:</strong> <code>dladm</code> and <code>ipadm</code></td>
<td><strong>Fixed:</strong> <code>dladm</code> and <code>ipadm</code></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Reactive:</strong> <code>netcfg</code> and <code>netadm</code></td>
<td><strong>Reactive:</strong> <code>netcfg</code>, and <code>netadm</code></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>From the desktop:</strong> NWAM GUI</td>
<td><strong>From the desktop:</strong> Network administration GUI</td>
</tr>
<tr>
<td><strong>Packaging (software management)</strong></td>
<td>SVR4 package and patch commands</td>
<td>Image Packaging System (IPS) <code>pkg(1)</code> commands, Package Manager, and Update Manager GUIs</td>
<td>Image Packaging System (IPS) <code>pkg(1)</code> commands, Package Manager, and Update Manager GUIs</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Chapter 6, &quot;Managing Software and Boot Environments”</strong></td>
<td><strong>Chapter 6, &quot;Managing Software and Boot Environments”</strong></td>
</tr>
<tr>
<td><strong>Print service (default)</strong></td>
<td>LP print service, <code>lp</code> print commands, Solaris Print Manager GUI</td>
<td>CUPS</td>
<td>CUPS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>“Printer Configuration and Management Changes” on page 129</em></td>
</tr>
</tbody>
</table>
TABLE 1–1 Oracle Solaris 10 Features Compared to Oracle Solaris 11 Features  (Continued)

<table>
<thead>
<tr>
<th>Feature or Command</th>
<th>Oracle Solaris 10</th>
<th>Oracle Solaris 11</th>
<th>Oracle Solaris 11.1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Security management</strong></td>
<td>root as a user account</td>
<td>root as a role</td>
<td>root as a role</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chapter 9, “Managing Security”</td>
<td></td>
</tr>
<tr>
<td><strong>System clustering</strong></td>
<td>Oracle Solaris Cluster 3.3</td>
<td>Oracle Solaris Cluster 4.0</td>
<td>Oracle Solaris Cluster 4.1</td>
</tr>
<tr>
<td><strong>System configuration and reconfiguration</strong></td>
<td>sysidtool, sys-unconfig, sysidconfig, and sysidcfg</td>
<td>sysconfig, System Configuration Interactive (SCI) tool, SC profiles</td>
<td>sysconfig, System Configuration Interactive (SCI) tool, SC profiles</td>
</tr>
<tr>
<td><strong>System configuration (naming services)</strong></td>
<td>Configured in files within /etc and /var</td>
<td>Managed through the Service Management Facility (SMF) feature of Oracle Solaris</td>
<td>Managed through the Service Management Facility (SMF) feature of Oracle Solaris</td>
</tr>
<tr>
<td><strong>System configuration (hostname)</strong></td>
<td>Edit /etc/nodename</td>
<td>svccfg -s sets the config/nodename property of the svc:system/identity:node service to the desired name.</td>
<td>Use the hostname command. “System Configuration Changes and Migration of System Configuration to SMF” on page 113</td>
</tr>
<tr>
<td><strong>System management (centralized)</strong></td>
<td>Oracle Enterprise Manager Ops Center 11g</td>
<td>Oracle Enterprise Manager Ops Center 12c</td>
<td>Oracle Enterprise Manager Ops Center 12c (12.1.2.0.0)</td>
</tr>
<tr>
<td><strong>System registration</strong></td>
<td>Auto Registration feature Oracle Configuration Manager, starting with Oracle Solaris 10 1/13</td>
<td>Oracle Configuration Manager</td>
<td>Oracle Configuration Manager and the Oracle Auto Service Request utility</td>
</tr>
<tr>
<td><strong>System upgrade and BE management</strong></td>
<td>lu and SVR4 package commands</td>
<td>pkg commands, Package Manager, Update Manager beadm utility for managing boot environments</td>
<td>pkg commands, Package Manager, Update Manager beadm utility for managing boot environments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chapter 6, “Managing Software and Boot Environments”</td>
<td></td>
</tr>
</tbody>
</table>
### Table 1–1  Oracle Solaris 10 Features Compared to Oracle Solaris 11 Features (Continued)

<table>
<thead>
<tr>
<th>Feature or Command</th>
<th>Oracle Solaris 10</th>
<th>Oracle Solaris 11</th>
<th>Oracle Solaris 11.1</th>
</tr>
</thead>
</table>
| **User account management** | useradd, usermod, userdel, groupadd, groupmod, groupmod, groupmod, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, 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rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, rolereadd, roleread

### Removal of Legacy System Management Commands, Tools, Services, and Files

The following table lists (in alphabetical order) the commands, files, services, and tools that are deprecated or have been removed.

<table>
<thead>
<tr>
<th>Legacy Command, File, Service, or Tool</th>
<th>Replacement Command, Tool, Service, or File</th>
<th>For More Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>bsmconv and bsmunconv</td>
<td>audit</td>
<td>audit(1M)</td>
</tr>
<tr>
<td>crypt and des</td>
<td>encrypt</td>
<td>encrypt(1)</td>
</tr>
<tr>
<td>/etc/defaultrouter</td>
<td>route</td>
<td>route(1M)</td>
</tr>
</tbody>
</table>

**Oracle Solaris 10 Features Compared to Oracle Solaris 11 Features**

**Removal of Legacy System Management Commands, Tools, Services, and Files**

The following table lists (in alphabetical order) the commands, files, services, and tools that are deprecated or have been removed.

**Table 1–2  Legacy System Management Commands, Files, Services, and Tools**

<table>
<thead>
<tr>
<th>Legacy Command, File, Service, or Tool</th>
<th>Replacement Command, Tool, Service, or File</th>
<th>For More Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>bsmconv and bsmunconv</td>
<td>audit</td>
<td>audit(1M)</td>
</tr>
<tr>
<td>crypt and des</td>
<td>encrypt</td>
<td>encrypt(1)</td>
</tr>
<tr>
<td>/etc/defaultrouter</td>
<td>route</td>
<td>route(1M)</td>
</tr>
</tbody>
</table>
TABLE 1–2  Legacy System Management Commands, Files, Services, and Tools  (Continued)

<table>
<thead>
<tr>
<th>Legacy Command, File, Service, or Tool</th>
<th>Replacement Command, Tool, Service, or File</th>
<th>For More Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>graph and spline</td>
<td>gnuplot</td>
<td>gnuplot(1)</td>
</tr>
<tr>
<td>SPARC: installboot</td>
<td>Oracle Solaris 11.1: bootadm</td>
<td>“ZFS Root Pool Disk and Boot Administration” on page 52</td>
</tr>
<tr>
<td>SPARC: installgrub</td>
<td>install-bootloader (SPARC and x86)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note – Install the image/gnuplot package.</td>
</tr>
<tr>
<td>localeadm</td>
<td>Locale facet mechanism</td>
<td>&quot;Internationalization and Localization Changes&quot; on page 131</td>
</tr>
<tr>
<td>Print commands:</td>
<td>cancel, cupsaccept, cupsreject, cupsdisable, cupsenable, lp, lpasswd, \lpc, \lpinfo, \lpmove, \lpoptions, \lpq, \lpr, \lpm, \lpstat, and system-config-printer (launches CUPS Print Manager)</td>
<td>&quot;Printer Configuration and Management Changes&quot; on page 129</td>
</tr>
<tr>
<td>Print (LP) files and descriptions:</td>
<td>\lpoptions(1)</td>
<td></td>
</tr>
<tr>
<td>~/.printers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/etc/printers.conf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/etc/lp/printers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/var/spool/lp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/var/lp/logs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legacy SMF print services:</td>
<td></td>
<td>&quot;Printer Configuration and Management Changes&quot; on page 129</td>
</tr>
<tr>
<td>svc:/application/print/ppd-cache-update:default</td>
<td></td>
<td></td>
</tr>
<tr>
<td>svc:/application/print/server:default</td>
<td></td>
<td></td>
</tr>
<tr>
<td>svc:/application/print/rfc1179:default</td>
<td></td>
<td></td>
</tr>
<tr>
<td>svc:/application/print/ipp-listener:default</td>
<td></td>
<td></td>
</tr>
<tr>
<td>svc:/application/print/service-selector:default</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replacement SMF print services:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>svc:/application/cups/scheduler</td>
<td></td>
<td></td>
</tr>
<tr>
<td>svc:/application/cups/in-lpd</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pmconfig and /etc/power.conf</td>
<td>poweradm</td>
<td>poweradm(1M)</td>
</tr>
<tr>
<td>rdist</td>
<td>rsync or scp</td>
<td>rsync(1) and scp(1)</td>
</tr>
<tr>
<td>rstart and rstartd</td>
<td>ssh</td>
<td>ssh(1)</td>
</tr>
</tbody>
</table>
TABLE 1–2 Legacy System Management Commands, Files, Services, and Tools (Continued)

<table>
<thead>
<tr>
<th>Legacy Command, File, Service, or Tool</th>
<th>Replacement Command, Tool, Service, or File</th>
<th>For More Information</th>
</tr>
</thead>
</table>
| saf, sac, sacadm, nlsadmin, pmadm, ttyadm, and listen | ttymon express mode is still supported by the following SMF services: 
- svc:/system/console-login:term | “System Console, Terminal Services, and Power Management Changes” on page 118 |
| /usr/include/listen.h, getty, /usr/lib/saf/nlps_server, /var/saf, /etc/saf, ttymon (sac and getty modes only), and ports (sac functionality) | | |
| | | |
| Network SMF services: | | Chapter 7, “Managing Network Configuration” |
| svc:/network/physical:default | | |
| svc:/network/physical:nwm | | |
| This SMF service is deprecated in Oracle Solaris 11. However, the service is still listed in the output of the svcs -a command. | | |
| | | |
| smoservice and smdiskless | No replacement available | |
| sysidtool, sys-unconfig, and sysidcfg | sysconfig, SCI tool, and SC configuration through profiles | “System Configuration Tools Changes” on page 120 |
| User account management: Solaris Management Console GUI, smc, smuser, smgroup, and passmgmt | useradd, usermod, userdel, groupadd, groupmod, groupdel, roleadd, rolemod, roledel | “Managing User Accounts” on page 156 |
| | Starting with Oracle Solaris 11.1: User Manager GUI | |
| void daemon | volfs and rmvolmgr | Chapter 3, “Managing Devices” |
| | | |

For more information about legacy commands that are no longer supported, see Oracle Solaris 11.1 Release Notes.
Transitioning Your Oracle Solaris 10 System to an Oracle Solaris 11 Release

When transitioning to Oracle Solaris 11, keep the following key points in mind:

- No upgrade methods or tools are available to transition from Oracle Solaris 10 to an Oracle Solaris 11 release. You cannot use an installer to upgrade from Oracle Solaris 10 to an Oracle Solaris 11 release. You must perform a fresh installation by using one of the installation options that are described in this chapter.

  However, you can migrate your Oracle Solaris 10 OS instances or zones and your data to an Oracle Solaris 11 system. For more information, see Table 1–3.

- The following Oracle Solaris 10 installation features are not available in an Oracle Solaris 11 release: the Oracle Solaris installation upgrade option, the Oracle Solaris Flash Archive installation method, JumpStart, and the Oracle Solaris Live Upgrade feature (lu suite of commands).

  The Automated Installer (AI) replaces JumpStart, and the beadm utility provides similar functionality to the lu commands. For more information, see “Migrating From JumpStart to AI” on page 35 and “Tools for Managing Boot Environments” on page 80.

- Oracle Solaris 11 introduces the Image Packaging System (IPS), which is a different mechanism than the legacy SVR4 package commands that are used in Oracle Solaris 10 and previous releases. See Chapter 6, “Managing Software and Boot Environments.”

Table 1–3 describes the tools and features that are available for transitioning to an Oracle Solaris 11 release.

<table>
<thead>
<tr>
<th>Tool or Feature</th>
<th>Description</th>
<th>For More Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>JumpStart Migration Utility (js2ai)</td>
<td>Used to convert Oracle Solaris 10 JumpStart rules, profiles, and sys.idcfg file to a format that is compatible with AI manifest entries.</td>
<td>Transitioning From Oracle Solaris 10 JumpStart to Oracle Solaris 11.1 Automated Installer</td>
</tr>
<tr>
<td>ZFS shadow migration feature</td>
<td>Used to migrate data from an existing file system to a new file system.</td>
<td>Chapter 4, “Managing Storage Features”</td>
</tr>
<tr>
<td>Oracle Solaris 11 support for Oracle Solaris 10 zones</td>
<td>Used to migrate your Oracle Solaris 10 application environments to an Oracle Solaris 11 system.</td>
<td>Chapter 10, “Managing Oracle Solaris Releases in a Virtual Environment”</td>
</tr>
</tbody>
</table>
### Installation Features

The following installation methods are available:

- **x86: GUI installation with the Live Media** – The GUI installer can be used to install Oracle Solaris 11 on x86 platforms only. The GUI installer is capable of functioning with a minimum 1.5 GB of memory. The exact minimum requirement varies depending on system specifications. See "Installing Oracle Solaris by Using Installation Media" on page 34 for details.

- **Interactive text installation (From media or over the network)** – The text installer enables you to install Oracle Solaris on SPARC and x86 based systems from media or over a network.

- **Automated installation on single or multiple systems** – The Automated Installer (AI) installs Oracle Solaris 11 on a single or multiple client systems from an installation server on a network. Similar to JumpStart, AI provides a hands-free installation. You can also perform automated installations that boot from media. See "Installing Oracle Solaris by Using AI" on page 38.

  AI also supports the installation of zones. See “Oracle Solaris 11 Zone Features” on page 148.

- **Customized installation image creation with the Distribution Constructor** – The Distribution Constructor tool creates preconfigured installation images. See “Oracle Solaris Installation Methods” on page 32.

These installation tools and methods are no longer available:

- **Oracle Solaris Flash Archive Installation** – For information about recovering from a system failure, see “System Boot, Recovery, and Platform Changes” on page 121.


- **Oracle Solaris Live Upgrade feature** – The suite of commands (lu) that are part of the Oracle Solaris Live Upgrade feature are also no longer supported. The `beadm` utility provides similar capability. See “Tools for Managing Boot Environments” on page 80.

See Chapter 2, “Transitioning to an Oracle Solaris 11 Installation Method.”

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**TABLE 1-3  Oracle Solaris 11 Transition Tools and Features (Continued)**

<table>
<thead>
<tr>
<th>Tool or Feature</th>
<th>Description</th>
<th>For More Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFS file sharing and pool migration</td>
<td>Used to access shared files from an Oracle Solaris 10 system on an Oracle Solaris 11 system.</td>
<td>Chapter 5, “Managing File Systems”</td>
</tr>
<tr>
<td></td>
<td>Used to import a ZFS storage pool from an Oracle Solaris 10 system into an Oracle Solaris 11 system.</td>
<td></td>
</tr>
</tbody>
</table>
Automated Installer Enhancements

The following automated installation enhancements are introduced in this release:

- **installadm command options** – The installadm command has three new options: update-service, update-profile, and set-service. These options enable you to maintain a set of installation services. The ability to specify a manifest location with a system boot argument has also been added in this release. See Part III, “Installing Using an Install Server,” in Installing Oracle Solaris 11.1 Systems.

- **Installer support for connecting to Oracle support services** – The Oracle Configuration Manager and the Oracle Auto Services Request utility are enabled by default for the purpose of collecting system configuration information during an installation. Both services are enabled through two new Oracle Solaris 11.1 installation screens. See Appendix A, “Working With Oracle Configuration Manager,” in Installing Oracle Solaris 11.1 Systems.

- **Interactive installation on iSCSI Targets** – The ability to install to iSCSI target logical unit numbers (LUNs) is included in the Oracle Solaris 11.1 interactive text and Live Media installers. You can choose between installing on local disks or connecting to a remote iSCSI disk by using DHCP auto-discovery or by manually specifying a target IP address, iSCSI target name and LUN, and an initiator name. This feature change enables installed OS images to be maintained in a central location. See “Installing With the GUI installer” in Installing Oracle Solaris 11.1 Systems.

- **Role-based access control (RBAC) profiles and authorizations for managing the Automated Install service** – Many of the commands that are used with an automated installation require increased privilege. Use one of the following methods to gain more privilege:
  - Use the profiles command to list the privileges that are assigned to you.
  - Use the sudo command with your user password to execute a privileged command. Use of the sudo command is dependent upon the security policy at your site.
  - Use the roles command to list the roles that are assigned to you. If you have the root role, you can use the su command to assume that role.

See “Install Server Requirements” in Installing Oracle Solaris 11.1 Systems.

Software and Boot Environment Management Features

The Oracle Solaris 11 software is distributed in packages that are managed by the Image Packaging System (IPS). After you install the OS, you can access package repositories to install additional or updated software packages on your system. With IPS commands, you can list, search, install, update, and remove software packages.
Software management includes the following components:

- **IPS command-line utilities** – IPS includes `pkg` commands that install and manage packages from the command line. IPS commands also enable you to manage package publishers and copy or create package repositories.

- **IPS repositories** – An IPS repository is a location from which you can install software packages.

- **Boot environment management** – Boot environments (BEs) are bootable instances of an image. The `beadm` utility is used to create and manage boot environments.

**Note** – No upgrade path from Oracle Solaris 10 to Oracle Solaris 11 is available. You must perform a fresh installation, but first review the migration features in Table 1–3. You can use the `pkg update` command to update one or more packages from one version to a newer version.

---

**Network Administration Features**

Network administration includes the following key features:

- **Bridging technologies** – Bridges are used to connect separate network segments that are paths between two nodes. When connected by a bridge, the attached network segments communicate as if they were a single network segment. Bridging is implemented at the datalink layer (L2) of the networking stack. Bridges use a packet-forwarding mechanism to connect subnetworks.

  Data center bridging (DCB) enables the same network fabric to be used for both Ethernet and storage traffic. For information about additional changes to bridging technologies in the current release, see “Network Configuration Feature Changes” on page 83.

- **Datalink and IP configuration migration to one SMF network configuration repository** – One SMF network configuration repository for both datalink and IP configuration is now used. Also, the `svc:/network/physical:default` SMF service now manages network configuration for both fixed and reactive network configuration.

- **Generic datalink name assignment** – Generic names are automatically assigned to datalinks using the `net0`, `net1`, `netN` naming convention, depending on the total number of network devices that are on the system. See “Displaying and Configuring Datalinks in Fixed Mode” on page 91.

- **Integrated Load Balancer (ILB)** – The ILB feature of Oracle Solaris provides Layer 3 and Layer 4 load-balancing capabilities for both SPARC and x86 based systems. ILB intercepts incoming requests from clients, decides which back-end server should handle the request based on load-balancing rules, and then forwards the request to the selected server. You can optionally configure an Oracle Solaris system as a load balancer. ILB performs optional
health checks and provides the data for the load-balancing algorithms, then verifies whether the selected server can handle the incoming request. See `1lbadm(1M)`.

- **IP network multipathing (IPMP) configuration changes** – Starting with Oracle Solaris 11, IPMP has a new conceptual model and different commands for managing IPMP configuration. See "Configuring IPMP in Oracle Solaris 11" on page 104.

- **Network observability** – In Oracle Solaris 10, the `ifconfig` and `netstat` commands are used to manage network observability. In Oracle Solaris 11, the `d1stat` and `flowstat` commands are used. For zones, you can use the `zonstat` command. See the `d1stat(1M)`, `flowstat(1M)`, and `zonstat(1)` man pages.

- **Profile-based network configuration** – Starting with Oracle Solaris 11, network configuration is profile-based. Two network configuration modes are used: fixed and reactive. The switch between network configuration modes no longer takes place at the service level, but at the profile level. The system defaults to fixed network configuration mode after a text installation or an installation with AI. See "How the Network Is Configured During an Installation" on page 86.

- **Virtual network interface cards (VNICs)** – VNICs are pseudo interfaces that you create on top of datalinks. Along with virtual switches, VNICs are the building blocks of a virtual network. You can create and modify VNICs in a system or in a zones environment. Starting with Oracle Solaris 11.1, the migration of VNICs is also possible. See "Building Virtual Networks" in Using Virtual Networks in Oracle Solaris 11.1.

See Chapter 7, “Managing Network Configuration.”

### System Configuration and SMF Features

The following system configuration and SMF features are supported:

- **Oracle Auto Service Request utility** – This feature can be used by customers who have a valid My Oracle Support account. See “System Registration and System Support Changes” on page 120.

- **SMF administrative layers** – Information for recording the source of properties, property groups, instances, and services has been added to the SMF repository. This information enables you to determine which settings are administrative customizations and which settings were delivered with Oracle Solaris by a manifest. See "SMF Administrative Changes" on page 116.

- **SMF manifest creation tool** – The `svcbundle` command can be used to generate SMF manifests, as well as profiles. The manifest is specified by using multiple `-s` options. To generate a manifest, you must specify the `service-name` and `start-method` command options. See `svcbundle(1M)`.
Storage and File Systems Features

- **System Configuration Interactive (SCI) utility** – Uses SMF to centralize configuration information. The `sysconfig` utility replaces the `sys-unconfig` and `sysidtool` utilities that are used in Oracle Solaris 10. You can run the `sysconfig` utility interactively by using the SCI utility or in an automated manner by creating an SC configuration profile. See “System Configuration Tools Changes” on page 120.

- **System console and terminal device management** – The system console and locally connected terminal devices are now managed by SMF. The `sac` and `saf` programs for managing console services and terminals are no longer available.

- **System, network, and name services configuration migration to SMF** – Several aspects of system and network configuration, including configuration that was previously stored in various files within the `/etc` directory, is now stored in an SMF repository. Migrating configuration data to SMF service properties enables the delivery of a uniform, extensible architecture for system configuration that provides customers with a more complete capability for managing system configuration. See “System Configuration Changes and Migration of System Configuration to SMF” on page 113.

- **System registration** – Oracle Configuration Manager collects configuration information and then anonymously uploads it to the Oracle repository during the first reboot of a system after an installation. This information is analyzed and then used by Oracle to provide better service to customers. In Oracle Solaris 10, the Auto Registration feature performs a similar function. Starting with the Oracle Solaris 10 1/13 release, Oracle Configuration Manager replaces the Auto Registration feature. See “System Registration and System Support Changes” on page 120.

See Chapter 8, “Managing System Configuration.”

Storage and File Systems Features

The following features are related to storage and file systems management:

- **Storage is simplified** – Oracle's Sun ZFS Storage Appliance provides a low-cost storage solution and simplified administration with a browser-based management and monitoring tool. The appliance can be used to share data between your Oracle Solaris 10 and Oracle Solaris 11 systems. As in Solaris 10 releases, data can be shared between your Oracle Solaris 10 and Oracle Solaris 11 systems by using the NFS protocol. In the Oracle Solaris 11 release, you can also share files between systems that are running Oracle Solaris and Windows by using the Server Message Block (SMB) protocol.

- **Improved device management** – New commands are available and existing commands have been updated to help you locate storage devices by their physical locations.

- **ZFS file system is the default file system** – ZFS fundamentally changes the way file systems are administered. ZFS includes features and benefits that are not found in any other file system that is available today.
The following features help you transition either your UFS file system or your ZFS storage pools to systems that are running Oracle Solaris 11:

- **Migrate your UFS data with ZFS shadow migration** – The ZFS shadow migration feature is used to migrate data from an existing file system to a new file system. You can either migrate a local file system to a new file system or migrate an NFS file system to a new local file system. For more information, see “Transitioning Your Oracle Solaris 10 System to an Oracle Solaris 11 Release” on page 23.

- **Migrate your Oracle Solaris 10 storage pools** – Storage devices that contain ZFS storage pools on your Oracle Solaris 10 systems can be exported, disconnected, if necessary, and imported into your Oracle Solaris 11 systems.

- **Migrate your UFS data** – You can remotely mount UFS file systems from an Oracle Solaris 10 system on an Oracle Solaris 11 system. In addition, a `ufsdump` of your UFS data can be restored into a ZFS file system by using the `ufrestore` command.


### Security Features

Oracle Solaris 11 introduces several new features and key enhancements in these areas:

- Auditing
- Containment security
- Cryptographic security
- Network security
- Rights management

For more information about these changes, see Chapter 9, “Managing Security.”

### Virtualization Features

Oracle Solaris 11 provides support for the following virtualization features:

- Oracle Solaris 10 zones
- Automated installation of non-global zones
- Zones monitoring
- NFS server support
- Network virtualization

For more information about these changes, see Chapter 10, “Managing Oracle Solaris Releases in a Virtual Environment.”
User Account Management and User Environment Features

Oracle Solaris 11 introduces several important changes to how user accounts are set up and managed, as well as changes to the default user environment.

Some key changes in this release include the following:

- **Tools for creating and managing user accounts** – In Oracle Solaris 11, user accounts are managed solely by using command-line tools, such as the `useradd`, `usermod`, and `userdel` commands. The Solaris Management Console GUI and its associated command-line, for example, the `smc` and `smuser` commands, are no longer available. Starting with Oracle Solaris 11.1, the User Manager GUI provides capability that is similar to Solaris Management Console. The User Manager GUI can be used to create and manage users from the desktop.

- **Default user shell and path** – Oracle Solaris 11 provides more familiarity with Linux and Berkeley Software Distribution (BSD) operating systems. As a result, the default user shell and path have been changed, See "Default Login Shell and PATH Environment Variable" on page 161.

- **Administrative command locations** – Administrative commands have moved from `/sbin` to `/usr/sbin`.

- **Development tools locations** – Development tools have moved from `/usr/ccs/bin` to `/usr/bin`.

See Chapter 11, “Managing User Accounts and User Environments.”

Desktop Features

Oracle Solaris 11 introduces several important changes to the desktop environment. The default desktop is now the Oracle Solaris Desktop, which includes GNOME 2.30 from the GNOME Foundation, the Firefox web browser, Thunderbird Email client, and the Lightning calendar manager from the Mozilla Foundation.

**Note** – The login manager has changed from CDE to the GNOME Desktop Manager (GDM). If you are transitioning from Oracle Solaris 10 to Oracle Solaris 11, and you previously customized your CDE login, review your display management configuration, as you might need to make some changes to the GDM configuration to ensure it works as expected. For more information, see "Troubleshooting Desktop Transition Issues" on page 168.

See Chapter 12, “Managing Desktop Features.”
Oracle Solaris 11 introduces new installation features and methods for system administrators. This chapter provides conceptual information and some brief examples to acquaint you with these new methods, including information that applies specifically to Oracle Solaris 11.1. See the relevant Oracle Solaris 11 installation product documentation for detailed installation instructions for the Oracle Solaris 11 release that you are installing. This chapter also includes basic information about migrating from JumpStart to the Automated Installer (AI).

The following topics are covered:
- “Oracle Solaris Installation Methods” on page 32
- “Oracle Solaris Installation Requirements” on page 32
- “Installing Oracle Solaris by Using Installation Media” on page 34
- “Migrating From JumpStart to AI” on page 35
- “Installing Oracle Solaris by Using AI” on page 38
- “Additional Installation Tasks” on page 42
- “Troubleshooting an Oracle Solaris Installation” on page 45

For an end-to-end example of a basic AI installation of a SPARC based system, see Appendix A, “SPARC Automated Installation Scenario.”

For information about upgrading your Oracle Solaris 11 system to Oracle Solaris 11.1, see Updating to Oracle Solaris 11.2.

For information about how the network is configured during an installation, see “How the Network Is Configured During an Installation” on page 86.
Oracle Solaris Installation Methods

Table 2–1 summarizes the installation methods that are available in this release. Except for AI, all of these installation methods are used to install single systems. AI can be used to install single systems or multiple systems over the network.

<table>
<thead>
<tr>
<th>Installation Method</th>
<th>Preparation?</th>
<th>Install Server?</th>
<th>Single or Multiple Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live Media installation (x86 only)</td>
<td>No</td>
<td>No</td>
<td>Single</td>
</tr>
<tr>
<td>Text installation</td>
<td>No</td>
<td>No</td>
<td>Single</td>
</tr>
<tr>
<td>Text installation over the network</td>
<td>Yes</td>
<td>Yes, for retrieving the installation image from the server.</td>
<td>Single</td>
</tr>
<tr>
<td>Automated installations booting from media</td>
<td>Yes</td>
<td>Yes, for customized media preparation. No for installation.</td>
<td>Single</td>
</tr>
<tr>
<td>Automated installations of multiple clients</td>
<td>Yes</td>
<td>Yes</td>
<td>Single or multiple</td>
</tr>
</tbody>
</table>

Oracle Solaris Installation Requirements

Before installing an Oracle Solaris 11 release, refer to the following requirements.

ZFS Root Pool Installation Requirements

Oracle Solaris 11 is installed in a ZFS storage pool called the root pool. The root pool installation requirements are as follows:

- **Memory** – The minimum memory requirement is 1 GB. The Live Media ISO image, and both the GUI and text installers, are capable of functioning with a limited amount of memory. The exact requirement varies, depending on system specifications.

  If you want to install an Oracle Solaris 11 virtual image on Oracle VM VirtualBox, see the memory requirements listed here:


- **Disk space** – At least 13 GB of disk space is recommended. The space is consumed as follows:
Swap area and dump device – The default sizes of the swap and dump volumes created by the Oracle Solaris installation programs vary, based on the amount of memory that is on the system and other variables.

After installation, you can adjust the sizes of your swap and dump volumes to the sizes of your choosing, as long as the new sizes support system operation. See “Managing Your ZFS Swap and Dump Devices” in Oracle Solaris 11.1 Administration: ZFS File Systems.

Boot environment (BE) – A ZFS BE is approximately 6–8 GB in size, but can vary greatly depending on the size of the dump device. The size of the dump device is based on the size of the system’s physical memory. In addition, consider that the size of a new BE increases when it is updated, depending on the amount of updates. You will need to monitor the disk space usage of all BEs on the system. All ZFS BEs in the same root pool use the same swap and dump devices.

Oracle Solaris OS components – All subdirectories of the root file system that are part of the OS image, with the exception of /var, must be in the same dataset as the root file system. In addition, all Oracle Solaris OS components must reside within the root pool, with the exception of the swap and dump devices. For information about specific disk requirements, see Chapter 3, “Managing Devices.”

x86 only: Support for running multiple operating systems – You can partition the disk that will contain the OS prior to an installation or during an installation. See “Partitioning Your System” in Installing Oracle Solaris 11.1 Systems.

Oracle Solaris Preinstallation Tasks

Before installing an Oracle Solaris 11 release, review the following information:

- **x86: Prepare the boot environment (applies to x86 based systems that will run multiple operating systems)** – See “Preparing a Boot Environment for Installing Multiple Operating Systems” in Installing Oracle Solaris 11.1 Systems.

- **Ensure that you have the proper device drivers** – Before installing Oracle Solaris 11, determine whether the devices on your system are supported. You can use the Device Driver Utility to ensure that your system has the proper devices. The Device Driver Utility can be accessed through the text installer menu options. See “Ensuring That You Have the Proper Device Drivers” in Installing Oracle Solaris 11.1 Systems. See also the Hardware Compatibility Lists (HCL) at http://www.oracle.com/webfolder/technetwork/hcl/index.html.

- **x86: Configure the system’s date and time (applies to x86 platforms that are installed with AI only)** – Oracle Solaris 11 keeps the Real Time Clock (RTC) in Coordinated Universal time (UTC) format. The behavior on x86 platforms is different than in Oracle Solaris 10. AI does not adjust the RTC date and time during an installation. To configure the date and time, see “Configuring Date and Time Before and After an Installation” on page 42.
Installing Oracle Solaris by Using Installation Media

Oracle Solaris can be installed by using any of the following installation methods:

- **x86: Live Media**
  
The installer on the Live Media ISO image is for x86 platforms only. The Live Media installs a GUI desktop. Also, the Live Media requires more memory than the text installer. The exact memory requirements vary for each system. See “Oracle Solaris Installation Requirements” on page 32.

  If you are installing on x86 platforms that will run multiple operating systems, you can partition your disk during the installation process. See “Partitioning Your System” in Installing Oracle Solaris 11.1 Systems.

  The GUI installer cannot upgrade your operating system. The default GUI installer settings are described in “Default Settings With the GUI Installer” in Installing Oracle Solaris 11.1 Systems.

  To install the OS by using either the Live Media or the text installer, download the installation media from:


  You can copy the downloaded image to removable media, such as a USB drive or burn it to a DVD by using the usbcopy utility. To use the usbcopy utility, you must first install the pkg:/install/distribution-constructor package. See “How to Perform a GUI Installation” in Installing Oracle Solaris 11.1 Systems.

- **Interactive text installer**
  
The text installation media contains a set of software that is more appropriate for a general-purpose server. The text installer can perform an installation on an existing Oracle Solaris x86 partition or on a SPARC slice. Or, the text installation can use the entire disk. If the whole disk option is chosen, a partition or slice is created to cover the targeted device. In either case, the installation overwrites everything on the targeted partition or slice. See “How to Perform a Text Installation” in Installing Oracle Solaris 11.1 Systems. If you use the text installer, you might have to install additional software packages afterwards. See “Adding Software After Text Installation” in Installing Oracle Solaris 11.1 Systems.

  If you are set up to perform an automated installation over the network, you can also perform an interactive text installation over the network. When using this method, you can only install a single system at a time. However, you can modify installation specifications by using the interactive selections. See “How to Perform a Text Installation Over the Network” in Installing Oracle Solaris 11.1 Systems.

- **Automated installations that boot from media**
  
  You can boot an AI image from media or a USB device to initiate a hands-free installation of just that system. An AI manifest provides installation instructions for the system. See “Creating a Custom AI Manifest” in Installing Oracle Solaris 11.1 Systems. The system must
have the minimum amount of required memory and adequate disk space. Also, the system must have network access so that software packages can be retrieved from an IPS repository on the Internet or on the local network. This step is required to complete the installation. See “Installing Using AI Media” in Installing Oracle Solaris 11.1 Systems.

For more information, see “Installing Oracle Solaris by Using AI” on page 38.

You can also create custom Live Media images, text installer images, and AI images. See Creating a Custom Oracle Solaris 11.1 Installation Image.

Note – After your system is installed, it cannot be updated by using a method that is similar to Solaris 10 upgrade methods. An Oracle Solaris 11 system is updated based on your desired maintenance schedule by using the pkg utility. See “Installing and Updating Packages” in Oracle Solaris Administration: Common Tasks. See also Updating to Oracle Solaris 11.2.

The following installation features are no longer supported:

- **Oracle Solaris Flash Archive Installation** – You can restore root pool snapshots to recover from a failed system or devices. See “System Boot, Recovery, and Platform Changes” on page 121.
- **JumpStart feature of Oracle Solaris** – The Automated Installer replaces this feature. See Transitioning From Oracle Solaris 10 JumpStart to Oracle Solaris 11.1 Automated Installer.

**Oracle Solaris 11.1 Installation Media Paths**

The media paths for the Oracle Solaris 11.1 installers are as follows:

- **x86 only: Live Media**
  - Oracle_Solaris-11_1-Live-X86
- **SPARC: Interactive text installer**
  - Oracle_Solaris-11_1-Text-SPARC
- **x86: Interactive text installer**
  - Oracle_Solaris-11_1-Text-X86
- **SPARC: Automated Installer**
  - Oracle_Solaris-11_1-AI-SPARC
- **x86: Automated Installer**
  - Oracle_Solaris-11_1-AI-X86

**Migrating From JumpStart to AI**

The Automated Installer (AI) performs automated installations of networked systems. This installation method replaces the JumpStart installation method that is used in Oracle Solaris 10. For a detailed comparison of the two installation methods, see Transitioning From Oracle Solaris 10 JumpStart to Oracle Solaris 11.1 Automated Installer.
JumpStart to AI Migration Tasks

The js2ai utility can be used to assist you in migrating from JumpStart to AI. The utility is used to convert Oracle Solaris 10 JumpStart rules, profiles, and sysidcfg files to an AI manifest and system configuration files. See the js2ai(1M) man page for more details.

To use the js2ai utility, install the software package:

```
# pkg install install/js2ai
```

You can use the js2ai utility to perform most of the following tasks:

- **Replace JumpStart rules and profile files with AI criteria files and AI manifests**
  AI uses client criteria to specify which AI manifest files each client system should use to complete an installation. When adding an AI manifest to an AI install service, the criteria can be specified on the command line or in a file. AI uses client criteria to specify which client systems should use which AI manifest files to complete their installation. Use the js2ai utility with the -r option to convert both JumpStart rules and their associated profiles to AI criteria and manifests. Initially, you can use the -S option to skip validation:

```
# /usr/sbin/js2ai -rS [-d sysidcfg-dir] [-D destination-dir]
```


- **Convert JumpStart files to an AI configuration files**
  AI system configuration profiles are SMF XML profile files that specify system configuration. Use the js2ai utility with the -s option to convert any sysidcfg files that are associated with this JumpStart configuration to system configuration profile files. Initially, use the -S option to skip validation:

```
# /usr/sbin/js2ai -sS [-d sysidcfg-dir] [-D destination-dir]
```

See “Using js2ai to Convert sysidcfg Files to System Configuration Profiles” in Transitioning From Oracle Solaris 10 JumpStart to Oracle Solaris 11.1 Automated Installer.

- **Set up an install server**
  You can use the same Oracle Solaris 11 server as both a JumpStart install server and an AI install server. However, JumpStart can only be used to install Oracle Solaris 10, not Oracle Solaris 11. See Chapter 4, “Installing Oracle Solaris 10 Using JumpStart on an Oracle Solaris 11 Server,” in Transitioning From Oracle Solaris 10 JumpStart to Oracle Solaris 11.1 Automated Installer.
Note – Customers who have a valid My Oracle Support contract can now set up an Oracle Solaris 10 1/13 system as an AI install server by installing extra software packages. This offering enables an installation of the Oracle Solaris 11 11/11 release only. For more information, go to https://support.oracle.com/.

- **Dynamically derive an AI provisioning manifest**

  As an alternative to creating custom AI manifests, you can write a script that dynamically creates an AI manifest for each client at client installation time. This manifest is called a *derived manifest* because it is based on attributes of each client that is discovered at installation time. JumpStart begin scripts provide the ability to dynamically manipulate installation parameters that are passed to the installer. See “Creating an AI Manifest at Client Installation Time” in *Installing Oracle Solaris 11.1 Systems*.

- **Access a software package repository for AI installations**

  After accessing the package repository (http://pkg.oracle.com/solaris/release) for AI installations, make a local copy of the package repository. See Chapter 2, "Copying IPS Package Repositories," in *Copying and Creating Oracle Solaris 11.1 Package Repositories*.

- **Provide system configuration instructions**

  You can use system configuration profiles to specify the configuration for the client system as a set of configuration parameters, in the form of a Service Management Facility (SMF) profile. This profile is applied during the first boot of the system after an AI installation. If you do not provide a system configuration profile for a particular client, the interactive configuration tool opens on that client during the installation. You can create a system configuration profile manually or by running the interactive configuration tool and saving the output to a file. For example, the following command creates a valid profile in sc.xml from responses that you provide interactively:

  ```bash
  # sysconfig create-profile -o sc.xml
  ```

  See Chapter 11, “Configuring the Client System,” in *Installing Oracle Solaris 11.1 Systems*.

- **Create an SMF service that runs on first boot and executes a user-defined script**

  For any additional installation or configuration that cannot be accomplished by using an AI manifest or a system configuration profile, you can create a script that is executed at first boot by a run-once SMF service. See Chapter 13, “Running a Custom Script During First Boot,” in *Installing Oracle Solaris 11.1 Systems*. 

Chapter 2 • Transitioning to an Oracle Solaris 11 Installation Method

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Installing Oracle Solaris by Using AI

The AI installation method can be used to perform a hands-free installation of Oracle Solaris. Keep the following key points in mind:

- You can use AI to install single or multiple clients over the network.
- An AI server provides multi-platform installation support. However, you must create a separate install service for each client architecture (SPARC and x86) that you plan to install.
- Clients must be able to access an Oracle Solaris Image Packaging System (IPS) software package repository to retrieve the required software packages for the installation.
- The location of the IPS package repository, which is specified by a Universal Resource Identifier (URI), can be on the install server, on a server that is on the local network, or on the Internet. See “Configuring Publishers” in Adding and Updating Oracle Solaris 11.1 Software Packages.
- Clients can optionally be customized with specific installation parameters, for example, disk layout and software selection.
- Clients can be optionally customized with specific system configuration parameters, for example, host name, network configuration, and user account information.
- Customizations can be made on a client-by-client basis and can also be scaled for large enterprise environments.

The AI process follows this general sequence:

1. The client system is booted from the network and retrieves its network configuration and the location of the install server from the DHCP server. SPARC clients can optionally get network configuration and location of the install server from by setting the network-boot-arguments variable in the Open Boot PROM (OBP).

   **Note** – The Reverse Address Resolution Protocol (RARP) does not work for booting and installing a system over the network with AI.

2. The install server provides a boot image to the client.
3. Characteristics of the client determine which installation instructions and which system configuration instructions are used to install the client.
4. Oracle Solaris 11 is installed on the client by pulling packages from the package repository that is specified by the installation instructions in the AI install service that you create.
AI Preinstallation Tasks

Prior to installing a system with AI, you must perform certain tasks. At minimum, you must set up an AI install server and create at least one install service. This scenario works well in situations where all of the clients are of the same architecture and will be installed with the same version of the Oracle Solaris OS. This type of installation uses the default AI manifest, which is not associated with any client criteria. When you create a new AI install service, 

/install-service-image-path/auto_install/manifest/default.xml

is the initial default AI manifest for that install service. In Oracle Solaris 11.1, the default AI manifest specifies the most recent version of the Oracle Solaris 11.1 release that is available from the IPS package repository (http://pkg.oracle.com/solaris/release).

AI uses DHCP to provide the IP address, subnet mask, router, name service server, and the location of the install server to the client machine to be installed. SPARC clients can optionally get their network configuration and install server location from the network-boot-arguments variable that is set in the OpenBoot PROM (OBP). Note that the DHCP server and AI install server can be the same system or two different systems. For more information about setting up an install server, see Chapter 8, "Setting Up an Install Server," in Installing Oracle Solaris 11.1 Systems.

For more information about the minimum set of tasks that must be completed to use AI, see "Minimum Requirements for AI Use" in Installing Oracle Solaris 11.1 Systems.

For a basic SPARC AI installation example that follows the minimum requirements for using AI, see Appendix A, "SPARC Automated Installation Scenario."

For additional information about customizing AI installations, provisioning client systems, and configuring client systems, refer to the following documentation:

- Chapter 9, “Customizing Installations,” in Installing Oracle Solaris 11.1 Systems
- Chapter 10, "Provisioning the Client System," in Installing Oracle Solaris 11.1 Systems
- Chapter 11, "Configuring the Client System," in Installing Oracle Solaris 11.1 Systems

Setting Up an Install Client

When you initially set up your install server, you created at least one install service for each client architecture and for each version of Oracle Solaris that you plan to install. For each install service that you create for the different client architectures, you must also create customized installation instructions and system configuration instructions. Each client is then directed to the AI install server to access the information for the correct install service, as well as the AI manifest, and the system configuration profiles within that install service. If adequate system
configuration instructions are not provided prior to the installation, an interactive tool opens during the first boot after an installation, prompting you to provide the missing system configuration information.

Setting up an install client requires you to run the `installadm create-client` command on the install server, which associates a particular client with a particular install service. For example, you would set up a SPARC install client and associate the client with the MAC address `00:14:4f:a7:65:70` and the `solaris11_1-sparc` install service, as follows:

```
# installadm create-client -n solaris11_1-sparc -e 00:14:4f:a7:65:70
```

In this particular example, the DHCP server does not require configuration because the SPARC `wanboot-cgi` boot file has already been configured by using the `create-service` command. See “Creating an AI Install Service” in Installing Oracle Solaris 11.1 Systems.

Confirm that the client was added successfully by checking the `/etc/netboot` directory:

```
lrwxrwxrwx 1 root staff 33 2012-05-09 08:53 0100144FA76570 -> /etc/netboot/solaris11_1-sparc
```

**EXAMPLE 2–1  Setting Up an x86 Installation Client**

The following example associates the x86 client with the MAC address `0:e0:81:5d:bf:e0` and the `solaris11_1-i386` install service. The DHCP configuration that is shown in the output of this command must be manually added to the DHCP server. Otherwise, the client system cannot boot the `solaris11_1-i386` install service.

```
# installadm create-client -n solaris11_1-i386 -e 0:e0:81:5d:bf:e0
```

No local DHCP configuration found. If not already configured, the following should be added to the DHCP configuration:

```
Boot server IP : 10.80.239.5
Boot file(s) :  
bios clients (arch 00:00): 0100E0815DBFE0.bios
uefi clients (arch 00:07): 0100E0815DBFE0.uefi
```

In the following example, the `installadm create-client` command is used to set the default PXE boot files for an x86 client in the `/etc/inet/dhcpd4.conf` file of the ISC DHCP configuration for an Oracle Solaris 11.1 i386 install service:

```bash
host 00E0815DBFE0 {  
  hardware ethernet 00:E0:81:5D:BF:E0;  
  if option arch = 00:00 {  
    filename "0100E0815DBFE0.bios";  
  } else if option arch = 00:07 {  
    filename "0100E0815DBFE0.uefi";  
  }  
}
Booting the Client and Initiating an Oracle Solaris Installation

After performing the required prerequisite tasks for using AI, plus any optional customization tasks, you are ready to install the client system. The installation begins when you boot the client system over the network.

Boot a SPARC client, as follows:

1. Bring the system to the ok PROM prompt, then boot the system.

   ```
   ok boot net:dhcp - install
   ```

   **Note** – The syntax for booting a SPARC based system from the network has changed in Oracle Solaris 11.

   If you are *not* using DHCP, use this command:

   ```
   ok setenv network-boot-arguments host-ip=client-ip, router-ip=router-ip, subnet-mask=subnet-mask, hostname=hostname, file=wanboot-cgi-file
   ```

   When you use the `network-boot-arguments` variable, the SPARC client does *not* have DNS configuration information. Ensure that the AI manifest that is used with the client specifies an IP address instead of a host name for the location of the IPS package repository, and for any other URI in the manifest.

2. Boot the system.

   ```
   ok boot net - install
   ```

   See “Installing a SPARC Client” in *Installing Oracle Solaris 11.1 Systems* for a list of the events that occur during a SPARC client installation.

Perform a PXE boot of an x86 client, as follows:

1. Boot the client system.

2. When the client boots, instruct the firmware to boot from the network by typing the specific keystroke sequence when the firmware screen (BIOS or UEFI) is displayed.

   For information about UEFI firmware support on x86 platforms, see “Booting Systems With UEFI and BIOS Firmware From the Network” in *Booting and Shutting Down Oracle Solaris 11.1 Systems*.

3. When the GRUB menu is displayed, select the second entry (Automated Install), then press Return to install that image.
See "Installing an x86 Client" in *Installing Oracle Solaris 11.1 Systems* for a list of the events that occur during an x86 client installation.

### Information About Installing and Configuring Zones

Non-global zones are installed and configured on the first reboot after the global zone is installed. With AI, non-global zones can be installed on the system by using the configuration element that is defined in the AI manifest. During the first boot after the global zone installation, the zone’s self-assembly SMF service (svc:/system/zones-install:default) configures and installs each non-global zone that is defined in the global zone AI manifest. If the zone is configured with the auto-boot property set to true (autoboot=true), the system/zones-install service boots the zone after it is installed. See Chapter 12, "Installing and Configuring Zones," in *Installing Oracle Solaris 11.1 Systems*.

### Download Locations for AI Files

During an AI installation, several important AI files are downloaded to the following locations:

- **Installation log file:**
  
  /system/volatile/install_log

- **AI client manifest that is downloaded from the AI server:**
  
  /system/volatile/ai.xml

- **AI client derived manifest (if used):**
  
  /system/volatile/manifest.xml

- **System configuration profiles downloaded from the AI server during installation:**
  
  /system/volatile/profile/*

- **List of AI services:**
  
  /system/volatile/service_list

### Additional Installation Tasks

You might need to perform the following additional tasks before or after an installation.

### Configuring Date and Time Before and After an Installation

Oracle Solaris 11 keeps the Real Time Clock (RTC) in Coordinated Universal time (UTC) format. The behavior on x86 platforms is different in Oracle Solaris 11 than in Oracle Solaris 10.
The interactive installers enable you to configure the date and time during the installation. As part of that process, the RTC is updated with the time in UTC format. However, AI does not adjust the RTC date and time during an installation. To ensure that the time stamp of installed files are correct, configure the time in the BIOS in UTC format before beginning the installation. On x86 platforms, when using the pkg update command, the OS continues to keep time in RTC in the local time format. This method is used to avoid time inconsistencies between Oracle Solaris 11 BEs and BEs from previous releases.

**Note** - If you are running Oracle Solaris 11 as an Oracle VM VirtualBox guest, you need to check or uncheck the Hardware Clock in UTC time setting in the system preferences for the virtual machine.

### How to Switch From Local Time Format to UTC Format

1. Set the time lag between the kernel and RTC to 0 (zero), as follows:
   ```
   # rtc -z GMT
   ```

2. If the date/time requires an adjustment, use the `date` command. See `date(1)`.

### How to Switch From UTC Format to Local Time Format

Use the following procedure when the switch from UTC to local time is complete, and each time you reconfigure the time zone setting by using the `sysconfig` command.

1. Run the `rtc timezone` command with the `-z` option.
   ```
   # rtc -z timezone
   ```
   For example:
   ```
   # rtc -z US/Pacific
   ```

2. If the date/time requires an adjustment, use the `date` command.

### Maintaining Local Time on a System Running Multiple Operating Systems That Keep RTC Time as Local Time

If you maintain and boot several operating systems on the same Oracle Solaris 11 system, and those operating systems keep RTC time as local time, there are several ways that these operating systems can coexist, from the RTC time point of view:

- Switch from local time to UTC format in the OS that keeps RTC time in local time format.
  
  For example, if you are dual-booting Windows 7, set the registry key as follows:
  ```
  [HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\TimeZoneInformation] \
  "RealTimeIsUniversal"="dword:00000001
  ```
- Switch from the UTC format to local time on a freshly installed Oracle Solaris 11 system.
- Enable the Network Time Protocol (NTP) in operating systems that assume that the RTC format is running in local time. In this case, the time is synchronized automatically.

**x86: Adding Custom Entries to the GRUB Menu After an Installation**

In Oracle Solaris 11, the GRUB Legacy boot loader uses the `menu.lst` file to maintain both Oracle Solaris and custom menu entries, for example a Linux menu entry. After installing Oracle Solaris, any custom menu entries that were not preserved during the installation can be manually added to the GRUB menu by editing the `menu.lst` file.

Starting with Oracle Solaris 11.1, GRUB (GRUB 2) uses a different boot loader and a different configuration file, `grub.cfg`. This file contains most of the GRUB configuration, including all of the Oracle Solaris menu entries. The file does not contain any custom menu entries. Unlike the `menu.lst` file, the `grub.cfg` file is managed solely by using the `bootadm` command. Do not directly edit this file. GRUB 2 includes an additional configuration (`custom.cfg`) that can be used to add custom menu entries to the GRUB menu after an installation. If you want to add custom boot entries to the GRUB configuration, you must first create a `custom.cfg` file and it must reside in the same location as the `grub.cfg` and `menu.conf` files, `/pool-name/boot/grub/`.

During the boot process, GRUB checks for the existence of a `custom.cfg` file in the top-level dataset of the root pool, in the `boot/grub` subdirectory. If the file exists, GRUB sources the file and processes any commands that are in the file, as if the contents were textually inserted in the main `grub.cfg` file.

On a system with 64-bit UEFI firmware, entries in the `custom.cfg` file might appear as follows:

```plaintext
menuentry "Windows (64-bit UEFI)" {
    insmod part_gpt
    insmod fat
    insmod search_fs_uuid
    insmod chain
    search --fs-uuid --no-floppy --set=root cafe-f4ee
    chainloader /efi/Microsoft/Boot/bootmgfw.efi
}
```

On a system with BIOS firmware, entries in this file might appear as follows:

```plaintext
menuentry "Windows" {
    insmod chain
    set root=(hd0,msdos1)
    chainloader --force +1
}
```

See “Customizing the GRUB Configuration” in *Booting and Shutting Down Oracle Solaris 11.1 Systems*.
Troubleshooting an Oracle Solaris Installation

Refer to the following troubleshooting information for issues that you might encounter during or after installing an Oracle Solaris 11 release:

- “What to Do If Your System Boots in Console Mode” in *Installing Oracle Solaris 11.1 Systems*
- Chapter 15, “Troubleshooting Automated Installations” in *Installing Oracle Solaris 11.1 Systems*

If you encounter login or password issues after installing an Oracle Solaris 11 release, see "Booting for System Recovery" on page 123.

Monitoring the Live Media Startup Process

Switching to the text boot screen is useful if you suspect that the system startup process is not proceeding normally. The text screen might contain informational messages or a request for user input. Switching to the text boot screen has no impact on the boot sequence, other than how the information is displayed on the screen. Initialization of the operating system continues and completes as normal.

To switch to a text boot, press any key a few seconds after the GUI boot screen appears and the progress animation begins. Note that after switching from the GUI boot to a text boot, you cannot switch back to the GUI boot screen.
Managing Devices

This chapter provides information about managing devices in Oracle Solaris 11 releases.

The following topics are covered:

- “Device Identity and Configuration Changes” on page 47
- “Preparing Disks for ZFS Storage Pools” on page 49
- “Swap and Dump Device Configuration Changes” on page 53

Device Identity and Configuration Changes

As in Oracle Solaris 10 releases, all supported devices that are connected to the system when it is installed should be accessible after installation. Devices can be configured with the `cfgadm` command and most devices are hot-pluggable, which means you can add and remove devices while the system is booted.

The new `hotplug` command is available for PCI Express (PCle) and PCI SHPC (Standard Hot Plug Controller) devices that provides offline and online capabilities as well as enable and disable operations. You would still use the `cfgadm` command to manage hot pluggable USB and SCSI devices as in previous Oracle Solaris releases.

For more information, see Chapter 4, “Dynamically Configuring Devices (Tasks),” in *Oracle Solaris 11.1 Administration: Devices and File Systems*.

In this release, you can more easily identify devices by using the `croinfo` command to identify physical device location information.

You can use the following commands to display information by chassis, receptacle, and occupant values for the devices on your system:

- `diskinfo` – Display general information about physical disk locations
- format – Display physical disk location information for disks when reviewing partition tables or relabeling. For example, the following format output identifies the two internal disks on this system, under /dev/chassis/SYS/HDO and /dev/chassis/SYS/HD1.

```
# format
Searching for disks...done

AVAILABLE DISK SELECTIONS:
0. c1t0d0 <FUJITSU-MAY2073RCSUN72G-0401 cyl 8921 alt 2 hd 255 sec 63> /pci@0,0/pci1022,7450@2/pci1000,3060@3/sd@0,0 /dev/chassis/SYS/HDO/disk
1. c1t1d0 <FUJITSU-MAY2073RCSUN72G-0401-68.37GB> /pci@0,0/pci1022,7450@2/pci1000,3060@3/sd@1,0 /dev/chassis/SYS/HD1/disk
```

The above output identifies two internal system disks but disks from a storage array are generally identified by their storage array name.

- prtconf -l – Display system configuration information that includes physical disk location information

- zpool status -l – Display physical disk location information for pool devices

In addition, you can use the fmadm add-alias command to include a disk alias name that helps you identify the physical location of disks in your environment. For example:

```
# fmadm add-alias SUN-Storage-J4200.0912QA001 J4200@RACK10:U26-27
# fmadm add-alias SUN-Storage-J4200.0905QA00E J4200@RACK10:U24-25
```

Use the diskinfo command to determine where a disk is located:

```
% diskinfo -c c0t24d0
D:devchassis-path t:occupant-type c:occupant-compdev
--------------------------------------------------- --------------- ------------------
/dev/chassis/J4200@RACK10:U26-27/SCSI_Device__9/disk disk c0t24d0
```

In this example, the /dev/chassis disk name includes an alias name that helps you locate the device in your environment.

The following diskinfo example shows how to display a specific disk’s physical location.

```
$ diskinfo -c c0t24d0 -o cp
 c:occupant-compdev p:occupant-paths
-------------------------------------- -----------------------------------------------
c0t24d0 /devices/pci@0,600000/pci@0/pci@9/LSILogic,sas@0/sd@18,0
```

**Note** – The diskinfo command require that chassis support SES diagnostic page 0xa (Additional Element Status) and must set the Element Index Present (EIP) bit to 1. Enclosures that do not meet this criteria will not be fully enumerated, and thus, will not be properly represented.
Changes to Device Driver Customization

In Oracle Solaris 11, driver customizations are made in the `/etc/driver/drv` directory rather than in the `/kernel` directory as in previous releases. This improvement means that your driver customizations are not overwritten when the system is upgraded. The files in the `/etc/driver/drv` directory are preserved during the upgrade. Customizing a driver configuration usually means that a per-device parameter or global property that impacts all devices is added or modified.

For more information, see “How to Customize a Driver Configuration” in Oracle Solaris 11.1 Administration: Devices and File Systems.

Preparing Disks for ZFS Storage Pools

Creating ZFS storage pools in Oracle Solaris 11 is similar to creating pools in Oracle Solaris 10. The following sections provide summary information about preparing disks for a ZFS root pool and non-root pools.

Review the following general pool device configuration recommendations:

- Create non-root pools by using whole disks, which are easier to manage than disk slices. For example, you can easily create a mirrored storage pool with four devices as follows:

  ```
  # zpool create tank mirror c0t1d0 c0t2d0 mirror c1t1d0 c1t2d0
  ```

- When ZFS storage pools are created with whole disks, the disks are labeled with an EFI label rather than an SMI label. You can identify an EFI label by the lack of cylinder information in the disk label as displayed in the format utility. For example:

  ```
  partition> print
  Current partition table (original):
  Total disk sectors available: 286478269 + 16384 (reserved sectors)
  Part Tag Flag First Sector Size Last Sector
  0   usr  wu 256     0   0     0
  1   unassigned  wm 0       0   0     0  
  2   unassigned  wm 0       0   0     0
  3   unassigned  wm 0       0   0     0
  4   unassigned  wm 0       0   0     0
  5   unassigned  wm 0       0   0     0
  6   unassigned  wm 286478303 8.00MB 286494686
  8   reserved  wm     0   0     0
  ```

- We recommend that you create non-root pools with whole disks.

Oracle Solaris releases support advanced format disks in addition to traditional 512n disks. For more information, see “Advanced Format Disk Support” in Oracle Solaris 11.1 Administration: Devices and File Systems.
ZFS Root Pool Installation Improvements

Review the following installation improvements for root pools:

- **Disk label improvements** – If the disk label or labels that are intended to contain the OS are unknown, the disks will be automatically relabeled with the appropriate disk label.
  
  In Oracle Solaris 11.1, SPARC based systems with GPT enabled firmware and most x86 based systems are installed with an EFI (GPT) label on the root pool disk or disks.
  
  In addition, the AI installer has improved the `whole_disk` keyword syntax so that if `whole_disk` is set to `true`, the disk’s contents are replaced, even if it has existing partitions or slices.

- **AI installation of a mirrored root pool** – Oracle Solaris 10 installation features allow you to create a mirrored root pool during installation.
  
  You can use AI manifest keyword syntax to create a mirrored root pool during an Oracle Solaris 11 automatic installation. For example, the following Oracle Solaris 11.1 syntax creates a mirrored root pool using whole disks:

```xml
<target>
  <disk whole_disk="true" in_zpool="rpool" in_vdev="mirrored">
    <disk_name name="c1t0d0" name_type="ctd"/>
  </disk>
  <disk whole_disk="true" in_zpool="rpool" in_vdev="mirrored">
    <disk_name name="c2t0d0" name_type="ctd"/>
  </disk>
  <logical>
    <zpool name="rpool" is_root="true">
      <vdev name="mirrored" redundancy="mirror"/>
    </zpool>
    Subsequent <filesystem> entries instruct an installer to create following ZFS datasets:
    <root_pool>/export (mounted on /export)
    <root_pool>/export/home (mounted on /export/home)
  </logical>
</target>
```

ZFS Root Pool Device Requirements

In general, root pool devices are relabeled and the root pool is created when the system is installed.
Oracle Solaris 11: An SMI (VTOC) label is applied automatically to the root pool disk or disks during installation on both SPARC and x86 based systems.

```
# zpool status rpool
pool: rpool
state: ONLINE
scan: none requested
config:

<table>
<thead>
<tr>
<th>NAME</th>
<th>STATE</th>
<th>READ</th>
<th>WRITE</th>
<th>CKSUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>rpool</td>
<td>ONLINE</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>c7t0d0s0</td>
<td>ONLINE</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
```

Oracle Solaris 11.1: An EFI label is applied automatically to the root pool disk or disks during installation on SPARC based systems with GPT enabled firmware and most x86 based systems. Otherwise, a VTOC disk label is installed on the root pool disk, as shown in the following example:

```
# zpool status rpool
pool: rpool
state: ONLINE
scan: none requested
config:

<table>
<thead>
<tr>
<th>NAME</th>
<th>STATE</th>
<th>READ</th>
<th>WRITE</th>
<th>CKSUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>rpool</td>
<td>ONLINE</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>c7t0d0</td>
<td>ONLINE</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
```

When you attach a disk to create a mirrored root pool, use the whole disk syntax.

```
# zpool attach rpool c7t0d0 c7t2d0
```

Make sure to wait until resilver is done before rebooting.

The pool remains in a DEGRADED state until the new disk is resilvered.

```
# zpool status rpool
pool: rpool
state: DEGRADED
status: One or more devices is currently being resilvered. The pool will continue to function in a degraded state.
action: Wait for the resilver to complete.
    Run `zpool status -v` to see device specific details.
scan: resilver in progress since Thu Jan 24 08:15:13 2013
    224M scanned out of 22.0G at 6.59M/s, 0h56m to go
    221M resilvered, 0.99% done
config:

<table>
<thead>
<tr>
<th>NAME</th>
<th>STATE</th>
<th>READ</th>
<th>WRITE</th>
<th>CKSUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>rpool</td>
<td>DEGRADED</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>mirror-0</td>
<td>DEGRADED</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>c7t0d0</td>
<td>ONLINE</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>c7t2d0</td>
<td>DEGRADED</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
```

- The pool must exist either on a disk slice or on disk slices that are mirrored. If you attempt to use an unsupported pool configuration during an `beadm` operation, you will see a message similar to the following:

```
ERROR: ZFS pool name does not support boot environments
```
On an x86 based system, the disk must contain an Oracle Solaris fdisk partition. An Oracle Solaris fdisk partition is created automatically when the x86 based system is installed. For more information about fdisk partitions, see “Guidelines for Creating an fdisk Partition” in Oracle Solaris 11.1 Administration: Devices and File Systems.

For more general information about creating ZFS root pools, see “ZFS Storage Pool Creation Practices” on page 56.

**ZFS Root Pool Disk and Boot Administration**

ZFS root pool disk and boot administration summary is as follows:

- **Oracle Solaris 10 and Oracle Solaris 11**
  - **SPARC:** (OBP) PROM needs root pool disk with an SMI (VTOC) label.
  - **SPARC:** If replacing a root pool disk with `zpool replace`, apply boot blocks manually.

```bash
# installboot -F zfs /usr/platform/`uname -i`/lib/fs/zfs/bootblk /dev/rdsk/c1t0d0s0
```

- **SPARC and x86:** Attaching a root pool disk with `zpool attach` to create a mirrored root pool requires the slice syntax.

```bash
# zpool attach rpool c0t5000CCA03C5A5314d0s0 c0t5000CCA03C5A5340d0s0
```

If you attempt to attach a disk with an EFI label to a root pool disk that requires an SMI (VTOC) label, you will need to relabel it manually before it can be attached.

```bash
# format -L vtoc -d clt0d0
Searching for disks...done
selecting clt0d0
[disk formatted]
clt0d0 is labeled with VTOC successfully.
```

Be very careful that you are relabeling the correct disk because this command does no error checking. If you force an SMI (VTOC) label on a disk that is intended for the root pool, the default partition table is applied. This means that the default s0 slice size might be too small. For more information about changing partition or slice sizes, see “How to Label a Disk” in Oracle Solaris 11.1 Administration: Devices and File Systems.

- **x86:** GRUB legacy and root pool disk needs an SMI (VTOC) label.
- **x86:** If replacing a root pool disk with `zpool replace`, apply the boot blocks manually.

```bash
# installgrub /boot/grub/stage1 /boot/grub/stage2 /dev/rdsk/c1t0d0s0
```

- **x86:** Root pool disk must be less than 2 TBs.

- **Oracle Solaris 11.1**
  - **SPARC:** OBP requires a root pool disk with an SMI (VTOC) label.
  - **SPARC:** If replacing a root pool disk with `zpool replace`, apply boot blocks manually.

```bash
# bootadm install-bootloader
```
- **SPARC**: Attaching a root pool disk with `zpool attach` to create a mirrored root pool requires the slice syntax.
  
  ```
  # zpool attach rpool c0t5000CCA03C5A5314d0s0 c0t5000CCA03C5A5340d0s0
  ```

- **x86**: GRUB 2 and root pool disk has an EFI label in most cases.

- **x86**: If replacing a root pool disk with `zpool replace`, apply the boot blocks manually.
  
  ```
  # bootadm install-bootloader
  ```

- **x86**: Attaching a root pool disk with `zpool attach` to create a mirrored root pool requires the whole disk syntax.
  
  ```
  # zpool attach rpool c0t5000CCA03C5A5314d0 c0t5000CCA03C5A5340d0
  ```

- **Current Oracle Solaris 10 and 11 Releases**

  Using the `zpool attach` command applies the boot blocks automatically.

---

### Swap and Dump Device Configuration Changes

In Oracle Solaris 10 releases, a UFS root environment provides one disk slice for both swap and dump devices. After an Oracle Solaris 11 system is installed, two separate volumes are created as a swap device and a dump device.

```
# dumpadm
  Dump content: kernel pages
  Dump device: /dev/zvol/dsk/rpool/dump (dedicated)
  Savecore directory: /var/crash
  Savecore enabled: yes
  Save compressed: on
```

```
# swap -l
swapfile    dev     swaplo  blocks  free
/dev/zvol/dsk/rpool/swap 182,2  8 4061176  4061176
```

Display information about the swap and dump volume names and sizes. For example:

```
# zfs list -t volume -r rpool
NAME  USED  AVAIL  REFER  MOUNTPOINT
rpool/dump  4.13G  51.6G  4.00G  -
rpool/swap  4.13G  51.6G  4.00G  -
```

You can also display swap space sizes in human-readable format. For example:

```
# swap -sh
total: 1.4G allocated + 227M reserved = 1.6G used, 432G available
# swap -lh
swapfile    dev     swaplo  blocks  free
/dev/zvol/dsk/rpool/swap 285,2  8K  4.0G  4.0G
```

The management of ZFS swap and dump volumes differs from the management of a single slice for a UFS swap and dump device in the following ways:
You cannot use a single volume for both swap and dump devices in a ZFS root environment.

You cannot use a file as swap device in a ZFS root environment.

The system requires that the dump device is approximately 1/2 to 3/4 the size of physical memory. If the dump device is too small, you will see an error similar to the following:

```
# dumpadm -d /dev/zvol/dsk/rpool/dump
dumpadm: dump device /dev/zvol/dsk/rpool/dump is too small to hold a system dump
dump size 36255432704 bytes, device size 34359738368 bytes
```

You can easily increase the size of the dump device by increasing the volume's `volsize` property, but it might take some time to reinitialize the volume. For example:

```
# zfs get volsize rpool/dump
NAME PROPERTY VALUE SOURCE
rpool/dump volsize 1.94G local
# zfs set volsize=3g rpool/dump
# zfs get volsize rpool/dump
NAME PROPERTY VALUE SOURCE
rpool/dump volsize 3G local
```

Changing the size of the swap volume is difficult if the swap device is in use. Consider creating a second swap volume and adding it as a swap device. For example:

```
# zfs create -V 3G rpool/swap2
# swap -a /dev/zvol/dsk/rpool/swap2
# swap -l
swapfile dev swaplo blocks free
/dev/zvol/dsk/rpool/swap 182,2 8 4061176 4061176
/dev/zvol/dsk/rpool/swap2 182,4 8 6291448 6291448
```

Then, add an entry for the new swap device in the `/etc/vfstab` file. For example:

```
/dev/zvol/dsk/rpool/swap2 - - swap - no -
```
Managing Storage Features

This chapter describes storage management changes in Oracle Solaris 11 releases.

The following topics are covered:

- “Comparison of Solaris Volume Manager Configurations to ZFS Configurations” on page 55
- “Recommended ZFS Storage Pool Practices” on page 56
- “COMSTAR Replaces iSCSI Target Daemon” on page 59

Comparison of Solaris Volume Manager Configurations to ZFS Configurations

In Oracle Solaris 10 releases, you could create redundant volumes for UFS file systems by using Solaris Volume Manager. Solaris Volume Manager is a traditional volume management product with a layer of volume management and a layer of file system management.

ZFS, available in Oracle Solaris 10 and Oracle Solaris 11 releases, eliminates volume management altogether. Instead of creating virtualized volumes, ZFS aggregates devices into a storage pool. The storage pool describes the physical characteristics of the storage (device layout, data redundancy, and so on) and acts as an arbitrary data store from which file systems can be created. File systems are no longer constrained to individual devices, allowing them to share disk space with all file systems in the pool.

In Oracle Solaris 11, you can easily create a redundant ZFS storage pool in one command. ZFS provides two types of redundant configurations, mirrored pools and RAID-Z pools. RAID-Z configurations have similar features to RAID-5.

ZFS dynamically stripes data across all non-redundant, mirrored, and RAID-Z configurations.

- Solaris Volume Manager RAID-0 (stripe and concatenation) is not available in ZFS RAID-Z configurations
Recommended ZFS Storage Pool Practices

ZFS uses a pool storage model where storage devices are aggregated into a storage pool. File systems within the storage pool use all the storage in the pool.

The following sections provide recommended practices for creating, monitoring, and troubleshooting ZFS storage pools.

ZFS Storage Pool Creation Practices

- Specific root pool device and boot disk requirements
  - “ZFS Root Pool Device Requirements” on page 50
  - “ZFS Root Pool Disk and Boot Administration” on page 52

- General root pool creation practices
  - The root pool must be created as a mirrored configuration or as a single-disk configuration. Neither a RAID-Z nor a striped configuration is supported. You cannot add additional disks to create multiple mirrored top-level virtual devices by using the `zpool add` command, but you can expand a mirrored virtual device by using the `zpool attach` command.
  - The root pool cannot have a separate log device.
  - Pool properties can be set during an AI installation by using the `pool_options` keyword syntax, but the gzip compression algorithm is not supported on root pools.
  - Do not rename the root pool after it is created by an initial installation. Renaming the root pool might cause an unbootable system.
  - Do not create a root pool on a USB stick for a production system because root pool disks are critical for continuous operation, particularly in an enterprise environment. Consider using a system’s internal disks for the root pool, or at least use, the same quality.
disks that you would use for your non-root data. In addition, a USB stick might not be large enough to support a dump volume size that is equivalent to at least 1/2 the size of physical memory.

- Consider keeping root pool components separate from non-root pool data.

- **Non-root pool creation practices** – Create non-root pools with whole disks by using the `d*` identifier. Do not use the `p*` identifier.

- ZFS works best without any additional volume management software.

- For better performance, use individual disks or at least LUNs made up of just a few disks. By providing ZFS with more visibility into the LUN setup, ZFS is able to make better I/O scheduling decisions.

- **Mirrored storage pools** – Consume more disk space but generally perform better with small random reads. For example:

  ```
  # zpool create tank mirror c1d0 c2d0 mirror c3d0 c4d0
  ```

  Mirrored storage pools are also more flexible in that you can detach, attach, and replace existing devices in the pool.

- **RAID-Z storage pools** – Can be created with 3 parity strategies, where parity equals 1 (raidz), 2 (raidz2), or 3 (raidz3).
  - A RAID-Z configuration maximizes disk space and generally performs well when data is written and read in large chunks (128K or more). Create a single-parity RAIDZ (raidz) configuration at 3 disks (2+1).
  - A RAIDZ-2 configuration offers better data availability, and performs similarly to RAID-Z. RAIDZ-2 has significantly better mean time to data loss (MTTDL) than either RAID-Z or 2-way mirrors. Create a double-parity RAID-Z (raidz2) configuration at 6 disks (4+2).
  - A RAIDZ-3 configuration maximizes disk space and offers excellent availability because it can withstand 3 disk failures. Create a triple-parity RAID-Z (raidz3) configuration at 8 disks (5+3).

- **Non-redundant pools** – If you create a non-redundant pool, you will see a message similar to the following:

  ```
  # zpool create pond c8t2d0 c8t3d0
  ‘pond’ successfully created, but with no redundancy; failure of one device will cause loss of the pool
  ```

  Creating a pool with no redundancy is not recommended because a device failure could mean that the data is unrecoverable. Consider creating a ZFS storage pool with redundancy. For example:

  ```
  # zpool create pond mirror c8t2d0 c8t3d0
  ```
ZFS Storage Pool Monitoring Practices

- Make sure that pool capacity is below 90% for best performance. Monitor pool and file system space to make sure that they are not full. Consider using ZFS quotas and reservations to make sure file system space does not exceed 90% pool capacity.
- Run `zpool scrub` on a regular basis to identify data integrity problems:
  - If you have consumer-quality drives, consider a weekly scrubbing schedule.
  - If you have datacenter-quality drives, consider a monthly scrubbing schedule.
  - You should also run a scrub prior to replacing devices to ensure that all devices are currently operational.
- Use `zpool status` on a weekly basis to monitor pool and pool device status. Also use `fmdump` or `fmdump -eV` to see if any device faults or errors have occurred.

ZFS Storage Pool Troubleshooting Practices

Troubleshooting pool problems in Oracle Solaris 11 is similar to diagnosing problems in the Oracle Solaris 10 release, but review the following new diagnostic descriptions and features:

- Failed devices – Review the `zpool status -l` output to identify the physical location of the failed device and replace it. For information about replacing a failed disk, see "Replacing or Repairing a Damaged Device" in Oracle Solaris 11.1 Administration: ZFS File Systems.
- Failed device notification – The `smtp-notify` service can be configured to send electronic mail notifications in response to various fault management events, such as when a hardware component has been diagnosed as faulty. For more information, see the notification parameters section of `smf(5)`.

By default, some notifications are set up automatically to be sent to the root user. If you add an alias for your user account as root in the `/etc/aliases` file, you will receive electronic mail notifications, similar to the following:

```
-------- Original Message --------
Subject: Fault Management Event: tardis:SMF-8000-YX
Date: Wed, 21 Sep 2011 11:11:27 GMT
From: No Access User <noaccess@tardis.drwho.COM>
Reply-To: root@tardis.drwho.COM
To: root@tardis.drwho.COM

SUNW-MSG-ID: ZFS-8000-D3, TYPE: Fault, VER: 1, SEVERITY: Major
PLATFORM: Sun-Fire-X4140, CSN: 0904QAD02C, HOSTNAME: tardis
SOURCE: zfs-diagnosis, REV: 1.0
EVENT-ID: d9e3469f-8d84-4a03-b8a3-d0beb178c017
for more information.
AUTO-RESPONSE: No automated response will occur.
IMPACT: Fault tolerance of the pool may be compromised.
REC-ACTION: Run 'zpool status -x' and replace the bad device.
```
Moving devices – Devices that are part of a ZFS storage pool contain a device ID if the device driver creates or fabricates device IDs. Like all file systems, ZFS has a very close relationship with its underlying devices so if you attempt to upgrade a system's firmware, move a pool device to a different controller, or change a device’s cabling, you might consider exporting the pool first. If the device ID does not follow the device change and this can happen with non-Oracle hardware, then the pool and pool data might become unavailable. In general, Oracle's Sun hardware can recover if a device is changed under a live pool because our drivers fully support device IDs, but you might consider exporting the pool before making any hardware changes.


COMSTAR Replaces iSCSI Target Daemon

The Oracle Solaris 10 release uses the iSCSI target daemon and the `iscsiadm` command and the ZFS shareiscsi property to configure iSCSI LUNs.

In the Oracle Solaris 11 release, the COMSTAR (Common Multiprotocol SCSI Target) features provide the following components:

- Support for different types of SCSI targets, not just the iSCSI protocol
- ZFS volumes are used as backing store devices for SCSI targets by using one or more of COMSTAR’s supported protocols.

Although the iSCSI target in COMSTAR is a functional replacement for the iSCSI target daemon, no upgrade or update path exist to convert your iSCSI LUNs to COMSTAR LUNs.

- Both the iSCSI target daemon and the shareiscsi property are not available in Oracle Solaris 11. The following commands are used to manage iSCSI targets and LUNs.
  - The `iscsiadm` command manages SCSI targets.
  - The `srptadm` command manages SCSI RDMA Protocol (SRP) target ports.
  - The `stmfadm` command manages SCSI LUNs. Rather than setting a special iSCSI property on the ZFS volume, create the volume and use `stmfadm` to create the LUN.

For information about COMSTAR, see Chapter 11, "Configuring Storage Devices With COMSTAR (Tasks)," in Oracle Solaris 11.1 Administration: Devices and File Systems.
Managing File Systems

This chapter provides information about managing file systems in Oracle Solaris 11 releases.

The following topics are covered:

- “Oracle Solaris 11 File System Changes” on page 61
- “Managing ZFS File System Changes” on page 63
- “Considering ZFS Backup Features” on page 69
- “Migrating File System Data to ZFS File Systems” on page 69

Oracle Solaris 11 File System Changes

The file systems that are available in the Oracle Solaris 11 release are very similar to the Oracle Solaris 10 file systems.

- Disk-based file systems – HSFS, PCFS, UDFS, UFS, and ZFS
- Network-Based file systems – NFS and SMB
- Virtual file systems – CTFS, FIFOFS, MNTFS, NAMEFS, OBJFS, SHAREFS, SPECFS, and SWAPFS
- Temporary file system (TMPFS)
- Loopback file system (LOFS)
- Process file system (PROCFS)

The general file system differences are as follows:

- CacheFS is not available in the Oracle Solaris 11 release.
- ZFS is the default root file system.
- UFS is a supported legacy file system, but it is not supported as a bootable root file system.
- The legacy Solaris Volume Manager product is supported, but you cannot boot from a Solaris Volume Manager root device.
ZFS uses a separate ZFS volume for swap and dump devices. UFS can use a single slice for both swap and dump devices.

**Root File System Requirements and Changes**

The root file system hierarchy is mostly identical to systems running Solaris 10 that have a ZFS root file system. A ZFS root pool contains a ZFS file system with separate directories of system-related components, such as `etc`, `usr`, and `var`, that must be available for the system to function correctly.

- After a system is installed, the root of the Solaris file system is mounted, which means files and directories are accessible.
- All subdirectories of the root file system that are part of the Oracle Solaris OS, with the exception of `/var`, must be contained in the same file system as the root file system.
- During an Oracle Solaris 11 installation, a separate `/var` file system is created automatically for a global zone and a non-global zone.
- During an Oracle Solaris 11.1 installation, a `rpool/VARSHARE` file system is mounted at `/var/share`. The purpose of this file system is to share file systems across boot environments so that the amount of space that is needed in the `/var` directory for all BEs is reduced.

```bash
# ls /var/share
audit cores crash mail
```

Symbolic links are automatically created from `/var` to the `/var/share` components listed above for compatibility purposes. This file system generally requires no administration except to ensure that `/var` components do not fill the root file system. If an Oracle Solaris 11 system is updated to Oracle Solaris 11.1, it might take some time to migrate data from the original `/var` directory to the `/var/share` directory.

- In addition, all Oracle Solaris OS components must reside in the root pool, with the exception of the swap and dump devices.
- A default swap device and dump device are automatically created as ZFS volumes in the root pool when a system is installed. You cannot use the same volume for both swap and dump devices. In addition, you cannot use swap files in a ZFS root environment. For more information, see “Swap and Dump Device Configuration Changes” on page 53.

**Mounting File System Changes**

Review the following considerations when mounting file systems on systems running Oracle Solaris 11.

- Similar to Oracle Solaris 10 releases, a ZFS file system is mounted automatically when it is created. No need exists to edit the `/etc/vfstab` to mount local ZFS file systems.
If you want to create and mount a local legacy UFS file system to be mounted at boot time, you will need to add an entry to the `/etc/vfstab` file as in previous Solaris releases.

If you want to mount a remote file system at boot time, you will need to add an entry to the `/etc/vfstab` file and start the following service:

```bash
# svcadm enable svc:/network/nfs/client:default
```

Otherwise, the file system is not mounted at boot time.

**Managing ZFS File System Changes**

The following ZFS file system features, not available in the Oracle Solaris 10 release, are available in Oracle Solaris 11:

- **ZFS file system encryption** – You can encrypt a ZFS file system when it is created. For more information, see Chapter 9, “Managing Security.”
- **ZFS file system deduplication** – For important information about determining whether your system environment can support ZFS data deduplication, see “ZFS Data Deduplication Requirements” on page 68.
- **ZFS file system sharing syntax changes** – Includes both NFS and SMB file system sharing changes. For more information, see “ZFS File System Sharing Changes” on page 65.
- **ZFS man page change** – The `zfs.1m` manual page has been revised so that core ZFS file system features remain in the `zfs.1m` page, but delegated administration, encryption, and share syntax and examples are covered in the following pages:
  - `zfs_allow(1M)`
  - `zfs_encrypt(1M)`
  - `zfs_share(1M)`

**Displaying ZFS File System Information**

After the system is installed, review your ZFS storage pool and ZFS file system information.

Display ZFS storage pool information by using the `zpool status` command.

Display ZFS file system information by using the `zfs list` command. For example:

For a description of the root pool components, see “Reviewing the Initial ZFS BE After an Installation” on page 80.

**Resolving ZFS File System Space Reporting Issues**

The `zpool list` and `zfs list` commands are better than the previous `df` and `du` commands for determining your available pool and file system space. With the legacy commands, you cannot
easily discern between pool and file system space, nor do the legacy commands account for space that is consumed by descendent file systems or snapshots.

For example, the following root pool (rpool) has 5.46 GB allocated and 68.5 GB free.

```bash
# zpool list rpool
NAME SIZE ALLOC FREE CAP DEDUP HEALTH ALTROOT
rpool 74G 5.46G 68.5G 7% 1.00x ONLINE -
```

If you compare the pool space accounting with the file system space accounting by reviewing the USED columns of your individual file systems, you can see that the pool space is accounted for. For example:

```bash
# zfs list -r rpool
NAME USED AVAIL REFER MOUNTPOINT
rpool 5.41G 67.4G 74.5K /rpool
rpool/ROOT 3.37G 67.4G 31K legacy
rpool/ROOT/solaris 3.37G 67.4G 3.07G /
rpool/ROOT/solaris/var 302M 67.4G 214M /var
rpool/dump 1.01G 67.5G 1000M -
rpool/export 97.5K 67.4G 32K /rpool/export
rpool/export/home 65.5K 67.4G 32K /rpool/export/home
rpool/export/home/admin 33.5K 67.4G 33.5K /rpool/export/home/admin
rpool/swap 1.03G 67.5G 1.00G -
```

**Resolving ZFS Storage Pool Space Reporting Issues**

The SIZE value that is reported by the `zpool list` command is generally the amount of physical disk space in the pool, but varies depending on the pool's redundancy level. See the examples below. The `zfs list` command lists the usable space that is available to file systems, which is disk space minus ZFS pool redundancy metadata overhead, if any.

- **Non-redundant storage pool** – Created with one 136-GB disk, the `zpool list` command reports SIZE and initial FREE values as 136 GB. The initial AVAIL space reported by the `zfs list` command is 134 GB, due to a small amount of pool metadata overhead. For example:

```bash
# zpool create tank c0t6d0
# zpool list tank
NAME SIZE ALLOC FREE CAP DEDUP HEALTH ALTROOT
tank 136G 95.5K 136G 0% 1.00x ONLINE -
# zfs list tank
NAME USED AVAIL REFER MOUNTPOINT
tank 72K 134G 21K /tank
```

- **Mirrored storage pool** – Created with two 136-GB disks, `zpool list` command reports SIZE as 136 GB and initial FREE value as 136 GB. This reporting is referred to as the deflated space value. The initial AVAIL space reported by the `zfs list` command is 134 GB, due to a small amount of pool metadata overhead. For example:

```bash
# zpool create tank mirror c0t6d0 c0t7d0
# zpool list tank
NAME SIZE ALLOC FREE CAP DEDUP HEALTH ALTROOT
tank 136G 95.5K 136G 0% 1.00x ONLINE -
# zfs list tank
NAME USED AVAIL REFER MOUNTPOINT
tank 72K 134G 21K /tank
```
RAID-Z storage pool – Created with three 136-GB disks, the `zpool list` commands reports SIZE as 408 GB and initial FREE value as 408 GB. This reporting is referred to as the *inflated* disk space value, which includes redundancy overhead, such as parity information. The initial AVAIL space reported by the `zfs list` command is 133 GB, due to the pool redundancy overhead. The following example creates a RAIDZ-2 pool.

```
# zpool create tank raidz2 c0t6d0 c0t7d0 c0t8d0
# zpool list tank
NAME SIZE ALLOC FREE CAP DEDUP HEALTH ALTROOT
  tank 408G 286K 408G 0% 1.00x ONLINE -
```

Making ZFS File Systems Available

Making ZFS file systems available is similar to Oracle Solaris 10 releases in the following ways:

- A ZFS file system is mounted automatically when it is created and then remounted automatically when the system is booted.
- You do not have to modify the `/etc/vfstab` file to mount a ZFS file system, unless you create a legacy mount for ZFS file system. Mounting a ZFS file system automatically is recommended over using a legacy mount.
- You do not have to modify the `/etc/dfs/dfstab` file to share file systems. For more information about sharing ZFS file systems, see “ZFS File System Sharing Changes” on page 65.
- Similar to a UFS root, the swap device must have an entry in the `/etc/vfstab` file.
- File systems can be shared between Oracle Solaris 10 and Oracle Solaris 11 systems by using NFS sharing.
- File systems can be shared between Oracle Solaris 11 systems by using NFS or SMB sharing.
- ZFS storage pools can be exported from an Oracle Solaris 10 system and then imported on an Oracle Solaris 11 system.

ZFS File System Sharing Changes

In Oracle Solaris 10, you could set the `sharesfs` or `sharesmb` property to create and publish a ZFS file system share, or you could use the legacy `share` command.

In Oracle Solaris 11, you create a ZFS file system share and then publish the share as follows:

- Create an NFS or SMB share of a ZFS file system by using the `zfs set share` command.
Publish the NFS or SMB share by setting the sharenfs or sharesmb property to on.

```
# zfs set sharenfs=on rpool/fs1
# cat /etc/dfs/sharetab
/rpool/fs1 fs1 nfs sec=sys,rw
```

The primary new sharing differences are as follows:

- Sharing a file system is a two-step process: creating a share by using the `zfs set share` command, then publishing the share by setting the sharenfs or sharesmb property.

- The `zfs set share` command replaces the sharemgr interface for sharing ZFS file systems.

- The sharemgr interface is no longer available. The legacy `share` command and the `sharenfs` property are still available. See the examples below.

- The `/etc/dfs/dfstab` file still exists but modifications are ignored. SMF manages ZFS or UFS share information so that file systems are shared automatically when the system is rebooted, similar to the way ZFS mount and share information is managed.

- If you unpublish a share, you can republish it by using the `share` command or by using the `share -a` command to republish all shares.

- Descendent file systems do not inherit share properties. If a descendent file system is created with an inherited `sharenfs` property set to on, then a share is created for the new descendent file system.

In Oracle Solaris 11.1, sharing ZFS file systems has improved with the following primary enhancements:

- The share syntax is simplified. You can share a file system by setting the new `share.nfs` or `share.smb` property.

  ```
  # zfs set share.nfs=on tank/home
  # zfs create tank/home/userA
  # zfs create tank/home/userB
  # zfs set share.nfs.nosuid=on tank/home/userA
  ```

- Better inheritance of share properties to descendent file systems. In preceding example, where the `share.nfs` property is set on the tank/home file system, the `share.nfs` property value is inherited to any descendent file systems.

These file sharing improvements are associated with pool version 34. For more information, see “Sharing and Unsharing ZFS File Systems” in Oracle Solaris 11.1 Administration: ZFS File Systems.
Legacy ZFS Sharing Syntax

Legacy sharing syntax is still supported without having to modify the /etc/dfs/dfs.tab file. Legacy shares are managed by an SMF service.

1. Use the share command to share a file system.

   For example, to share a ZFS file system:

   ```
   # share -F nfs /tank/zfsfs
   # cat /etc/dfs/sharetab
   /tank/zfsfs - nfs rw
   ```

   The above syntax is identical to sharing a UFS file system:

   ```
   # share -F nfs /ufsfs
   # cat /etc/dfs/sharetab
   /ufsfs - nfs rw
   /tank/zfsfs - nfs rw
   ```

2. You can create a file system with the share nfs property enabled, as in previous releases. The Oracle Solaris 11 behavior is that a default share is created for the file system.

   ```
   # zfs create -o sharenfs=on rpool/data
   # cat /etc/dfs/sharetab
   /rpool/data rpool_data nfs sec=sys,rw
   ```

   The above file system shares are published immediately.

ZFS Sharing Migration/Transition Issues

Review the share transition issues in this section.

- **Upgrading your system** – ZFS shares will be incorrect if you boot back to an older BE due to property changes in this release. Non-ZFS shares are unaffected. If you plan to boot back to an older BE, save a copy of the existing share configuration prior to the pkg update operation to be able to restore the share configuration on the ZFS datasets.
  - In the older BE, use the `sharemgr show -vp` command to list all shares and their configuration.
  - Use the `zfs get sharenfs filesystem` command and the `zfs sharesmb filesystem` commands to get the values of the sharing properties.
  - If you boot back to an older BE, reset the share nfs and share smb properties to their original values.

- **Legacy unsharing behavior** – Using the unshare -a command or unshareall command unpublishes a share, but does not update the SMF shares repository. If you try to re-share the existing share, the shares repository is checked for conflicts, and an error is displayed.
ZFS Data Deduplication Requirements

In Oracle Solaris 11, you can use the deduplication (dedup) property to remove redundant data from your ZFS file systems. If a file system has the dedup property enabled, duplicate data blocks are removed synchronously. The result is that only unique data is stored, and common components are shared between files. For example:

```
# zfs set dedup=on tank/home
```

Do not enable the dedup property on file systems that reside on production systems until you perform the following steps to determine if your system can support data deduplication.

1. Determine if your data would benefit from deduplication space savings. If your data is not dedup-able, there is no point in enabling dedup. Running the following command is very memory intensive:

```
# zdb -S tank
```

```
Simulated DDT histogram:


<table>
<thead>
<tr>
<th>refcnt</th>
<th>blocks</th>
<th>LSIZE</th>
<th>PSIZE</th>
<th>DSIZE</th>
<th>blocks</th>
<th>LSIZE</th>
<th>PSIZE</th>
<th>DSIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.27M</td>
<td>239G</td>
<td>188G</td>
<td>194G</td>
<td>2.27M</td>
<td>239G</td>
<td>188G</td>
<td>194G</td>
</tr>
<tr>
<td>2</td>
<td>327K</td>
<td>34.3G</td>
<td>27.8G</td>
<td>28.1G</td>
<td>698K</td>
<td>73.3G</td>
<td>59.2G</td>
<td>59.9G</td>
</tr>
<tr>
<td>4</td>
<td>38.1K</td>
<td>2.10G</td>
<td>2.11G</td>
<td>152K</td>
<td>14.9G</td>
<td>10.6G</td>
<td>10.6G</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>7.73K</td>
<td>691M</td>
<td>529M</td>
<td>529M</td>
<td>74.5K</td>
<td>6.25G</td>
<td>4.79G</td>
<td>4.80G</td>
</tr>
<tr>
<td>16</td>
<td>673</td>
<td>43.7M</td>
<td>25.8M</td>
<td>25.9M</td>
<td>13.1K</td>
<td>822M</td>
<td>492M</td>
<td>494M</td>
</tr>
<tr>
<td>32</td>
<td>197</td>
<td>12.3M</td>
<td>7.02M</td>
<td>7.03M</td>
<td>7.66K</td>
<td>480M</td>
<td>269M</td>
<td>270M</td>
</tr>
<tr>
<td>64</td>
<td>47</td>
<td>1.72M</td>
<td>626K</td>
<td>626K</td>
<td>3.86K</td>
<td>103M</td>
<td>51.2M</td>
<td>51.2M</td>
</tr>
<tr>
<td>128</td>
<td>22</td>
<td>908K</td>
<td>258K</td>
<td>251K</td>
<td>3.71K</td>
<td>150M</td>
<td>40.3M</td>
<td>40.3M</td>
</tr>
<tr>
<td>256</td>
<td>7</td>
<td>302K</td>
<td>48K</td>
<td>53.7K</td>
<td>2.27K</td>
<td>88.6M</td>
<td>17.3M</td>
<td>19.5M</td>
</tr>
<tr>
<td>512</td>
<td>4</td>
<td>131K</td>
<td>7.50K</td>
<td>7.75K</td>
<td>2.74K</td>
<td>102M</td>
<td>5.62M</td>
<td>5.79M</td>
</tr>
<tr>
<td>2K</td>
<td>1</td>
<td>2K</td>
<td>2K</td>
<td>2K</td>
<td>3.23K</td>
<td>6.47M</td>
<td>6.47M</td>
<td>6.47M</td>
</tr>
<tr>
<td>8K</td>
<td>1</td>
<td>128K</td>
<td>5K</td>
<td>5K</td>
<td>13.9K</td>
<td>1.74G</td>
<td>69.5M</td>
<td>69.5M</td>
</tr>
<tr>
<td>Total</td>
<td>2.63M</td>
<td>277G</td>
<td>218G</td>
<td>225G</td>
<td>3.22M</td>
<td>337G</td>
<td>263G</td>
<td>270G</td>
</tr>
</tbody>
</table>

dedup = 1.20, compress = 1.28, copies = 1.03, dedup * compress / copies = 1.50

If the estimated dedup ratio is greater than 2, then you might see dedup space savings.

In this example, the dedup ratio (dedup = 1.20) is less than 2, so enabling dedup is not recommended.

2. Make sure your system has enough memory to support dedup.
   - Each in-core dedup table entry is approximately 320 bytes.
   - Multiply the number of allocated blocks times 320. For example:

   
in-core DDT size = 2.63M x 320 = 841.60M

3. Dedup performance is best when the deduplication table fits into memory. If the dedup table has to be written to disk, then performance will decrease. If you enable deduplication on your file systems without sufficient memory resources, system performance might
degradeduring file system related operations. For example, removing a large dedup-enabled file system without sufficient memory resources might impact system performance.

**Considering ZFS Backup Features**

- There are no `ufsdump` and `ufrestore` command equivalents – You can use a combination of features to provide file system backup features.
- Create ZFS snapshots of important file systems and clone file systems that you can then modify as needed
- Send and receive ZFS snapshots to a remote system
- Save ZFS data with archive utilities such as `tar`, `cpio`, and `pax` or enterprise backup products.

**Migrating File System Data to ZFS File Systems**

Consider the following recommended data migration practices, if you are migrating data to systems running the Oracle Solaris 11 release.

**Recommended Data Migration Practices**

- Do not mix UFS directories and ZFS file systems in the same file system hierarchy because this model is confusing to administer and maintain.
- Do not mix NFS legacy shared ZFS file systems and ZFS NFS shared file systems because this model is difficult to maintain. Consider using only ZFS NFS shared file systems.
- Use the shadow migration feature to migrate existing UFS data over NFS to ZFS file systems.

**Migrating Data With ZFS Shadow Migration**

ZFS shadow migration is a tool you can use to migrate data from an existing file system to a new file system. A *shadow* file system is created that pulls data from the original source as necessary.

You can use the shadow migration feature to migrate file systems as follows:

- A local or remote ZFS file system to a target ZFS file system
- A local or remote UFS file system to a target ZFS file system
Shadow migration is a process that pulls the data to be migrated:

- Create an empty ZFS file system.
- Set the shadow property on an empty ZFS file system, which is the target (or shadow) file system, to point to the file system to be migrated. For example:

```bash
# zfs create -o shadow=nfs://system/export/home/ufsdata users/home/shadow2
```
- Data from the file system to be migrated is copied over to the shadow file system. For step-by-step instructions, see "Migrating ZFS File Systems" in Oracle Solaris 11.1 Administration: ZFS File Systems.

Review the following considerations when migrating file systems:

- The file system to be migrated must be set to read-only. If the file system is not set to read-only, in progress changes might not be migrated.
- The target file system must be completely empty.
- If the system is rebooted during a migration, the migration continues after the reboot.
- Access to directory content that is not completely migrated or access to file content that is not completely migrated is blocked until the entire content is migrated.
- If you want the UID, GID, and ACL information to be migrated to the shadow file system during an NFS migration, make sure that the name service information is accessible between the local and remote systems. You might consider copying a subset of the file system data to be migrated for a test to see that all the ACL information is migrated properly before completing a large migration of data over NFS.
- Migrating file system data over NFS can be slow, depending on your network bandwidth.
- Monitor file system data migration with the `shadowstat` command. See "Migrating ZFS File Systems" in Oracle Solaris 11.1 Administration: ZFS File Systems.

### Migrating UFS Data to a ZFS File System (ufsdump and ufsrestore)

You can also use `ufsrestore` to restore a previous `ufsdump` dump. For example:

```bash
# mount -F nfs rsystem:/export/ufsdata /tank/legacyufs
# ls /tank/legacyufs
ufsdump-a
# zfs create tank/newzfs
# cd /tank/newzfs
# ufsrestore rvf /tank/legacyufs/ufsdump-a
```

If the original UFS file system data includes POSIX-draft ACLs, they are translated into NFSv4 ACLs. See the Chapter 7, "Using ACLs and Attributes to Protect Oracle Solaris ZFS Files," in Oracle Solaris 11.1 Administration: ZFS File Systems.
Managing Software and Boot Environments

This chapter provides information about how to manage software and boot environments (BEs) in an Oracle Solaris 11 release.

The following topics are covered:

- “Oracle Solaris 11 Package Changes” on page 71
- “Oracle Solaris 10 SVR4 and IPS Package Comparison” on page 72
- “Displaying Information About Software Packages” on page 76
- “Updating the Software on Your Oracle Solaris 11 System” on page 77
- “Managing Boot Environments” on page 80

Oracle Solaris 11 Package Changes

The Image Packaging System (IPS) is a framework that provides the capability for software lifecycle management, which includes installation, upgrade, and the removal of packages. IPS uses packaging mechanisms that are significantly different than the legacy SVR4 packaging mechanism that is used in Oracle Solaris 10. An IPS package is a collection of directories, files, links, drivers, dependencies, groups, users, and license information in a defined format. This collection represents the installable objects of a package. Packages have attributes, such as package name and description. IPS packages are stored in IPS package repositories that are populated by IPS publishers. See Chapter 1, “Introduction to the Image Packaging System,” in *Adding and Updating Oracle Solaris 11.1 Software Packages.*
The following IPS components, as well as the utility for managing boot environments, are described in this chapter:

- **IPS command-line utilities** – IPS includes a suite of pkg commands that enable you to list, search, install, update, and remove software packages. See pkg(1). IPS commands also enable you to manage package publishers and copy or create package repositories. See “Updating the Software on Your Oracle Solaris 11 System” on page 77.

- **IPS publishers and repositories** – A publisher identifies a person or an organization that provides one or more packages. A repository is a location from which you can install packages. See http://pkg.oracle.com/solaris/release/.

  If you have a system with zones that does not have direct access to a public IPS repository, see “Proxy Configuration on a System That Has Installed Zones” in Oracle Solaris 11 Administration: Oracle Solaris Zones, Oracle Solaris 10 Zones, and Resource Management.

- **Boot environment management** – An image is a location where IPS packages are installed and where other IPS operations are performed. Boot environments, also called a BEs, are bootable instances of an image. The beadm utility is used to create and manage boot environments, along with any other software packages that are installed in that image. Multiple BEs can be maintained on a single system, and each BE can have a different software version installed. A new BE can also be created automatically, as a result of a package operation. See “Tools for Managing Boot Environments” on page 80.

## Oracle Solaris 10 SVR4 and IPS Package Comparison

Review the following information about software packaging in Oracle Solaris 11:

- The SUNW prefix for package names is no longer used. With the introduction of IPS, all software packages are renamed. A set of mappings has been added to the former SVR4 package database for compatibility. The mappings ensure package dependencies are met for administrators who want to install a legacy SVR4 package.

- Certain SVR4 package commands, such as pkgadd, are retained for administering legacy SVR4 packages, but the primary package installation and update interface is now the pkg(1) set of commands. If you previously used the pkgadd command to install a particular package, you can check whether that package is available as an IPS package. The IPS package name will most likely be different.

Locate an SVR4 package as follows:

```
$ pkg info -g http://pkg.oracle.com/solaris/release/ SUNWcsl
Name: SUNWcsl
   Summary: Not installed (Renamed)
   Renamed to: system/library@0.5.11-0.133
              consolidation/osnet/osnet-incorporation
   Publisher: solaris
   Version: 0.5.11
   Build Release: 5.11
```

This output shows that the SVR4 SUNWcsl package has been renamed (Rename) is now the IPS system/library package. If the package you want is not installed, use the pkg install command to install the package:

```
$ pkg install system/library
```

- If an SVR4 package is available as an IPS package, install the IPS package and not the SVR4 package. Installing the IPS package provides many advantages, including that only versions compatible with the rest of the image can be installed and dependencies are automatically checked and updated. See Adding and Updating Oracle Solaris 11.1 Software Packages.
- Certain SVR4 package commands, for example, patchadd, are no longer available. Instead, use the IPS pkg update command. When you use this command, any package dependencies are automatically resolved.
- IPS packages have FMRIs, similar to SMF service names. Package names are also hierarchical instead of abbreviated. As described previously, the core system library package in Oracle Solaris 10 is SUNWcsl but the IPS name is system/library. The FMRI format of system/library is similar to:

```
pkg://solaris/system/library@0.5.11,5.11-0.133:20101027T183558Z
```

See “Fault Management Resource Identifiers” in Adding and Updating Oracle Solaris 11.1 Software Packages.

---

**Note** – Due to organizational restructuring of the files that are delivered with each package, there is not an exact one-to-one mapping of Oracle Solaris 10 package names to Oracle Solaris 11 package names.

- Oracle Solaris packages are not split into development, documentation, and runtime components. For example, in Oracle Solaris 10, the standard X11 library (libX11) runtime is in the SUNWxwp1t package, while the headers for the same package are in SUNWxwin, and the documentation is in the SUNWxwpd documentation package. In Oracle Solaris 11, all of these components are located in the pkg:/x11/library/libx11 package. If you want to minimize the system, you can choose to exclude certain components by using the pkg facet command.

Remove the man pages as follows:

```
# pkg change-facet facet.doc.man=false
```

Remove the header files as follows:

```
# pkg change-facet facet.devel=false
```
Note – These are global settings that remove all of the man pages for all packages and all of the header files for all packages.

See “Controlling Installation of Optional Components” in Adding and Updating Oracle Solaris 11.1 Software Packages.

- SVR4 packaging and patch tools are still supported in Oracle Solaris 10 Containers. These Oracle Solaris 10 branded, non-global zones run on Oracle Solaris 11, utilizing the zones and branded zones technology. See “Oracle Solaris 11 Zone Features” on page 148.

- For SVR4 package to IPS package conversion information, see “Converting SVR4 Packages To IPS Packages” in Packaging and Delivering Software With the Image Packaging System in Oracle Solaris 11.1.

The following table compares SVR4 package and patch commands with IPS package commands.

<table>
<thead>
<tr>
<th>SVR4 Package Command</th>
<th>IPS Package Command Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>pkgadd</td>
<td>pkg install</td>
</tr>
<tr>
<td>patchadd</td>
<td>pkg update</td>
</tr>
<tr>
<td>pkgrm</td>
<td>pkg uninstall</td>
</tr>
<tr>
<td>pkgadm addcert, pkgadm removecert</td>
<td>pkg set-publisher -k, -c, --approve-ca-cert, --revoke-ca-cert, unset-ca-cert</td>
</tr>
<tr>
<td>pkginfo, pkgchk -l</td>
<td>pkg info, pkg list, pkg contents, pkg search</td>
</tr>
<tr>
<td>pkgchk</td>
<td>pkg verify, pkg fix, pkg revert</td>
</tr>
</tbody>
</table>

IPS Installation Package Groups

Oracle Solaris 10 installation methods provide software package clusters that install a group of packages based on the system’s purpose, such as minimal network, desktop, developer, and all for servers.

Oracle Solaris 11 provides three group packages that install different sets of packages appropriate for a larger server, a smaller server or non-global zone, or a graphical desktop environment.

The following table describes the group packages that are installed on the system, depending upon the default installation method that is used.
### Oracle Solaris 11 Group Packages Installed by Default

<table>
<thead>
<tr>
<th>Group Name/Summary</th>
<th>Description</th>
<th>Default Installation Method</th>
<th>Distribution Constructor ISO Boot Image</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>group/system/solaris-desktop</code></td>
<td>Provides the GNOME desktop environment and other GUI tools such as web browsers and mail. It also includes drivers for graphics and audio devices.</td>
<td>Live Media</td>
<td>Live Media</td>
</tr>
<tr>
<td>Oracle Solaris Desktop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><code>group/system/solaris-large-server</code></td>
<td>Provides common network services for an enterprise server. This group package also contains hardware drivers that are required for servers, such as InfiniBand drivers.</td>
<td>Text installer from media and default Automated Installer</td>
<td>Text installer</td>
</tr>
<tr>
<td>Oracle Solaris Large Server</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><code>group/system/solaris-small-server</code></td>
<td>Provides a command-line environment and is also a smaller set of packages to be installed on a server.</td>
<td>Non-global Zones</td>
<td></td>
</tr>
<tr>
<td>Oracle Solaris Small Server</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Display package group information as follows:

```
# pkg info -r *group*
```

Display the contents of these package groups:

```
# pkg contents -o fmri -r -t depend pkg-grouping
```

Determine which package group is currently installed on your system:

```
# pkg list group/system/
```

IPS also includes other meta and group packages that can be installed on your system to provide a trusted desktop or multi-user desktop.

If you want to install most packages, similar to installing the Solaris 10 SUNWCall package cluster, consider installing the `group/system/solaris-large-server` package group. See "Listing All Installable Packages in a Group Package" in *Adding and Updating Oracle Solaris 11.1 Software Packages*.
Displaying Information About Software Packages

To display information about software packages, refer to the following examples. No special privileges are required to display information about packages.

List the packages that are currently installed on your system:

$ pkg list | more

Determine whether a specific package is installed in the current image and whether an update is available.

$ pkg list amp
pkg list: no packages matching 'amp' installed

Display more information about a package that is not installed. Use the -r option to query the package repository, as follows:

$ pkg info -r amp
Name: amp
Summary:
State: Not installed (Renamed)
Renamed to: web/amp@0.5.11-0.133
consolidation/sfw/sfw-incorporation
Publisher: solaris
Version: 0.5.11
Build Release: 5.11
Branch: 0.133
Packaging Date: Wed Oct 27 18:31:05 2010
Size: 0.00 B
FMRI: pkg://solaris/amp@0.5.11,5.11-0.133:20101027T183105Z
Name: group/feature/amp
Summary: AMP (Apache, MySQL, PHP) Deployment Kit for Oracle Solaris
Description: Provides a set of components for deployment of an AMP (Apache, MySQL, PHP) stack on Oracle Solaris
Category: Meta Packages/Group Packages (org.opensolaris.category.2008)
Web Services/Application and Web Servers (org.opensolaris.category.2008)
State: Not installed
Publisher: solaris
Version: 0.5.11
Build Release: 5.11
Branch: 0.175.1.0.0.0.24.0
Packaging Date: Tue Sep 04 18:03:28 2012
Size: 5.46 kB
FMRI: pkg://solaris/group/feature/amp@0.5.11,5.11-0.175.1.0.0.0.24.0:20120904T180328Z
Name: web/amp
Summary:
State: Not installed (Renamed)
Renamed to: group/feature/amp@0.5.11-0.174.0.0.0.0.0
consolidation/ips/ips-incorporation
Publisher: solaris
Version: 0.5.11
Build Release: 5.11
If you know the name of the tool that you want to install, but not the name of the package, use the search subcommand in one of the following ways:

```
$ pkg search /usr/bin/emacs
INDEX ACTION VALUE PACKAGE
path file  usr/bin/emacs pkg:/editor/gnu-emacs@23.4-0.175.1.0.0.24.0
$ pkg search file::emacs
INDEX ACTION VALUE PACKAGE
basename file  usr/share/info/emacs pkg:/editor/gnu-emacs@23.4-0.175.1.0.0.24.0
basename file  usr/bin/emacs pkg:/editor/gnu-emacs@23.4-0.175.1.0.0.24.0
```

### Updating the Software on Your Oracle Solaris 11 System

With IPS, you can update all of the packages on your system that have available updates, or you can update individual packages that are not constrained by the system. If a package is constrained, an appropriate message indicating why it has been constrained is provided. Package constraints generally represent a dependency or a versioning issue. For most package update operations, either a clone BE is created or a backup BE is created before applying the software updates to the clone BE so that you can boot back to the previous BE. Some `pkg update` operations, such as updating a non-global zone or updating a specific package, might not generate a clone BE or a backup BE.

The following options are available:

- **Adding software packages after an installation** – The Live Media contains a set of software that is appropriate for a desktop or laptop computer. The text installation media contains a smaller set of software that is more appropriate for a general-purpose server system. The text installer does not install the GNOME desktop. To add packages, including the Oracle Solaris Desktop (GNOME 2.30), after a text installation, see “Adding Software After Text Installation” in *Installing Oracle Solaris 11.1 Systems*.

- **Updating all of the packages on your installed system** – To update all of the packages on your system that have available updates, use the `pkg update` command, as follows:

```
# pkg update
```

Running this command updates packages that you might not otherwise consider updating, for example, kernel components and other low-level system packages.

Depending on your package repository or publisher status, your system could be updated automatically from Solaris 11 to Solaris 11.1. If you want to update your system image, but you do not want to update to another release, see “Updating an Image” in *Adding and Updating Oracle Solaris 11.1 Software Packages*.
See an example of using this command to update a BE in "Managing Boot Environments" on page 80.

Display those packages on a system that require an update without actually installing the packages.

```bash
# pkg update -nv --accept
```

- **Adding or updating individual packages** – To add individual software packages, use the `pkg install` command. Any dependent packages are also updated at the same time.

  Install an individual package as follows:

  ```bash
  # pkg install communication/im/pidgin
  ```

  Update an individual package as follows:

  ```bash
  # pkg update system/management/ocm
  ```

- **Install package updates that deliver fixes** – A `pkg update` operation might include bug fixes, so the operation is similar to applying a specific patch or patches in previous Oracle Solaris releases.

## Installing Maintenance Updates on an Oracle Solaris 11 System

Oracle customers with an active Oracle support plan have access to the support package repository so that you can routinely update your Oracle Solaris 11 systems. Updates to the support repository are called Support Repository Updates (SRUs) and occur on a regular basis. See "How to Configure the Oracle Solaris support Repository" on page 79.

If you need to access an IPS repository on a system that has Oracle Solaris Zones installed by using `https_proxy` and `http_proxy`, see “Proxy Configuration on a System That Has Installed Zones” in *Oracle Solaris 11.1 Administration: Oracle Solaris Zones, Oracle Solaris 10 Zones, and Resource Management*.

- **SRUs** – Updates from the Oracle Solaris 11 support repository are available as support repository updates (SRUs). SRUs take the place of maintenance updates or patch bundles that are available for Oracle Solaris 10 releases.

- **Future Oracle Solaris 11 releases** – Future Oracle Solaris 11 releases are made available in the support repository or a release repository that provides the currently available OS.

The following summary provides information about selecting the update method that works best for your environment. For more information about the best way to update your system images, see “Updating an Image” in *Adding and Updating Oracle Solaris 11.1 Software Packages*.

- **Desktop systems or laptop computers** – In a desktop environment, you can identify what updates are available by using the following command:

  ```bash
  # pkg update -nw --accept
  ```
■ **Development systems** – You can use the pkg update operation to apply a specific fix or apply an SRU to these systems to assess the impact of your applications that are currently under development. A new BE is created when an SRU is applied, and you can fall back to the original BE, if necessary.

■ **Production systems** – In a large enterprise environment, SRUs can be applied to a non-production system to assess the impact of the OS changes to the currently running production environment. If the non-production system remains stable after the SRU installation and assessment is complete, the SRU can be applied to a new BE on the production system, and you can fall back to the original BE, if necessary.

▼ **How to Configure the Oracle Solaris support Repository**

Use the following steps to configure the support repository, if you want to apply support updates.

1. **Log into the following site.**
   
   `http://pkg-register.oracle.com/`

2. **Download the SSL key and certificate for the Oracle Solaris 11 release.**
   Consider creating a directory inside `/var/pkg` to store the key and certificate.
   
   ```
   # mkdir -m 0755 -p /var/pkg/ssl
   # cp -i Oracle_Solaris_11_Support.key.pem /var/pkg/ssl
   # cp -i Oracle_Solaris_11_Support.certificate.pem /var/pkg/ssl
   ```

3. **Copy the key and certificate from the directory that you downloaded the key and certificate into this directory.**
   The key files are kept by reference, so if the files become inaccessible to the packaging system, you will encounter errors.

4. **Set the publisher to the support repository.**
   
   ```
   # pkg set-publisher \
   -k /var/pkg/ssl/Oracle_Solaris_11_Support.key.pem \
   -c /var/pkg/ssl/Oracle_Solaris_11_Support.certificate.pem \
   -O https://pkg.oracle.com/solaris/support solaris
   ```

5. **Install the updated packages from the support repository, if desired.**
   
   ```
   # pkg update
   ```
   As mentioned previously, this operation updates the packages on the system with the latest package versions either by creating a new BE or by creating a backup BE.
Managing Boot Environments

Previously, you could perform a live upgrade or use the `patchadd` command to update your BE. In Oracle Solaris 11, the `pkg update` command is used to update a BE, or you can use the `beadm` command set to create, display, and remove BEs.

Tools for Managing Boot Environments

In Oracle Solaris 11, the `beadm` utility replaces the `lu` set of commands for managing ZFS BEs. In most cases, the `pkg update` command creates and updates a clone BE, so you boot back to the previous BE, if necessary.

<table>
<thead>
<tr>
<th>Oracle Solaris 10 Syntax</th>
<th>Oracle Solaris 11 Syntax</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>lucreate -n newBE</code></td>
<td><code>beadm create newBE</code></td>
<td>Create a new BE</td>
</tr>
<tr>
<td><code>lustatus</code></td>
<td><code>beadm list</code></td>
<td>Display BE information</td>
</tr>
<tr>
<td><code>luactivate newBE</code></td>
<td><code>beadm activate newBE</code></td>
<td>Activate a BE</td>
</tr>
<tr>
<td><code>ludelete BE</code></td>
<td><code>beadm destroy BE</code></td>
<td>Destroy an inactive BE</td>
</tr>
<tr>
<td><code>luupgrade or patchadd</code></td>
<td><code>pkg update</code></td>
<td>Upgrade or update a BE</td>
</tr>
</tbody>
</table>

See *Creating and Administering Oracle Solaris 11.1 Boot Environments* and `beadm(1M)`.

The system performs the following actions in most cases:

1. Creates a clone of the current BE that is a bootable image.
2. Updates the packages in the clone BE, but does not update any packages in the current BE.
3. Sets the new BE as the default boot choice the next time the system is booted. The current BE remains as an alternate boot choice.

Use the `beadm` command to create, rename, mount, unmount, activate, or destroy BEs.

Reviewing the Initial ZFS BE After an Installation

After a system is installed, the following root pool file systems and components are available:

```
$ zfs list -r rpool
NAME       USED  AVAIL REFER MOUNTPOINT
rpool      13.0G 121G  4.58M /rpool
rpool/ROOT 6.81G 121G  31K legacy
rpool/ROOT/solaris 6.81G 121G  4.07G /
rpool/ROOT/solaris/var 364M 121G 207M /var
```
### How to Update Your ZFS Boot Environment

To update a ZFS boot environment, use the `pkg update` command. A clone or backup BE is created and automatically activated in most cases. The `pkg update` command displays whether a backup BE or a new BE is created.

**Caution** – If you update your BE and also upgrade your root pool version, if one is available for the recent update, you will not be able to boot back to a previous BE, if previous BE is in a lower pool version. Make sure you have tested all the features and you are satisfied with the current release update before upgrading your pool version.

For information about upgrading your pool version, see “Upgrading ZFS Storage Pools” in *Oracle Solaris 11.1 Administration: ZFS File Systems.*

#### 1 Display your existing BE information.

```
# beadm list
BE Active Mountpoint Space Policy Created
... ... ... ... ... ... ... ... 
solaris NR / 9.71G static 2013-01-04 12:35
```

In the above output, NR means the BE is active now and will be the active BE on reboot.

#### 2 Update your BE.

```
# pkg update
Packages to remove: 117
Packages to install: 186
```
Packages to update: 315
Create boot environment: Yes

Download PKGS FILES XFER (MB)
Completed 618/618 29855/29855 600.7/600.7

If your existing BE name is solaris, a new BE, solaris-1, is created and automatically activated after the pkg update operation is complete.

3 Reboot the system to complete the BE activation. Then, confirm your BE status.
   # init 6
   
   # beadm list
   BE Active Mountpoint Space Policy Created
   -- ------ ---------- ----- ------ -------
   solaris - - 18.19M static 2013-01-04 12:35
   solaris-1 NR / 9.82G static 2013-01-31 13:03

4 If an error occurs when booting the new BE, activate and boot to the previous BE.
   # beadm activate solaris
   # init 6

   If the activated BE does not boot, see “How to Boot From a Backup BE for Recovery Purposes” on page 124.
Managing Network Configuration

Network configuration in Oracle Solaris 11 works differently than in Oracle Solaris 10. This chapter provides basic information about how to configure your network in an Oracle Solaris 11 release.

The following topics are covered:
- “Network Configuration Feature Changes” on page 83
- “How the Network Is Configured in Oracle Solaris” on page 85
- “Network Configuration Commands” on page 88
- “Managing Network Configuration in Fixed Mode” on page 89
- “Managing Network Configuration in Reactive Mode” on page 97
- “Creating Persistent Routes (Fixed and Reactive)” on page 103
- “Configuring IPMP in Oracle Solaris 11” on page 104
- “Managing Network Configuration From the Desktop” on page 105
- “Network Configuration and Administration Commands (Quick Reference)” on page 106

Network Configuration Feature Changes

The following features are new or have changed in Oracle Solaris 11.1:

- **One SMF network configuration repository for both datalink and IP configuration** – Oracle Solaris 11 uses one SMF network configuration repository for both datalink and IP configuration. As a result, the commands that are used to manage network configuration have also changed.

- **Networking command changes** – You can now use the `dladm` and `ipadm` commands to manage a reactive network configuration profile (NCP). To use fixed networking commands on a reactive NCP, it *must* be currently active. Otherwise, use the `netcfg` command to modify the NCP. See “Network Configuration Commands” on page 88.
**Note** – When the DefaultFixed NCP is active, you must use fixed networking commands to manage network configuration.

- **DefaultFixed Location** – In addition to the Automatic and NoNet system-defined Locations, the DefaultFixed Location profile has been added. This Location tracks changes that are made to naming services, etc., while the profile is active. Whenever the DefaultFixed NCP is active, the DefaultFixed Location is also active.

- **Link aggregations that span multiple switches** – Link aggregation support now includes a solution that enables the spanning of aggregations across multiple switches, independent of the switch vendor. See Chapter 2, “Using Link Aggregations,” in *Managing Oracle Solaris 11.1 Network Performance*.

- **Multihoming policy changes** – The multihoming model controls the system policy for accepting and transmitting IP packets when multiple IP interfaces are simultaneously enabled. For example, if a system is configured with more than one IP interface, there might be multiple equivalent routes to a given destination. Similarly, a packet destined for an IP address that is hosted on another IP interface might arrive on a different IP interface. The system’s behavior in these situations is determined by the selected multihoming policy. Oracle Solaris 11 supports three multihoming properties. The following properties are equivalent to the ndd multihoming policies used in Oracle Solaris 10:
  - **strong**  
    Equivalent to the `ip_strict_dst_multihoming = 1` setting through `ndd`, with an additional requirement that packets originated from the host are only sent out on interfaces where the IP source address of the outgoing packet is an address that is configured on the outgoing interface.
  - **weak**  
    Equivalent to the `ip_strict_dst_multihoming = 0` setting through `ndd`.
  - **src-priority**  
    Equivalent to the weak end-system model in receive behavior, for example, the packet is accepted on any interface, as long as the IP destination of the packet is configured on one of the host’s interfaces.

See `ipadm(1M)` for more details.

- **Advanced networking features**
  - **Edge virtual bridging (EVB)** – EVB is a technology that enables a host to exchange virtual link information with an external switch. EVB features enable you to advertise more information about virtual link configurations on the network than just the bandwidth share or priority definitions for physical links that data center bridging (DCB) features provide. See Chapter 9, “Edge Virtual Bridging in Oracle Solaris,” in *Managing Oracle Solaris 11.1 Network Performance*.  

Transitioning From Oracle Solaris 10 to Oracle Solaris 11.1 • September 2013
How the Network Is Configured in Oracle Solaris

Oracle Solaris 11 uses profile-based network configuration, which is comprised of two network configuration modes: fixed (manual) and reactive (automatic). The way you manage network configuration depends on the configuration mode that you are using and the profiles that are currently active on the system. After an installation, two system-defined network configuration profiles (NCPs) are present on the system: DefaultFixed and Automatic. Three system-defined Location profiles are present on the system after an installation: Automatic, NoNet, and DefaultFixed (new in Oracle Solaris 11.1). Additional reactive profiles can be created after an installation.

Both the text and AI installation methods default to fixed network configuration. For fixed network configuration, the dladm and ipadm commands are used. If the Automatic NCP or another reactive NCP is active after the installation, the netcfg and netadm commands are used to manage network configuration. Starting with Oracle Solaris 11.1, you can also use the dladm and ipadm commands to manage a reactive NCP, but the NCP must be currently active on the system.

- **Exclusive IP zones by default** – Exclusive IP zones enable you to assign a separate IP stack, per zone. Each zone has the flexibility to configure IP within that stack, completely separate of other zones. See Part II, “Oracle Solaris Zones,” in Oracle Solaris 11.1 Administration: Oracle Solaris Zones, Oracle Solaris 10 Zones, and Resource Management.

- **VNIC migration** – Associations between Physical NICs (PNICs) and VNICs can now be migrated without disrupting network connectivity. Use the dladm modify-vnic command to migrate one or more VNICs from one underlying datalink to another underlying datalink, without having to delete and reconfigure the VNICs. The underlying link can be a physical link, a link aggregation, or an etherstub. For example:

  ```
  # dladm modify-vnic -l net1 -L ether0
  -l  Refers to the destination datalink to which the VNICs are migrated.
  -L  Refers to the original datalink over which the VNICs are configured. The -L option is restricted to global modification only.
  ```

  See “Migrating VNICs” in Using Virtual Networks in Oracle Solaris 11.1.
Note the following additional information about profile-based network configuration:

- **Profile types and network configuration** – The two main profile types are the network configuration profile (NCP) and the Location profile. An NCP specifies the configuration of network datalinks and IP interfaces and addresses. The Location profile manages system-wide network configuration, for example naming services and IP filter settings. Exactly one NCP and one Location profile must be active on the system at all times. If the DefaultFixed NCP is active, the system-defined DefaultFixed Location profile is also active. If any other reactive NCP is active, the Location that is activated is determined by rules and criteria that are specified in each of the reactive Locations. For information about other network profile types, see “Network Profiles and Types” in Connecting Systems Using Reactive Network Configuration in Oracle Solaris 11.1.

- **Using the Automatic NCP** – The Automatic NCP is a system-defined profile that manages datalink and IP configuration, based on the current network environment. This NCP is automatically updated whenever your network environment changes, for example, when network devices are added or removed from the system. You cannot delete the Automatic NCP. You can modify this NCP by using the `dladm` and `ipadm` commands, but any modifications should be made with care. Rather than directly modifying the Automatic NCP, the preferred method is to clone this NCP, and then apply your changes to the copy. Because the system does not change the configuration for any user-defined NCPs, including copies of the Automatic NCP, any changes that you make are preserved. See Example 7–8.

- **How system-defined Locations work** – These profiles include the Automatic, NoNet, and DefaultFixed Locations. The DefaultFixed Location (new in Oracle Solaris 11.1) tracks changes that are made to naming services, etc. For example, the system updates the DefaultFixed Location to preserve changes that are made to any relevant SMF services (while the Location is active). When the DefaultFixed NCP is active on the system, so is the DefaultFixed Location. System-defined Location profiles can be modified by using the `netcfg` command, but only after these profiles have been activated on a system for the first time. For more information, see Chapter 1, “Reactive Network Configuration (Overview),” in Connecting Systems Using Reactive Network Configuration in Oracle Solaris 11.1.

### How the Network Is Configured During an Installation

During an installation, the network is configured, as follows:

- For a GUI installation, the Automatic NCP is activated, and the network is automatically configured, based on current network conditions.
- For a text installation, you must choose Automatic, Manual, or None.
  - If you choose Automatic, the Automatic NCP is activated, and the network is automatically configured upon reboot.
If you choose Manual, the DefaultFixed NCP is activated, and you are presented with a series of installation screens that enable you to manually configure network settings.

If you choose None, the DefaultFixed NCP is activated, but you do not provide network parameters during the installation. Thus, after a reboot, no network interface is plumbed or configured. Only the loopback IPv4 and IPv6 interfaces (lo0) are activated. You can create persistent network configuration by using dladm and ipadm after the installation. See “Managing Network Configuration in Fixed Mode” on page 89.

For an installation with AI, the network is configured according to the profile that you set up before the installation. If you did not specify any network settings prior to installing Oracle Solaris, the interactive sysconfig tool runs during the installation, enabling you to set network parameters for the system. See “Installing Oracle Solaris by Using AI” on page 38.

Note – Several aspects of network configuration have changed in Oracle Solaris 11, including where certain network configuration information is stored. For example, a system’s default route is no longer stored in the /etc/defaultrouter file because this file is deprecated in Oracle Solaris 11. Do not check this file after an installation to determine a system’s default route. Instead, use the route -p show command or the netstat -nr command. For more information, see “Creating Persistent Routes (Fixed and Reactive)” on page 103.

EXAMPLE 7–1 Verifying the Active NCP on a System

After an installation, use the netadm list command to determine which NCP is active (online). In the following example, the output of the netadm list command shows that the Automatic NCP is currently active:

```
$ netadm list
TYPE       PROFILE  STATE
ncp        Automatic online
ncu:phys   net0     online
ncu:ip     net0     online
ncu:phys   net1     offline
ncu:ip     net1     offline
ncu:phys   net2     offline
ncu:ip     net2     offline
ncu:phys   net3     offline
ncu:ip     net3     offline
loc        Automatic offline
loc        NoNet offline
loc        myloc online
loc        myncp disabled
```

In the previous output, a user-defined Location named myloc is also online. This Location defines system-wide network settings for this particular configuration. When using reactive network configuration, exactly one NCP (either the Automatic NCP or another reactive NCP) and one Location must be active on the system at all times.
EXAMPLE 7–1  Verifying the Active NCP on a System  (Continued)

The output of the `netadm list` command in the following example shows that the DefaultFixed NCP is active, which means you must configure the network manually by using the `dladm` and `ipadm` commands. Note that whenever the DefaultFixed NCP is online, the DefaultFixed Location is also online:

```
# netadm list
TYPE   PROFILE     STATE
ncp    Automatic   disabled
ncp    DefaultFixed online
loc    Automatic   offline
loc    NoNet       offline
loc    DefaultFixed online
```

EXAMPLE 7–2  Switching the Default NCP

Switching network configuration modes requires you to enable the appropriate NCP for that configuration mode. The following example shows how to switch from reactive mode to fixed mode by enabling the DefaultFixed NCP:

```
$ netadm enable -p ncp DefaultFixed
```

Switch to the Automatic NCP, as follows:

```
$ netadm enable -p ncp Automatic
```

The process of switching network configuration modes can take a few minutes. During this time, any messages about various network services that are displayed can be safely ignored.

Network Configuration Commands

The following commands are used to manage network configuration:

- `dladm` – Configures datalinks. The command creates persistent configuration that is applied to the currently active profile on the system (fixed and reactive).
- `ipadm` – Configures IP interfaces and addresses. The command creates persistent configuration that is applied to the currently active profile on the system (fixed and reactive).
- `netcfg` – Administers reactive network configuration on the system for both active and non-active NCPs.
- `netadm` – Displays information about the system’s network profiles; enables and disables NCPs and Locations.
Starting with Oracle Solaris 11.1, you can use fixed networking commands to manage reactive NCPs, provided that the NCP is currently active. This change applies generally to all fixed networking commands. You can still use the `netcfg` and `netadm` commands to manage any reactive NCP (active and non-active).

Note the following additional information about using networking commands in this release:

- The `dladm` and `ipadm` commands are used to configure data links and IP interfaces, respectively, for the currently active NCP (fixed and reactive).
- The `netcfg` command is used to configure other properties of reactive NCPs (active and non-active).
- You cannot use the `netcfg` and `netadm` commands to administer the `DefaultFixed` NCP, which is the system’s only fixed NCP. However, you can view the properties and the status (online or offline) of this NCP by using these commands.
- Configure and view properties that refer to the default route, as follows:
  - For both fixed and reactive NCPs, you can use the `route -p add` command to create a static route (default or otherwise) that is applied to the currently active NCP. This command directly sets the default route in the system’s routing table. See “Creating Persistent Routes (Fixed and Reactive)” on page 103.
  - For reactive NCPs only, you can use the `netcfg` command to create a single, per-interface default route. To view the default route for the NCP, use the `netcfg` command.
  - To view the currently active routes on a system for any NCP, use the `netstat -rn` command.


**Managing Network Configuration in Fixed Mode**

If you are managing the network in fixed mode, the active NCP is `DefaultFixed`. This profile is system-defined and is the only fixed profile on the system. Oracle Solaris does not support the use of multiple fixed profiles. The properties of the `DefaultFixed` NCP reflect the persistent configuration for the system while this NCP is active.

**Note** – Starting with Oracle Solaris 11.1, you can use fixed networking commands to configure reactive profiles that are currently active.

Using fixed network configuration enables you to have full control of all network configuration information. If the `DefaultFixed` NCP is active, you make explicit changes to network
configuration by using the `dladm` and `ipadm` commands. Conversely, with reactive network configuration, the network is automatically configured, as a direct result of changes in the current network conditions. If you are using reactive networking, the `netcfg` command is used to create and manage reactive profiles that specify network configuration parameters. See “Managing Network Configuration in Reactive Mode” on page 97.

When configuring the network in fixed mode, note the following additional information:

- Persistent network configuration is now managed through SMF, not by editing the following files:
  - `/etc/defaultdomain`
  - `/etc/dhcp.*`
  - `/etc/hostname.*`
  - `/etc/hostname.ip*.tun*`
  - `/etc/nodename`
  - `/etc/nsswitch.conf`

  **Note** – The `/etc/nsswitch.conf` file is still referenced in this release, but you do not directly edit the file to make configuration changes. See “Configuring Naming Services in Fixed Mode” on page 93.

For more information about setting a system’s host name, see “System Configuration Changes and Migration of System Configuration to SMF” on page 113.

- During an installation, the system undergoes a one time upgrade to convert any existing `/etc` network configuration files to their respective `ipadm` and `dladm` configurations. The `dladm` command is used to configure datalinks. The `ipadm` command is used to configure IP interfaces. The `ipadm` command provides almost equivalent functionality to the `ifconfig` command. The `ipadm` command also replaces the `ndd` command. To compare `ifconfig` and `ndd` command options with the `ipadm` command, see Appendix A, “Comparison Map: `ifconfig` and `ipadm` Commands,” in Connecting Systems Using Fixed Network Configuration in Oracle Solaris 11.1 and Appendix B, “Comparison Map: `ndd` and `ipadm` Commands,” in Connecting Systems Using Fixed Network Configuration in Oracle Solaris 11.1.

- Network virtualization features are also configured and managed by using the `dladm` and `ipadm` commands. Objects that are in the link layer (Layer 2) of the network stack, for example, virtual local area networks (VLANs), tunnels, link aggregations, and the newer virtual NICs (VNICs), are configured by using the `dladm` command. Interfaces that are on the IP layer (Layer 3) are configured by using the `ipadm` command. See Chapter 2, “Creating and Administering Virtual Networks in Oracle Solaris,” in Using Virtual Networks in Oracle Solaris 11.1 and Chapter 6, “Configuring IP Tunnels,” in Configuring and Administering Oracle Solaris 11.1 Networks.
For additional information about setting network properties, see Chapter 5, "Internet Protocol Suite Tunable Parameters," in Oracle Solaris 11.1 Tunable Parameters Reference Manual.

Displaying and Configuring Datalinks in Fixed Mode

When you perform a fresh installation, all datalinks are automatically assigned generic names by using the net0, net1, and netN naming convention, depending on the total number of network devices on a system. After the installation, you can use different datalink names. See Chapter 3, "Working With Datalinks," in Connecting Systems Using Fixed Network Configuration in Oracle Solaris 11.1.

Note – During an upgrade, link names that were used previously are retained.

Display information about the datalinks on a system, as follows:

```
# dladm show-phys
LINK  MEDIA   STATE  SPEED  DUPLEX  DEVICE
net2  Ethernet up  10000  full  hxge0
net3  Ethernet up  10000  full  hxge1
net4  Ethernet up  10000  full  usbecm0
net0  Ethernet up  1000  full  igb0
net1  Ethernet up  1000  full  igb1
net9  Ethernet up  0    half  e1000g0
net5  Ethernet up  0    half  e1000g1
net10 Ethernet up  0    half  e1000g2
net11 Ethernet up  0    half  e1000g3
```

Note – In Oracle Solaris 10, the /etc/path_to_inst file can be used to store information about physical and virtual network devices. In Oracle Solaris 11, this file does not contain link names for physical network interfaces. To display this information, use the dladm show-phys command, as shown in the previous example.

Display a datalink name, its device name, and its location in this manner:

```
# dladm show-phys -L net0
LINK  DEVICE  LOC
net0  e1000g0  I080
```

Rename a datalink, as follows:

If an IP interface is configured over the datalink, first remove that interface:

```
# ipadm delete-ip interface
```
Then, change the link’s current name:

```
# dladm rename-link old-linkname new-linkname
```


**EXAMPLE 7-3  Displaying a System’s MAC Addresses**

Display the MAC addresses of the physical links in a system, as follows:

```
# dladm show-phys -m
```

This command is similar to using the `ifconfig` command.

Display the MAC addresses of all of the links in a system, physical and non-physical, as follows:

```
# dladm show-linkprop -p mac-address
```

### Configuring IP Interfaces and Addresses in Fixed Mode

The `ipadm` command is used to manually configure IP interfaces and addresses. For example, a static IPv4 interface is configured as follows:

```
# ipadm create-ip net0
# ipadm create-addr -T static -a local=10.9.8.7/24 net0
net0/v4
```

The `-T` option can be used to specify three address types: `static`, `dhcp`, and `addrconf` (for auto-configured IPv6 addresses). In this example, the system is configured with a static IPv4 address. You can use the same syntax to specify a static IPv6 address. However, static IPv6 addresses require that a link-local IPv6 address be configured prior to creating any static IPv6 addresses. This configuration is accomplished by creating an IPv6 `addrconf` address before creating the static IPv6 address:

```
# ipadm create-ip net0
# ipadm create-addr -T addrconf net0
net0/v6
# ipadm create-addr -T static -a local=ec0:a:99:18:209:3dff:fe00:4b8c/64 net0
net0/v6a
```

Configure an interface with DHCP, as follows:
# ipadm create-ip net0
# ipadm create-addr -T dhcp net0
net0/v6a

Use the `addrconf` argument with the `-T` option to specify an automatically generated IPv6 address:

# ipadm create-ip net0
# ipadm create-addr -T addrconf net0
net0/v6

If you wanted to change the IP address that was provided for the `net0` interface in the previous example, you would need to first remove the interface and then re-add it. For example:

# ipadm delete-addr net0/v4
# ipadm create-addr -T static -a local=10.7.8.9/24 net0
net0/v4

See also Chapter 2, “Configuring a System for the Network,” in Connecting Systems Using Fixed Network Configuration in Oracle Solaris 11.1 and `ipadm(1M)`.

## Configuring Naming Services in Fixed Mode

The SMF repository is the primary repository for all naming services configuration. The previous behavior, where you modified a configuration file to configure naming services no longer works. These services must be enabled or refreshed for any changes to take affect.

**Note** – If no network configuration exists, naming services default to files only behavior, rather than nis files. The `svc:/system/name-service/cache` SMF service should be enabled at all times.

The following table describes the naming service configuration that has migrated to SMF:

<table>
<thead>
<tr>
<th>SMF Service</th>
<th>Files</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>svc:/system/name-service/switch:default</code></td>
<td><code>/etc/nsswitch.conf</code></td>
<td>Naming service switch configuration (used by the <code>nscd</code> command)</td>
</tr>
<tr>
<td><code>svc:/system/name-service/cache:default</code></td>
<td><code>/etc/nscd.conf</code></td>
<td>Naming service cache (nscd)</td>
</tr>
<tr>
<td><code>svc:/network/dns/client:default</code></td>
<td><code>/etc/resolv.conf</code></td>
<td>DNS naming service</td>
</tr>
</tbody>
</table>
TABLE 7–1  SMF Service to Legacy File Mapping  (Continued)

<table>
<thead>
<tr>
<th>SMF Service</th>
<th>Files</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>svc:/network/nis/domain:default</td>
<td>/etc/defaultdomain</td>
<td>Shared NIS domain configuration (used by all NIS services). Also historical shared use by LDAP naming services</td>
</tr>
<tr>
<td></td>
<td>/var/yp/binding/$DOMAIN/*</td>
<td>Note – Must be enabled when using nis/client or ldap/client</td>
</tr>
<tr>
<td>svc:/network/nis/client:default</td>
<td>Not applicable</td>
<td>NIS client naming service (ypbind and related files)</td>
</tr>
<tr>
<td>svc:/network/ldap/client:default</td>
<td>/var/ldap/*</td>
<td>LDAP client naming service (ldap_cachemgr and related files)</td>
</tr>
<tr>
<td>svc:/network/nis/server:default</td>
<td>Not applicable</td>
<td>NIS server naming service (ypserv)</td>
</tr>
<tr>
<td>svc:/network/nis/passwd:default</td>
<td>Not applicable</td>
<td>NIS server passwd service (rpc.yppasswd)</td>
</tr>
<tr>
<td>svc:/network/nis/xfr:default</td>
<td>Not applicable</td>
<td>NIS server transfer naming service (ypxfrd)</td>
</tr>
<tr>
<td>svc:/network/nis/update:default</td>
<td>Not applicable</td>
<td>NIS server update naming service (rpc.yppdated)</td>
</tr>
<tr>
<td>svc:/system/name-service/upgrade:default</td>
<td>Not applicable</td>
<td>Naming legacy file to SMF upgrade service</td>
</tr>
</tbody>
</table>

EXAMPLE 7–4  Configuring Naming Services by Using SMF

The following example shows how to configure DNS by using SMF commands.

```
# svccfg
svc:/network/dns/client> select dns/client
svc:/network/dns/client> setprop config/search = astring: \
("us.company.com" "eu.company.com" "companya.com" "companyb.com" "company.com"
) svc:/network/dns/client> setprop config/nameserver = net_address: \
(10.2.201.12 10.2.201.30 ) svc:/network/dns/client> select dns/client:default
svc:/network/dns/client:default> refresh
svc:/network/dns/client:default> validate
svc:/system/name-service/switch> setprop config/host = astring: "files dns"
svc:/system/name-service/switch> select system/name-service/switch:default
svc:/system/name-service/switch:default> refresh
svc:/system/name-service/switch:default> validate
```

Managing Network Configuration in Fixed Mode

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EXAMPLE 7–4  Configuring Naming Services by Using SMF  (Continued)

# svcadm enable dns/client
# svcadm refresh name-service/switch
# grep host /etc/nsswitch.conf
hosts:  files dns
# cat /etc/resolv.conf
#
# copyright (c) 2011, Oracle and/or its affiliates. All rights reserved.
#
#
# _AUTOGENERATED_FROM_SMF_V1_
#
# WARNING: THIS FILE GENERATED FROM SMF DATA.
# DO NOT EDIT THIS FILE. EDITS WILL BE LOST.
# See resolv.conf(4) for details.

search   us.company.com eu.company.com companya.com companyb.com company.com
nameserver 10.2.201.12
nameserver 10.2.201.30
.
.
.

EXAMPLE 7–5  Setting Multiple NIS Servers by Using SMF

The following example shows how to set multiple NIS servers.

# svcfg -s nis/domain setprop config/ypservers = host: "(1.2.3.4 5.6.7.8)"

Note that there is space between 1.2.3.4 and 5.6.7.8.

EXAMPLE 7–6  Setting Multiple DNS Options by Using SMF

The following example shows how to set multiple /etc/resolv.conf options.

# svcfg

svc:> select /network/dns/client
svc:/network/dns/client> setprop config/options = "ndots:2 retrans:3 retry:1"
svc:/network/dns/client> listprop config/options
config/options astring      ndots:2 retrans:3 retry:1

# svcadm refresh dns/client
# grep options /etc/resolv.conf
options ndots:2 retrans:3 retry:1
svc:/network/dns/client> exit

resolv.conf Error-Checking Capabilities

Prior to the naming services migration to SMF, errors in the resolv.conf file configuration were processed silently and went undetected without producing any warnings. As a result, the resolv.conf file did not behave according to how it was configured. In Oracle Solaris 11, some
basic error checking is performed through the use of SMF templates so that error conditions are properly reported. Note that other SMF services also all have some rudimentary error-checking capabilities. However, the resolv.conf error reporting is the most prominent, due to the absence of error reporting in libresolv2. See resolv.conf(4).

**Temporarily Resetting SMF Naming Services**

Reset the configuration properties of an SMF naming service back to the files only mode, as follows:

```
# /usr/sbin/nscfg unconfig name-service/switch
# svcadm refresh name-service/switch
```

**Note** – Refresh the name-service switch SMF service for the changes to take affect.

The nscfg unconfig command resets the SMF configuration only. The sysconfig command executes the appropriate SMF services, as well as resets SMF and on disk legacy files and services to their original state.

**Importing Naming Services Configuration**

The nscfg command transfers legacy file configuration for the name-service switch components into the SMF repository. The command imports the legacy file, converting and pushing the configuration to SMF. For example:

```
# /usr/sbin/nscfg import -f FMRI
```

The command that is used in the following example is the simplest way to populate the DNS configuration with information from the resolv.conf file. In this example, the nscfg command reads the information in the /etc/resolv.conf file, converts it, then stores the information in the svc:/network/dns/client SMF service.

```
# /usr/sbin/nscfg import -f dns/client
```

If your system is running in files only mode, and no naming services have been configured or enabled, use the nscfg command to manually configure the system, as shown here:

```
# vi /etc/resolv.conf
# /usr/sbin/nscfg import -f dns/client
# cp /etc/nsswitch.dns /etc/nsswitch.conf
# /usr/sbin/nscfg import -f name-service/switch
# svcadm enable dns/client
# svcadm refresh name-service/switch
```

For more information, see nscfg(1M).
How to Use a Legacy nsswitch.conf File

When you change a system’s naming service, you need to modify the name service switch information accordingly.

1 Become an administrator.

2 Copy the nsswitch.conf file to the new system.

3 Load the information from the file into the SMF repository.
   
   # nscfg import -f svc:/system/name-service/switch:default

4 Refresh the name service switch SMF service.
   
   # svcadm refresh name-service/switch

Configuring LDAP in Fixed Mode

The easiest way to set up LDAP is to enable the DefaultFixed NCP and perform fixed network configuration. Then, if you want to use an LDAP proxy or LDAP self modes and some form of security credentials, run the ldapclient command to complete the LDAP setup. See ldapclient(1M).

Managing Network Configuration in Reactive Mode

Reactive network configuration handles network connectivity and network configuration based on current network conditions through the use of several different types of profiles. Individual profiles contain properties that determine how the network is configured. These profiles are then activated and deactivated by the system, or by you. Assuming your site has a DHCP server that can provide IP addresses and name service information, reactive network configuration provides out-of-box functionality for automatic network configuration of a system that does not require manual configuration. See Chapter 1, "Reactive Network Configuration (Overview)," in Connecting Systems Using Reactive Network Configuration in Oracle Solaris 11.1.

When you are using reactive network configuration, the system automatically detects changes in network conditions and adjusts the network configuration accordingly, based on the new network environment. So, in situations where cables are regularly plugged or unplugged, cards are added or removed, etc., the system restores network connectivity without any user intervention. One disadvantage of using reactive network configuration is that you have less control over network configuration in the event that network conditions change.

For reactive network configuration, the system provides the Automatic NCP and the Automatic Location. These two profiles perform basic configuration of wired and wireless
networking. The only time you are required to interact with reactive networking is if you are prompted by the system for more information, for example, to provide a security key or password for a wireless network.

You can optionally create user-defined reactive NCPs and Locations that are configured with properties that you specify. Use the netcfg command, either in command-line mode or interactively, to create reactive NCPs, Locations, and other profile types.

Part of the process of creating a reactive NCP is to configure the individual components that are contained within the NCP. These individual configuration objects are called Network Configuration Units (NCUs), and each NCU represents a physical link or an interface with properties that define the configuration for that particular link or interface, as shown in the output of the following example:

```
netcfg> select ncp myncp
netcfg:ncp:myncp> select ncu ip nge0
netcfg:ncp:myncp:ncu:nge0> list
ncu:nge0
  type interface
  class ip
  parent "myncp"
  enabled true
  ip-version ipv4,ipv6
  ipv4-addrs src dhcp
  ipv6-addrs src dhcp,autoconf
```

The following examples show how to create and modify NCPs by using the netcfg command interactively. See Chapter 2, “Creating and Configuring Reactive Network Profiles (Tasks),” in Connecting Systems Using Reactive Network Configuration in Oracle Solaris 11.1 for detailed instructions.

**EXAMPLE 7-7  Creating a New Reactive NCP**

In the following example, a new NCP named myncp and two NCUs (one link and one interface) are created.

```
$ netcfg
netcfg> create ncp myncp
netcfg:ncp:myncp> create ncu phys net0
Created ncu 'net0', Walking properties ...
activation-mode (manual) [manual|prioritized]>
mac-address>
autopush>
mtu>
netcfg:ncp:myncp:ncu:net0> end
Committed changes
netcfg:ncp:myncp> create ncu ip net0
Created ncu 'net0', Walking properties ...
ip-version (ipv4,ipv6) [ipv4|ipv6]>
ipv4
ipv4-addrs src (dhcp) [dhcp|static]>
dhcp
ipv4-default-route>
netcfg:ncp:myncp:ncu:net0> verify
```
EXAMPLE 7–7  Creating a New Reactive NCP  (Continued)

All properties verified
netcfg:ncp:myncp:ncu:net0> end
Committed changes
netcfg:ncp:myncp> list
ncp:myncp
  management-type reactive
NCUs:
phys net0
ip net0
netcfg:ncp:myncp> list ncu phys net0
ncu:net0
  type link
  class phys
  parent "myncp"
  activation-mode manual
  enabled true
netcfg:ncp:myncp> list ncu ip net0
ncu:net0
  type interface
  class ip
  parent "myncp"
  enabled true
  ip-version ipv4
  ipv4-addrsrc dhcp
netcfg:ncp:myncp> exit

In this example, because the ipv4 value is selected, no prompt is displayed for the ipv6-addrsrc property, as this property is unused. Likewise, for the phys NCU, the default value (manual activation) for the priority-group property is accepted, so no other conditionally related properties are applied.

EXAMPLE 7–8  Creating a New Reactive NCP by Cloning the Automatic NCP

You can optionally create a new reactive NCP by cloning the Automatic NCP, then modifying its properties to set new network configuration parameters. This method is preferred to modifying the original system-defined Automatic NCP, because that NCP is subject to change if network conditions change. In the following example, a new NCP named newncp is created by cloning the system-defined Automatic NCP:

netcfg> list
NCPs:
  Automatic
  DefaultFixed
  bs
Locations:
  Automatic
  NoNet
  DefaultFixed
netcfg> create -t Automatic ncp newncp
netcfg:ncp:newncp> list
ncp:newncp
  management-type reactive
NCUs:
EXAMPLE 7–8 Creating a New Reactive NCP by Cloning the Automatic NCP (Continued)

    phys net1
    phys net0
    ip net1
    ip net0
netcfg:ncp:newncp> destroy ncu ip net1
Destroyed ncu 'net1'
netcfg:ncp:newncp> list
ncp:newncp
management-type reactive
NCUs:
    phys net1
    phys net0
    ip net0
netcfg:ncp:newncp> exit

EXAMPLE 7–9 Creating an NCU for an Existing Reactive NCP

You can configure network settings for a reactive NCP when you create the profile, or you can modify an existing NCP by using the netcfg select command, as shown in the following example where an NCU is created for an existing NCP. The difference between the following example and Example 7–7 is that the select subcommand is used instead of the create subcommand. In the following example, an IP NCU for an existing NCP is created interactively.

$ netcfg
netcfg> select ncp myncp
netcfg:ncp:myncp> list
ncp:myncp
management-type reactive
NCUs:
    phys net0
netcfg:ncp:myncp> create ncu ip net0
Created ncu 'net0'. Walking properties ...
ip-version (ipv4,ipv6) [ipv4|ipv6]> ipv4
ipv4-addrsrc (dhcp) [dhcp|static]> dhcp
ipv4-default-route>
netcfg:ncp:myncp:ncu:net0> end
Committed changes
netcfg:ncp:myncp> list
ncp:myncp
management-type reactive
NCUs:
    phys net0
    ip net0
netcfg:ncp:myncp> list ncu phys net0
ncu:net0
    type link
    class phys
    parent "myncp"
    activation-mode manual
    enabled true
netcfg:ncp:myncp> list ncu ip net0
ncu:net0
    type interface
    class ip
EXAMPLE 7–9  Creating an NCU for an Existing Reactive NCP  (Continued)

```
parent       "myncp"
enabled      true
ip-version   ipv4
ipv4-addrsrcc dhcp
netcfg:ncp:myncp> exit
```

EXAMPLE 7–10  Configuring a Static IPAddress for an existing NCP

In the following example, a static IP address is configured for an existing NCP.

```
netcfg> select ncp myncp
netcfg:ncp:mynscp:ncu:nge0> list
ncu:nge0  
type       interface
class      ip
parent     "myncp"
enabled    true
ip-version ipv4,ipv6
ipv4-addrsrcc dhcp
ipv6-addrsrcc dhcp,autoconf
netcfg:ncp:mynscp:ncu:nge0> set ipv4-addrsrcc=static
netcfg:ncp:mynscp:ncu:nge0> set ipv4-addrsrcc=1.2.3.4/24
netcfg:ncp:mynscp:ncu:nge0> set ipv4-default-route=1.2.3.1
netcfg:ncp:mynscp:ncu:nge0> end
Committed changes
netcfg:ncp:mynscp>
```

EXAMPLE 7–11  Enabling an NCP

In the following example, an NCP named myncp is enabled.

```
$ netadm enable -p ncp myncp
Enabling ncp 'myncp'
```

Configuring Naming Services in Reactive Mode

System-wide network configuration is managed in the Location profile. There are system-defined and user-defined Locations. Properties of user-defined Locations are configured by using the `netcfg` command. See Chapter 2, "Creating and Configuring Reactive Network Profiles (Tasks)," in *Connecting Systems Using Reactive Network Configuration in Oracle Solaris 11.1* for step-by-step instructions.
The following system-defined Locations are used for specific conditions and then automatically activated when those conditions are met:

- **DefaultFixed** – Is activated when the DefaultFixed NCP is active.
  
  You cannot manually enable the DefaultFixed Location or switch the active Location when the DefaultFixed NCP is active because fixed network configuration is being used. However, if a reactive NCP (Automatic or any user-defined NCP) is active, you can use the netadm command to manually enable any different Location, which can be either a system-defined Location (Automatic or NoNet), or any manually enabled user-defined Location.

- **Automatic** – Is activated when any reactive NCP is active, at least one IP address is “up”, and there is no other user-defined Location with activation rules that make it a better match.
  
  The Automatic Location configures DNS through DHCP only.

- **NoNet** - Is activated when a reactive NCP is active and there are no “up” IP addresses.

**Note** – Before configuring naming service properties in a Location, you need to update the file that is to be referenced by the nameservices-config-file property of the specified Location. This file can be stored anywhere on the system. However, do not use the /etc/nsswitch.conf file name, as this file is overwritten.

Create a new user-defined Location profile and then configure NIS, as follows:

```
$ netcfg
netcfg> create loc officeloc
Created loc 'officeloc'. Walking properties ...
activation-mode (manual) [manual|conditional-any|conditional-all]>
  conditional-all
conditions> advertised-domain contains oracle.com
nameservices (dns) [dns|files|nis|ldap]>
  nis
nameservices-config-file ('/etc/nsswitch.dns')>
  /etc/nsswitch.nis
nis-nameservice-configsrc [manual|dhcp]>
  dhcp
nis-v4-domain>
ipfilter-config-file>
ipfilter-v6-config-file>
ippnat-config-file>
ippool-config-file>
ikey-config-file>
ipsecpolicy-config-file>
netcfg:loc:officeloc> end
Committed changes
netcfg> exit
```

In the following example NIS is configured for an existing Location.

```
$ netcfg> select loc origloc
netcfg:loc:origloc> set nameservices=nis
netcfg:loc:origloc> set nis-nameservice-configsrc=manual
netcfg:loc:origloc> set nis-nameservice-servers="1.2.3.38,1.3.3.36"
netcfg:loc:origloc> set default-domain="org.company.com"
```
**Configuring LDAP in Reactive Mode**

Reactive network configuration mode provides limited support for LDAP. Only LDAP anonymous mode works when in reactive mode. If you want to use an LDAP proxy or LDAP self modes and some form of security credentials you must first enable the DefaultFixed profile and manually configure your network. For instructions, see Chapter 12, “Setting Up LDAP Clients (Tasks),” in *Working With Naming and Directory Services in Oracle Solaris 11.1*.

**Creating Persistent Routes (Fixed and Reactive)**

The `/etc/default router` file is deprecated in Oracle Solaris 11. You can no longer manage routes (default or otherwise) by using this file. Also, after an installation, you cannot determine a system’s default route by checking this file. Instead, choose from the following methods to determine the system’s default route.

You can configure route information for a system in the following ways:

- For any currently active NCP (fixed or reactive), use the `route` command with the `-p` option to persistently add a route:

  ```
  # route -p add default ip-address
  ```

  Because this command applies the specified route to the currently active NCP, the default route is removed and potentially replaced, if the active NCP changes.

  **Note** – This behavior is true for all types of network configuration, not just the default route settings.

  For routes that are created by using this method, use the `route -p show` command to display all of the static routes that are associated with the currently active NCP:

  ```
  # route -p show
  ```

- Display the currently active routes on a system (applies to both types of NCPs) by using the `netstat` command:

  ```
  # netstat -rn
  ```

- Create a single, per-interface default route for any reactive NCP (active or non-active) by using the `netcfg` command. See Example 7–9.

  Display the default route for the NCP, as follows:
Default routes that are created with the netcfg command can also be viewed by using the netstat -rn command, but only when the relevant NCP is active. Routes that are created in this way cannot be viewed by using the route -p show command.

For more information, see the netstat(1M) and route(1M) man pages.

Configuring IPMP in Oracle Solaris 11

IPMP works differently in Oracle Solaris 11 than in Oracle Solaris 10. One significant change is that IP interfaces are now grouped into a virtual IP interface, for example, ipmp0. The virtual IP interface serves all of the data IP addresses, while test addresses that are used for probe-based failure detection are assigned to an underlying interface such as net0. For more information, see “How IPMP Works” in Managing Oracle Solaris 11.1 Network Performance.

Oracle Solaris 11 also uses different commands for managing IPMP configuration. As a result, some configuration tasks are also performed differently. Refer to the following general workflow when transitioning from your existing IPMP configuration to the new IPMP model:

1. Make sure you are using fixed network configuration and that the Default Fixed NCP is enabled on your system prior to configuring IPMP. See “How to Change the Active NCP On the System” in Connecting Systems Using Fixed Network Configuration in Oracle Solaris 11.1.

2. Ensure that MAC addresses on SPARC based systems are unique. See “How to Ensure That the MAC Address of Each Interface Is Unique” in Connecting Systems Using Fixed Network Configuration in Oracle Solaris 11.1.

3. Use the dladm command to configure datalinks. To use the same physical network devices within your IPMP configuration, you will need to first identify the datalinks that are associated with each device instance:

   ```bash
   # dladm show-phys
   LINK MEDIA STATE SPEED DUPLEX DEVICE
   net1 Ethernet unknown 0 unknown bge1
   net0 Ethernet up 1000 full bge0
   net2 Ethernet unknown 1000 full e1000g0
   net3 Ethernet unknown 1000 full e1000g1
   ```

   If you previously used e1000g0 and e1000g1 for your IPMP configuration, you now use net2 and net3. Note that datalinks can be based not only on physical links but also on aggregations, VLANs, VNICS, and so on. For more information, see “Displaying a System’s Datalinks (dladm show-link)” in Connecting Systems Using Fixed Network Configuration in Oracle Solaris 11.1.

4. Use the ipadm to perform the following tasks:
   - Configure the network layer
   - Create IP interfaces
Managing Network Configuration From the Desktop

You can manage network configuration from the desktop by using the Network Administration GUI (formerly NWAM). The tool is similar to using the netcf and netadm commands. With the GUI, you can connect to a wired or wireless network, configure a new wired or wireless connection, create Location profiles, and activate or deactivate profiles. Managing reactive network configuration from the desktop works best for users of laptop computers, and in situations where network conditions change often, for example when switching from a home office to the wireless network at work, or when traveling.

Note – If the Default Fixed NCP is currently active, you can view information about your network configuration and you can switch to another NCP, but to configure network settings for this NCP, you must use the dladm and ipadm commands.

Follow these general guidelines and best practices for managing network configuration from the desktop:

- When managing network configuration from the desktop, the simplest solution is to enable the system-generated Automatic NCP. See Example 7–2. At home, you can use this NCP to connect to your wireless network.
- If you decide you want to use a wired connection, plug in the Ethernet cable. Do not switch the default Automatic NCP. The network connection will automatically adapt from a wireless network connection to a wired network connection, without having to make any other changes to your existing network configuration.
- At the office, the same rules apply. If no Ethernet cable is plugged into the network, and the Automatic NCP is enabled, reactive networking is used and a wireless network connection is automatically established.
- If you switch to the Default Fixed NCP, you must then configure the various network components manually by using the dladm and ipadm commands.
- Keep in mind that for both the home and office scenario, you must initially choose a wireless network and save it to your list of favorite wireless networks, if you have not already done so.
Choose a wireless network by using the network administration GUI or by running the `netadm select-wifi` command. For example:

```
$ netadm select-wifi net1
1: ESSID home BSSID 0:b:e:85:26:c0
2: ESSID neighbor1 BSSID 0:b:e:49:2f:80
3: ESSID testing BSSID 0:40:96:29:e9:d8
4: Other
Choose WLAN to connect to [1-4]: 1
```

To view the status of your current network connection, hover your mouse over the Network Status notification icon located on the desktop or just click the icon. The Network Status notification icon also includes contextual menu for creating and managing network configuration with the GUI.

If the Network Status notification icon is not visible in the desktop, start it by choosing System → Administration → Network. To start the GUI from the command line, run the `nwam-manager` command. See the `nwam-manager(1M)` man page in the JDS/GNOME man page collection for more information.

- IP-related configuration is managed in the Network Profile section of the Network Preferences dialog box. The Network Preferences icon is displayed in the upper right-hand corner of the desktop. Access the Network Preferences dialog box by clicking the Network Status notification icon located on the desktop or by choosing the Network Preferences option from the Network Status notification icon’s contextual menu.

See Chapter 4, “Using the Network Administration Graphical User Interface,” in Connecting Systems Using Reactive Network Configuration in Oracle Solaris 11.1 or the online help for detailed instructions.

---

**Network Configuration and Administration Commands (Quick Reference)**

The following table describes the commands that are used to manage network configuration in both fixed and reactive mode.

**Note** – Starting with Oracle Solaris 11.1, you can use fixed networking commands to manage reactive NCPs, provided that the NCP is currently *active*. The command usage in the following table reflects this change.
## TABLE 7–2  Commands That Are Used to Configure and Administer the Network

<table>
<thead>
<tr>
<th>Configuration/Administration Task</th>
<th>Commands to Use in Reactive Mode</th>
<th>Commands to Use in Fixed Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch network configuration modes (enable or disable an NCP or a Location profile).</td>
<td>Enable the Automatic NCP: <code>netadm enable -p ncp Automatic</code>&lt;br&gt;Enable any reactive NCP: <code>netadm enable -p ncp ncp-name</code>&lt;br&gt;Enable a Location: <code>netadm enable -p loc loc-name</code></td>
<td>Enable the Default Fixed NCP: <code>netadm enable -p ncp DefaultFixed</code></td>
</tr>
<tr>
<td>List the status of all network profiles on a system.</td>
<td><code>netadm list</code></td>
<td><code>netadm list</code></td>
</tr>
<tr>
<td>Configure link properties.</td>
<td><code>netcfg &quot;create ncp ncp-name; create ncu phys ncu-name; set property=value&quot;</code>&lt;br&gt;<code>dladm set-linkprop -p property=value link</code></td>
<td></td>
</tr>
<tr>
<td>Configure IP interfaces.</td>
<td><code>netcfg &quot;create ncp ncp-name; create ncu ip ncu-name; set property=value&quot;</code></td>
<td><code>ipadm create-ip interface</code></td>
</tr>
<tr>
<td>Configure IP addresses.</td>
<td>Static IP: <code>netcfg &quot;select ncp ncp-name; select ncu ip ncu-name; set ipv4-addrsrc=static; set ipv4-addr=1.1.1.1/24&quot;</code>&lt;br&gt;DHCP: <code>netcfg &quot;create ncp ncp-name; create ncu ip ncu-name; set ipv4-addrsrc=dhcp&quot;</code>&lt;br&gt;DHCP: <code>ipadm create-addr -T static -a IP-address address-object</code>&lt;br&gt;DHCP: <code>ipadm create-addr -T dhcp address-object</code>&lt;br&gt;Auto-generated IPv6 address based on a system’s MAC address: <code>ipadm create-addr -T addrconf address-object</code></td>
<td>IPv4 or IPv6 static address: <code>ipadm create-addr -T static -a IP-address address-object</code>&lt;br&gt;DHCP or IPv6 DHCP address: <code>ipadm create-addr -T dhcp address-object</code>&lt;br&gt;Auto-generated IPv6 address based on a system’s MAC address: <code>ipadm create-addr -T addrconf address-object</code></td>
</tr>
<tr>
<td>Set the netmask property.</td>
<td>- For the Automatic NCP: The DHCP server assigns the netmask property.&lt;br&gt;- For other reactive NCPs: This property is set by using the <code>netcfg</code> command and is assigned as part of the static IP address. To assign the property, append the end of the IP address with <code>address/prefixlen</code> (192.168.1.1/24).&lt;br&gt;View the netmask property: <code>ipadm show-addr</code>&lt;br&gt;View the netmask property: <code>ipadm show-addr</code>&lt;br&gt;View the netmask property: <code>ipadm show-addr</code></td>
<td>This property is set by using the <code>ipadm</code> command, as part of the static IP address assignment. To assign the property, append the end of the IP address with <code>address/prefixlen</code> (192.168.1.1/24).&lt;br&gt;See “How to Configure an IP Interface” in Oracle Solaris Administration: Network Interfaces and Network Virtualization.&lt;br&gt;View the netmask property: <code>ipadm show-addr</code>&lt;br&gt;View the netmask property: <code>ipadm show-addr</code></td>
</tr>
<tr>
<td>Configuration/Administration Task</td>
<td>Commands to Use in Reactive Mode</td>
<td>Commands to Use in Fixed Mode</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Modify existing network configuration.</td>
<td>Configure link properties: netcfg &quot;select ncp ncp-name; select ncu phys ncu-name; set property=value&quot;</td>
<td>dladm set-linkprop -p property=value link</td>
</tr>
<tr>
<td></td>
<td>Configure an IP interface: netcfg &quot;select ncp ncp-name; select ncu ip ncu-name; set property=value&quot;</td>
<td>ipadm set-prop [-t] -p prop=value[,...] protocol</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Configure or modify naming services (NIS and DNS).</td>
<td>Configure DNS from DHCP: netcfg &quot;create loc loc-name; set dns-nameservice-configsrc= dhcp&quot;</td>
<td>Set parameters for naming services: svccfg and svcadm</td>
</tr>
<tr>
<td></td>
<td>Manually configure DNS: netcfg &quot;create loc loc-name; set dns-nameservice-config=static; set dns-nameservice-servers=1.1.1.1; set dns-nameservice-search=foo.com&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For an existing Location: netcfg &quot;select...&quot;</td>
<td></td>
</tr>
<tr>
<td>Configure LDAP.</td>
<td>Only LDAP anonymous mode works when in reactive mode. To use an LDAP proxy or LDAP self-modes, enable the DefaultFixed NCP.</td>
<td>ldapclient or SMF commands to select LDAP.</td>
</tr>
<tr>
<td>Configure default route.</td>
<td>For any reactive NCP: netcfg &quot;select ncp ncp-name; select ncu ip ncu-name; set ipv4-default-route=1.1.1.1&quot;</td>
<td>Persistently set a default route: route -p add default routerIP-address</td>
</tr>
<tr>
<td></td>
<td>Persistently set a default route: route -p add default routerIP-address</td>
<td>Set any persistent route: route -p add -net nIP-address -gateway gIP-address</td>
</tr>
<tr>
<td>Configuration/Administration Task</td>
<td>Commands to Use in Reactive Mode</td>
<td>Commands to Use in Fixed Mode</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Display default route.</td>
<td>netstat -rn displays all of the active routes currently in use by the kernel, regardless of how the route was configured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For any reactive NCP configured with a single, per-interface default route: netcfg &quot;select ncp ncp-name; select ncu ip ncu-name; get ipv4=default-route&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>route -p show displays all of the static routes that are associated with the currently active NCP, if it was added with the route -p add command</td>
<td></td>
</tr>
<tr>
<td>Configure host name (nodename).</td>
<td>When the Automatic NCP is enabled, the SMF service property is only set if the DHCP server does not provide a value for the nodename/hostname option (DHCP standard option code 12). See nodename(4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oracle Solaris 11: svccfg -s sets the config/nodename property of the svc:system/identity:node SMF service to the desired name.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oracle Solaris 11.1: Use the hostname command. See hostname(1)</td>
<td></td>
</tr>
<tr>
<td>Import naming service configuration.</td>
<td>Configured in the Locations profile.</td>
<td>nsccfg exports existing legacy files into the SMF repository.</td>
</tr>
<tr>
<td>Unconfigure and reconfigure a system (including all network configuration).</td>
<td>Unconfigure an Oracle Solaris instance: sysconfig unconfigure system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reconfigure an Oracle Solaris instance: sysconfig configure system</td>
<td></td>
</tr>
</tbody>
</table>
Managing System Configuration

This chapter provides information about the system configuration features and tools that are supported in Oracle Solaris 11 releases.

The following topics are covered:

- “Comparing Oracle Solaris 10 System Configuration to Oracle Solaris 11 System Configuration” on page 111
- “System Configuration Changes and Migration of System Configuration to SMF” on page 113
- “System Console, Terminal Services, and Power Management Changes” on page 118
- “System Configuration Tools Changes” on page 120
- “System Registration and System Support Changes” on page 120
- “System Boot, Recovery, and Platform Changes” on page 121
- “Printer Configuration and Management Changes” on page 129
- “Internationalization and Localization Changes” on page 131

Comparing Oracle Solaris 10 System Configuration to Oracle Solaris 11 System Configuration

<table>
<thead>
<tr>
<th>System Configuration Feature, Tool, or Function</th>
<th>Oracle Solaris 10</th>
<th>Oracle Solaris 11</th>
<th>Oracle Solaris 11.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>System configuration (network, and naming service configuration)</td>
<td>Configured in various files within the /etc directory</td>
<td>Configured through properties of the appropriate SMF service</td>
<td>Configured through properties of the appropriate SMF service. See “Configuring Naming Services in Fixed Mode” on page 93</td>
</tr>
<tr>
<td>System Configuration Feature, Tool, or Function</td>
<td>Oracle Solaris 10</td>
<td>Oracle Solaris 11</td>
<td>Oracle Solaris 11.1</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>------------------</td>
<td>------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>System console service (serial port monitor) configuration</td>
<td>getty, pmadm, ttyadm, ttymon</td>
<td>Configured through properties of the appropriate SMF service</td>
<td>Configured through properties of the appropriate SMF service See &quot;System Console and Terminal Services Changes&quot; on page 118</td>
</tr>
<tr>
<td>System configuration (nodename/hostname)</td>
<td>Edit /etc/nodename</td>
<td>Configured through properties of the appropriate SMF service See &quot;System Configuration Changes and Migration of System Configuration to SMF&quot; on page 113</td>
<td>Use the hostname command. See hostname(1)</td>
</tr>
<tr>
<td>System logging</td>
<td>syslog (default) and rsyslog</td>
<td>syslog</td>
<td>syslog (default) and rsyslog See &quot;System Configuration Changes and Migration of System Configuration to SMF&quot; on page 113</td>
</tr>
<tr>
<td>Power management</td>
<td>Edit /etc/power.conf file or use the pmconfig command</td>
<td>poweradm</td>
<td>poweradm See &quot;Power Management Configuration Changes&quot; on page 119</td>
</tr>
<tr>
<td>System unconfiguration and reconfiguration</td>
<td>By using the sysidtool, sys-unconfig, sysidconfig, and sysidcfg commands</td>
<td>sysconfig or the SCI tool</td>
<td>sysconfig or the SCI tool See &quot;System Configuration Tools Changes&quot; on page 120</td>
</tr>
<tr>
<td>System registration</td>
<td>Auto Registration feature Starting with Oracle Solaris 10 1/13: Oracle Configuration Manager</td>
<td>Oracle Configuration Manager</td>
<td>Oracle Configuration Manager See &quot;System Registration and System Support Changes&quot; on page 120</td>
</tr>
</tbody>
</table>
## System Configuration Changes and Migration of System Configuration to SMF

In Oracle Solaris 11, certain aspects of system configuration have migrated to SMF. For information about naming services that have migrated to SMF, see Table 7–1.

The following key changes are introduced in this release:

- **DNS server setup** – The process for setting up a DNS server has changed. For detailed instructions, see “Administering DNS (Tasks)” in Working With Naming and Directory Services in Oracle Solaris 11.1.

- **/etc/default/init file is now read-only** – Locale and time zone configuration have migrated to SMF. All changes to environment variables should be managed through the new svc:/system/environment:init SMF service.

  To use the svc:/system/environment:init SMF service, make sure the skip_init_upgrade property is set to true:

### TABLE 8–1  Oracle Solaris 10 and Oracle Solaris 11 System Configuration Comparison (Continued)

<table>
<thead>
<tr>
<th>System Configuration Feature, Tool, or Function</th>
<th>Oracle Solaris 10</th>
<th>Oracle Solaris 11</th>
<th>Oracle Solaris 11.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>System recovery</td>
<td>Flash archive features</td>
<td>Use backup boot environments (BEs) and system recovery procedures</td>
<td>Use backup boot environments (BEs) and system recovery procedures “System Boot, Recovery, and Platform Changes” on page 121</td>
</tr>
<tr>
<td>Printer configuration and administration</td>
<td>LP print commands, Solaris Print Manager</td>
<td>CUPS command-line, CUPS Print Manager, and CUPS web browser interface</td>
<td>CUPS command-line, CUPS Print Manager, and CUPS web browser interface See “Printer Configuration and Management Changes” on page 129</td>
</tr>
<tr>
<td>Locale and time zone configuration</td>
<td>Edit /etc/default/init</td>
<td>Configured through properties of the appropriate SMF service</td>
<td>Configured through properties of the appropriate SMF service See “Locale and Time Zone Configuration Changes” on page 133</td>
</tr>
</tbody>
</table>
# svccfg -s svc:/system/environment:init setprop \
upgrade/skip_init_upgrade=true
# svcadm refresh svc:/system/environment:init

For more information, see "Internationalization and Localization Changes" on page 131.

■ /etc/dfs/dfstab configuration – Publishing and unpublishing a file system share is now done with the zfs command. See Chapter 5, "Managing File Systems."

■ /etc/hostname,<if>, /etc/dhcp,<if>, and /etc/hostname.ip*.tun* configuration – Persistent network configuration by editing these files is no longer necessary. The ipadm and dladm commands are used to manage this type of network configuration. See "Managing Network Configuration in Fixed Mode" on page 89.

■ Mapping a system’s host name – Depending on the Oracle Solaris 11 release you are running, a system’s host name is mapped as follows during an installation:
  ■ Oracle Solaris 11: In Oracle Solaris 10, during an installation, the /etc/hosts file is updated to map the system’s host name to one of the its non-loopback IP addresses. In Oracle Solaris 11, the host name is mapped to a system’s IPv4 and IPv6 addresses. For example:

```
::1 foobar localhost
127.0.0.1 foobar loghost localhost
```

If you prefer the previous behavior, where hostname maps to the IP address of a non-loopback interface, you must manually modify the /etc/hosts file to include this type of mapping, as shown in the following example:

```
::1 localhost
127.0.0.1 loghost localhost
129.148.174.232 foobar
```

■ Oracle Solaris 11.1: The host name is mapped to the primary interface at installation time. The system/identity:node SMF service includes a property that enables an administrator to disable the feature.

■ Power management configuration – Power management is no longer configured by editing the /etc/power.conf file and by using the pmconfig command. Instead, the poweradm command is used. See "Power Management Configuration Changes" on page 119.

■ Configuring a system’s identity – Depending on the Oracle Solaris 11 release that you are running, configure a system’s identity as follows:
  ■ Oracle Solaris 11: Configure a system’s identify (nodename/hostname) by setting the config/nodename service property of the svc:/system/identity:node SMF service, as shown in this example:

```
# svccfg -s svc:/system/identity:node setprop config/nodename = astring: nodename
# svcadm refresh svc:/system/identity:node
# svcadm restart svc:/system/identity:node
```
Note – If the system is configured to use DHCP, which is always the case if the Automatic NCP is enabled, the SMF service property can only be set if the DHCP server does not provide a value for the nodename/hostname option (DHCP standard option code 12). See nodename(4).

Oracle Solaris 11.1: Use the hostname command to permanently set the system’s host name. Initially, the hostname value is stored in config/nodename, but this value is overridden if the system is configured by DHCP, in which case, DHCP provides the hostname value. If the hostname command is used, then the hostname value is whatever is specified in config/nodename. If you set a system’s identity by using the hostname command, this setting cannot be overridden by DHCP until you execute the hostname command with the -D option. The corresponding SMF properties and the associated SMF service are also automatically updated when you use the hostname command. See hostname(1).

System console and terminal services configuration – The sac command and the Service Access Facility (SAF) program are no longer supported. The system console and locally connected terminal devices are represented as instances of the SMF console-login service, svc:/system/console. See “System Console, Terminal Services, and Power Management Changes” on page 118.

System logging services – New in Oracle Solaris 11.1, rsyslog is a reliable and extended syslog daemon with a modular design implementation that supports several features, for example, filtering, TCP, encryption, high-precision timestamps, as well as output control. The status of the system-log services can be displayed by running the following command:

```
# svcadmin -a | grep system-log
```

disabled Nov 21 svc:/system/system-log:rsyslog
online Nov 30 svc:/system/system-log:default

Note – The syslog SMF service, svc:/system/system-log:default, continues to be the default logging service for in Oracle Solaris 11.

Time zone configuration – In Oracle Solaris 10, the time zone is configured by editing the /etc/TIMEZONE (/etc/default/init) file. In Oracle Solaris 11, the svc:/system/timezone:default SMF service enables you set a system’s time zone. See “Locale and Time Zone Configuration Changes” on page 133.
SMF Administrative Changes

Information for recording the source of properties, property groups, instances, and services has been added to the SMF repository. This information enables users to determine which settings are administrative customizations and those settings that are delivered with Oracle Solaris by a manifest.

The different settings by administrator, profile, or manifest are captured in layers. Use the `svccfg listprop` command with the new `-l` option to explore the values that are in each of the layers. The `svccfg -s service:instance listprop -l all` command lists all of the property groups and property values for the selected `service:instance`, with all of the layers that are available for each property group and the property value that is set. For example:

```
root@system1# svccfg -s mysvc:default listprop -l all
start               method    manifest
start/exec           astring   manifest   /var/tmp/testing/blah.ksh
start/timeout_seconds count     manifest   600
start/type           astring   manifest   method
stop                 method    manifest
stop/exec            astring   manifest   /var/tmp/testing/blah.ksh
stop/timeout_seconds count     manifest   600
stop/type            astring   manifest   method
startd               framework  manifest
startd/duration      astring   manifest   transient
ifoo                 framework  site-profile
ifoo                framework  manifest
ifoo/ibar            astring   admin      adminv
ifoo/ibar            astring   manifest   imanifest_v
ifoo/ibar            astring   site-profile iprofile_v
general              framework  site-profile
general              framework  manifest
general/complete     astring   manifest
general/complete     boolean   site-profile   true
general/complete     boolean   manifest   true
```

In this example, the property group `ifoo` shows the type of information that is listed when the new `-l` option is used.

By comparison, running the same command without the new `-l` options lists the information, as follows:

```
# svccfg -s mysvc:default listprop
start               method
start/exec           astring   /var/tmp/testing/blah.ksh
start/timeout_seconds count   600
start/type           astring   method
stop                 method
stop/exec            astring   /var/tmp/testing/blah.ksh
stop/timeout_seconds count   600
stop/type            astring   method
startd               framework
startd/duration      astring   transient
ifoo                 framework
```
In addition, the `svccfg listcust` command can be used to list customizations only.

Services and instances that are delivered in standard locations (/lib/svc/manifest, /var/svc/manifest, and /etc/svc/profile) are now managed by the `manifest-import` SMF service. To completely remove these services from the system, an administrator should uninstall the package that delivers the supporting files. This change triggers the removal of the service or instance from the system. If the delivering files are not managed by a package, then removing the file and restarting the `manifest-import` service removes the services or instances that are delivered from the system entirely.

If the files cannot be removed, or the administrator does not want the service or instance to run on the system, and disabling the service or instance is not an option, the `svccfg delete` command can be used. The `svccfg delete` command is considered an administrative customization to the way the system is currently installed when the delivering files that are still present in the standard locations.

**Note** – The `svccfg delete` command does not delete the service. The command only hides the service from other SMF consumers.

To remove any administrative customizations, including customizations that were made by the `svccfg delete` command, and return to the configuration that is provided by the service manifest, use the `delcust` subcommand of the `svccfg` command with care. For example, you would list and delete all of the customization on `sendmail-client:default`, as follows:

```
# svccfg
svc:> select svc:/network/sendmail-client:default
svc:/network/sendmail-client:default> listcust
...  # Configuration is masked
svc:/network/sendmail-client:default> delcust
Deleting customizations for instance: default
```

For more information, see the `svccfg(1M)` man page.

### SMF Manifest Creation Tool

New in Oracle Solaris 11.1, the `svcbundle` command enables you to generate SMF manifests. You can also use the command to generate profiles by specifying the `bundle-type` option. The generated bundle is entirely defined by the use of multiple `-s` options. Each NV pair is of the form, `name=value`. To generate a manifest, you must specify a `service-name` and `start-method`. When generating a manifest, the `svcbundle` command makes several basics
assumptions, which can be modified after the manifest is generated. For detailed instructions on using the svcbundle command, see svcbundle(1M).

**System Process Summary**

Oracle Solaris 10 and Oracle Solaris 11 releases include system processes that perform a specific task, but typically do not require any administration.

<table>
<thead>
<tr>
<th>Process</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fsflush</td>
<td>System daemon that flushes pages to disk</td>
</tr>
<tr>
<td>init</td>
<td>Initial system process that starts and restarts other processes and SMF components</td>
</tr>
<tr>
<td>intrd</td>
<td>System process that monitors and balances system load due to interrupts</td>
</tr>
<tr>
<td>kmem_task</td>
<td>System process that monitors memory cache sizes</td>
</tr>
<tr>
<td>pageout</td>
<td>System process that controls memory paging to disk</td>
</tr>
<tr>
<td>sched</td>
<td>System process that is responsible for OS scheduling and process swapping</td>
</tr>
<tr>
<td>vm_tasks</td>
<td>System process with one thread per processor that balances and distributes virtual memory related workloads across CPUs for better performance.</td>
</tr>
<tr>
<td>zpool-pool-name</td>
<td>System process for each ZFS storage pool containing the I/O taskq threads for the associated pool</td>
</tr>
</tbody>
</table>

**System Console, Terminal Services, and Power Management Changes**

The following system console, terminal services, and power management changes are introduced.

**System Console and Terminal Services Changes**

The sac command and the Service Access Facility (SAF) program are not supported in Oracle Solaris 11. The system console and locally connected terminal devices are represented as instances of the SMF console-login service, svc:/system/console. This service defines most of the behavior. Each instance can have specific overrides to the settings that are inherited from the service.
Note – The sac and getty modes of the ttymon command are no longer supported. However, the ttymon express mode is still supported.

If you want to offer login services on auxiliary terminals, use one of the following services:

- `svc:/system/console-login:termangled`
- `svc:/system/console-login:termshell`

The ttymon program is used to offer login services for these terminals. Each terminal uses a separate instance of the ttymon program. Command-line arguments that are passed by the service to the ttymon program govern the terminal’s behavior. For more information, see Chapter 5, “Managing the System Console, Terminal Devices, and Power Services (Tasks),” in Managing System Information, Processes, and Performance in Oracle Solaris 11.1.

**Power Management Configuration Changes**

In Oracle Solaris 10, power management is administered by configuring the `/etc/power.conf` file and by using the `pmconfig` command. In Oracle Solaris 11, the `poweradm` command replaces the `pmconfig` command. Power administration now includes a small number of controls that manage platform and implementation details. The `poweradm` command enables you to simplify power administration by manipulating these small number of controls. For more information, see the `poweradm(1M)` man page.

Review the following potential power management transition issues:

- By default, suspend is not enabled on any system. To enable suspend and inspect this setting on systems that support this feature, use the `poweradm` command as follows:

  ```bash
  # poweradm set suspend-enable=true
  # poweradm get suspend-enable
  ```

- By default, the administrative-authority SMF service property of the `poweradm` command is set to the `platform` value. However, the power service goes into maintenance mode if the administrative-authority service property is set to the `smf` value before the `time-to-full-capacity` and `time-to-minimum-responsiveness` values have been set. If this problem occurs, you can recover as follows:

  ```bash
  # poweradm set administrative-authority=none
  # poweradm set time-to-full-capacity=
  # poweradm set time-to-minimum-responsiveness=
  # svcadm clear power
  # poweradm set administrative-authority=smf
  ```

- The GNOME power manager (GPM) feature, which runs when the GUI starts, changes the power management settings. This behavior is intentional to enable the integration of power management administration with GNOME Desktop behavior. See “Managing System Power Services” in Managing System Information, Processes, and Performance in Oracle Solaris 11.1.
System Configuration Tools Changes

An Oracle Solaris instance, which is defined as a boot environment in either a global or a non-global zone, is created and configured during an installation. After installing or creating an Oracle Solaris instance, you can unconfigure and reconfigure the instance by using the new `sysconfig` utility. This tool replaces the `sys-unconfig` and `sysidtool` utilities.

In Oracle Solaris 11, the `sysconfig configure` command produces similar results to the `sys-unconfig` command that is used to unconfigure and halt a system in Oracle Solaris 10. For example:

```
# sysconfig configure -s
This program will re-configure your system.
Do you want to continue (y/(n))? y
```

The following example shows how to unconfigure a previously configured Oracle Solaris instance and leave it in an unconfigured state:

```
# sysconfig unconfigure -g system
```

You can also reconfigure an Oracle Solaris instance by specifying an existing configuration XML profile:

```
# sysconfig configure -c profile-name.xml
```

If you do not specify an existing configuration profile prior to an installation, the SCI tool launches during the installation process. The SCI tool enables you to provide specific configuration information for that Oracle Solaris instance. The SCI tool consists of a series of interactive panels that enable you to provide configuration information as part of a text installation. You can also run the tool on an installed Oracle Solaris system to create a new system configuration profile that is based on specifications that you provide.

Start the SCI tool from the command line, as follows:

```
# sysconfig configure
```

See the `sysconfig(1M)` man page and See Chapter 6, “Unconfiguring or Reconfiguring an Oracle Solaris instance,” in *Installing Oracle Solaris 11.1 Systems*.

System Registration and System Support Changes

Oracle Configuration Manager is used to personalize and enhance the customer support experience by collecting configuration information and uploading it to the Management Repository. This information is then analyzed by customer support representatives to provide better service to customers. Benefits of using this feature include reduced time for problem resolution, proactive problem avoidance, and access to best practices and the Oracle knowledge
base. In some Oracle Solaris 10 releases, the Auto Registration feature performs a similar function. Starting with the Oracle Solaris 10 1/13 release, Oracle Configuration Manager replaces the Auto Registration feature.

You can configure the Oracle Configuration Manager and the Oracle Auto Service Request features during an interactive installation, if you plan to install these features on your system. Several options are available to choose from during an installation, including the ability to start Oracle Configuration Manager in the disconnected mode. This option replaces the “opt out” choice that is available in the Oracle 11 11/11 release. If you choose the disconnected mode option, no data is sent to My Oracle Support during the first reboot after an installation. Note that you can manually activate Oracle Configuration Manager later. See “Using Oracle Configuration Manager” in Installing Oracle Solaris 11.1 Systems.

Oracle Auto Service Request (ASR) is a secure, customer-installable feature of your Oracle or Sun hardware warranty and Oracle Premier Support for Systems. ASR assists in resolving specific hardware faults that occur by automatically opening service requests for Oracle's qualified server, storage, Exadata and Exalogic systems. The Oracle Auto Service Request is integrated with My Oracle Support. For more information, go to http://www.oracle.com/technetwork/systems/asr/overview/index.html.

System Boot, Recovery, and Platform Changes

The system boots from a ZFS root file system in Oracle Solaris 11. By default, the ZFS root file system is contained within a ZFS root pool, named rpool. Creating a UFS file system is still supported, but you cannot boot from a UFS or a Solaris Volume Manager root file system in this release.

Review the following information that impacts the way the system is booted for recovery purposes:

- If you use a system’s service processor (SP) or ILOM to recover from a system problem, accessing a system’s SP or ILOM is identical to previous releases. The differences mostly pertain to how the system is booted after you get to a SPARC based system’s ok PROM prompt or to an x86 based system’s firmware screen (BIOS or UEFI).
- In Oracle Solaris 10, you use flash archive features to create a copy of a UFS or ZFS root environment and then restore the flash archive to recover the system environment, in the case of a system or device failure.

In Oracle Solaris 11, the system recovery process includes the following steps:

- Archiving the root pool snapshots on a remote system
- Replacing any failed system component or device
- Recreating the root pool and setting the bootfs property
- Restoring the previously archive root pool snapshots
- Manually installing the boot blocks

- When attempting to boot a system for recovery purposes, if the system cannot be booted, but the failure is not because the root pool is unavailable, you can use new boot options from the installation media or from an installation server to resolve the problem. See “Booting for System Recovery” on page 123.

GRUB, Firmware, and Disk Labeling Changes

Starting with Oracle Solaris 11.1, the following changes are introduced:

- **GRUB 2 is the default boot loader on x86 platforms** – GRUB 2 replaces the original GRUB 0.97-based boot loader (GRUB Legacy). GRUB 2 fully supports booting from disks that are larger than 2TB. GRUB 2 also supports the Unified Extensible Firmware Interface (UEFI) and the GUID Partition Table (GPT) partitioning scheme.

- **GRUB menu changes** – Unlike the editable menu.lst file that is used by GRUB Legacy, GRUB 2 uses a configuration file named grub.cfg that is syntactically different than the legacy menu.lst file. The grub.cfg file stores most of the GRUB configuration and is managed solely by using the bootadm command. To accommodate this change, the bootadm command has been expanded to include several new subcommands and a new -P option that enables you to administer the GRUB configuration for multiple root pools.

  **Note** – Because GRUB configuration changes can automatically overwrite changes that are made to the grub.cfg file, do not manually edit this file. See Chapter 2, “Administering the GRand Unified Bootloader (Tasks),” in Booting and Shutting Down Oracle Solaris 11.1 Systems and bootadm(1M).

- **Management of non-Oracle Solaris boot entries** – GRUB 2 includes an additional configuration file named custom.cfg. This file can be used to add custom menu entries to the GRUB configuration. The custom.cfg file does not exist on the system by default. You must create the file and it must be stored in the same location as the grub.cfg file (/pool-name/boot/grub/). During the boot process, GRUB checks for the custom.cfg file in the top-level dataset of the root pool (boot/grub). If the file exists, GRUB sources the file and processes any commands within the file as if the contents were actually part of the grub.cfg file. See “Customizing the GRUB Configuration” in Booting and Shutting Down Oracle Solaris 11.1 Systems.

- **64-Bit UEFI firmware support** – Oracle Solaris now supports x86 based systems with 64-bit UEFI firmware. An installation on UEFI firmware is supported through the DVD, USB, and network installation methods. UEFI version 2.1+ is required.

  If you are booting a system with UEFI firmware from the network, the boot process has changed slightly. See “Booting Systems With UEFI and BIOS Firmware From the Network” in Booting and Shutting Down Oracle Solaris 11.1 Systems for more details.
Booting from GPT labeled disks—GPT labeled disks are now supported on both SPARC and x86 platforms. Installing Oracle Solaris 11.1 on an x86 or SPARC based system with GPT-aware firmware applies a GPT disk label on the root pool disk that uses the entire disk in most cases. Otherwise, installing Oracle Solaris 11.1 on a SPARC based system applies an SMI (VTOC) label to the root pool disk with a single slice 0.

For SPARC based systems that support a GPT labeled boot disk, see “Support for GPT Labeled Disk Added on SPARC Platforms” in Oracle Solaris 11.1 Release Notes for more information about how to apply the GPT-aware firmware update.

If you are running a release that supports GRUB Legacy and are moving to a release that supports GRUB 2, see “Upgrading Your GRUB Legacy System to a Release That Supports GRUB 2” in Booting and Shutting Down Oracle Solaris 11.1 Systems.

Booting for System Recovery

The following error and recovery scenarios are similar to previous releases:

- You can use the boot -a command to bypass a problem in the /etc/system file. When prompted, use syntax that is similar to the following:

  ```
  Name of system file [/etc/system]: /dev/null
  ```

  Press Return at the other prompts, as needed.

- A backup BE is created automatically during most pkg update operations. This feature enables you to boot back to a previous BE in case some error occurs during the image update process. Consider creating a backup BE before you make a system configuration change.

  ```
  # beadm create solaris-backup
  # beadm list
  BE     Active Mountpoint Space Policy Created
        ------ ------- ---------- ----- ------- ------- ------ ------- -------
  solaris R    -  4.01G static 2013-02-08 16:53
  solaris-backup N   /  47.95M static 2013-02-11 10:48
  ```

  See “How to Boot From a Backup BE for Recovery Purposes” on page 124 for the steps to boot from a backup BE.

- Boot from the installation media or from an install server over the network to recover from a problem that is preventing the system from booting or to recover from a lost root password. On SPARC based systems, the boot net: dhcp command replaces the boot net command that is used in Oracle Solaris 10 releases.

- Boot a system in single-user mode to resolve a minor problem, such as correcting the root shell entry in the /etc/passwd file or changing a NIS server.

- Resolving a boot configuration problem generally involves importing the root pool, mounting the BE, and fixing the problem, for example reinstalling a corrupt x86 boot loader.
How to Boot From a Backup BE for Recovery Purposes

Booting the failsafe archive is no longer supported on SPARC and x86 platforms. Whenever possible, use up-to-date backup BEs for recovery purposes. BEs are bootable instances of the Oracle Solaris image, plus any other application software packages that are installed into that image. Multiple BEs reduce risk when updating software because the backup BE preserves the original BE.

You can create a new BE based on an active or an inactive boot environment. Or, you can create a new BE based on a clone of your original BE. A clone copies the root dataset and everything hierarchically under the main root dataset of the original BE. See Creating and Administering Oracle Solaris 11.1 Boot Environments.

If the system does not boot from the active BE, select a backup BE from which to boot.

Boot from a backup BE, as follows:

- **SPARC:** Boot the system so that you can select an alternate or backup BE.

  a. **Boot with the `boot -L` command.**

  ```
  ok boot -L
  ```

  b. **Select an alternate or backup BE.**

  ```
  Boot device: /pci@7c0/pci@0/pci@1/pci@0,2/LSILogic,sas@2/disk@0,0:a
  File and args: -L
  1 Oracle Solaris 11.1 SPARC
  2 solaris-backup
  Select environment to boot: [ 1 - 2 ]: 2
  ```

  In the previous output, the active BE is Oracle Solaris 11.1 SPARC, which most likely does not match the actual BE name, but it represents the current BE.

  c. **Boot the backup BE.**

  After you select the BE from which to boot, identify the on-screen boot path and type that information at the prompt.

  ```
  To boot the selected entry, invoke:
  boot [root-device>] -Z rpool/ROOT/solaris-backup
  ```

  Program terminated

  ```
  {0} ok boot -Z rpool/ROOT/solaris-backup
  ```

  If the system does not boot, review the additional boot recovery steps in "How to Boot the System For Recovery Purposes" on page 125.
x86: Boot the system to identify the alternate or backup BE from the GRUB menu.

a. When the GRUB menu is displayed, identify the backup BE.

b. Select the backup BE, then press Return to boot that entry.

If the system does not boot from the backup BE, review the additional boot recovery steps in “How to Boot the System For Recovery Purposes” on page 125.

How to Boot the System For Recovery Purposes

1. Select the appropriate boot method.

Note – On x86 platforms, use the `reboot` command with the `-p` option to initiate a standard reboot of the system, which enables you to view the GRUB menu or select an installation option. Otherwise, the system defaults to a fast reboot.

- **x86: Live Media** – Boot from the installation media and use a GNOME terminal for the recovery procedure.
- **SPARC: Text installation** – Boot from the install media or from the network, and select option 3 Shell from the text installation screen.
- **x86: Text installation** – From the GRUB menu, select the Text Installer and command line boot entry, then select the option 3 Shell from the text installation screen.
- **SPARC: Automated installation** – Use the following command to boot directly from an installation menu that allows you to exit to a shell.

  ```
  ok boot net:dhcp
  ```
- **x86: Automated installation** – Boot from an install server on the network that supports a PXE boot. Select the Text Installer and command line entry from the GRUB menu. Then, select the option 3 Shell from the text installation screen.

For example, after the system is booted, select option 3 Shell:

1. Install Oracle Solaris
2. Install Additional Drivers
3. Shell
4. Terminal type (currently xterm)
5 Reboot

Please enter a number [1]: 3
To return to the main menu, exit the shell
#

2 Select from the following boot recovery problems:

- Resolve a bad root shell by booting the system to single-user mode and correcting the shell entry in the /etc/passwd file.

- On x86 based systems, boot the system in single-user mode by editing the selected boot entry in the GRUB menu. Add the -s option to end of the $multiboot line.

  $multiboot /ROOT/sllu1_24b/@/$kern $kern -B $zfs_bootfs -s

- On SPARC based systems, shutdown the system and boot in single-user mode. After you log in as root, edit the /etc/passwd file, and fix the root shell entry.

# zpool import -f rpool
# beadm list
be_find_current_be: failed to find current BE name
BE Active Mountpoint Space Policy Created
-- ------- ------ ------ ------ -------
solaris - - 7.74M static 2013-02-09 09:40
solaris-1 R - 4.08G static 2013-02-13 07:24
# mkdir /a
# beadm mount solaris-1 /a
# TERM=vt100
# export TERM
# cd /a/etc
# vi shadow
<Carefully remove the unknown password>
# cd /
# beadm umount solaris-1
# halt

# init 0
ok boot -s

Boot device: /pci@780/pci@0/pci@9/scsi@0/disk@0,0:a File and args: -s
SunOS Release 5.11 Version 11.1 64-bit
Copyright (c) 1983, 2012, Oracle and/or its affiliates. All rights reserved.
Booting to milestone "milestone/single-user:default".
Hostname: tardis.central
Requesting System Maintenance Mode
SINGLE USER MODE

Enter user name for system maintenance (control-d to bypass): root
Enter root password (control-d to bypass): xxxxxxxx
single-user privilege assigned to root on /dev/console.
Entering System Maintenance Mode

Feb 13 00:21:31 su: 'su root' succeeded for root on /dev/console
Oracle Corporation SunOS 5.11 11.1 September 2012
su: No shell /usr/bin/mybash. Trying fallback shell /sbin/sh.
root@tardis.central:~# TERM=vt100; export TERM
root@tardis.central:~# vi /etc/passwd
root@tardis.central:~# <Press control-d>
logout
svc.startd: Returning to milestone all.

- x86: Resolve a corrupt boot loader problem by reinstalling it, as follows:
  
a. Follow the directions in Step 1 to boot the system from media or from the network, then import the root pool.

```bash
# zpool import -f rpool
```

b. Reinstall the boot loader.

```bash
# bootadm install-bootloader -f -P pool-name
```

where -f forces the installation of the boot loader and bypasses any versioning checks for not downgrading the version of the boot loader on the system. The -P option is used to specify the root pool.

---

**Note** – Do not use the -f option unless you are sure that you want to overwrite the boot loader with the version that is on the media. See “Installing GRUB 2 by Using the bootadm install-bootloader Command” in Booting and Shutting Down Oracle Solaris 11.1 Systems.


c. Export the root pool.

```bash
# zpool export pool-name
```

d. Reboot the system.

- Resolve an unknown root password problem that prevents you from logging into the system.

a. Follow the instructions in Step 1 to boot from media or from the network, then import the root pool (rpool) and mount the BE to remove the root password entry.

This process is identical on SPARC and x86 platforms.

b. Set the root password by booting in single-user mode and setting the password.

This step assumes that you have removed an unknown root password in the previous step.

- On x86 based systems, edit the selected boot entry in the GRUB menu, adding the -s option at the end of the $multiboot line.

```bash
$multiboot /ROOT/s11u1_24b/@@/skern $kern -B $zfs_bootfs -s
```
On SPARC based systems, boot the system to single-user mode, log in as root, and set the root password. For example:

```bash
ok boot -s

Boot device: /pci@780/pci@0/pci@9/scsi@0/disk@0,0:a File and args: -s
SunOS Release 5.11 Version 11.1 64-bit
Copyright (c) 1983, 2012, Oracle and/or its affiliates. All rights reserved.
Booting to milestone "milestone/single-user:default".
Hostname: tardis.central
Requesting System Maintenance Mode
SINGLE USER MODE

Enter user name for system maintenance (control-d to bypass): root
Enter root password (control-d to bypass): <Press return>
single-user privilege assigned to root on /dev/console.
Entering System Maintenance Mode

Feb 13 00:58:42 su: 'su root' succeeded for root on /dev/console
Oracle Corporation SunOS 5.11 11.1 September 2012
root@tardis.central:~# passwd -r files root
New Password: xxxxxx
Re-enter new Password: xxxxxx
passwd: password successfully changed for root
root@tardis.central:~# <Press control-d>
logout
svc.startd: Returning to milestone all.
```

### Boot, Platform, and Hardware Changes

Note the following boot, platform, and hardware feature changes in Oracle Solaris 11:

- **x86 platform support is 64–bit only** – Support for booting a 32–bit kernel on x86 platforms has been removed. Systems that have 32-bit hardware must either be upgraded to 64–bit hardware or continue to run Oracle Solaris 10. Note that 32–bit applications are not impacted by this change.

- **Bitmapped console support** – Oracle Solaris 11 includes support for high resolution and color depth consoles. By default, your machine will boot with a 1024x768x16-bit console, unless your video card does not support this setting. In which case, the setting will fall back to 800x600, then finally to 640x480. The console type (and also the older VGATEXT 640x480 console) can be controlled through both kernel parameters and through options that you specify by editing the GRUB menu at boot time, as follows:

  ```bash
  -B console={text|graphics|force-text}
  ```

  See “Redirecting the Oracle Solaris Console at Boot Time” in Booting and Shutting Down Oracle Solaris 11.1 Systems.

- **Fast Reboot support on x86 and SPARC platforms** – On x86 platforms, Fast Reboot implements an in-kernel boot loader that loads the kernel into memory and then switches to that kernel. For SPARC based systems that support the Fast Reboot feature, the boot process is accelerated by skipping certain POST tests.
The Fast Reboot feature works differently on SPARC platforms than it does on x86 platforms. To initiate a fast reboot of a SPARC based system, use the `-f` option with the `reboot` command. Because Fast Reboot is the default behavior on x86 platforms, the `-f` option is not required. Use either the reboot command or the `init 6` command to initiate a fast reboot of an x86 based system. The Fast Reboot feature is managed through SMF properties that can be enabled or disabled, as required. For more details, see “Accelerating the Reboot Process” in Oracle Solaris Administration: Common Tasks.

- **Removal of support for the SPARC sun4u architecture** - With the exception of the M-series (OPL) hardware, you cannot boot Oracle Solaris 11 on the sun4u architecture. If you attempt to boot Oracle Solaris 11 on one of these systems, the following error message is displayed:

  ```
  Rebooting with command: boot
  Error: 'cpu:SUNW,UltraSPARC-IV+' is not supported by this release of Solaris.
  NOTICE: f_client_exit: Program terminated!
  ```

**Printer Configuration and Management Changes**

The legacy LP print service has been replaced by the Common UNIX Printing System (CUPS). CUPS is a modular, open-source printing system that uses the Internet Printing Protocol (IPP) as the basis for managing printers, print requests, and print queues. CUPS supports network printer browsing and PostScript Printer Description-based printing options. CUPS also provides a common printing interface across a local network.

**Removal of the LP Print Service**

The following important changes are a result of the removal of the LP print service:

- Solaris Print Manager is no longer available in the desktop. CUPS Print Manager replaces this tool. See “Setting Up Printers by Using CUPS Print Manager” in Oracle Solaris Administration: Common Tasks.

- Several LP print commands, files, and services are no longer available. Some LP print commands, for example `lp`, `lpadmin`, `lpc`, `lpr` are still available. However, these commands are now managed by CUPS. For a complete list of the commands, services, and files that have been removed, refer to "Removal of Legacy System Management Commands, Tools, Services, and Files" on page 20.

- Printer configuration that is stored in the NIS naming service in Oracle Solaris 10 is not used by CUPS. CUPS auto-discovers printers on a network, enabling you to print to these printers without any manual configuration. Administrators can share network printers that are configured by using CUPS by turning on the sharing feature. See “How to Unshare or Share a Printer” in Configuring and Managing Printing in Oracle Solaris 11.1.
In Oracle Solaris 10 and previous releases, the /etc/printers.conf file is where details about all of the printers that are set up by using the LP print service is stored. In Oracle Solaris 11, this file is no longer generated after a fresh installation. Any information about printers that were configured by using lp print commands is removed. The resulting behavior is as though these printers were never configured on the system. Any previously configured printers must be reconfigured by using CUPS. Note that you do not need to delete existing printers prior to reconfiguring them. For information about setting up your printing environment to work with CUPS, see “How to Set Up Your Printing Environment After Installing Oracle Solaris 11” on page 130.

Printers that are configured on a per-user basis in the ~/.printers file no longer work. Printer configuration is now solely managed by using CUPS. The default printer can be set on a per-user basis, by setting either the LPDEST or PRINTER environment variables, or by using the new lpoptions command. The lpoptions command creates an ~/.lpoptions file that has the default printer entry listed within that file. By default, all print jobs are directed to this printer.

List specific options for a printer as follows:

```
# lpoptions -l printer-name
```

Set the default destination or instance for the default printer by using the -d option:

```
# lpoptions -d printer-name
```

See “Setting a Default Printer” in Configuring and Managing Printing in Oracle Solaris 11.1.

The lp entry in the /etc/passwd file is now as follows:

```
lp:x:71:8:Line Printer Admin:/:
```

The lp entry in the /etc/group file remains as it is in previous releases.


### How to Set Up Your Printing Environment After Installing Oracle Solaris 11

Use the following procedure to set up your printing environment to work with CUPS after a fresh installation.

1. **Verify that the cups/scheduler and the cups/in-lpd SMF services are online.**
   ```
   # svcs -a | grep cups/scheduler
   # svcs -a | grep cups/in-lpd
   ```

2. **If these services are not online, enable them.**
   ```
   # svcadm enable cups/scheduler
   # svcadm enable cups/in-lpd
   ```
Check that the `printer/cups/system-config-printer` package is installed.  

```
# pkg info print/cups/system-config-printer
```

- If the package is already installed, you are ready to configure printers by using CUPS.
- If the package is not installed, install the package:
  
  ```
  # pkg install print/cups/system-config-printer
  ```

**Next Steps**

For instructions, see “Setting Up and Administering Printers by Using CUPS Command-Line Utilities” in *Oracle Solaris Administration: Common Tasks*.

---

**Internationalization and Localization Changes**

Oracle Solaris 11 introduces the following internationalization and localization changes:

- **Language and locale support** – Oracle Solaris 11 supports over 200 locales. By default, only a core set of locales is installed on the system. Core locales typically provide better support at the level of localized messages than locales that are available for additional installation. Specific Oracle Solaris components, such as the installers or Package Manager, are localized for core locales only. Note that localized messages for third-party software, for example GNOME and Firefox, include additional locales.

The core set of locales support the following languages:

- Chinese – Simplified (`zh_CN.UTF-8`)
- Chinese – Traditional (`zh_TW.UTF-8`)
- English (`en_US.UTF-8`)
- French (`fr_FR.UTF-8`)
- German (`de_DE.UTF-8`)
- Italian (`it_IT.UTF-8`)
- Japanese (`ja_JP.UTF-8`)
- Korean (`ko_KR.UTF-8`)
- Portuguese – Brazilian (`pt_BR.UTF-8`)
- Spanish (`es_ES.UTF-8`)

Notable core locale changes include the addition of the Portuguese – Brazilian locale and the removal of the Swedish locale.

- **Oracle Solaris 11.1 locale changes** – The following locale changes are introduced in this release:
  
  - Japanese (`ja_JP.UTF-8@cldr`) locale – This locale is a new variant of the Japanese UTF-8 locale (`ja_JP.UTF-8`) that conforms to the Unicode Common Locale Data Repository (CLDR) for the Japanese locale. The locale is an optional component that is installable from the `system/locale/extra` package.
Local data for Simplified Chinese, Traditional Chinese, Korean, and Thai UTF-8 locales has been updated to support Unicode 6.0.

Language and locale packaging – The locale facet mechanism replaces the `localeadm` command in Oracle Solaris 11. In Oracle Solaris 10, optional package components, such as documentation, localization, or debug files are split into separate packages. In Oracle Solaris 11, IPS enables you to store these various package components in the same package by using special tags that are called facets. Facets simplify the packaging process, as well as minimize disk space usage. Locale facets are used to mark files or actions that are language or locale-specific.

Display the status of the facets on a system as follows:

```
$ pkg facet
```

The following example shows how to install the Danish locale and any available translations:

```
# pkg change-facet facet.locale.da=True
# pkg change-facet facet.locale.da_DK=True
```

Note – Non-UTF-8 locales, such as `da_DK.ISO8859-1`, are packaged separately. To enable these locales, install the `system/locale/extra` package.

See “Controlling Installation of Optional Components” in Adding and Updating Oracle Solaris 11.1 Software Packages.

Setting a system’s default locale – In Oracle Solaris 10, the default system locale is configured in `/etc/default/init`. In Oracle Solaris 11, this file is obsoleted, and the configuration has moved to the corresponding properties of the `svc:/system/environment:init` SMF service. See “Locale and Time Zone Configuration Changes” on page 133.

Short form locales – Solaris 10 supports a number of short form locale names that do not follow the `language_country.encoding[@modifier]` format, for example, `ja, de, de_AT`, and so on. These locales are not present in Oracle Solaris 11 in their original form, only as aliases to fully qualified locale names through the `locale_alias` mechanism. See `locale_alias(5)`. In Oracle Solaris 11, it is recommended that the fully qualified locale names be used instead. Or, if possible, use UTF-8 locales. For more information, see the end-of-feature announcements at [http://www.oracle.com/technetwork/systems/end-of-notices/eonsolaris11-392732.html](http://www.oracle.com/technetwork/systems/end-of-notices/eonsolaris11-392732.html).

Locale aliasing – Locale aliases are new in Oracle Solaris 11. Locale name aliases are accepted and mapped to the corresponding canonical locale names. For example, the `de` locale is mapped to the canonical locale `de_DE.ISO8859-1`. For all of the locale name mappings, see `locale_alias(5)`.
Keyboard layout setting for the console – In Oracle Solaris 11, the keyboard layout setting for the console has migrated to SMF. To change the keyboard layout in the console, modify the keymap/layout property of the system/keymap:default SMF service. The following example shows how to set the UK-English layout for the console.

```
# svccfg -s keymap:default setprop keymap/layout = UK-English
# svcadm refresh keymap
# svcadm restart keymap
```

Note – The keyboard layout in the graphical interface is set separately.

Locale and Time Zone Configuration Changes

Locale and time zone configuration is set in the /etc/default/init file in Oracle Solaris 10. In Oracle Solaris 11, this configuration is managed through the following SMF service properties:

- Locale: svc:/system/environment:init
- Time zone: svc:/system/timezone:default

For example, to change the default system locale to fr_FR.UTF-8, you would configure the SMF service property as follows:

```
# svccfg -s svc:/system/environment:init \
setprop environment/LANG = astring: fr_FR.UTF-8
# svcadm refresh svc:/system/environment
```

The service must be refreshed for changes to take affect.

1. For the time zone setting, make sure the TZ in the /etc/default/init file is set to localtime.

   `grep TZ /etc/default/init`
   `TZ=localtime`

2. Then, set the time zone SMF property to the required time zone.

   ``
   # svccfg -s timezone:default setprop timezone/localtime= astring: US/Mountain
   # svcadm refresh timezone:default
   ``

For other date and time configuration changes in this release, see “Configuring Date and Time Before and After an Installation” on page 42.
Managing Security

This chapter describes security feature changes in Oracle Solaris 11 releases.

The following topics are covered:

- "Security Feature Changes" on page 135
- "Roles, Rights, Privileges, and Authorizations" on page 138
- “File and File System Security Changes” on page 142

Security Feature Changes

Oracle Solaris 11 introduces the following key security changes:

- **Address Space Layout Randomization (ASLR)** – Starting with Oracle Solaris 11.1, ASLR randomizes addresses that are used by a given binary. ASLR causes certain types of attacks that are based on knowing the exact location of certain memory ranges to fail and detects the attempt when it likely stops the executable. Use the `sxadm` command to configure ASLR. Use the `elfedit` command to change the tagging on a binary. See `sxadm(1M)` and `elfedit(1)`.

- **Administrative Editor** – Starting with Oracle Solaris 11.1, you can use the `pfedit` command to edit system files. If defined by the system administrator, the value of this editor is `$EDITOR`. If undefined, the editor defaults to the `vi` command. Start the editor as follows:

  ```
  $ pfedit system-filename
  ```

  See the `pfedit(1M)` man page and Chapter 3, “Controlling Access to Systems (Tasks),” in *Oracle Solaris 11.1 Administration: Security Services*.

- **Auditing** – Auditing is a now a service and is enabled by default. No reboot is required when disabling or enabling this service. The `auditconfig` command is used to view information about audit policy and to change audit policy. The auditing of public objects generates less noise in the audit trail. In addition, auditing of non-kernel events has no performance impact.
For information about creating a ZFS file system for audit files, see "How to Create ZFS File Systems for Audit Files" in Oracle Solaris 11.1 Administration: Security Services.

- **Audit Remote Server (ARS)** – ARS is a feature that receives and stores audit records from a system that is being audited and is configured with an active audit_remote plug-in. To distinguish an audited system from an ARS, the audited system can be termed the locally audited system. This feature is new in Oracle Solaris 11.1. Refer to the information about the -set remote option in the auditconfig(1M) man page.

- **Basic Audit Reporting Tool (BART)** – The default hash that is used by BART is now SHA256, not MD5. In addition to SHA256 being the default, you can also select the hash algorithm. See Chapter 6, “Verifying File Integrity by Using BART (Tasks),” in Oracle Solaris 11.1 Administration: Security Services.

- **Cryptographic Framework** – This feature now includes more algorithms, mechanisms, plug-ins, and support for Intel and SPARC T4 hardware acceleration. Also, Oracle Solaris 11 provides better alignment with the NSA Suite B cryptography.

- **Kerberos DTrace providers** – A new DTrace USDT provider that provides probes for Kerberos messages (Protocol Data Unit) has been added. The probes are modeled after the Kerberos message types that are described in RFC4120.

- **Key Management enhancements:**
  - PKCS#11 keystore support for RSA keys in the Trusted Platform Module
  - PKCS#11 access to Oracle Key Manager for centralized enterprise key management

- **lofi command changes** – lofi now supports the encryption of block devices. See lofi(7D).

- **profiles command changes** – In Oracle Solaris 10, the command is only used to list profiles for a specific user or role, or a user’s privileges for specific commands. In Oracle Solaris 11, you can also create and modify profiles in files and in LDAP by using the profiles command. See profiles(1).

- **sudo command** – The sudo command is new in Oracle Solaris 11. This command generates Oracle Solaris audit records when running commands. The command also drops the proc_exec basic privilege, if the sudoers command entry is tagged as NOEXEC.

- **ZFS file system encryption** – ZFS file system encryption is designed to keep your data secure. See “Encrypting ZFS File Systems” on page 144.

- **rstchown property** – The rstchown tunable parameter that is used in previous releases to restrict chown operations is now a ZFS file system property, rstchown, and is also a general file system mount option. See Oracle Solaris 11.1 Administration: ZFS File Systems and mount(1M).

  If you attempt to set this obsolete parameter in the /etc/system file, the following message is displayed:

  **sorry, variable 'rstchown' is not defined in the 'kernel'**
Network Security Features

The following network security features are supported:

- **Internet Key Exchange (IKE) and IPsec** – IKE now includes more Diffie-Hellman groups and can also use Elliptic Curve Cryptography (ECC) groups. IPsec includes AES-CCM and AES-GCM modes and is now capable of protecting network traffic for the Trusted Extensions feature of Oracle Solaris (Trusted Extensions).

- **IPfilter Firewall** – IPfilter Firewall, which is similar to the open source IPfilter feature, is compatible, manageable, and now highly integrated with SMF. This feature enables selective access to ports, based on IP address.

- **Kerberos** – Kerberos is now capable of mutual authentication of clients and servers. Also, support for initial authentication by using X.509 certificates with the PKINIT protocol has been introduced. See Part VI, “Kerberos Service,” in Oracle Solaris 11.1 Administration: Security Services.

- **Secure by Default** – In Oracle Solaris 10, this feature was introduced, but was limited and was also turned off by default. In Oracle Solaris 11, this feature is enabled. The Secure by Default feature is used to disable and protect several network services from attack and provides minimization of network exposure. Note that only SSH is enabled.

- **SSH** – Support for host and user authentication by using X.509 certificates is now available.

Pluggable Authentication Module Changes

The following Pluggable Authentication Module (PAM) changes are introduced:

- **Module to enable per-user PAM stacks** – Enables you to configure the PAM authentication policy on a per-user basis, when used in conjunction with the new RBAC pam_policy key (user_attr(4)). The default pam.conf file has also been updated to enable you to use this feature by specifying the pam_policy in a user’s extended attributes or in a profile that is assigned to a user. For example:

  ```
  # usermod -K pam_policy=krb5_only username
  ```

  See pam_user_policy(5).

- **PAM configuration in /etc/pam.d** – Adds support for configuring PAM by using per-service files. As a result, the contents of the /etc/pam.conf file have been migrated to multiple files within the /etc/pam.d/ directory, based on the relevant PAM service name. This mechanism is now the method for configuring PAM in Oracle Solaris and is the default method that is used for all new installations. The /etc/pam.conf file is still consulted, so any existing or new changes that are made to this file continue to be recognized.

  If you have never edited the /etc/pam.conf file, the file only contains comments that direct you to the per-service equivalents in the /etc/pam.d/ directory. If you previously edited the /etc/pam.conf file, for example, to enable LDAP or Kerberos, a new file name named /etc/pam.conf.new is delivered with the changes you made. See pam.conf(4).
definitive flag added to pam.conf – The pam.conf file now includes the definitive control_flag. See pam.conf(4).

Removed Security Features

The following security features are excluded from Oracle Solaris 11:

- **Automated Security Enhancement Tool (ASET)** – The ASET functionality is replaced by a combination of IPFilter, which includes svc.ipfd, BART, SMF, and other security features that are supported in Oracle Solaris 11.
- **Smartcard** – Smartcard support is no longer available.

Roles, Rights, Privileges, and Authorizations

The following information describes how roles, rights, privileges, and authorizations work in Oracle Solaris 11:

- **Assign versus delegate authorizations** – Oracle Solaris provides authorizations for delegating specific administrative rights to individual users and roles to implement separation of duty. In Oracle Solaris 10, authorizations ending in .grant are required to delegate an authorization to another user. In Oracle Solaris 11, two new suffixes, .assign and .delegate, are used, for example, /usr/local/security/role/solaris_profile//assign and /usr/local/security/role/solaris_profile//delegate. The former grants the right to delegate any rights profile to any user or role. The latter is more restrictive, in that only the rights profiles that are already assigned to the current user can be delegated. Since the root role is assigned solaris.*, this role can assign any authorization to any user or role. As a safety measure, no authorizations that end in .assign are included in any profiles by default.

- **groupadd Command Changes** – At group creation, the system now assigns the /usr/local/security/role/groupname//assign authorization to the administrator. This authorization gives the administrator complete control over that group, enabling the administrator to modify or delete the groupname, as needed. For more information, see the groupadd(1M) and groupmod(1M) man pages.

- **Media Restore rights profile** – This rights profile and set of authorizations can escalate the privileges of a non root account. The profile exists, but is not part of any other rights profile. Because the Media Restore rights profile provides access to the entire root file system, its use is a possible escalation of privilege. Deliberately altered files or substitute media could be restored. By default, the root role includes this rights profile.

- **Primary Administrator profile removed** – The initial user that is created at installation time is given the following roles and rights:
  - root role
  - System Administrator rights profile
Access to the sudo command for all commands that are run as root

**Role authentication** – You can specify either user or role for the roleauth keyword. See `user_attr(4)`.

**root as a Role** – root is now a role by default, therefore, not anonymous and cannot remotely log in to a system. For information about changing the root role to a user, see “How to Change the root Role Into a User” in Oracle Solaris 11.1 Administration: Security Services.

**Oracle Solaris basic privileges include the following:**
- file_read
- file_write
- net_access

**Profile shell versions of regular shells** – Every regular shell now has its own profile version. The following profile shells are available:
- pfbash
- pfcsh
- pfksh
- pfksh93
- pfksh93
- pfsh
- pfzsh
- pftcsh

See `pfexec(1)`.

**Rights profiles** – The `user_attr`, `prof_attr`, and `exec_attr` databases are now read-only. These local files databases are assembled from fragments that are located in `/etc/user_attr.d`, `/etc/security/prof_attr.d`, and `/etc/security/exec_attr.d`. The fragment files are not merged into a single version of the file, but left as fragments. This change enables packages to deliver complete or partial RBAC profiles. Entries that are added to the local files repository with the `useradd` and `profiles` commands are added to the `local-entries` file in the fragment directory. To add or modify a profile, use the `profiles` command. See “About Rights Profiles” on page 140.

**Stop rights profile** – This profile enables administrators to create restricted accounts. See “RBAC Rights Profiles” in Oracle Solaris 11.1 Administration: Security Services.

**pfsh script command** – This command now runs the same as the `pfsh -c script` command. Previously, commands within a script would not be able to take advantage of RBAC, unless the script specified a profile shell as its first line. This rule required you to modify any scripts to use RBAC, which is now unnecessary because the caller of the script (or an ancestor within the session) can specify a profile shell.
• **pfexec command** – This command is now no longer setuid root. The new PF_PFXEC process attribute is set when the pfexec command or a profile shell is executed. Then, the kernel sets the appropriate privileges on exec. This implementation ensures that sub-shells are empowered or restricted, as appropriate.

When the kernel is processing an exec(2), it treats setuid to root differently. Note that setuid to any other uid or setgid is as it was previously. The kernel now searches for an entry in the Forced Privilege RBAC profile in exec_attr(4) to determine which privileges the program should run with. Instead of having the program start with uid root and all privileges, the program runs with the current uid and only the additional privileges that the Forced Privilege RBAC execution profile have assigned to that path name.

**About Rights Profiles**

Rights profiles are collections of authorizations and other security attributes, commands with security attributes, and supplementary rights profiles. Oracle Solaris provides many rights profiles. You can modify existing rights profiles, as well as create new ones. Note that rights profiles must be assigned in order, from most to least powerful.

The following are some of the rights profiles that are available:

• **System Administrator** – Is a profile that is able to perform most tasks that are not connected with security. This profile includes several other profiles to create a powerful role. Use the profiles command to display information about this profile. See Example 9–1.

• **Operator** – Is a profile with limited capabilities to manage files and offline media.

• **Printer Management** – Is a profile that provides a limited number of commands and authorizations to handle printing.

• **Basic Solaris User** – Is a profile that enables users to use the system within the bounds of security policy. This profile is listed by default in the policy.conf file.

• **Console User** – Is a profile for the workstation owner. This profile provides access to authorizations, commands, and actions for the person who is seated at the computer.

Other rights profiles that are available in this release include the All rights profile and the Stop rights profile. For more information, see Chapter 10, "Security Attributes in Oracle Solaris (Reference)," in Oracle Solaris 11.1 Administration: Security Services.

**Example 9–1**  Displaying Information About the System Administrator Rights Profile

Use the profiles command to display information about a specific rights profile. In the following example, information about the System Administrator rights profile is displayed:

```bash
$ profiles -p "System Administrator" info
name=System Administrator
desc=Can perform most non-security administrative tasks
profiles=Install Service Management,Audit Review,Extended Accounting Flow
```
Example 9-1  Displaying Information About the System Administrator Rights Profile  (Continued)

Management, Extended Accounting Net Management, Extended Accounting Process Management,
Extended Accounting Task Management, Printer Management, Cron Management, Device Management,
File System Management, Log Management, Mail Management, Maintenance and Repair,
Media Backup, Media Catalog, Media Restore, Name Service Management, Network Management
Object Access Management, Process Management, Project Management, RAD Management,
Service Operator, Shadow Migration Monitor, Software Installation, System
Configuration, User Management, ZFS Storage Management
help=RtSysAdmin.html

Viewing Privileges and Authorizations

When a user is directly assigned privileges, in effect, the privileges are in every shell. When a user
is not directly assigned privileges, then the user must open a profile shell. For example,
when commands with assigned privileges are in a rights profile that is in the user's list of rights
profiles, then the user must execute the command in a profile shell.

To view privileges online, see privileges(5). The privilege format that is displayed is used by
developers.

$ man privileges
Standards, Environments, and Macros privileges(5)

NAME
privileges - process privilege model
...
The defined privileges are:

PRIV_CONTRACT_EVENT

Allow a process to request reliable delivery of events to an event endpoint.

Allow a process to include events in the critical event set term of a template which could be generated in
volume by the user.
...

Example 9-2  Viewing Directly-Assigned Privileges

If you have been directly assigned privileges, then your basic set contains more than the default
basic set. In the following example, the user always has access to the proc_clock_highres
privilege.

$ /usr/bin/whoami
jdoe
$ ppriv -v $$
1800: pfksh
flags = <none>
E: file_link_any,....,proc_clock_highres,proc_session
I: file_link_any,....,proc_clock_highres,proc_session
Viewing Directly-Assigned Privileges (Continued)

P: file link any,...,
proc_clock_highres,proc_session
L: cpc_cpu,dtrace_kernel,dtrace_proc,dtrace_user,...,sys_time

$ ppriv -vl proc_clock_highres
Allows a process to use high resolution timers.

To view authorizations, use the auths command:

$ auths list

The output of this command produces a more readable summary (one per line) of the authorizations that are assigned to a user. Starting with Oracle Solaris 11.1, several new options have been added to the auths command. For example, the check option is useful for scripting. Other new options provide the ability to add, modify, and remove authorizations to and from files or LDAP. See auths(1).

File and File System Security Changes

The following sections describe changes to file and file system security.

aclmode Property Is Reintroduced

The aclmode property that determines how the ACL permissions on a file are modified during a chmod operation is reintroduced in Oracle Solaris 11. The aclmode values are discard, mask, and passthrough. The discard default value is the most restrictive, and the passthrough value is the least restrictive.

EXAMPLE 9–3  ACL Interaction With chmod Operations on ZFS Files

The following examples illustrate how specific aclmode and aclinherit property values influence the interaction of existing ACLs with a chmod operation that either reduces or expands any existing ACL permissions to be consistent with the ownership of a group.

In this example, the aclmode property is set to mask and the aclinherit property is set to restricted. The ACL permissions in this example are displayed in compact mode, which more easily illustrates changing permissions.

The original file and group ownership and ACL permissions are as follows:

# zfs set aclmode=mask pond/whoville
# zfs set aclinherit=restricted pond/whoville
# ls -1V file.1
-rwxrwx---+ 1 root root 206695 Aug 30 16:03 file.1
EXAMPLE 9–3   ACL Interaction With chmod Operations on ZFS Files (Continued)

    user:amy:r-----a-R-c---:-------:allow
    user:rory:r-----a-R-c---:-------:allow
    group:sysadmin:rw-p--aARWc---:-------:allow
    group:staff:rw-p--aARWc---:-------:allow
    owner@:rwxp--aARWcCos:-------:allow
    group@:rwxp--aARWc--s:-------:allow
    everyone@:------a-R-c--s:-------:allow

A chown operation changes the file ownership on file.1 and the output is now seen by the owning user, amy. For example:

    # chown amy:staff file.1
    # su - amy
    $ ls -lV file.1
    -rwxrwx---+ 1 amy staff 206695 Aug 30 16:03 file.1
    user:amy:r-----a-R-c---:-------:allow
    user:rory:r-----a-R-c---:-------:allow
    group:sysadmin:rw-p--aARWc---:-------:allow
    group:staff:rw-p--aARWc---:-------:allow
    owner@:rwxp--aARWcCos:-------:allow
    group@:rwxp--aARWc--s:-------:allow
    everyone@:------a-R-c--s:-------:allow

The following chmod operation changes the permissions to a more restrictive mode. In this example, the modified sysadmin group’s and staff group’s ACL permissions do not exceed the owning group’s permissions.

    $ chmod 640 file.1
    $ ls -lV file.1
    -rw-r----- 1 amy staff 206695 Aug 30 16:03 file.1
               user:amy:rw--a-x-r---:-------:allow
               user:rory:r-----a-R-c---:-------:allow
               group:sysadmin:rw-p--aARWc---:-------:allow
               group:staff:rw-p--aARWc---:-------:allow
               owner@:rw-p--aARWcCos:-------:allow
               group@:rwxp--aARWc--s:-------:allow
               everyone@:------a-R-c--s:-------:allow

The following chmod operation changes the permissions to a less restrictive mode. In this example, the modified sysadmin group’s and staff group’s ACL permissions are restored to allow the same permissions as the owning group.

    $ chmod 770 file.1
    $ ls -lV file.1
    -rwxrwx--- 1 amy staff 206695 Aug 30 16:03 file.1
               user:amy:rw--a-x-r---:-------:allow
               user:rory:r-----a-R-c---:-------:allow
               group:sysadmin:rw-p--aARWc---:-------:allow
               group:staff:rw-p--aARWc---:-------:allow
               owner@:rw-p--aARWcCos:-------:allow
               group@:rwxp--aARWc--s:-------:allow
               everyone@:------a-R-c--s:-------:allow
Encrypting ZFS File Systems

In previous Oracle Solaris releases and in this release, the Cryptographic Framework feature provides the encrypt, decrypt, and mac commands to encrypt files.

Oracle Solaris 10 does not support ZFS encryption, but Oracle Solaris 11 supports the following ZFS encryption features:

■ ZFS encryption is integrated with the ZFS command set. Like other ZFS operations, key change and rekey operations are performed online.
■ You can use your existing storage pools as long as they are upgraded. You have the flexibility of encrypting specific file systems.
■ ZFS encryption is inheritable to descendent file systems. Key management can be delegated through ZFS delegated administration.
■ Data is encrypted by using AES (Advanced Encryption Standard) with key lengths of 128,192, and 256 in the CCM and GCM operation modes.
■ ZFS encryption uses the Cryptographic Framework feature, which gives it access to any available hardware acceleration or optimized software implementations of the encryption algorithms automatically.

Note – Currently, you cannot encrypt a ZFS root file system or other OS components, such as the /var directory, even if it is a separate file system.

EXAMPLE 9–4  Creating an Encrypted ZFS File System

The following example shows how to create an encrypted ZFS file system. The default encryption policy is to prompt for a passphrase, which must be a minimum of 8 characters in length.

```
# zfs create -o encryption=on tank/data
Enter passphrase for 'tank/data': xxxxxxxx
Enter again: xxxxxxxx
```

The default encryption algorithm is aes-128-ccm when a file system's encryption value is on.

After an encrypted file system is created, it cannot be unencrypted. For example:

```
# zfs set encryption=off tank/data
cannot set property for 'tank/data': 'encryption' is readonly
```

For more information, see “Encrypting ZFS File Systems” in Oracle Solaris 11.1 Administration: ZFS File Systems.
**Immutable Zones**

New in Oracle Solaris 11, the `file-mac-profile` property enables you to run zones with a read-only root file system. This feature enables you to choose between four predefined profiles that determine how much of a zone file system is read-only only, even for processes that have all zone privileges. See "zonecfg file-mac-profile Property" in *Oracle Solaris 11.1 Administration: Oracle Solaris Zones, Oracle Solaris 10 Zones, and Resource Management.*
Managing Oracle Solaris Releases in a Virtual Environment

This chapter describes the virtualization features that are supported in Oracle Solaris 11 releases.

The following topics are covered:

- “Installing and Managing Oracle Solaris 11 Virtualization Features” on page 147
- “Consolidating Legacy Solaris Systems With Oracle VM Server” on page 148
- “Oracle Solaris 11 Zone Features” on page 148
- “Transitioning an Oracle Solaris 10 Instance to an Oracle Solaris 11 System” on page 152

Installing and Managing Oracle Solaris 11 Virtualization Features

The following table provides a brief description of virtualization features that are supported in Oracle Solaris 11.

<table>
<thead>
<tr>
<th>Oracle Solaris 11 Feature</th>
<th>Description</th>
<th>Oracle Solaris 10 Support</th>
<th>For More Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oracle VM Server for SPARC (Sun Logical Domains)</td>
<td>Hypervisor-based virtualization for SPARC servers</td>
<td>Yes</td>
<td>Oracle VM Server for SPARC 2.2 Administration Guide</td>
</tr>
</tbody>
</table>
TABLE 10–1  Oracle Solaris 11 Virtualization Features  (Continued)

<table>
<thead>
<tr>
<th>Oracle Solaris 11 Feature</th>
<th>Description</th>
<th>Oracle Solaris 10 Support</th>
<th>For More Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oracle Solaris Zones</td>
<td>A zone is a virtualized operating system environment created within a single instance of the Oracle Solaris operating system</td>
<td>Yes</td>
<td>Part II, “Oracle Solaris Zones,” in <em>Oracle Solaris 11.1 Administration: Oracle Solaris Zones, Oracle Solaris 10 Zones, and Resource Management</em></td>
</tr>
</tbody>
</table>

**Consolidating Legacy Solaris Systems With Oracle VM Server**

You can use the Oracle VM Server for SPARC physical-to-virtual (P2V) conversion tool to automatically convert an existing physical system to a virtual system that runs the Oracle Solaris 10 OS in a logical domain on a chip multithreading (CMT) system. Run the `ldmp2v` command from a control domain that runs the Oracle Solaris 10 OS or the Oracle Solaris 11 OS to convert one of the following source systems to a logical domain:

- Any `sun4u` SPARC based system that runs at least the Solaris 8, Solaris 9, or Oracle Solaris 10 OS
- Any `sun4v` system that runs the Oracle Solaris 10 OS, but does not run in a logical domain

Note that the `ldmp2v` command does not support any SPARC based system that runs the Oracle Solaris 10 OS with a ZFS root or the Oracle Solaris 11 OS.


**Oracle Solaris 11 Zone Features**

- **Oracle Solaris 10 branded zones** – Oracle Solaris 10 Zones provide an Oracle Solaris 10 environment on Oracle Solaris 11. You can migrate an Oracle Solaris 10 system or zone to a `solaris10` zone on an Oracle Solaris 11 system in the following ways:
  - Create a zone archive and use the archive to create an `s10` zone on the Oracle Solaris 11 system. See “Transitioning an Oracle Solaris 10 Instance to an Oracle Solaris 11 System” on page 152.
- Detach the zone from the Oracle Solaris 10 system and attach the zone on the Oracle Solaris 11 zone. The zone is halted and detached from its current host. The zone path is moved to the target host, where it is attached. See “About Detaching and Attaching the solaris10 Zone” in Oracle Solaris 11.1 Administration: Oracle Solaris Zones, Oracle Solaris 10 Zones, and Resource Management.

- **Oracle Solaris 11 installation support** – You can specify the configuration and installation of non-global zones as part of an AI client installation. Non-global zones are installed and configured on the first reboot after the global zone is installed. See Chapter 12, “Installing and Configuring Zones,” in Installing Oracle Solaris 11.1 Systems.

- **Whole root zones only** – Oracle Solaris Zones are whole-root type only, but you can configure your zones in a more flexible way, such as when disk space is limited or if you prefer a read-only zone root configuration. By default, zone boot environments are compressed.

  In addition, you can automatically update any non-global zone to ensure consistency across the system. An added benefit is individual software stacks for each non-global zone are independent of the global zone.

- **Legacy branded zones** – The following legacy branded zone features are only supported in Oracle Solaris 10 releases:
  - Linux brand (lx)
  - Oracle Solaris 8 Containers (solaris8)
  - Oracle Solaris 9 Containers (solaris9)

- **Exclusive IP zones by default** – Exclusive-IP zones enable you to assign a separate IP stack per zone. Each zone has the flexibility to configure IP within that stack completely separate to other zones. You can easily observe network traffic, per zone, and apply individual network resources. In previous versions of Oracle Solaris this was dependent on the number of physical NICs per system. The addition of network virtualization provides enhanced flexibility when managing zones, without the restrictions of physical network hardware. Newly created zones in Oracle Solaris 11 are exclusive-IP zones with a VNIC, net0, whose underlying lower link is automatically selected at boot time. See Part II, “Oracle Solaris Zones,” in Oracle Solaris 11.1 Administration: Oracle Solaris Zones, Oracle Solaris 10 Zones, and Resource Management.

- **Network virtualization for zones** – Oracle Solaris 11 network virtualization features can be applied to a zone by creating a virtual NIC (VNIC) for the zone and applying bandwidth limits and traffic flows to the zone’s assigned VNIC. The VNIC is created when the zone boots and deleted when the zone halts, and will be created within the non-global zone’s datalink namespace. This feature allows you to provision a zone without having to learn the details of network configuration and topology. If you want to assign a preexisting datalink to an exclusive-IP zone, you can still do so during the zone configuration.

  For example, create a virtual NIC, limit the SPEED of the VNIC, create an address for it, and then assign it to zone.

  ```bash
  # dladm create-vnic -l net0 -p maxbw=600 vnic0
  # ipadm create-addr -T static -a local=x.x.x.x/24 vnic0/v4static
  ```
The `ip-type` value for the zone can either be `shared` or `exclusive`:

- The `ip-type=exclusive` value means that you are dedicating a datalink, which can be a virtual (VNIC) for exclusive use by the zone. This strategy brings some of the network stack management benefits to the zone. Historically, this has not been practical if a system has many zones, but only a maximum of 4 network interfaces.

  Exclusive IP is now the recommended `ip-type` for zones. The `set physical` value identifies the system’s network interface cards that is assigned to the zone. Using an `ip-type` of exclusive allows the zone to manage its IP stack directly.

- If `ip-type=shared` was identified in the above example, you would have to specify an IP address and other resources.

- **NFS server support in non-global zones** – You can share file systems in a non-global zones by using the NFS protocol. The SMB (CIFS) sharing protocol is not currently available in a non-global zone.

- **Zone monitoring** – System resources that are consumed by non-global zones can be monitored by using the `zones tat` command.

- **Immutable Zones** – The `file-mac-profile` property enables you to run a non-global zone with a read-only root file system. See “zonecfg file-mac-profile Property” in *Oracle Solaris 11.1 Administration: Oracle Solaris Zones, Oracle Solaris 10 Zones, and Resource Management*.

### Oracle Solaris 11.1 Zones Features

The following Oracle Solaris zone enhancements are available in the Oracle Solaris 11.1 release.

- **Parallel zone updates** – A system with multiple Oracle Solaris zones is now updated in parallel. The increase in speed for updating 20 zones is in the 4x range.

- **Improved install and attach performance** – Installing a zone is 27 percent faster and attaching a zone is 91 percent faster. These performance improvements mean that a planned service window of a system with Oracle Solaris zones can be shorter because installing and updating Oracle Solaris zones is much faster.

- **Zone file system statistics** – A per-fstype `kstat` (kernel statistic) for each zone is provided so that you can monitor file system activity in each non-global zone. In addition, a `kstat` is available for monitoring the global zone.
• **Zones on shared storage** – Deployment and migration of Oracle Solaris zones can be simplified by running zones on arbitrary storage objects like Fibre Channel devices or iSCSI targets. You can configure a device path directly with the `zonecfg` command. The zone is automatically encapsulated into its own ZFS storage pool.

See *Oracle Solaris 11.1 Administration: Oracle Solaris Zones, Oracle Solaris 10 Zones, and Resource Management*.

### Oracle Solaris 10 Branded Zones Preparation

Prepare for migrating a Oracle Solaris 10 OS instance or zone to your Oracle Solaris 11 system.

- Confirm that your Oracle Solaris 10 instance or zone is running the Oracle Solaris 10 9/10 release, which is the minimum OS requirement.
- Confirm that your Oracle Solaris 10 instance or zone is the same platform as the system migration target. You can only migrate a SPARC instance to a SPARC system and an x86 instance to an x86 based system.
- Download and run the `/usr/sbin/zonep2vchk` script on the Oracle Solaris 10 system to determine if any issues would prevent the Oracle Solaris 10 zone or instance from running successfully on an Oracle Solaris 11 system.

On an Oracle Solaris 10 1/13 system, the `/usr/sbin/zonep2vchk` utility is included in the release. For a system running an older Oracle Solaris 10 release, download the unbundled package from Oracle Technology Network (OTN):


Keep in mind that this script is only for system migration purposes.

- Enable the Oracle Solaris 10 package and patch tools.

To use the Oracle Solaris 10 package and patch tools in your Oracle Solaris 10 zones, install the following patches on your source Oracle Solaris 10 system before the image is created.

- 119254-75, 119534-24, 140914-02 (SPARC platforms)
- 119255-75, 119535-24 and 140915-02 (x86 platforms)

The physical to virtual (P2V) process works without the patches, but the package and patch tools do not work properly within the Oracle Solaris 10 zones unless these patches are installed.
You can transition your Oracle Solaris 10 environment to a non-global zone on an Oracle Solaris 11 system by creating a zone archive and migrating the zone archive to an Oracle Solaris 11 system. The following steps describe this process.

1. Install the Oracle Solaris 10 zone package on your Oracle Solaris 11 system. For example:

   ```bash
   s11sysB# pkg install system/zones/brand/brand-solaris10
   ```

2. Run the `zonep2vchk` script to identify any issues that might prevent the instance from running as a `solaris10` zone.

   ```bash
   s10sys# ./zonep2vchk
   --Executing Version: 1.0.5-11-15652
   - Source System: tardis
     Solaris Version: Oracle Solaris 10 8/11 s10s_u10wos_17b SPARC
     Solaris Kernel: 5.10 Generic 147440-01
     Platform: sun4u SUNW,Sun-Fire-V440
   - Target System:
     Solaris Version: Solaris 10
     Zone Brand: native (default)
     IP type: shared
   --Executing basic checks
   ```

3. Create a ZFS filesystem that will contain the flash archive of the Oracle Solaris 10 system instance, if necessary. Then, create an NFS share of the ZFS filesystem on your Oracle Solaris 11 system. For example:

   ```bash
   s11sysB# zfs create pond/s10archive
   s11sysB# zfs set share=name=s10share,path=/pond/s10archive,prot=nfs,root=s10sysA
   pond/s10archive
   name=s10share,path=/pond/s10archive,prot=nfs,sec=sys,root=s10sysA
   s11sysB# zfs set share nfs on pond/s10archive
   ```

4. Select an Oracle Solaris 10 instance, which could be a virtual environment or a global zone on a Solaris 10 system. Note the Oracle Solaris 10 system’s hostid.

   ```bash
   s10sysA# hostid
   8439b620
   ```

5. Create an archive of the Oracle Solaris 10 instance that you would like to migrate to a non-global zone on the Oracle Solaris 11 system.

   ```bash
   s10sysA# flarcreate -S -n s10sysA -L cpio /net/s11sysB/pond/s10archive/s10.flar
   ```

6. Create a ZFS file system for the Oracle Solaris 10 zone.

   ```bash
   s11sysB# zfs create -o mountpoint=/zones pond/zones
   s11sysB# chmod 700 /zones
   ```
7. Create the non-global zone for the Oracle Solaris 10 instance.

    s11sys# zonecfg -z s10zone
s10zone: No such zone configured
Use 'create' to begin configuring a new zone.
zonecfg:s10zone> create -t SYSsolaris10
zonecfg:s10zone> set zonepath=/zones/s10zone
zonecfg:s10zone> set ip-type=exclusive
zonecfg:s10zone> add anet
zonecfg:s10zone:net> set lower-link=auto
zonecfg:s10zone:net> end
zonecfg:s10zone> set hostid=8439b629
zonecfg:s10zone> verify
zonecfg:s10zone> commit
zonecfg:s10zone> exit

8. Install the Oracle Solaris 10 non-global zone.

    s11sys# zoneadm -z s10zone install -u -a /pond/s10archive/s10.flar
A ZFS file system has been created for this zone.
Progress being logged to /var/log/zones/zoneadm.20110921T135935Z.s10zone.install
Installing: This may take several minutes...
Postprocess: Updating the image to run within a zone
Postprocess: Migrating data
    from: pond/zones/s10zone/rpool/ROOT/zbe-0
    to: pond/zones/s10zone/rpool/export

9. Boot the Oracle Solaris 10 zone.

    # zoneadm -z s10zone boot

10. Configure the Oracle Solaris 10 non-global zone.

    s11sys# zlogin -C s10zone
[Connected to zone 's10zone' console]

    s10zone console login: root
Password: xxxxxxxxx
    # cat /etc/release
Oracle Solaris 10 8/11 s10s_u10wos 17b SPARC
Copyright (c) 1983, 2011, Oracle and/or its affiliates. All rights reserved.
Assembled 23 August 2011
    # uname -a
SunOS supernova 5.10 Generic_Virtual sun4v sparc SUNW,Sun-Fire-T1000
    # zfs list
CREATE       USED   AVAIL  REFER MOUNTPOINT
rpool        4.53G   52.2G  106K  /rpool
rpool/ROOT   4.53G   52.2G   31K  legacy
rpool/ROOT/zbe-0  4.53G   52.2G  4.53G  /
rpool/export  63K   52.2G  32K  /export
rpool/export/home  31K   52.2G  31K  /export/home

---

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Managing User Accounts and User Environments

This chapter provides information about the management of user accounts, groups, roles, and a user’s environment in Oracle Solaris 11 releases.

The following topics are covered:

- “Commands and Tools for Managing User Accounts” on page 155
- “Managing User Accounts” on page 156
- “User Environment Feature Changes” on page 160
- “Oracle Solaris Man Page Changes” on page 161

Commands and Tools for Managing User Accounts

Note – The Solaris Management Console graphical tool and its associated command line interface have been removed. To create and manage user accounts, use the command-line and graphical tools that are described or referenced in this chapter.

<table>
<thead>
<tr>
<th>Command/Tool Name</th>
<th>Description</th>
<th>For More Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>useradd, groupadd, roleadd</td>
<td>Commands for adding users, groups, and roles.</td>
<td>Managing User Accounts “How to Create a Role” in Oracle Solaris 11.1 Administration: Security Services</td>
</tr>
<tr>
<td>usermod, groupmod, rolemod</td>
<td>Commands for modifying users, groups, and roles.</td>
<td>Oracle Solaris 11.1 Administration: Security Services</td>
</tr>
</tbody>
</table>
TABLE 11–1  Commands and Tools for Managing User Accounts  (Continued)

<table>
<thead>
<tr>
<th>Command/Tool Name</th>
<th>Description</th>
<th>For More Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>userdel</code>, <code>groupdel</code>, <code>roledel</code></td>
<td>Commands for deleting users, groups, and roles.</td>
<td>“How to Delete a User” in <em>Managing User Accounts and User Environments in Oracle Solaris 11.1</em> and <code>userdel(1M)</code>, <code>groupdel(1M)</code>, <code>roledel(1M)</code></td>
</tr>
<tr>
<td><code>User Manager GUI</code></td>
<td>GUI for creating and managing users.</td>
<td>Chapter 3, “Managing User Accounts by Using the User Manager GUI (Tasks),” in <em>Managing User Accounts and User Environments in Oracle Solaris 11.1</em></td>
</tr>
</tbody>
</table>

Managing User Accounts

In this release, you can create and manage user accounts from the command line or with the User Manager GUI. The GUI replaces some of the functionality of the Solaris Management Console and its associated command-line. For more information, see *Managing User Accounts and User Environments in Oracle Solaris 11.1*.

User Account Management Changes

The following features are new or have changed in this release:

- **Addition of the User Manager GUI** – The User Manager GUI is part of the Visual Panels project and is accessible from the desktop. The GUI replaces some of the functionality of the Solaris Management Console. See Chapter 3, “Managing User Accounts by Using the User Manager GUI (Tasks),” in *Managing User Accounts and User Environments in Oracle Solaris 11.1*.

- **Creating user accounts** – User account creation has changed in the following ways:
  - In Oracle Solaris 11, user accounts are created as individual ZFS file systems, which enables users to have their own file system and their own ZFS dataset. Every home directory that is created with the `useradd` and `roleadd` commands places the user’s home directory on `/export/home` as an individual ZFS file system.
  - The `useradd` command relies on the automount service, `svc:/system/filesystem/autofs`, to mount home directories. This service should never be disabled. Each home directory entry for a user in the `passwd` database uses the format, `/home/username`, which is an autofs trigger that is resolved by the automounter through the `auto_home` map.
The `useradd` command automatically creates entries in the `auto_home` map that correspond to the pathname that is specified by the `-d` option of this command. If the pathname includes a remote host specification, for example, `foobar:/export/home/jdoe`, then the home directory for `jdoe` must be created on the system `foobar`. The default pathname is `localhost:/export/home/user`. Because `/export/home` is the mount point for a ZFS dataset, the user's home directory is created as a child ZFS dataset, with the ZFS permission to take snapshots delegated to the user. If a pathname that does not correspond to a ZFS dataset is specified, then a regular directory is created. If the `-S ldap` option is specified, then the `auto_home` map entry is updated on the LDAP server instead of the local `auto_home` map.

### Modifying user accounts

In Oracle Solaris 11, the `usermod` command works with LDAP and files. All security attributes can be assigned to a user by using this mechanism. For example, an administrator can add a role to a user's account by using the `usermod` command.

```
# roleadd -K roleauth=user -P "Network Management" netmgt
# usermod -R +netmgt jdoe
```

See `usermod(1M)` for additional examples.

### Creating and managing groups

An administrator who has the `solaris.group.manage` authorization can create a group. At group creation, the system assigns the `solaris.group.assign/groupname` authorization to the administrator, which gives the administrator complete control over that group. The administrator can then modify or delete that `groupname`, as needed. See the `groupadd(1M)` and `groupmod(1M)` man pages.

### Creating and managing roles

Roles can be created locally and in an LDAP repository. To create a role and assign an initial password, you must be assigned the User Management rights profile. For instructions on creating a role, see “How to Create a Role” in Oracle Solaris 11.1 Administration: Security Services.
User Password and Login Changes

User password management and login information have changed in the following ways:

- **Property definition refinements for the `password` command** – This change clarifies which user accounts can and cannot be locked. The primary changes impact the LK and NL property definitions, as follows:

  **LK**  The account is locked for UNIX authentication. The `passwd -l` command was run, or the account was automatically locked due to the number of authentication failures reaching the configured maximum that is allowed. See the `policy.conf` and `user_attr(4)` man pages.

  **NL**  The account is a no login account. The `passwd -N` command was run.

- **Failed login count notification** – The system now notifies users of failed authentication attempts, even if the user account is not configured to enforce failed logins. Users who fail to authenticate correctly, will see a message similar to following upon successful authentication:

  Warning: 2 failed authentication attempts since last successful authentication. The latest at Thu May 24 12:02 2012.

  To suppress such notifications, create a `~/.hushlogin` file.

- **Default password hashing algorithm** – The default password hashing algorithm is now SHA256. This password hash is similar to the following:

  `5$cg0k2juy$AhHtGx50d0.W3NCKj1kb8.Kh0ia40pxsW55sP8UnYD`

  Also, there is no longer an eight character limitation for user passwords. The eight character limitation only applies to passwords that use the older `crypt_unix(5)` algorithm, which has been preserved for backwards compatibility with any existing `passwd` file entries and NIS maps. Starting with Oracle Solaris 11, the `crypt_sha256` algorithm is the default.

  Passwords are encoded by using one of the other `crypt(3c)` algorithms, including the SHA256 algorithm, which is the default in the `policy.conf` file. Thus, passwords can now be much longer than eight characters. See `policy.conf(4)`.
Sharing Home Directories That Are Created as ZFS File Systems

An NFS or an SMB share of a ZFS file system is created and then shared as follows:

- **Oracle Solaris 11**: The file system share is created by using the `zfs set share` command. At this time, specific share properties can be defined. If share properties are not defined, the default property values are used.
  
The NFS or SMB share is published by setting the `share.nfs` or `share.smb` property. The share is published permanently until the property is set to `off`.

- **Oracle Solaris 11.1**: The following sharing features are provided on ZFS storage pool version 34:
  
  - The `share.nfs` property replaces the `sharenfs` property in previous releases to define and publish an NFS share.
  - The `share.smb` property replaces the `sharesmb` property in previous releases to define and publish an SMB share.
  - ZFS share administration is simplified by leveraging ZFS property inheritance. If you want to share the `tank/home` file system, use syntax similar to the following:

    ```
    # zfs set share.nfs=on tank/home
    # zfs create tank/home/userA
    # zfs create tank/home/userB
    ```

    The share.nfs property value is inherited to any descendent file systems.

See “How to Share Home Directories That Are Created as ZFS File Systems” in *Managing User Accounts and User Environments in Oracle Solaris 11.1*.

How Home Directories Are Mounted in Oracle Solaris

Because home directories are created as ZFS file systems in Oracle Solaris 11, you typically do not need to manually mount home directories. The home directory is automatically mounted during its creation and also at boot time from the SMF local file system service. For instructions on manually mounting a user’s home directory, see “Manually Mounting a User’s Home Directory” in *Managing User Accounts and User Environments in Oracle Solaris 11.1*. 
User Environment Feature Changes

Oracle Solaris 11 includes the following user environment and command-line argument changes:

- **Addition of /var/user/$USER** – Starting with Oracle Solaris 11.1, whenever a user logs in and successfully authenticates by using the `pam_unix_cred` module, a `/var/user/$USER` directory is explicitly created, if the directory does not already exist. This directory enables applications to store persistent data that is associated with a particular user on the host system. The `/var/user/$USER` directory is created upon initial credential establishment, as well during a secondary authentication when changing users by using the `su`, `ssh`, `rlogin`, and `telnet` commands. The `/var/user/$USER` directory does not require any administration. However, users should be aware of how the directory is created, its function, and that it is visible in the `/var` directory.

- **Shell changes** - The default shell, `/bin/sh`, is now linked to `ksh93`. The default user shell is the Bourne-again (`bash`) shell.
  - The legacy Bourne shell is available as `/usr/sunos/bin/sh`.
  - The legacy `ksh88` is available as `/usr/sunos/bin/ksh` from the `shell/ksh88` package.
  - Korn shell compatibility information is available in `/usr/share/doc/ksh/COMPATIBILITY`.

- **Default path** – The default user path is `/usr/bin`. The default path for the root role is `/usr/bin:/usr/sbin`.

- **Command locations** – Administration commands that were previously in `/sbin` have moved to `/usr/sbin`. In addition, the `/sbin` directory has been replaced by an `/usr/sbin` symbolic link.

- **MANPATH variable** – The `MANPATH` environment variable is no longer required. The `man` command determines the appropriate `MANPATH`, based on the `PATH` environment variable setting.

- **Developer tools locations** – Developer tools that were previously in `/usr/ccs/bin` have moved to `/usr/bin`. The `/usr/ccs/bin` directory is replaced by a `/usr/ccs/bin` symbolic link.

- **File locations** – Files that were previously in the `/usr/sfw` directory are now in `/usr/bin`.

- **Editor changes** – The `vi` family of editors, including `/usr/bin/vi`, `/usr/bin/view`, and `/usr/bin/ex`, are now links to the `vim` open source implementation of the `vi` editor. The traditional SunOS versions of these commands are available in `/usr/sunos/bin/`.

- **Java version** – Java 7 is the default Java version in this release. Java 7 includes several feature, security, and performance enhancements for Oracle Solaris, including the new OracleUcrypto Provider, which on SPARC T4 platforms directly accesses the underlying
native (on-chip) T4 crypto capabilities for maximum performance while minimizing CPU load. For more details, go to [http://www.oracle.com/technetwork/java/javase/compatibility-417013.html](http://www.oracle.com/technetwork/java/javase/compatibility-417013.html).

Change the default version to Java 7, as follows:

```
# pkg set-mediator -V 1.7 java
```

## Default Login Shell and PATH Environment Variable

In Oracle Solaris 10, the default scripting shell (/bin/sh) is the Bourne shell. In Oracle Solaris 11, /bin/sh is the Korn shell (ksh93), and the default interactive shell is the Bourne-again (bash) shell. When used as a login shell, bash retrieves configuration information from the first instance of .bash_profile, .bash_login, or .profile file.

The default PATH environment variable for bash is:

```
/usr/bin:/usr/sbin
```

## Oracle Solaris Man Page Changes

The following man page features are new or have changed:

- **Locating information in man pages** – This release has the capability of searching man pages with query strings by using the `man -K keywords` command. The `-K` (uppercase) option works similarly to the `-k` (lowercase) option, with the exception that the `-k` option is limited to searching only the NAME subsection of all of the man page sections.

  The `-k` and `-K` options uses index files for searching. A new SMF service, `svc:/application/man-index:default`, triggers the automatic regeneration of new index files whenever new man pages are added to the `/usr/share/man` and `/usr/gnu/share/man` directories, if these directories exist. This service is enabled by default.

- **Package Name Change** – The SUNWman package that contained the Oracle Solaris man pages in previous releases has changed to the smaller `system/manual` package. The bulk of the man pages are now packaged separately with their component technology packages. For example, `ls.1m` for the `/usr/bin/ls` command is part of the `system/core-os` package.

- **Man Page Display** – If the man pages are not displaying on your system, you can use the following command to toggle whether man pages are installed on the system:

  ```
  # pkg change-facet facet.doc.man=true
  ```

  **Note** – Be aware that running the previous command downloads several files to local disk, which effectively is the reverse of the command that you run to remove all man pages.
Managing Desktop Features

This chapter describes the desktop features that are supported in Oracle Solaris 11 releases.

The following topics are covered:

- “Oracle Solaris Desktop Feature Summary” on page 163
- “Desktop Features That Have Been Removed” on page 167
- “Xorg Family of Servers” on page 167
- “Troubleshooting Desktop Transition Issues” on page 168

Oracle Solaris Desktop Feature Summary

The default desktop environment in Oracle Solaris 11 is the Oracle Solaris Desktop, which includes GNOME 2.30 from the GNOME Foundation. Also included is the Firefox web browser, Thunderbird Email client, and the Lightning calendar manager from the Mozilla Foundation.

**Note** – If you use the text installation method, the Oracle Solaris Desktop package (solaris-desktop) is not installed on your system by default. Also, the solaris-desktop package cannot be applied directly to a running system. For more information, see “Installing the Oracle Solaris Desktop Software Package After an Installation” on page 168.

Other new desktop features include the following:

- Accessibility feature enhancements
- Bluefish HTML editor
- Compiz OpenGL based window manager
- D-Bus IPC Framework
- Evince PDF viewer
Key Desktop Features

The following key features are new or enhanced in Oracle Solaris 11:

- **Accessibility enhancements** – Users with disabilities can use a wide range of accessibility features, including Orca, espeak, and brltty. These features replace gnopernicus and provide better text-to-speech support. The dasher on-screen keyboard also has been added in this release.

  Note that the GNOME On-screen Keyboard (GOK) program that is used Oracle Solaris 10 is no longer available. The new dasher application can be used as a replacement for some users.

- **Command Assistant** – Locates command-line information in Oracle Solaris managed content, for example books and man pages. To add Command Assistant to the desktop panel, use the Add to Panel → Command Assistant dialog box.

- **Graphical login manager** – Oracle Solaris 10 uses the Common Desktop Environment (CDE) and dtlogin as the default login GUI. The GNOME graphical desktop manager (GDM) is also available in Oracle Solaris 10. In this release, GDM is the only graphical login option.

  The GDM configuration process has also changed considerably in Oracle Solaris 11. To learn more, consult the gdm and console-kit-daemon man pages. ConsoleKit configuration features are now used to manage multi-seat environments. To troubleshoot transition issues, see “GNOME Desktop Manager Issues” on page 169.

- **Multimedia support:**
  - **FreeDesktop GStreamer** – The FreeDesktop GStreamer module is a desktop tool that provides multimedia support. GStreamer uses a plug-in infrastructure that enables the use of additional media formats.
  - **gksu** – Is the graphical version of the sudo command. When launched, the tool displays a prompt that enables you to type an additional password to run an administrative tool.
- **Multimedia formats** – The FLAC, Speex, Ogg Vorbis, and Theora media formats are supported through the use of GStreamer plugins. Oracle Solaris 11 provides GStreamer 0.10, while Oracle Solaris 10 uses GStreamer 0.8.

- **Open Sound System** – The Open Sound System (OSS) framework manages audio devices and provides better audio support. Some audio devices that were previously supported are no longer supported. Programs that use the Sun Audio Device Architecture (SADA) interfaces continue to be supported. If your audio device is not working properly, you can launch a dialog box from the desktop that enables you to choose which audio device and GStreamer audio input/output plugins to use:

  $ /usr/bin/gstreamer-properties

  This program also includes a Test button that enables you to determine whether your audio settings are correct. Note that some audio cards present themselves as having more than one device, for example, one for analog audio and one for digital audio. If you are currently using RealPlayer, you will need to transition to the multimedia tools that are currently supported.

- **PulseAudio sound server** – Introduced in Oracle Solaris 11.1, the PulseAudio sound server supports improved audio mixing. The /usr/bin/gnome-volume-control Device combo-box displays additional PulseAudio devices. For desktop and laptop computers, the “OSS” device choice should work best. To determine the best setting for your audio hardware, some initial trial-and-error might be required. If you continue to experience audio problems, run the following command to verify that the correct default Input/Output audio plug-ins are selected:

  $ /usr/bin/gstreamer-properties

  PulseAudio additionally provides CLI configuration capabilities: $HOME/.pulse, and $HOME/.pulse-cookie. See pulseaudio(1) for details. On systems with a working audio card, you will notice that the /usr/bin/pulseaudio process is running for GNOME sessions. More information can be found at [http://www.freedesktop.org/wiki/Software/PulseAudio](http://www.freedesktop.org/wiki/Software/PulseAudio).

- **Other media tools** – The Rhythmbox media player, Cheese photo/video tool, the Ekiga video conference tool, and the Brasero CD/DVD burner are included in this release.

- **Network configuration management** – The network administration GUI (formerly NWAM) is used to manage network configuration from the desktop. This tool functions similarly to the various networking command-line tools. See “Managing Network Configuration From the Desktop” on page 105.

- **Package Manager and Update Manager** – Are the graphical versions of the IPS command-line tools. Package Manager and Update Manager can be used to manage and update software packages from the desktop. See Chapter 2, “IPS Graphical User Interfaces,” in *Adding and Updating Oracle Solaris 11.1 Software Packages* for instructions on using these tools.
**Print management** – CUPS is the default print service in Oracle Solaris 11, replacing the LP print service. Solaris Print Manager is no longer available. CUPS has a print manager that can be started from the desktop by choosing System → Administration → Print Manager. See “Setting Up Printers by Using CUPS Print Manager” in *Oracle Solaris Administration: Common Tasks*.

**Removable media** – Oracle Solaris 11 includes various removable media enhancements, including support for hot-pluggable device discovery, content recognition, usability, security, and performance across all layers of the software stack, from device drivers to the GUI. You can use the Eject button on a CD/DVD drive’s front panel to eject a disc, even if it is mounted. The Nautilus file manager automatically registers when external hard drives or flash cards are inserted.

The functions of the `vold` daemon and the `volcheck` command are now performed by the Hardware Abstraction Layer (HAL) through the `rmvolmgr` and `gvfs-hal-volume-monitor` commands, which are HAL-aware. See `rmvolmgr(1M)`.

**Seahorse** – GnuPG is now supported. The Seahorse application manages encryption keys and passwords in the `gnome-keyring`. Seahorse also replaces the `gnome-keyring-manager` for managing SSH and GnuPG keys.

**Trusted Extensions (GNOME) desktop** – The Trusted Extensions feature of Oracle Solaris is now supported only in the Oracle Solaris Desktop (GNOME 2.30). In Oracle Solaris 10, this feature is supported in both CDE and the GNOME Desktop. In Solaris 8, this support is limited to CDE.

This version of the Trusted Extensions desktop includes significant changes that improve usability, robustness, and functionality, which also includes zones and RBAC improvements. For example, the `txzongr` GUI has significantly improved. This tool can now be used to manage most aspects of Trusted Extensions. If you are currently using Trusted CDE, you will need to migrate to the a currently supported version of the product.

For up-to-date information about Sun Ray software support for the Oracle Solaris Desktop and Trusted Extensions, go to [http://www.oracle.com/technetwork/server-storage/sunrayproducts/overview/index.html](http://www.oracle.com/technetwork/server-storage/sunrayproducts/overview/index.html).

**Time Slider** – Manages ZFS snapshots. The tool can be used to regularly back up data by taking timed ZFS snapshots.

**Virtual console terminals** – You can now switch between an X session and a virtual console terminal. This service is enabled by default. To switch between sessions, use the Alt + Ctrl + F# hotkey combination. For example, to switch to vt2, press Alt + Ctrl + F2. Also, you can create graphical VT sessions and then switch between those sessions by using the User Switcher panel applet. To add the applet to the desktop, right click the panel, then select the Add to Panel... option. To switch to a new or different graphical login session, click the applet, then select Switch User.

**Web browser and Email** – Oracle Solaris 11 includes the new Firefox and Thunderbird applications.
Desktop Features That Have Been Removed

The following desktop features have been replaced or removed. Note that some features were introduced later than Oracle Solaris 10:

- Adobe Flash Player – This feature was present in Oracle Solaris 11, but removed in Oracle Solaris 11.1. You can download older versions from Adobe's web site, but Adobe no longer produces or supports Flash for Oracle Solaris.

- Common Desktop Environment (CDE) – CDE is replaced by the Oracle Solaris Desktop (GNOME 2.30).

- ESounD – Migrate to the GStreamer programs, such as `gst-launch`.

- `gnome-keyring-manager` – Seahorse replaces this feature.

- GNOME On-screen Keyboard (GOK) program – The dasher application can be used as a replacement in some instances.

- GNOME System tools (Introduced in an earlier Oracle Solaris 11 release):
  - `network-admin` – NWAM replaces this feature.
  - `services-admin` – Use the `/usr/bin/vp svcs` command.
  - `shares-admin` – Use the `/usr/bin/vp sharemgr` command.
  - `time-admin` – Use the `/usr/bin/vp time` command.
  - `users-admin` (GNOME Users and Groups tool) – No replacement is currently available. See “Commands and Tools for Managing User Accounts” on page 155.

  The GNOME System tools are not available in Oracle Solaris 10.

- Solaris Management Console – This tool and its equivalent command-line are no longer available. The User Manager GUI replaces this tool in Oracle Solaris 11.1. See “Commands and Tools for Managing User Accounts” on page 155.

- Solaris Print Manager – This tool is replaced by CUPS Print Manager. See “Printer Configuration and Management Changes” on page 129.

- Xsun family of servers – The Xorg family of servers is still supported. See “Xorg Family of Servers” on page 167.

Xorg Family of Servers

While Oracle Solaris 10 includes both the Xsun family of X servers, with Xsun as the default on SPARC platforms, and Xorg as the default on x86 platforms, Oracle Solaris 11 only supports the Xorg family of servers. X server information has moved from `/usr/x11/bin` to `/usr/bin`. Note that Xorg packages are included on the Live Media, but not with the text installer. The following table lists legacy Oracle Solaris X server commands and the corresponding Oracle Solaris 11 commands.
TABLE 12–1 Oracle Solaris 11 X Server Commands

<table>
<thead>
<tr>
<th>Legacy Command</th>
<th>Oracle Solaris 11 Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>/usr/openwin/bin/Xsun</td>
<td>/usr/bin/Xorg</td>
</tr>
<tr>
<td>/usr/openwin/bin/Xnest</td>
<td>/usr/bin/Xephyr</td>
</tr>
<tr>
<td>/usr/openwin/bin/Xvfb</td>
<td>/usr/bin/Xvfb</td>
</tr>
</tbody>
</table>

**X Server Key Maps**

Oracle Solaris 11 has moved to more common Xorg key mappings. For example, the Copy key is now mapped to XF86Copy.

▼ **How to Update Custom Hot Key Configurations or Enable Legacy Mappings**

1. To update custom hot key configurations or enable the legacy mappings from the desktop, open the Keyboard panel from the System → Preferences menu.

2. Select the Layouts tab, then click the Options... button to open the Keyboard Layout Options dialog box.

3. Select the Maintain key compatibility with old Solaris keycodes option, then select the Sun Key Compatibility checkbox.

**Troubleshooting Desktop Transition Issues**

Refer to the following troubleshooting information when transitioning to the Oracle Solaris Desktop (GNOME 2.30).

**Installing the Oracle Solaris Desktop Software Package After an Installation**

The Oracle Solaris 11 text installer does not include the primary software package that includes the GNOME 2.30 desktop. If you use this installation method, you will need to install the solaris-desktop package afterwards. For information about using the pkg install command to add packages after a text installation, see “Adding Software After Text Installation” in *Installing Oracle Solaris 11.1 Systems*.
If you have a situation where you need to install the `solaris-desktop` package on a system running a live session, create a new boot environment, install the `solaris-desktop` package, then activate the new boot environment, as follows:

```bash
# beadm create be-name
# beadm mount be-name /mnt
# pkg -R /mnt install group/system/solaris-desktop
# bootadm update-archive -R /mnt
# beadm umount be-name
# beadm activate be-name
```

### GNOME Desktop Manager Issues

Note the following potential GDM login issues:

- **CDE to GDM login configuration** – If you customized your CDE login in Oracle Solaris 10, you will likely need to reintegrate your configuration choices to work with GDM in Oracle Solaris 11. Note that an exact one-to-one mapping between CDE and GDM login features does not exist. Some CDE login configuration choices are not available in the GDM login, and there are some GDM login configuration choices that are not available in the CDE login. For example, the GDM login screen does not offer a chooserscreen by default.

Another example is the X Display Manager Control Protocol (XDMCP) feature, which is configured and enabled differently in Oracle Solaris 11 than Oracle Solaris 10. The new GDM provides the ability to run an XDMCP server, but this feature is disabled by default. You can enable the feature by modifying the GDM configuration file.

Another requirement of XDMCP is that X11 allow TCP/IP connections, which is also disabled by default. Refer to the `Xserver(1)` man page for instructions on how to enable this feature. See also the `gdm(1)` man page, the yelp-tools manual, and the online help.

- **Support for Oracle Solaris 10 GDM themes in Oracle Solaris** – In Oracle Solaris 10, GDM is shipped as a non-default login program, which includes a GUI configuration tool. In Oracle Solaris 11, GDM does not have this GUI configuration tool. Also, the GDM themes that work with GDM in Oracle Solaris 10 are not supported in this release. You can change the appearance of the new GDM login GUI by modifying the `/usr/share/gdm/gdm-greeter-login-window.ui` file, as desired.
This appendix includes an end-to-end example of installing a SPARC based system with Oracle Solaris 11.1 by using the automated installation method.

The following topics are covered:
- “Installing a System by Using AI” on page 171
- “Configuring an AI Server” on page 172
- “Booting the Installation Client” on page 178

Installing a System by Using AI

There are many different ways to configure an AI server and perform automatic installations. This section provides a minimal AI installation example.

- **Minimum installation server configuration**
  - Install Oracle Solaris 11.1
  - Configure a static IP address, set a default router, and enable multicast DNS
  - Download an Oracle Solaris 11.1 IPS image
  - Confirm install/installadm package is available
  - Create an install service
  - Associate any clients with the install service
  - Provide access to a package repository server – Client systems install software from a package server so they need to access to the release repository (http://pkg.oracle.com/solaris/release), the My Oracle Support (MOS) repository (https://pkg.oracle.com/solaris/support/) or a local package repository. If you use a local package repository, then you will need to customize a manifest to include the local repository server.
DHCP and DNS information – When you need to install many client systems, providing access to DHCP and DNS info is a best practice. It is not required, however, if you want to install SPARC client systems individually.

No DHCP service – You can install a SPARC client system without a DHCP server, but an AI installation does not support RARP. This means the SPARC client must specify the network boot arguments at the PROM level. See “Booting the Installation Client” on page 178 for a SPARC client boot example.

In addition, if a local package repository is not available, the SPARC client installation fails when attempting to resolve the pkg.oracle.com address without DHCP. The best resolution is to provide a local package repository or use DHCP. The x86 text-based installation installs without access to a package repository.

Additional installation configuration considerations – There are many configuration options, but the following example provides a local package repository, accessible DHCP and DNS information, and a minimally customized manifest.

A default AI manifest is customized to add a local repository.

Installation client selection criteria – You can include criteria keywords that identify specific client configuration information. This information is provided to the install service. Selection criteria is somewhat similar to a JumpStart rules file. Installation selection criteria is not included in the example that follows.

AI manifests – You can customize an existing default manifest to install from a local package repository or to install a specific package group, or to modify target disks or file systems. An AI manifest is somewhat similar to a JumpStart profile file. See “Configure an AI Manifest” on page 176.

System configuration profiles – You can create a customized system profile to configure a specific root password, user account, or keyboard layout. A profile is somewhat similar to the output that is generated by the previous sysidcfg tool. A system configuration profile is now generated by the sysconfig tool. A customized profile is not included in the example that follows.

For more information about customizing manifests and profiles, see Installing Oracle Solaris 11.1 Systems.

Configuring an AI Server

The following example illustrates the primary tasks of configuring an AI server to install a SPARC based system on an IPv4 network with a local package repository, and a minimally customized AI manifest.

This example uses the following configuration options:

- DNS is configured for name resolution
- The AI server provides a local package repository
- DHCP is configured for the install service
- The install client is a SPARC based system

Confirm Network Related Resources Are Available

Configuration steps covered in this task:

- Confirm the installation server’s static IP and router information.
- Identify the DHCP range of IP addresses to install, if necessary.
  When you create the install service, you need to specify the starting address of the IP address range and the number of addresses.
- You can specify fixed IP addresses for client systems in the following ways:
  - Generate a system configuration profile with the `sysconfig` tool or customize a profile in `/usr/share/auto_install/sc_profiles` and add it to the install service.
    ```shell
    # sysconfig create-profile -o /var/tmp/manifests/client_sc.xml
    ```
  - Include fixed IP addresses in the `/etc/inet/dhcpd.conf` file. See Example A–3.
  - Create a customized script that associates client systems’ MAC addresses with a specific IP address and install server.
- If you want to use DNS for name resolution, make sure the DNS server is accessible.

**EXAMPLE A–1  How to Confirm Network Related Resources Are Available**

Confirm the install server has a static IP and router information.

```shell
# ipadm show-addr
<table>
<thead>
<tr>
<th>ADDR_OBJ</th>
<th>TYPE</th>
<th>STATE</th>
<th>ADDR</th>
</tr>
</thead>
<tbody>
<tr>
<td>lo0/v4</td>
<td>static</td>
<td>ok</td>
<td>127.0.0.1/8</td>
</tr>
<tr>
<td>e1000g0/v4static1</td>
<td>static</td>
<td>ok</td>
<td>1.2.3.10/24</td>
</tr>
<tr>
<td>lo0/v6</td>
<td>static</td>
<td>ok</td>
<td>::/128</td>
</tr>
<tr>
<td>e1000g0/v6dhcp</td>
<td>addrconf</td>
<td>ok</td>
<td>fe80::aaa:bbbb:cccc:8988/10</td>
</tr>
</tbody>
</table>

# netstat -nr
Routing Table: IPv4
<table>
<thead>
<tr>
<th>Destination</th>
<th>Gateway</th>
<th>Flags</th>
<th>Ref</th>
<th>Use</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>default</td>
<td>1.2.3.1</td>
<td>UG</td>
<td>3</td>
<td>115957</td>
<td>net0</td>
</tr>
<tr>
<td>1.2.3.64</td>
<td>1.2.3.10</td>
<td>U</td>
<td>4</td>
<td>287300</td>
<td>net0</td>
</tr>
<tr>
<td>127.0.0.1</td>
<td>127.0.0.1</td>
<td>UH</td>
<td>2</td>
<td>116</td>
<td>lo0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Make sure the DNS server is accessible.

```shell
# getent hosts daleks
1.2.3.99 daleks
```
Create a Local Package Repository

Configuration steps covered in this task:

- Download a repository image from pkg.oracle.com and mount the image
- Create a file system for the repository and copy the image into the repository file system
- Refresh the repository
- Enable the package repository service so that it can be available from an http: location

**EXAMPLE A-2 How to Create a Local Package Repository**

These steps are performed on the install server or on another system that is accessible over the network.

Copy the repository image by using your favorite tool, such as rsync or tar. Using tar is generally faster than rsync, but the tar operation might take a while.

```
# mount -F hsfs /tmp/sol-11.1-repo-full.iso /mnt
# zfs create rpool/export/s11.1repo
# cd /mnt/repo; tar cf - . | (cd /export/s11.1repo; tar xfp - )
# pkgrepo -s /export/s11.1repo refresh
Initiating repository refresh.
```

Next, start the package service so that the package repository is accessible.

```
# svcfg -s application/pkg/server setprop pkg/inst_root=/export/s11.1repo
# svcfg -s application/pkg/server setprop pkg/readonly=true
# svcadm refresh application/pkg/server
# svcadm enable application/pkg/server
# pkg set-publisher -G "*" -g http://tardis.dw.com/ solaris
```

Create an AI Install Service

Configuration steps covered in this task:

- Confirm that the installadm package is installed
- Create a file system for the image that is created from the local package repository
- Start the multicast DNS service
- Create the install service
- Add the client information to the install service

**EXAMPLE A-3 How to Create an Install Service**

The following steps are performed on the install server to create the install service. In Oracle Solaris 11.1, the install service image can be created directly from a local package repository.

Confirm that the install/installadm package is available.
# pkg info installadm
Name: install/installadm
Summary: installadm utility
Description: Automatic Installation Server Setup Tools
Category: System/Administration and Configuration
State: Installed
Publisher: solaris
Version: 0.5.11
Build Release: 5.11
Branch: 0.175.1.0.0.24.1736
Packaging Date: Wed Sep 12 19:32:53 2012
Size: 1.23 MB
FMRI: pkg://solaris/install/installadm@0.5.11,5.11-0.175.1.0.0.24.1736:
20120912T193253Z

If not installed, install it:

# pkg install install/installadm

Create a filesystem for the image and enable the multicast DNS service. Then, create the install service. In this example, the starting DHCP address is specified with the -i option and the -c option identifies the number of addresses. This syntax creates an ISC DHCP server on the install server if it does not already exist.

# zfs create rpool/export/image
# svcadm enable svc:/network/dns/multicast:default
# installadm create-service -n sol-11u1-sparc -d /export/image -i 1.2.3.66
-c 20
Creating service from: Creating service from: pkg://install-image/solaris-auto-install
Setting up the image ...

<table>
<thead>
<tr>
<th>PHASE</th>
<th>ITEMS</th>
<th>PHASE</th>
<th>ITEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installing new actions</td>
<td>187/187</td>
<td>Updating package state database</td>
<td>Done</td>
</tr>
<tr>
<td>Updating image state</td>
<td>Done</td>
<td>Creating fast lookup database</td>
<td>Done</td>
</tr>
<tr>
<td>Reading search index</td>
<td>Done</td>
<td>Updating search index</td>
<td>1/1</td>
</tr>
</tbody>
</table>

Creating sparc service: sol-11u1-sparc

Image path: /export/image

Service discovery fallback mechanism set up
Creating SPARC configuration file
Starting DHCP server...
Adding IP range to local DHCP configuration
Creating default-sparc alias
Service discovery fallback mechanism set up

Refreshing install services
The DCHP configuration information is included in the `/etc/inet/dhcpd4.conf` file. The range of dynamic IP addresses looks similar to this:

```
range 1.2.3.66 1.2.3.86
```

You can also identify fixed addresses for clients by including syntax similar to the following in the `/etc/inet/dhcpd4.conf` file:

```
host neo {
    hardware ethernet 0:3:3:4:5:2 ;
    fixed-address 1.2.3.88 ;
}
```

Add the client's MAC address to the install service:

```
# installadm create-client -e 0:3:ba:dd:ff:2 -n sol-11ul-sparc
```

If you do not specify the DHCP information when the install service is created, the SPARC client boot information is provided on the screen:

```
# installadm create-service -n sol-11ul-sparc -d /export/image
```

Configuration steps covered in this task:

- Create an optional file system for the AI manifest
- Export a default manifest template copy that is called `sclient.xml`
Modify the sclient.xml manifest to match your installation needs
Create the manifest and associate it with the install service
Display the install service and manifest to ensure that it is available
Activate the manifest

EXAMPLE A–4  How to Configure an AI Manifest

The following example describes how to create a file system for manifests, modify a default manifest, and associate it with the install service.

# zfs create rpool/export/manifests
# cd /export/manifests
# installadm export -n sol-11ul-sparc -m orig_default -o sclient.xml
# vi sclient.xml
# installadm create-manifest -n sol-11ul-sparc -f ./sclient.xml -m sclient
# installadm list -n sol-11ul-sparc -m
# installadm set-service -o default-manifest=sclient sol-11ul-sparc
# installadm list -n sol-11ul-sparc -m

The sclient manifest is modified as follows:

- Add the auto_reboot keyword so that the client is rebooted automatically.
- Include a local package repository (tardis.dw.com) instead of pkg.oracle.com.

The sclient manifest changes are included in bold as follows:

```xml
<ai_instance name="orig_default" auto_reboot="true">
```

If you change the manifest after it has been activated, update it so the changes take affect.

```
# installadm update-manifest -n sol-11ul-sparc -f ./sclient.xml -m sclient
```

If you change the manifest after it has been activated, update it so the changes take affect.
Booting the Installation Client

The following examples show how to boot the SPARC client with or without DHCP and how to monitor the installation process. A brief description of the client configuration after an installation is also provided.

**EXAMPLE A-5**  How to Boot the Installation Client

If DHCP was configured, boot the SPARC client as follows.

```
ok
boot net:dhcp - install
```

If DHCP was not configured, boot the SPARC client with the `network-boot-arguments` syntax. Be sure to supply the install server information from the output of the `installadm create-service` command.

In the following example, `host-ip=1.2.3.88` identifies the client’s IP address, `router-ip=1.2.3.1` is the IP address of the router, `hostname=neo` identifies the client’s hostname, and the `http: wanboot` string address includes the AI server’s system name and IP address.

```
ok
setenv network-boot-arguments host-ip=1.2.3.88,router-ip=1.2.3.1, subnet-mask=255.255.255.0,hostname=neo,file=http://1.2.3.10:5555/cgi-bin/wanboot-cgi
```

```
ok
boot net - install
```

The network boot arguments are echoed to the screen and any errors are displayed automatically.

After the client boots and the installation process begins successfully, you can log in to the client system to monitor the installation process.

```
Automated Installation started
The progress of the Automated Installation will be output to the console
Detailed logging is in the logfile at /system/volatile/install_log
Press RETURN to get a login prompt at any time.
solaris login: root
password: solaris
# tail -f /system/volatile/install_log
```

After the installation, the log file is available here:

```
# more /var/log/install/install_log
```

If client configuration information is not provided by using DHCP, DNS, or through a customized profile or criteria, you are prompted to provide the system’s configuration information, such as network, host name, time zone, and root password, after the client is first booted.
This information is prompted by the
/usr/share/auto_install/sc_profiles/enable_sci.xml profile found on an installed
system.

A message similar to the following identifies where the system information is stored on the local
client system:

SC profile successfully generated.
Exiting System Configuration Tool. Log is available at:
/system/volatile/sysconfig/sysconfig.log.553