

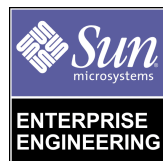


Solaris™ Operating Environment Minimization for Security: A Simple, Reproducible and Secure Application Installation Methodology

Updated for Solaris 8 Operating Environment

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Solaris™ Operating Environment Minimization for Security: A Simple, Reproducible, and Secure Application Installation Methodology

Updated for Solaris 8 Operating Environment

This article provides an update to *Solaris Operating Environment Minimization for Security: A Simple, Reproducible, and Secure Application Installation Methodology*, Sun BluePrints™ Online, December 1999 available from the following URL:

<http://www.sun.com/blueprints/1299/minimization.pdf>

The content of the original article has been updated to also include discussions of:

- Solaris Operating Environment (Solaris OE) version 8
- 32 bit and 64 bit required packages
- PCI based Ultra Enterprise™ server support
- Scripts updated for JumpStart™ Architecture Security Scripts (“JASS” Toolkit) compliance
- iPlanet™ Web Server 4.1 support

This updated version extends the Solaris OE software and hardware discussed originally to include Solaris 8 OE and the Ultra Enterprise server line. Specifically, this article discusses 32 bit and 64 bit Solaris 8 OE installations. The hardware platform, `sun4m`, used for the original article has been replaced by Ultra Enterprise server systems, `sun4u`, using PCI interface cards. The servers used as the testbed for this update include: Netra™ t1, Sun Enterprise™ 420R and 250 servers.

The scripts released with this article have been updated to be compatible with the “JASS” Toolkit version 0.2 discussed in the three Sun BluePrints OnLine articles *JumpStart Architecture and Security Scripts (Toolkit)* published in November, 2000. Please refer to the section “References,” for additional information on where to access the Sun BluePrints OnLine articles about the Toolkit and the Toolkit source. The scripts released with this article are included in version 0.2 of the Toolkit.

Since the original release of this article, a new version of the iPlanet Web Server from iPlanet E-Commerce Solutions, a Sun-Netscape Alliance, (iPlanet Web Server (iWS)) has been released. All Solaris OE package listings have been reviewed to verify support for this new product release. The version of iWS used in this article is 4.1sp2.

No changes have been made to the actual methodology presented in the original article.

Note – All references to Solaris 2.5.1 OE have been removed from this update. Solaris 2.5.1 OE is not supported on either the hardware or software discussed in this update.

Introduction

Securing computer systems against unauthorized access is one of the most pressing issues facing today’s datacenter administrators. Recent studies suggest that the number of unauthorized access continues to rise, as do the monetary losses associated with these security breaches.

One way to reduce system vulnerabilities is to minimize the amount of software on a server. Fewer software components on a server means fewer security holes to detect and fill. The majority of system penetrations are accomplished through the exploitation of security holes in the operating system (OS) itself. Thus, minimizing the number of OS modules installed on a server can greatly improve overall system security by reducing the sheer number of vulnerabilities.

This article focuses on operating system installation practices designed to improve overall system security by proposing a minimized and automated Solaris OE installation methodology. Unfortunately, the minimal OS requirements of a server vary depending on the applications, operating system release being utilized, and the hardware itself. You can use the process presented in this article to assist you in determining the minimum OS modules which must be installed on a particular server. This is done within the framework of a Jumpstart installation, which makes it

possible to completely automate the installation process. This automation is particularly important in a datacenter environment, where machines typically number in the hundreds.

Installation Clusters

The Solaris OE installation process requires the selection of one of four installation clusters:

- Core
- End User
- Developer
- Entire Distribution

Each installation cluster represents a specific group of *packages* to be installed. This grouping together of packages into large clusters is done to simplify the installation of the OS for the mass market. Because each of these installation clusters contains support for a variety of hardware platforms (microSPARC™, UltraSPARC™, UltraSPARC II, and more) and software requirements (NIS, NIS+, DNS, OpenWindows™, Common Desktop Environment (CDE), Development, Computer Aided Design (CAD), and more), far more packages are installed than will normally be used on a single Solaris OE.

The Core cluster installs the smallest Solaris OE image. Only packages that may be required for any SPARC™ or Solaris OE (Intel Platform Edition) system are installed. The End User cluster builds on the Core cluster by also installing the window managers included with the Solaris OE (OpenWindows and CDE). The Developer cluster includes additional libraries, header files, and software packages that may be needed on systems used as compile and development servers. The Entire Distribution, or OEM cluster, includes all Solaris OE software on the installation CDs.

The size of the clusters varies significantly: with Solaris 8 OE the Core cluster contains only 62 packages and uses 61 Mbytes; the End User cluster has 313 packages and uses 471 Mbytes; the Developer cluster has 390 packages and consumes 679 Mbytes of disk space; the OEM cluster, has 459 packages and consumes 711 Mbytes.

Note – The previous package and size information was obtained through installations performed on a Netra t1 server. Different hardware platforms may vary.

Experience to date has shown that in many cases, a secure server will normally require less than 20 Solaris OE packages and use as little as 36 MBytes of disk space.

Installing unnecessary services, packages, and applications can severely compromise system security. One example of this is the OpenWindows Calendar Manager Server Daemon (`rpc.cmsd`), which is unnecessary on many datacenter systems. This daemon is installed and started by default when the End User, Developer, or Entire Distribution cluster is chosen during the installation process.

There have been many known bugs filed against the `rpc.cmsd` subsystem of OpenWindows/CDE, and at least two CERT/CC advisories (CA-99-08, CA-96-09). To make matters even worse, scanners for `rpc.cmsd` are included in the most common scanning tools available on the Internet. The best protection against `rpc.cmsd` vulnerabilities is to not install the daemon at all, and avoid having to insure it is not accidentally enabled.

The problem described above is well known in the computer industry, and there are hundreds of similar examples. Not surprisingly, almost every security reference book ever written discusses the need to perform “minimal OS installations” [Garfinkel]. Unfortunately, this is easier said than done. Other than the occasional firewall, no software applications are shipped with lists of their package requirements, and there’s no easy way of determining this information other than through trial and error.

Because it is so difficult to determine the minimal set of necessary packages, system administrators commonly just install the Entire Distribution cluster. While this may be the easiest to do from the short-term perspective of getting a system up and running, it makes it considerably more difficult to secure the system.

The rest of this article presents a methodology for determining the minimal set of packages required to successfully install and run a particular application—the iPlanet Web Server (iWS).

Test Environment

The processes presented in this methodology are orientated toward the classic lights-out datacenter environment. The following assumptions are made about server configurations:

- JumpStart software is available for system installations.
- JumpStart software is configured properly for hands-off system installation and configuration (see References for additional information).
- The “JASS” Toolkit is used as the framework to deploy these scripts (see References for additional information).
- Terminal consoles (character-based) are used for console access.
- No video cards will be used on any of the systems.

- No X Window server software is required on the server.

The software builds were performed on sun4u-based systems which are UltraSPARC™ based (Netra and Ultra Enterprise servers) and use PCI interface cards. Specifically, these builds documented in this article were tested and verified on the Netra t1, Sun Enterprise 420R and 250 servers. Additional packages will be required to support other hardware platforms.

Methodology Overview

The goal of this article is to create a simple, reproducible, and secured application installation methodology. A secondary benefit is the automation of the entire operating system and software installation process.

The following steps summarize the process.

1. Verify that JumpStart software is using the latest Solaris OE release.
2. Install the Core Solaris OE cluster plus any additional required packages.
3. Install all patches.
4. Remove all unnecessary packages.
5. Use JumpStart software in conjunction with the framework of the “JASS” Toolkit to configure the OS for the datacenter environment.
6. Install and configure the software package.
7. Check the logs for errors; if necessary, fix the errors and repeat the installation process.
8. Test the software installation.

Verifying JumpStart Software

Verify the version of the Solaris OE installed on the JumpStart boot server. For the purposes of the testing performed for this article the following Solaris OE revisions were used:

- Solaris 2.6 OE (update release 5/98)
- Solaris 7 OE (update release 11/99)
- Solaris 8 OE (update release 06/00)

The installation and configuration of a JumpStart server is beyond the scope of this article. For details, please see the Sun BluePrints OnLine article *Jumpstart Architecture and Security Scripts Toolkit - Part 1*, (<http://www.sun.com/blueprints/1100/jssec-updt1.pdf>) for step-by-step documentation, the excellent FAQ available from SunSolve™ (<http://sunsolve.sun.com>), and the *Solaris Advanced Installation Guide* manual (<http://docs.sun.com>).

Depending on the Solaris OE version used on the JumpStart server and the hardware platform being installed, some kernel patching of the boot image may be required. If unexpected results are encountered during the installation refer to SunSolve OnLine (<http://sunsolve.sun.com>) to determine if any patches are required.

The scripts used in the validation and testing of this methodology can be downloaded from <http://www.sun.com/blueprints/tools/>. Only those scripts specific to the iWS installation are included, but all are based on, and included in, the “JASS” Toolkit. The JumpStart framework and automation capabilities of the Toolkit are used to simplify steps two through six of the methodology. The included scripts support Solaris OE version 2.6 through version 8.

- `install-iPlanetWS.driver`—Provides a framework, based on the “JASS” Toolkit, in which all other scripts are run.
- `install-iPlanetWS.fin`—Extracts and installs the iWS software onto the server.
- `minimize-iPlanetWS.fin`—Removes unnecessary Solaris OE packages according to the Solaris OE being installed.
- `minimal-iPlanetWS-Solaris8-32bit.profile`—Defines which cluster and packages should be installed for a 32 bit Solaris 8 OE installation.
- `minimal-iPlanetWS-Solaris8-64bit.profile`—Defines which cluster and packages should be installed for a 64 bit Solaris 8 OE installation.
- `minimal-iPlanetWS-Solaris7-32bit.profile`—Defines which cluster and packages should be installed for a 32 bit Solaris 7 OE installation.
- `minimal-iPlanetWS-Solaris7-64bit.profile`—Defines which cluster and packages should be installed for a 64 bit Solaris 7 OE installation.
- `minimal-iPlanetWS-Solaris26.profile`—Defines which cluster and packages should be installed for a Solaris 2.6 OE installation.

Installing Core Solaris OE Cluster

The initial installation should only include the Core Solaris OE cluster and a few other packages which contain critical functionality. In JumpStart server terminology the Core Solaris OE cluster is referred to as the `SUNWCreq` cluster. In your initial

Core Solaris OE cluster please remember that each OS version requires specific additional packages. See section titled “Final Configuration of iWS 4.1” for specific version details.

The profile, which is used by the JumpStart software to define what OS cluster and packages will be installed, must specify both the Solaris OE install cluster and any additional packages required. Sample profiles are available and can be downloaded at:

<http://www.sun.com/blueprints/tools/>

and in the “JASS” Toolkit.

Installing Patches

Before making any other changes to the system, it is critical to install, on the server, all recommended, security, and software vendor patches. This is especially true when the goal is to minimize the number of installed packages, since specific patches may install unwanted packages. Sun recommends installing the *Recommended and Security Patch Cluster* for the Solaris OE version being installed. It contains all recommended and security patches. Access to these patch clusters does not require a service contract.

You can find the Recommended Patches, the Patches Containing Security Fixes, and the Kernel Update Patches on the SunSolve Web site

<http://sunsolve.sun.com>.

The kernel update patch, 106541 for Solaris 7 OE, is an example of why patches must be installed before any minimization or security hardening is performed. The README and pkgmap of this patch, shows that the following files will be updated when the patch is installed:

- /etc/rc2.d/S71rpc
- /etc/syslog.conf
- /etc/init.d/rpc

The presence of any of these files may either enable a service that has previously been disabled (rpc, automounter, or volume manager) or overwrite a file with specific configuration information in it (syslog.conf).

Note – Once package removal and system configuration has begun, patch installation should *only* be done after the README and pkgmap of a package is reviewed for possible conflicts.

Removing Unnecessary Packages

Once the Solaris OE has been installed and patched, unnecessary packages must be removed. The package removal process deletes all packages not explicitly required by either the OS or the software package being installed.

In the test environment, `sun4u/SPARC/PCI/headless` systems were used and it was possible to remove more than half of the 62 packages included in the Solaris 8 OE Core Cluster. The specific number of packages depended on the exact system being used. This package removal was automated with the `minimize-iPlanetWS.fin` script. This minimization script is both application and OS-specific, as each software package and OS have slightly different requirements. You can download this script at:

<http://www.sun.com/blueprints/tools/>

Specific package listing for all Solaris OE versions are included in the section “Final Configuration of iWS 4.1.” Different hardware architectures, environments, and software packages may require other packages for specific installations.

Additional configuration and hardening of the OS will not be covered in this article. Refer to the Section , “References,” for pointers to the Sun BluePrint OnLine articles discussing these topics.

Using JumpStart Software to Configure the OS

Due to the repetitive nature of the installations required in this methodology, the basic network configuration steps for a server have been automated. This includes both required network and operating systems configuration. The capabilities of the “JASS” Toolkit to automate the creation of files such as `/etc/defaultrouter` and configure services are used in this step to simplify system configuration.

Installing and Configuring Software Packages

The final step in the automated portion of the methodology is to install and configure as much of the software package as possible. The level of automation implemented depends on the how the software package is installed and the time available to automate the process. In the case of the iWS software, which uses a `curses`-based installation process, the only automated task is to extract the source packages into an appropriate directory. Once extracted, the installation routines must be run manually to configure the server. The `install-iPlanetWS.fin` script copies and extracts the software package into the `/opt` directory of the client.

Checking For Errors

Before continuing with the installation of the software, it is important that the installation logs on the server be examined for any errors or configuration problems. The JumpStart logs are located in the `/var/sadm/system/logs` directory. The `begin.log` contains all pre-OS installation operations while the `finish.log` contains all post-OS installation steps. Usually the `finish.log` contains the most pertinent messages. If errors are found, correct them and repeat the installation. This process should be repeated until all errors are resolved.

Testing Software Installation

To test the software installation, run the setup routine and select a default configuration for both the administrative and production web server ports. Once configured, the `startconsole` command is used to start up the admin server. In the test environment, this command, while successfully starting the iWS software, also attempted to launch a local Netscape™ Communicator session; it failed because Netscape Communicator was not installed locally on the system. Rather than managing the installation locally, a remote Netscape Communicator session was used to configure the web server through the administration port.

Final Configuration of iWS 4.1

The process, procedures, and scripts previously defined are used to determine the minimal OS installation for iPlanet Web Server (iWS) software. The minimum Solaris OE cluster (Core) was installed in the test environment. Beyond this each Solaris OE installation is different. See the sections below for details on the packages required for:

- Solaris 8 OE
 - 32 bit
 - 64 bit
- Solaris 7 OE
 - 32 bit
 - 64 bit
- Solaris 2.6 OE

The packages removed are specific to each version of the operating system.

Solaris 8 OE

This section presents the minimum packages required to successfully install and run a 32 bit and a 64 bit Solaris 8 OE environment. In addition, the packages specifically required for iWS are also listed. The package listing is presented in an interactive fashion with explanations as to why these packages are required.

Solaris 8 OE—32 Bit

Solaris 8 OE running in 32 bit mode requires the following packages:

PackageType	Description
SUNWcar	Core Architecture, (Root)
SUNWcsd	Core Solaris Devices
SUNWcsl	Core Solaris, (Shared Libs)
SUNWcsr	Core Solaris, (Root)
SUNWcsu	Core Solaris, (Usr)
SUNWesu	Extended System Utilities
SUNWhmd	SunSwift SBus Adapter Drivers
SUNWkvm	Core Architecture, (Kvm)
SUNWlibms	Sun WorkShop Bundled shared libm
SUNWloc	System Localization
SUNWnamos	Northern America OS Support
SUNWpd	PCI Drivers
SUNWswmt	Install and Patch Utilities

The Netra t1 server installation process requires these additional packages as part of its installation process as it a sun4ui system with IDE disk:

Package Type	Description
SMEvplr	SME platform links
SMEvplu	SME usr/platform links
SUNWensqr	Ensoniq ES1370/1371/1373 Audio Device Driver (32-bit), (Root)

Package Type	Description
SUNWglmr	Symbios 875/876 SCSI device driver, (Root)
SUNWidecr	IDE device drivers
SUNWider	IDE Device Driver, (Root)

Solaris 8 OE—64 Bit

In addition, to the 32 bit packages required for Solaris 8 OE, the following packages must be added to run Solaris 8 OE in 64 bit mode:

Package Type	Description
SUNWcarx	Core Architecture, (Root) (64-bit)
SUNWcslx	Core Solaris Libraries (64-bit)
SUNWcsxu	Core Solaris (Usr) (64-bit)
SUNWesxu	Extended System Utilities (64-bit)
SUNWhmdx	SunSwift SBus Adapter Drivers (64-bit)
SUNWkvmx	Core Architecture (Kvm) (64-bit)
SUNWlmsx	Sun WorkShop Bundled 64-bit shared libm
SUNWlocx	System Localization (64-bit)
SUNWnamox	Northern America 64-bit OS Support
SUNWpdx	PCI Drivers (64-bit)

Altogether, a minimum of 22 packages are required to boot a Solaris 8 OE system running in a 64 bit mode.

Solaris 8 OE—iPlanet Web Server (iWS)

In order to successfully install and run the iWS product on a minimized system additional packages are required. These packages are:

Package Type	Description
SUNWlibC	Sun Workshop Compilers Bundled libC
SUNWlibCx	Sun WorkShop Bundled 64-bit libC

The 64 bit package is only required on a system running in 64 bit mode.

Solaris 8 OE—Infrastructure Services

The goal of building a minimized OS is to include only those components required for the system. The above listing of packages required for iWS does not include support for some services and protocols which may be required in any datacenter environment. The most important of these services are listed below.

To provide Network Time Protocol (NTP) support add the following packages.

Package Type	Description
SUNWntpr	NTP, (Root)
SUNWntpu	NTP, (Usr)

To provide Simple Mail Transport Protocol (SMTP) capabilities add the following packages.

Package Type	Description
SUNWsndmu	Sendmail user
SUNWsndmr	Sendmail root

To provide support for `truss` add the following packages.

Package Type	Description
SUNWtoo	Programming Tools
SUNWtoox	Programming Tools (64-bit)

To provide support for `gzip` add the following package.

Package Type	Description
SUNWgzip	GNU Zip (gzip) compression utility

To provide support for `snoop` add the following packages.

Package Type	Description
SUNWfns	Federated Naming System
SUNWfnstx	Federated Naming System (64-bit)

To provide support for OpenSSH X Tunneling add the following packages.

Package Type	Description
SUNWxcu4	XCU4 Utilities
SUNWxcu4x	XCU4 Utilities (64-bit)
SUNWxwplt	X Window System platform software
SUNWxwplx	X Window System library software (64-bit)
SUNWxwrtl	X Window System & Graphics Runtime Library Links in <code>/usr/lib</code>
SUNWxwrtx	X Window System Runtime Compatibility Package (64 bit)
SUNWswmt	Install and Patch Utilities
SUNWxwice	ICE components
SUNWxwicx	X Window System ICE library (64-bit)

Solaris 7 OE

This section presents the minimum packages required to successfully install and run a 32 bit and a 64 bit Solaris 7 OE. The package listing is presented in an interactive fashion with explanations as to why certain packages are required.

Solaris 7 OE—32 Bit

These Solaris 7 OE packages are required to run iWS 4.1.

Package Type	Description
SUNWcar	Core Architecture, (Root)
SUNWcsd	Core Solaris Devices
SUNWcsl	Core Solaris, (Shared Libs)
SUNWcsr	Core Solaris, (Root)
SUNWcsu	Core Solaris, (Usr)
SUNWesu	Extended System Utilities
SUNWhmd	SunSwift SBus Adapter Drivers
SUNWkvm	Core Architecture, (Kvm)
SUNWlibC	Sun Workshop Compilers Bundled libC
SUNWlibms	Sun WorkShop Bundled shared libm
SUNWloc	System Localization
SUNWpd	PCI Drivers
SUNWploc	Partial Locales
SUNWswmt	Install and Patch Utilities

The total disk space used for these packages is less than 40 MBytes.

For Netra t1 server you must also install the following packages.

Package Type	Description
SMEvplr	SME platform links
SMEvplu	SME usr/platform links
SUNWide	IDE device drivers
SUNWidecr	IDE Device Driver, (Root)
SUNWider	IDE device drivers
SUNWpci	PCI Simba device drivers

Solaris 7 OE—64 Bit

For 64 bit Solaris 7 OE the following packages must be installed in addition to the packages specified above in the 32 bit mode section.

Package Type	Description
SUNWcarx	Core Architecture, (Root) (64-bit)
SUNWcslx	Core Solaris Libraries, (64-bit)
SUNWcsxu	Core Solaris, (Usr) (64-bit)
SUNWesxu	Extended System Utilities (64-bit)
SUNWhmdx	SunSwift SBus Adapter Drivers (64-bit)
SUNWkvmx	Core Architecture, (Kvm) (64-bit)
SUNWlibCx	Sun WorkShop Bundled 64-bit libC
SUNWlmsx	Sun WorkShop Bundled 64-bit shared libm
SUNWlocx	System Localization (64-bit)
SUNWpdx	PCI Drivers (64-bit)

Solaris 7 OE—Infrastructure Services

The goal of building a minimized OS is to include only those components required for the system. The packages listed in “Solaris 7 OE—32 Bit” and “Solaris 7 OE—64 Bit,” does not include support for some services and protocols which may be required in some datacenter environments. Depending on the package, a datacenter may either need to add packages to the Profile or not remove certain packages with the `minimize-iPlanetWS.fin` script. The most commonly used services are listed below.

To provide Network Time Protocol (NTP) support add the following packages.

Package Type	Description
SUNWntpr	NTP, (Root)
SUNWntpu	NTP, (Usr)

To provide Simple Mail Transport Protocol (SMTP) capabilities add the following packages.

Package Type	Description
SUNWsndmu	Sendmail user
SUNWsndmr	Sendmail root

To provide support for `truss` add the following packages.

Package Type	Description
SUNWtoo	Programming Tools
SUNWtoox	Programming Tools (64-bit)

To provide support for `snoop` add the following packages.

Package Type	Description
SUNWfns	Federated Naming System
SUNWfnstx	Federated Naming System (64-bit)

To provide support for OpenSSH X Tunneling add the following packages.

Package Type	Description
SUNWxcu4	XCU4 Utilities
SUNWxwplt	X Window System platform software
SUNWxwplx	X Window System library software (64-bit)
SUNWxwrtl	X Window System & Graphics Runtime Library Links in /usr/lib
SUNWxwrtx	X Window System Runtime Compatibility Package (64-bit)
SUNWxwice	ICE components
SUNWxwicx	X Window System ICE library (64-bit)

Solaris 2.6 OE

The final Solaris 2.6 OE software package listing for iWS contains the following packages.

Package Type	Description
SUNWcar	Core Architecture, (Root)
SUNWcsd	Core Solaris Devices
SUNWcsr	Core Solaris, (Root)
SUNWcsu	Core Solaris, (Usr)
SUNWesu	Extended System Utilities
SUNWglmr	Symbios 875/876 SCSI device driver, (Root)
SUNWhmd	SunSwift SBus Adapter Drivers
SUNWkvm	Core Architecture, (Kvm)
SUNWlibC	SPARCompilers Bundled libC
SUNWlibms	Sun WorkShop Bundled shared libm
SUNWloc	System Localization
SUNWpd	PCI Drivers
SUNWploc	Partial Locales
SUNWswmt	Install and Patch Utilities

The total disk space used by these packages is approximately 40 Mbytes.

The following packages are added, by the Solaris OE installation program, for the Netra t1 system.

Package Type	Description
SMEvplr	SME platform links
SMEvplu	SME usr/platform links
SUNWide	IDE device drivers
SUNWidecr	IDE Device Driver, (Root)
SUNWider	IDE device drivers
SUNWpci	PCI Simba device drivers

Solaris 2.6 OE—Infrastructure Services

The goal of building a minimized OS is to include only those components required for the system. The packages listed in “Solaris 2.6 OE,” does not include support for some services and protocols which may be required in some datacenter environments. The most commonly used services are listed below.

To provide Network Time Protocol (NTP) support add the following packages.

Package Type	Description
SUNWntpr	NTP, (Root)
SUNWntpu	NTP, (Usr)

To provide support for `truss` add the following package.

Package Type	Description
SUNWtoo	Programming Tools

To provide support for `snoop` add the following package.

Package Type	Description
SUNWfns	Federated Naming System

To provide support for OpenSSH X Tunneling add the following packages.

Package Type	Description
SUNWxcu4	XCU4 Utilities
SUNWxwplt	X Window System platform software
SUNWxwrtl	X Window System & Graphics Runtime Library Links in /usr/lib

Case Study

This is a case study of the methodology process as used in the test environment for Solaris 8 OE 32 bit. Each step of the process is documented and discussed to provide additional information on the problems encountered and how they were resolved.

In this case study, the Core OS packages are:

Package Type	Description
SUNWcar	Core Architecture, (Root)
SUNWcsd	Core Solaris Devices
SUNWcsl	Core Solaris, (Shared Libs)
SUNWcsr	Core Solaris, (Root)
SUNWcsu	Core Solaris, (Usr)
SUNWkvm	Core Architecture, (Kvm)

While these packages comprise the Core Solaris OE packages, they are still not sufficient to successfully boot the system from its internal hard drives. Install the following additional package so that the system can boot the OS from internal disks.

Package Type	Description
SUNWpd	PCI Drivers

At this point the system will boot Solaris 8 OE, but it will still produce the following errors:

```
configuring IPv4 interfaces:ifconfig: plumb: hme0:
  Bad file number
ifconfig: SIOCGLIFNETMASK: hme0: no such interface hme0.
```

Based on the error messages displayed during system boot the network interfaces built into the system are not being configured properly through `plumb`. To resolve this error install the following package.

Package Type	Description
SUNWhmd	SunSwift SBus Adapter Drivers

The system will now boot properly and configure the internal network interfaces. However, errors are produced when the system attempts to use `awk` and `nawk`. These error messages are:

```
/etc/rcS.d/S50devfsadm: /usr/bin/awk: not found
The system is coming up. Please wait.
/etc/rc2.d/S01MOUNTFSYS: /usr/bin/nawk: not found
/etc/rc2.d/S69inet: /usr/bin/awk: not found
```

A quick check of a complete Solaris 8 OE installation using either of the two following commands will determine which package contains the `/usr/bin/awk` command:

```
# /usr/bin/pkgchk -l -p /usr/bin/awk
Pathname: /usr/bin/awk
Type: regular file
Expected mode: 0555
Expected owner: root
Expected group: bin
Expected file size (bytes): 85828
Expected sum(1) of contents: 9434
Expected last modification: Jan 05 19:00:06 2000
Referenced by the following packages:
    SUNWesu
Current status: installed
```

or:

```
# grep /usr/bin/awk /var/sadm/install/contents
/usr/bin/awk f none 0555 root bin 85828 9434 947116806 SUNWesu
/usr/bin/oawk=../../usr/bin/awk l none SUNWesu
```

Another additional package is required for `awk` and `nawk` support. This package is:

Package Type	Description
SUNWesu	Extended System Utilities

The system will now boot properly and configure the internal network interfaces, however, startup errors are still produced similar to the following:

```
ld.so.1: /usr/bin/nawk: fatal: libm.so.1: open failed: No such
file or directory
ld.so.1: /usr/bin/awk: fatal: libm.so.1: open failed: No such file
or directory
```

Using the `grep` command described above produces the following:

```
# grep libm.so.1 /var/sadm/install/contents
/usr/lib/libm.so=libm.so.1 s none SUNWlibms
/usr/lib/libm.so.1 f none 0755 root bin 102424 23721 934315443
SUNWlibms
```

In order to resolve these error messages add the package listed here.

Package Type	Description
SUNWlibms	Sun WorkShop Bundled shared libm

The system will now boot properly and configure the internal network interfaces. However, localization errors are still produced similar to the following.

```
couldn't set locale correctly
couldn't set locale correctly
```

In order to resolve these error messages, add the packages listed here.

Package Type	Description
SUNWloc	System Localization
SUNWnamos	Northern America OS Support

These are the packages required when performing a system installation with the `system_locale` defined in the JASS Toolkit provided Solaris 8 OE `sysidcfg`.

```
system_locale=en_US
```

Other packages may be required when using other locales than Northern America.

References

Garfinkel, Simon and Spafford, Gene; *Practical Unix and Internet Security*, Published by O'Reilly & Associates; 04/1996; ISBN: 1565921488.

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Noordergraaf, Alex and Watson, Keith, *Solaris Operating Environment Minimization for Security*, Sun BluePrints OnLine, December 1999.

<http://www.sun.com/blueprints/1299/minimization.pdf>

Noordergraaf, Alex and Watson, Keith, *Solaris Operating Environment Security*, Sun BluePrints OnLine, January 2000.

<http://www.sun.com/blueprints/0100/security.pdf>

Related Web Sites

CERT/CC <http://www.cert.org> is a federally funded research and development center working with computer security issues.

Security Focus <http://www.securityfocus.org> is a Web site dedicated to discussing pertinent security topics.

The rootshell.com Web site <http://www.rootshell.com> provides a searchable list of vulnerabilities posted to the various full-disclosure mailing lists.

The attrition Web site <http://www.attrition.org> maintains an archive of defaced sites for those interested in others experiences.

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Alex Noordergraaf has over 9 years experience in the area of Computer and Network Security. As a Senior Staff Engineer in the Enterprise Engineering group of Sun Microsystems he is developing, documenting, and publishing security best practices through the Sun BluePrints OnLine program. Articles completed include recommendations on: Solaris Security settings, Solaris Minimization, and Solaris Network settings.

Prior to his role in Enterprise Engineering he was a Senior Security Architect with Sun Professional Services where he worked with many Fortune 500 companies on projects that included , security assessments, architecture development, architectural reviews, and policy/procedure review and development.. In addition to providing billable services to customers he developed and delivered an Enterprise security assessment methodology and training curriculum to be used worldwide by SunPS. His customers have included major telecommunication firms, financial institutions, ISPs, and ASPs.